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NOAA Series on U.S. Caribbean Fishing Communities

Entangled Communities: Socioeconomic Profiles of Fishers, their Communities and their Responses to Marine Protective Measures in Puerto Rico (Volume 1: Overview)

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PREFACE

NOAA Series U.S. Caribbean Fishing Communities is result the Southeast Fisheries Science Center's Caribbean Sustainable Fishing Communities Initiate, which was brought about by the recognition that the success of coral reef conservation strategies hinged on the ability to reconcile the need to protect coral reef and associated environments with the local cultural, economic, political and social requirements of coastal communities. While valuable socio-economic work had been conducted, there was no comprehensive program to collect baseline socio-economic data is in place for entire U.S. Caribbean. Most of the earlier research was driven by specific management concerns and had a restricted geographic scope. Moreover, a significant share of this research is now outdated and inadequate to support management actions and meet the new legal definitions and requirements put forth by Magnuson Stevens Act (MSA), particularly National Standard 8, National Environmental Policy Act (NEPA), and Executive Order 12898.

To address the above challenges, the Southeast Fisheries Science Center has commissioned a number of studies to develop a comprehensive overview of the historical, cultural, economic, and social condition of fishing communities in the Commonwealth of Puerto Rico and the Territory of the U.S. Virgin Islands. This report entitled "*Entangled Communities: Socioeconomic profiles of fishers, their Communities, and their Responses to Marine Protective Measures in Puerto Rico*" crafted by Drs. David Griffith, Manuel Valdés-Pizzini, and Carlos García-Quijano shows that there is a need to redefine the concept of 'fishing community' in light of local, regional and global realities, particularly in small-scale fisheries where fishermen engage in multiple livelihood strategies. They also show that there are a number of forces and processes that are gradually transforming our notion of a traditional Puerto Rican fishing community. Thus, the development of sound policies that seek to conserve and protect marine resources and habitats and maintain the economic and social viability of fishing communities need to recognize the challenges and opportunities that forces and processes bring about.

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J. J Agar and B. Stoffle

Editors

EXECUTIVE SUMMARY

Over seven centuries of human interaction with the Caribbean's coastal and marine resources have brought us to the challenges and opportunities that Puerto Rican fishing communities, households, and individual fishers face today. This interaction, whether extractive or aesthetic, protective or destructive, has been irregular, sporadic, and uneven across space and time, resulting in wide variations in such factors as the compositions of *Villa Pesqueras* (fishing associations), the density of fish marketing outlets, the presence of charter boat captains, and the roles that tourism and gentrification play in a fishing community's failure or success. This report, based on two years of ethnographic and survey research and analysis, addresses the underlying reasons for this variation, focusing on assessing the impacts of recent marine protective measures known as Marine Protected Areas (MPAs), and on profiling fishing communities with an eye toward assessing their dependence on and engagement with marine resources. According to the Magnuson-Stevens Fishery Conservation and Management Act (hereafter referred to as the Magnuson-Stevens Act),

> "Substantially dependent implies that loss of access may lead to some change in the character of the community, perhaps a major change, or may even threaten its existence. Substantially engaged, on the other hand, implies a level of participation in commercial, recreational, or subsistence fisheries that includes social and economic networks that are directly and indirectly associated with these fisheries (such as the harvesting and/or processing sector)" (NOAA, 2004; see, 63 FR 24235, May 1, 1998).

In Puerto Rico, our research suggests that it is difficult to find many communities so heavily dependent on fishing that a decline in fishery resources would result in the entire community's collapse, yet the communities we designate highly dependent on fishing certainly would experience widespread economic dislocation with a substantial decline in fishing resources or activity. Commercial fishing in Puerto Rico has remained a viable economic niche through the 20th century and into the 21st century, and recreational fishing, including charter boat fishing, has increased in importance with the general growth of tourism around the island. At the heart of the commercial fishery of Puerto Rico are *Villa Pesqueras*. Villas Pesquera is the term used to name those government-built facilities since the 1960's in the traditional fishing communities and landing centers of the island. A Villa Pesquera comprises a pier, lockers for the fishermen's equipment, and an area for freezers and selling fish. Since the 1960's, Villas Pesqueras have been the home of fisher organizations or associations. In order to deal with the fishers in an orderly and effective manner, the government, under the agency of CODREMAR, which has since been disbanded, helped organize fisher associations. Associations grouped fishers by place, provided them the benefit of the facilities of the Villa Pesquera, and served as a medium to deal with government officials.

Subsistence fishing—or fishing for food—has been important throughout the Caribbean since prehistoric times. Counts of recreational and subsistence fishers have been difficult to estimate, but the number of commercial fishers in Puerto Rico has been around 2000 (±500) since the United States took control of Puerto Rico in 1898, indicating a stable population whose members come and go but whose base remains important to coastal landscapes. Throughout this report, we will emphasize, again and again, that Puerto Rican fishing has always been entangled in other, more heavily capitalized coastal pursuits, including, most importantly, military uses of the coast, sugar cane production, shipping, and, most recently, tourism and coastal construction. This observation applies to full-time commercial fishers as well as those who fish recreationally or for subsistence, supplementing household incomes with food or escaping to the sea to enjoy and experience some attributes of coastal lifestyles that have made fishing important to Puerto Rican identity and cultural nationalism.

Nearly every social scientific analysis of commercial fishing peoples around the world opens with a litany of problems threatening their livelihoods; nearly everywhere, too, recreational and casual uses of coastal zones are implicated in those problems, including recreational, sport, subsistence, and part-time fishing. This report does not significantly deviate from this reporting tradition, yet neither does it take the fatalist position that Puerto Rican commercial fisheries are dying or that alternative occupational paths are inevitable for coastal peoples.[1] The opinions, perceptions, observations, quotes, and quantitative and qualitative data presented here speak to the issues of the viability and future of the fisheries of Puerto Rico as much as they describe current and past fishing practices, circumstances surrounding fishing in the islands, and problems over coastal development.

This work has been accomplished three decades after passage of the Magnuson-Stevens Fishery Conservation and Management Act (hereafter referred to as the Magnuson-Stevens Act), during which time increasing attention has been devoted to studying the socioeconomic characteristics of fishing families and fishing communities across the United States. These studies have been directed toward understanding how these entities have been and will be impacted by various legislative initiatives and estimating the extent to which these entities are dependent on marine resources. Several relatively new pieces of legislation have fortified this effort, including Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*), which requires that social impact studies recognize that regulations are likely to affect different groups differently, and similar regulations from the EPA.

The importance of profiling fishing populations accurately is particularly timely in the current environmental/ ecological and regulatory environment. Fish stocks and marine resources generally are under stress from a variety of pressures, including harvesting pressures by commercial and recreational fishers, misguided management and enforcement practices, coastal development, the destruction of wetlands and nursery areas, and deteriorating water quality. Management techniques developed to deal with these problems include season and area closures, MPAs, limited entry, size limits, and gear restrictions and modifications (e.g. Turtle and Fish Excluder Devices, mesh sizes for traps and nets). Since the Magnuson-Stevens Act, imposing new federal regulations and their corresponding management alternatives has required social impact assessments, specifically stating, "Conservation and management measures shall…take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities." The more recent pieces of legislation noted above, from the executive branch, expand this mandate by understanding that "fishing communities" can be either place based or non-placed based; with developments along the coast that have reconstructed coastal areas and marginalized or displaced commercial fishing families, non-place based fishing communities have become more and more common, with place based fishing communities nevertheless serving as important loci for cultural expression that serves to legitimize commercial fishing as a way of life. Non-place based fishing communities may also include professional communities such as charter boat fishers, or interest group communities such as sports or recreational fishers.

This report profiles fishing families and communities of the 42 of 43 coastal municipalities of Puerto Rico.[2] The specific goals of the research underlying the report were to:

[1] In Puerto Rico, at least, the notion of alternative economic paths becomes lost in the historical reality that few fishers have ever relied on fishing full-time throughout their lives; multiple livelihoods have been a facet of Puerto Rican fishing for nearly as long as people have been writing about the islands' fisheries. This was the central theme of Griffith and Valdés Pizzini's book on Puerto Rican fishing (2002).

[2] Yauco was not included. It does not have a lengthy coastline and does not report landings data.

1. Conduct community profiles to satisfy the legal requirements of the Magnuson-Stevens Act, particularly National Standard 8, the National Environmental Policy Act, and Executive Order 12898 in Puerto Rico;
2. Conduct a socioeconomic evaluation of the performance of the region's federal MPAs, including 'Reserva Natural de Canal Luis Peña' (Culebra Island, Puerto Rico), Laguna del Condado, the Marine Conservation District (US Virgin Islands), the seasonal closures off the west coast of Puerto Rico (Buoy 8/Tourmaline Bank, Buoy 6/Abrir la Sierra Bank, and Bajo de Sico) on the fishers, their families, and their communities of Puerto Rico. We also evaluated Desecheo. We emphasize that the notion of *performance* here refers to how they have performed vis-à-vis fishing lifestyles, and not how they have performed in a biological sense (except in terms of how fishers perceive their benefits to fish stocks and habitats).

In the course of this work, we pay particular attention to the notion of *community* as it applies to the fishing populations of Puerto Rico. We define a community as a group of people living and working together, exchanging services and goods, who share some common interests while diverging at times according to different class backgrounds, where many also share a common cultural and linguistic background. Communities are social fields, comprised of overlapping networks of kin, neighbors, friends, co-workers, and others who interact with one another regularly. Communities may be place-based, network-based, knowledge-based, or may transcend specific geographic locations, although many community members usually share attachments to a specific place.

Again, we emphasize that, in Puerto Rico, it is impossible to characterize any specific municipality and few communities as "fishery dependent," given that fishing families in Puerto Rico tend to be dispersed rather than concentrated and that, through occupational multiplicity and other activities, fishing families are entangled in several economic sectors of coastal and more distant environments. Despite this, we argue that fishing communities continue to occupy an important economic and cultural niche in Puerto Rican society, and that their entanglements with other sectors are in fact critical to this importance, enhancing the economy, society, and culture of the region in many ways. The profiles we present below are designed to bring fishing families' contributions to the forefront in the process of satisfying the objectives noted above.

a. Aspects of Puerto Rican Fishing

Information presented here is based on research conducted from November 2003 to July 2006, combining a variety of ethnographic and survey methods as well as drawing on several secondary sources for background to the current work. Secondary sources included landings data, U.S. census data, the census of Puerto Rican fishers conducted in 2002, historical and ethnographic writing about Puerto Rican fishing and ways of life, published life histories and interviews with fishers, and technical reports. We present the work in three volumes: Volume I includes this executive summary and six other sections that synthesize the data and give overviews of the fisheries; Volumes II and III include 13 regional profiles that provide more detailed descriptions of the fisheries and fishing communities, along with the work's appendices and references. This work, designed to profile fishing communities, fishing households, individual fishers, and significant fishing locations and practices across the islands of Puerto Rico, has resulted in several key findings and recommendations. We have organized these into six groups:

1) Profiles of fishing populations, which present the basic characteristics of commercial, recreational, and subsistence fisheries based on our synthesis of the ethnographic work, survey work, and secondary data sources.
2) Issues relating to MPA performance, such as the impacts of MPAs on different fishing communities or regions.

3) Issues relating to coral reefs, including the ways in which fishers' local knowledge and practices protect or influence the health of coral reefs.
4) Issues of importance to fishing communities around the islands, such as gentrification, coastal development, and marketing.
5) Policy and Management Issues.
6) Recommendations for Future Research.

The Executive Summary ends with a table, beginning on page 16, which provides more details regarding the relevance of these issues to the specific coastal regions of Puerto Rico. This table can be used as a guide to further reading in Volumes II and III, for those who wish more details than are presented either in the executive summary or the syntheses and overviews.

1) Profiles of Puerto Rican Fisheries

- Puerto Rico's commercial fishery is primarily small-scale in nature and often referred to as "artisanal," lacking many vessels larger than 40', with most between 18' and 25' in length. Commercial fishing effort is highest during the months of May through July and lowest in October and November, although average fishing effort only ranges from 15 to 18 days per month. It is a multi-gear, multi-species fishery, with nearly two-thirds (63.2%) regularly using at least three gear types. The three most common primary gear types are hooks & lines (20.2%), fish traps (15.3%), and gill nets (12.7%). The most common species captured with these gear types are snapper-grouper species (reef fish) and lobster, which account for 42.8% and 12.9% of landings, respectively.

- Numbers of commercial fishers have remained relatively stable for the past century, fluctuating between 1,500 and 2,500, although local long-time fishers consider this number an underestimate. The most recent, 2003 census of commercial fishers included 1,132 fishers. During workshops held with commercial fishers during June of 2006, nearly all fishers contested these figures as far too low.

- Numbers of recreational fishers in Puerto Rico have been growing over the past few years and current estimates place them at around 160,000 to 170,000. The most recent, 2004 estimate placed numbers of resident recreational fishers at 141,000, down from 185,000 in 2003. An additional 25,000 to 35,000 recreational fishers from outside Puerto Rico fish in Puerto Rican waters.

- Fishing provides the sole income for around 40% to 45% of commercial fishing families, yet nearly half (46.5%) of commercial fishers interviewed in the survey reported working outside of fishing, most primarily in the construction trades, including masonry, carpentry, welding, plumbing, painting, and manual labor. At the household level, this figure rises to 56.5%, which includes working spouses, children, and others. This suggests that fishing and other coastal occupations subsidize one another. Earlier studies of fishers have found that over 90% of commercial fishers work outside of fishing at some time during their lifetime.

- Recent government data on the local fisheries underscores the increasing importance of SCUBA diving in the total amount of fish and shellfish landed. This is a major change in the Puerto Rican fisheries, as the key producers are young newcomers who are removed from the traditional ways of using fishing territories. For the first time in the history of fishing, SCUBA was the most important gear, measured in terms of the percentage of the catch landed; revenues from diving are high as well, as divers tend to target high value species such as lobster and conch. At the same

time, SCUBA requires less capital than many other gear types in Puerto Rico, and thus is an easy fishery to enter.

- From 1999 to 2003, the last five years for which we have landings data, the commercial fisheries of Puerto Rico landed 14,313,149 pounds of fish and shellfish worth an estimated $32,489,237. This constitutes an annual average estimate of between 2.8 and 2.9 million pounds with an ex-vessel value of around $6.5 million. These figures are slightly higher with correction factors, or calculations that compensate for underreporting, based on repeated site visits to fish marketing centers. In 2003, using a correction factor of 56%, the amount landed was 4,265,645 pounds valued at $7,848,786; in 2004, using a correction factor of 61%, the amount landed was 3,056,852 pounds valued at $7,519,857 (Matos-Caraballo 2005: 4).

- Recreational landings in Puerto Rico totaled 1,527,000 fish and 3,768,000 pounds in 2003 and 887,000 fish and 2,214,000 pounds in 2004. These landings were spread over 1,111,000 trips in 2003 and 1,055,000 trips in 2004, indicating a decrease in catch per unit of effort (CPUE) from 3.9 pounds per trip to 2.0 pounds per trip. While numbers of fish and pounds landed decreased, numbers of released fish increased, from 150,000 in 2003 to 249,000 in 2004.

- Crews of two per trip are most common, usually consisting of the owner of the vessel and equipment and a hired hand (*proel*) who works for a share (usually one-third) of the catch. Half of the commercial fishers surveyed reported using friends as crew, 30.5% reported using relatives (12.9% of these were sons or daughters), 16.7% reported using "fishing partners," and the remainder listed "others." This contrasts with recreational fishers, 70% of whom reported that they fished with friends, 7.6% with fishing partners, 4.3% with siblings, and the remaining 18.1% with other relatives.

- Beyond providing fresh fish for their families and communities, most commercial fishers contribute economically to their communities in their purchases of locally constructed vessels, gear, and bait, and in vessel and gear maintenance. Around 70% purchase their vessels locally, 98% maintain their vessels locally, 94% service their motors locally, 70% purchase their non-electronic gear locally, 43% purchase their electronic gear locally, and 60% purchase their bait locally. Commercial fishers also generate local employment through hiring crew and through the use of family members and others in seafood markets and restaurants.

- Puerto Rico's commercial fishery is family-based, similar to commercial fisheries in many other parts of the United States: specifically, women play important supportive roles in fishing and children usually learn fishing from their parents or from other family members. Family involvement in fisheries seems to increase with the elaboration of fish markets, and especially when *Villas Pesqueras* (fishing associations) and private fish markets add seafood restaurants to their facilities. Women often manage or staff seafood restaurants, add value to or process seafood, and assist with fish marketing; children often work in these areas as well. Fishers' households tend to be between 3 and 4 people in size, with most fishers (60-70%) married. These figures do not vary significantly among commercial, recreational, or subsistence fishers.

- The exact number of fishing communities in Puerto Rico has been difficult to determine, in that many former fishing communities have been altered significantly by coastal development and gentrification. However, there are between 88 and 100 official landing centers across the island and we visited 93 locations that were important commercial or recreational fishing locations in Puerto Rico. We were able to collect detailed enough information on 54 fishing communities to estimate their level of dependence on fishing. Of these 54, 16 (29.7%) were network-based and

38 (70.3%) were place-based communities. While the 38 constitute nearly all of the place-based fishing communities in Puerto Rico, most of the other 55 locations we visited are network-based.

- Fishing communities in Puerto Rico can be place-based, network-based, or knowledge-based, with the first becoming less common and the other two increasing in importance. Place-based communities are those in which a majority of fishing families lives in a specific, relatively small, geographical location, such as a neighborhood or small town. Network-based communities are comprised of fishers who work together but live mostly apart, dispersed over several towns or neighborhoods in one or two municipalities. Knowledge-based communities tend to overlap with both place-based and network-based communities, consisting of groups of fishers who share knowledge about, for example, fishing territories, gear, fishing practices, political aspects of fishing, etc. Knowledge-based communities often serve as the basis for opposition to, or cooperation with, fishery management.

- As place-based communities become less common and network-based communities become more common, the significance of coastal gathering places as places where fishers exchange knowledge has increased. In addition, network-based communities have become repositories of *social capital*, or social relationships that enable members of meaningful groups (e.g. groups of fishers) to influence the economic well-being of the group and group members. Social capital can benefit individual group members or it can constrain group members' behavior. The more fishery managers learn about the ways network-based fishing communities marshal their social capital, the more they may be able to assist fishers in adding value to fishery products and to join them in their own efforts to pressure network members to learn about and abide by existing fishery regulations.

- The recreational fishery of Puerto Rico draws participants from all walks of life, from professionals and government officials to factory workers, the temporarily employed, the unemployed, and the retired. The survey elicited 76 occupations spread over 98 working respondents, suggesting that recreational fishers do not cluster in any specific occupation. Recreational fishing effort is highest from May through August and lowest from November through February, with participation averaging between 8 and 12 days per month. Most common gear are hooks & lines (54.4%) and SCUBA diving equipment (10.4%). Fishers using the first two gear types tend to catch snapper-grouper species, including silk snapper (14%) and yellowtail snapper (12%); SCUBA divers tend to catch lobster (23.1%) and conch (15.4%).

- A majority of recreational fishers contribute to local economies by purchasing vessels, gear, bait, and other services locally. Of the 70% who own vessels, nearly 90% have purchased vessels constructed locally and have their vessels and motors maintained locally. Most fishing gear and bait are purchased locally as well, although electronic gear is purchased elsewhere (e.g. Miami) about half the time.

- Puerto Rico's recreational fishers range from professional charter boat captains to individuals fishing with a hand line wound around a can. Its charter boats industry is unevenly spread over the island, with the San Juan area, the Northeast, and the Southwest regions supporting the most charter boats and other regions witnessing an occasional fisher entering the industry seasonally or on a temporary basis, often supplementing commercial fishing. There are at least 15 Club Nauticos (nautical clubs for recreational fishers and boaters) around the islands that sponsor tournaments, and these are important to the recreational fishing community politically.

- The subsistence fishery in Puerto Rico—or people who fish primarily for food for their households—is made up mostly of people from working class backgrounds who target snapper-

grouper species (40%) and pelagic species such as dolphin (7.4%) and king mackerel (5.9%), but almost no shellfish. Their gear varieties are similar to those of recreational fishers, but with fewer who use SCUBA gear.

- Recreational, subsistence, and commercial fishers most frequently learn the craft of fishing from their fathers and second most frequently from friends.

- Dependence on fishing varies around the islands by several factors. For the commercial fishery, in addition to high average annual landings (> 100,000 lbs) and revenues (> $250,000), most fishing dependent communities are place based (as opposed to network based), where at least one third of its fishers fish full time, where ties between the commercial fishery and the tourist sector are complex, where both commercial and recreational fishing infrastructure are highly developed, and where the cultural significance of fishing is reaffirmed in festivals, statues, sculptures, murals, or other icons. Many fishing dependent communities also have close ties with the state, receiving government funding for vessels or infrastructure, and many are actively involved in conflicts over coastal development, new regulations, or other issues. Examples of communities that are highly dependent on fishing include: La Parguera, Lajas; Puerto Real, Cabo Rojo; La Playa, Ponce; Punta Santiago, Humacao; Pozuelo, Guayama; La Estella, Rincón; and the Downtown Harbor neighborhoods of Fajardo (Maternillo, Mansion del Sapo, and Puerto Real). The north coast has the fewest communities that are highly dependent on fishing.

- While there is not enough background data on the recreational fisheries of Puerto Rico to estimate levels of dependence on fishing for them, many marinas and several Club Nauticos in Puerto Rico regularly have annual fishing tournaments that generate income and employment for Puerto Ricans. Estimates of the economic impacts of billfish tournaments, for example, range from $25,000,000 to over $43,000,000, accounting for over 200 seasonal or part-time jobs. In general, however, recreational fishing from marinas and other boat-storage locations is far less important than recreational boating, usually accounting for less than 10% of the activity.

2) Issues Related to MPA Performance

We emphasize here that the points that follow derive from fishers *perceptions* of the performance of MPAs, *not* from actual biological studies that show that, in fact, MPAs protect fish stocks or habitats, or create problems for fishing community members. The same holds true of our points regarding coral reefs in the following section. We do not wish to downplay their importance, however, by suggesting that human perceptions may not conform to biological realities: whether they reflect the actual performance of MPAs or the health of coral reefs is secondary to the fact that fishers perceive them as reality. Understanding these perceptions is important to the process of improving communication between resource users and resource managers, particularly in cases where the science of fisheries management does not conform to the perceived realities of fishing folk.

- In general, most fishers believe that most of the MPAs of Puerto Rico are achieving their biological goals of protecting fish stocks, spawning aggregations, etc., but have more mixed views about the sociological effects of MPAs.

- MPAs present a problem for navigation, in that fishers need to sail around them when they have fish in their vessels. During stormy seas this increases the danger of seagoing travel and on a routine basis this increases trip expenses, particularly fuel costs.

- The seasonal closure for conch, which some fishers believe occurs at the wrong time of year in terms of conch breeding, has caused two problems: 1) it encourages "derby fishing" among divers, or fishing at high levels, making repeated hazardous dives, in the days immediately prior to the closure; 2) conch shells provide protection from predators from juvenile species.

- For Tourmaline, Bajo de Sico, La Mona/ Monito, Abrir la Sierra, and Desecheo, between 70% and 90% of those interviewed in the survey strongly agree that MPAs maintain spawning aggregations, improve the quantity of fish inside the MPA, improve the quantity of fish adjacent to the MPA, protect species in vulnerable areas, and restore or maintain habitat quality.

- Experienced fishers interviewed in the survey were less sanguine about Canal de Luis Peña in Culebra and Laguna Condado in San Juan, however. For Canal de Luis Peña, while over 70% believed that the MPA improved the quantity of fish inside and adjacent to the MPA and protected species in vulnerable areas, only 65.8% believed it maintained spawning aggregations and only 68% believed that it restored or maintained habitat quality. Around 70% of fishers familiar with Canal de Luis Peña cite contamination from the boating traffic and coastal construction projects as responsible for the declining health of marine resources.

- The MPA viewed as least effective by those interviewed was the Laguna de Condado, in San Juan. Only between 50 and 60% of fishers believed that this MPA maintained spawning aggregations, improved fish quantities inside and adjacent to the MPA, protected species, or restored or maintained habitat quality. Over 60% of those familiar with Condado viewed contamination, primarily from boating and construction but also from industrial sources, as the principal cause of resource decline.

- Puerto Rican fishers, whether commercial, recreational, or subsistence in nature, have almost no experience with the MPAs of the U.S. Virgin Islands. They are very likely unaffected by them, except indirectly, in so far as they may contribute to the protection of fish that eventually make their way into Puerto Rican waters.

3) Issues Related to Coral Reefs

- Overall, fishers believe that the health of coral reefs has been declining over the past ten years and that it will continue to decline in the next five years. Asked about the health of reefs, 64.8% believe they were healthy 10 years ago while only 3.2% believe they were dead or nearly dead. By contrast, 10.9% believe they are healthy today while 50.1% believe they are dead or nearly dead.

- Survey respondents cited "contamination" as the principal cause of the declining health of coral reefs, with boating traffic, coastal construction, and industrial run-off as the three principal sources of contamination. Direct interaction with reefs by fishers was considered a cause of declining reef health by less than 5% of those interviewed.

- Regarding boating traffic in particular, many fishers viewed it as detrimental to coral reefs primarily because of anchoring behavior. Especially recreational boaters are liable to place their anchors directly on coral reefs. Fishers sensitive to this are less likely to damage reefs in this way.

- Commercial divers report that they have witnessed recreational divers damaging coral reefs by standing on top of them instead of swimming over them. The increase in divers in Puerto Rico in recent years is important to coral reef health in that commercial divers are often the first to spot

problems with coral reefs such as bleaching, damage from anchors, etc. Fishery managers and others interested in the health of coral reefs would benefit from engaging in more cooperative efforts with commercial divers to monitor coral reef health.

- Fishers in Gúanica claimed that they had defended coral reefs by discouraging, through direct confrontation, the use of *filetitos* (small gill nets), which snagged on coral reefs and caused damage.

- Divers in the east and south possess two conflicting theories regarding the impacts of discarding conch shells: 1) that conglomerations of empty conch shells attract conch; and 2) that conglomeration of conch shells repel conch by giving them the impression of a conch graveyard. Whichever view a fisher holds is likely to influence where they dispose of empty conch shells. Those who hold the first view are likely to leave them on coral reefs, while those who believe the second are likely to leave them on sandy bottoms where they will be covered, or in grass beds where they will be hidden. Other divers report that conch shells provide shelter for juvenile species on and near reefs.

- Traps are a major gear that can affect coral reefs, both as working traps, as they sit on top of coral reefs, or as ghost traps, that continue fishing (and rolling) over coral reefs after they have been lost. Commercial trap fishers in Fajardo and Yabucoa design and place traps in ways that are sensitive to coral reefs, and most commercial fishers are careful to place their traps alongside coral reefs, on sandy bottoms, rather than on top of them.

- In both the ethnographic work and the survey, fishers reported that they had witnessed people fishing for octopus, on coral reefs, with Clorox.

4) Issues of Importance to Fishing Communities

- Despite their small numbers relative to all Puerto Ricans, the numbers of commercial fishing families have remained stable over time because fishing continues to provide symbolic and material resources to coastal communities. Among their most important services is that they provide high quality, fresh fish to locally-owned and -operated seafood restaurants. Commercial fishers commonly hold the view that they "defend themselves with *fresh* fish" (or, sometimes, they "defend themselves with lobster"), contrasting their product to imported frozen, canned, dried, or other preserved products.

- Although the high quality of their seafood enables commercial fishers to compete with lower-cost imports, most fishers view imports as a problem, particularly when imported fish is smaller than legal size limits on fish captured in Puerto Rican waters. The issue of imported fish, however, is more complicated than their competition with local seafood. At especially busy times of the year, imports enable small, family-owned coastal restaurants to provide seafood to customers in the absence of a sufficient supply of fresh local seafood.

- Some commercial fishing in Puerto Rico is done as part of the informal or underground economy. All communities that sit directly on the coast in Puerto Rico have members who fish, but in some cases, fishers are reluctant to report earnings from fishing, fearing they will jeopardize their ability to receive social services or increase their tax bills. In some rural and isolated communities, the links between fishing, contraband trade, smuggling, and other uses of coastal environments continue to the present, undermining the extent to which fishing has been able to develop as a legitimate (i.e. officially recognized) occupation.

- Dependence on, and engagement with, Puerto Rican fisheries varies geographically, from rural to urban settings, and in tandem with trends in tourism and other leisure, aesthetic, or recreational uses of coastal, littoral, and sea environments. The most viable fisheries are those that have managed to take advantage of a combination of state resources and tourism revenues. The most fishery dependent regions of Puerto Rico are the Southwest, Northeast, and Northwest; the least fishery dependent region is the North coast. However, there are families dependent on fishing in all the coastal municipalities.

- Fishers and their families vary in attachment to marine resources, from most attached to least attached, as follows: 1) full-time commercial fishers with direct personal ties to fish marketing (i.e. they also own or operate fish markets, seafood restaurants, or other sales outlets); 2) full-time commercial fishers without direct personal ties to fish marketing beyond selling their catch; 3) professional recreational or sport fishers, such as charter boat captains; 4) part-time commercial fishers; 5) subsistence fishers, whose fishing is directed primarily toward providing high quality fish proteins for themselves and their families; and 6) recreational fishers, whose fishing is directed primarily toward enjoyment. The most fishery dependent communities tend to have all six types of fishers.

- Fishing in Puerto Rico is intimately tied to trends in coastal gentrification, in both positive and negative ways. Relations between commercial fishers and the tourist industry are ambivalent: on the one hand, some fishing groups have utilized coastal tourism to increase revenue streams, establishing seafood restaurants that cater to tourists, providing water taxi services, selling bait to recreational fishers, and so forth; on the other, particularly near luxury resorts, fishers become involved in disputes with tourist developers over the destruction of mangroves and other critical habitats, slip space and coastal access, and crowding and contamination from recreational boating traffic.

- Fishers' reactions to coastal development/ construction are similarly mixed, with over 20% of the fishers interviewed in the survey believing that coastal development destroys mangrove forests and causes contamination that leads to the deaths of coral reefs and declining fishery resources. Other fishers, however, view coastal development positively, as a source of increased demand for seafood and tourist services that fishers can provide; in addition, coastal construction provides work for many fishers and their family members when they are not fishing, and in this sense subsidizes fishing operations.

- When fishers view coastal development as positive, this derives from the historical role of fishing in the Puerto Rican economy and its tendency to be dependent on other economic sectors and activities. Fishing operates as a function of other economic endeavors, namely, sugar cane cultivation, manufacturing, *chiripas* (odd jobs), and construction, among others. In the new context of coastal development, fishing is synchronized with sportfishing, boating and marine recreation. In La Parguera, fishers are critical of development, but also work in the recreational boats, or take care of boats for the visitors. In Puerto Real, perhaps the most traditional fishing community, fish dealers saw in development the future and the well being of the community. Development is viewed as equivalent to more local opportunities for economic growth and income. However, fishers also see the deleterious effects of that development and their physical displacement from their traditional communities and fishing areas.

- Puerto Rican fishing has always been intertwined with other pursuits in the insular society and economy. Recreational fishing offers a respite from work and high quality protein additions to family diets while taking advantage of public and private infrastructure. Commercial fishing

historically supplemented work in the sugar fields and other seasonal agricultural endeavors, and today is most often a component of multiple livelihoods in the lives and households of fishing families. Further, fishing and coastal lifestyles have been a part of the region's shipping, maritime commerce, boating, and tourist traffic from the early days of European occupation of Puerto Rico through the Spanish-American war and U.S. colonization to the present. They have enriched coastal society and culture in many symbolic and material ways. It is this dimension of Puerto Rican fishing that underlies the title of this work.

- Full-time Puerto Rican commercial fishers view fishing as a "moral" enterprise, even in the context of attempts to professionalize the fishery through the modernization of equipment and improvements in record keeping. This implies that they view fishing as a productive use of natural resources that provides some food or subsistence security and is directed toward socially beneficial outcomes, such as raising families and providing consumers high quality, fresh seafood. As such, they regard wasting fish, as occurs when they have to discard undersized species, as morally reprehensible.

- Commercial fishers in Puerto Rico possess a great deal of local knowledge about the fishery resources of the region that could constitute a valuable cultural resource for fisheries management. Currently, it forms a basis from which fishers criticize current regulations. Their knowledge includes information on reproductive, schooling, feeding, and other habits of fish and shellfish; factors that lead to resource decline; threats to water quality and nursery grounds; conditions of coral reefs, grass beds, and other substrates; conditions of estuaries; relations between lunar cycles and marine life behavior; seasonal changes in fish stocks; migration patterns of fish and shellfish; spawning aggregation sites; the health of stocks of different species of fish and shellfish; and so forth.

5) Policy and Management Issues

- To the extent that fishing effort varies seasonally, regulatory officials may wish to consider the timing of seasonal closures to coincide with periods in which fishing activity is lower, if such closures can still meet their biological objectives. May through July are the busiest months for commercial fishing, and March through August for recreational fishing (particularly billfish tournament fishing), while fishing activity during October and November is somewhat lower. Marketing factors also affect levels of fishing activity, in that the demand for seafood is particularly robust during Lent but less robust during the period leading up to Christmas, when pork is in particularly high demand for the holidays.

- *Departmento de Recursos Naturales y Ambientales* (Department of Natural Resources and the Environment—DRNA) officials believe they are doing their best to protect marine resources under the current limitations that government agencies face in Puerto Rico. Similarly, NOAA Fisheries and Caribbean Fishery Management Council (CFMC) personnel also aim to protect marine resources with the tools available to them. Unfortunately, many problems with fish stocks derive from sources outside of their jurisdiction or control. The lack of connection between resource managers and resource users would seem to encourage more participatory co-management. This could build on the widespread consensus that coral reefs, fishery resources, mangroves, and other coastal and marine environments and resources are in dire straights. Our survey found that between 60 and 70% of active fishers are highly pessimistic about the future health of coastal and marine resources and habitats.

- State efforts to protect marine species and stocks are relatively recent in Puerto Rico. Regardless of the qualms and complaints of the fishermen, local authorities (the DRNA and the CFMC) do make an effort to conserve species and protect the environment. More needs to be done, and that is almost unanimous in the voice of the fishers interviewed and visited for this study. One of the missing aspects of policy is the conservation and protection of fishing communities, through economic opportunities, cultural protection of their patrimony and architectural and cultural integrity. Change, development and gentrification are altering the landscape of coastal communities, and also restructuring labor and economic interest in those communities that served as the stewards of marine and coastal resources. Policies on conservation of habitats and species do not take into consideration the future integrity and well being of those communities, and the individuals. This report is the first step into the process of delineating a comprehensive plan for the protection of fishing communities.

- Due to the events associated with the development and implementation of fishing regulations by the DRNA, local fishers are boycotting the process of data gathering on fish landings. An essential component of the information used for the management of species and stocks, the situation threatens to harm the management process and increase the gap in communication and understanding between managers and fishers. Fishers are far removed from the process and few understand it. Government officials, researchers, and extension agents must make an effort to explain the social, biological, economic and management importance of providing landings data. They, however, must also be incorporated into the process of designing methods and procedures for the acquisition of that data, and other relevant information for the process.

- Commercial fishers routinely report that DRNA officials have not been properly trained in fish identification, and that they often attempt to fine fishers because the officials misidentify a legal species for a protected species. This undermines the legitimacy of the DRNA as an agency that is knowledge about the resource and, hence, as an agency charged with responsibility for protecting the resource. This suggests that training of DRNA officials in fish identification would be advisable. Such training would be most effective if combined with additional training about the biological, social, economic, and management goals of marine resource protection.

- Given that communication between fishery managers and fishing populations in Puerto Rico has suffered from a lack of trust in recent years, and that soliciting support for and educating fishers about MPA placement and design has not been accomplished through traditional channels, fishery managers should consider other methods of communicating with fishing populations than public hearings, written communications (e.g. newsletters, posters), or other formal methods. DRNA officials themselves acknowledge that many of those who complain about the new regulations have not read them, and that misinformation is common among fishers. This research has reaffirmed the effectiveness of an ethnographic approach to communicating with fishers: this consists of several interconnected, largely informal methods of meeting and talking with fishers in their homes and at their fishing centers, establishing rapport, and listening to their opinions more than imposing "top-down" perspectives from state and federal agencies.

- Improving communication between fishers and fishery managers could benefit from reinstating port agents in fishing communities. Formerly, these individuals officially received landings reports, yet they also responded to fishers' complaints, communicated the reasons behind new regulations, and addressed other issues relating to marine resource management. They were also instrumental in forging ties between managers and fishers, as well as fishers and marine scientists, that resulted in increased understanding and awareness about the perspectives of various stakeholder groups.

- One of the key complaints of the fishermen visited and interviewed for this project was the government's failure to incorporate their opinions effectively into the policy process. This resulted in the perceived fiasco of the fishing regulations, and the constant fracas with the DRNA. There is an urgent need for a well thought process to incorporate the fishers' knowledge, data on species, perceptions and opinions into the fisheries management process. Such a process must go beyond the present *Junta Pesquera*, or Fisheries Board with representatives from different sectors. The Caribbean Fishery Management Council (CFMC) developed a protocol for the incorporation of the fishermen, based on data from the Coral Reef Ecosystems Studies project, and data from this community profile.[3] The protocol addresses many of the communication and trust matters that are reviewed in this report, and provides a blueprint for action.

- Various groups of fishers around the island are engaging in marine protective measures and other behaviors that could serve as models for fishers in other regions. For example, Yabucoa and Fajardo fishers have been designing traps that are more coral-reef friendly, and Rincón fishers are educating one another on the importance of reporting landings data and keeping accurate records for fishery management as well as business/ loan purposes.

- Fishery managers may use the information on dependence on fishing by community to locate communities where they are likely to find knowledgeable and well-respected fishers and locations where fishers are likely to exchange information. Place based communities are preferable to network based communities for communication purposes, but when working in network based communities managers need to locate significant coastal locations where fishers gather.

- The most pervasive fisher perception regarding the failure of fishery management is the regulation against keeping undersized species, specifically because this results in the waste of fish landed from great depths. This issue was repeated in nearly every fishing community we visited and always in conjunction with a generally negative view of DRNA and other fishery management personnel. Many fishers added that they see undersized imported fish in Puerto Rico's supermarkets.

- Secondary source data, such as landings data and the fisher census, sometimes do not correspond to the views of fishers regarding their most important species, based on ethnographic interviews. For example, while both the landings data and the ethnographic interviews agree that lobster and yellowtail snapper are two of the most important species, most fishers also mentioned *sierra*, or king mackerel, as a highly prized, important species to them, as well as other, similar pelagic fish. However, the landings data indicate that king mackerel accounted for only around 3% of the total landings from 1999 to 2003 (the last five years for which we have landings data). On the other hand, some species that show up in the landings data as frequently landed fish, such as white grunt, are mentioned far more rarely than king mackerel as important species.

- Relations between the state and Puerto Rico's fishers are ambivalent. While some state support derives from the Department of Agriculture, as it did formerly from CODREMAR, coming in the form of investment in *Villas Pesqueras* and other infrastructure and technology, other parts of the state apparatus in Puerto Rico have erected barriers to fishing activities to protect fish stocks. Most fishers we interviewed, recreational and commercial alike, view the DRNA, the organization responsible for enforcing most fisheries regulations in Puerto Rico (all within 9 miles), as overly aggressive in their enforcement and their protection of fish stocks, as misguided

[3] The protocol is available at: http://www.caribbeanfmc.com/pdfs/Vald%E9s%20Trumble%20Methodology%20and%20protocol%20for%20fishers%20partic%85.pdf

in their development of fishery regulations, and as unqualified to adequately protect fishery resources.

- Fishers perceive current licensing requirements as costly, burdensome, and biased against older, experienced fishers who do not happen to keep accurate records or do not keep records in an officially recognized way. Some highly experienced fishers have been humiliated when they receive licenses that designate them as beginners, which other fishers perceive as a serious blow to their dignity and to the dignity of the noble, moral, and at times dangerous craft of fishing. DRNA officials believe that this could be resolved simply by changing the name of the license.

- Some influential fishers and fish merchants have been promoting civil disobedience vis-à-vis fishery regulations, encouraging their peers or their clients to ignore or violate regulations that they consider poorly conceived.

- In addition to ambivalent relations between the state and fishers, investment in fishing has proceeded unevenly and at times without great benefit to the fishing community at large. The construction and outfitting of *Villas Pesqueras* are often accomplished through political mechanisms, as a kind of "pork" to communities, without enhancing the local fishing population's ability to make a living from fishing. As such, the composition, management, and organization of *Villas Pesqueras* are highly variable across the islands, with some *Villas* having been effectively privatized.

6) Recommendations for Future Research

- Detailed multidisciplinary research, combining economics and sociological or anthropological approaches to an analysis of the specific linkages among fishing, tourism, and coastal development, focusing on transfers of human and social capital among economic sectors and their implications for fishing effort, investment in fishing, wage structures, returns to labor and capital, and other economic factors. Such analyses should also address the multiplier effects of the recreational fisheries of Puerto Rico and the ways in which the commercial catch enhances local restaurants, markets, and other coastal businesses.

- Multidisciplinary research comparing fishers' knowledge with scientific knowledge about the fisheries of Puerto Rico would determine where the two knowledge bases correspond to or conflict with one another, establish a basis for consensus and areas in need of additional research and education, and enhance current baseline studies in biology and anthropology that have collected data on fishers' knowledge and on the biology of Caribbean marine resources. This work might also enable managers to determine where fishers' knowledge bases could be relied on to inform management decisions.

- Fishing as a productive process is well understood, and there are technical and ethnographic descriptions of fishing with gillnets, reel-lines and traps, among others. However, there has been very little research on the activities of the SCUBA divers, including their life histories and their lifestyles. Divers bring a new dimension to fishing, and they appear to be a group with socio-demographic characteristics different from the rest of the fishers. They are perceived as a threat to conservation, having a faulty conservation ethic, prone to trap theft, and belonging to the underclass of coastal communities. Shifts in gear, from traps to hand lines and to gillnets, is attributed to their success in fishing. SCUBA is at the present time the most important gear, responsible for most of the landings. This merits an effort to understand them in a social and economic context.

- The distribution of fish, its circulation as a commodity, its cultural significance, dietary and nutritional impact, and the local restaurant market remain ill understood aspects of fishing despite a handful of studies. This is the weakest link in management. The market usually remains untouched when regulations and prohibitions are in place, as long there is a paper-trail documenting catch and transactions of the species. As stated by Valdés Pizzini (1985) and others, fresh fish in coastal communities is a hook to entice customers to the local restaurants, where frozen and imported fish and shellfish are served as local. Puerto Rican fishermen have always complained on the frailty of the market as they felt victims to dumping by longliners, cheap fish imported by fish dealers during Lent (and other times of the year as well), and stringent regulations by the management agencies. Yet, it is in the circulation of fish, as presents, foodstuffs and commodities, that fishing acquires its true values in coastal communities. Fish for subsistence, as part of the local system of reciprocity, as a special item for the restaurant market, as food for local communities, and as a priceless delicacy for the tourist and visitors, the circulation of fish continues to add value to coastal communities, and sense to an activity in a difficult situation.

- Research on the relationship between recreational boating/ diving and recreational fishing, including practices that some currently believe to be harmful to coral reefs and to seafood markets, would increase our ability to predict the scope, character, and impact of recreational fishing in Puerto Rico based on existing licensing records and other indicators or boating traffic.

- Research on two fishing practices that are currently poorly understood: 1) fishing for aquarium fish, including its prevalence, regional variation, and its market; and 2) research on bait fish, including the relationships between recreational and commercial sectors that derive from the sale of bait fish. Aquarium fishing is particularly important in that it usually removes undersized and juvenile fish from the resource.

- Outbreaks of *ciguatera,* a marine toxin that bio-accumulates in certain species of fish (e.g. barracuda) and is prevalent in some reef-feeding species, have unnecessarily negatively affected fish markets in Puerto Rico, with consumers rejecting fish after news coverage of a harmful algae bloom or other toxic marine event. Research into the perceptions of Puerto Rican consumers toward seafood, and their relationship to various sources of information, could be used to design more effective educational campaigns to inform consumers, perhaps through the public schools, which species of fish are susceptible to *ciguatera* poisoning and which are not. This work could be directed toward improving consumers' overall "seafood literacy," or their appreciation of the benefits and drawbacks of consuming various species of fish.

- Research on current systems of folk management of resources, including where and how fishers have protected coral reefs, mangroves, and other important marine resources, would increase DRNA's abilities to utilize practices already in place to protect marine resources. Included in this study would be cases of where the political organization of fishers has resulted directly from efforts to protect resources.

- An oral history project on the history of specific components of the marine ecosystem, as understood by elder fishers who have interacted with different components of the marine environment throughout their lives.

- Research on the cultural significance of fishing to non-fishing Puerto Ricans would enable an understanding of the subtle ways that the loss of fishing may diminish the ambiance of coastal landscapes for more than fishers and their families.

The above issues constitute a necessarily incomplete list of what we believe to the salient issues currently facing Puerto Rican fishing communities and fishery managers. Part of the difficulty we face in characterizing the many attributes of Puerto Rican fishing and fishery management derives from their being complex and deeply entangled with other coastal lifestyles and developments, as well as from the variation we have noted from region to region and fishery to fishery. To attempt to isolate key issues from the rich mosaic we call Puerto Rican fishing is at best a challenge, and at worst a disservice to a centuries-old Caribbean tradition.

Table A. Issues by Region							
Region	**MPA Issues**	**Coral Reef & Habitat Issues**	**Fisher Knowledge**	**Management Issues**	**Social & Cultural Issues**	**Livelihood/ Economic Issues**	**Conflicts**
Southwest ***Cabo Rojo Lajas***	Boqueron fishers used to fish Bajo de Sico & Abrir la Sierra; Fishers risk fines to fish MPAs; Divers still fish MPAs; Fishers displaced from fishing turn to smuggling.	Puerto Real fishers careful to place lobster pots to side of reefs.	Landing deep water species kills/wastes them; trap placement based on lobsters' habits; grouper restrictions are sound but other protected species are plentiful; dorado migrate from Dominican Republic to Africa and feed around gill nets; *sierra* feeding habits reflect lunar cycles.	Regulations create a black market for fish; fishers aren't reporting landings or filling out trip tickets; licensing requirements costly and cumbersome; perception that regulations are designed to put fishers out of business; size limits ridiculous if can't help catching deepwater species and if imports are undersized; recreational fish sales depress the market.	Dealers and prominent fishers encouraging civil disobedience with regard to fishery regulations; relations with dealers based on trust; "fishing village" identity important to Parguera residents; moral basis to fishing includes the reproduction of the family by fishing; DRN regulations have promoted fisher solidarity.	"We defend ourselves with lobster;" relations between fish dealers and retail outlets based on trust, loyalty; boat storage for seasonal residents important for Parguera fishers; growth of seasonal population has created jobs for fishing households (Boquerón, Parguera); increased tourism boosts seafood sales.	Gentrification has caused problems in Boquerón; ambivalent reactions to development in Puerto Real; commercial fishers oppose charter boat and recreational fishers selling fish.

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Northeast ***Fajardo*** ***Ceiba*** ***Vieques*** ***Culebra***	Conch closures lead to "derby fishing"/ hazardous diving; Culebra fishers were early proponents of an MPA in the Canal Luis Peña.	Hurricane Hugo damaged east coast reefs; reef conserving trap placement/ trap designs common in Fajardo; military control of Ceiba coast preserved mangrove forests; Ceiba divers limit their direct interaction with reefs; need to let marine environments lie fallow (shift fishing territory); part-time fishers in Vieques less conscious about reef protection; boaters and inexperienced fishers damage reefs with anchors; Culebra fishers sought coral reef protective measures early.	Conch breed in December, yet closure in July; landing deep water species kills/ wastes them; marina development lowers water quality; Ceiba fishers concerned about sedimentation; knowledge of grass beds & reefs extensive among divers; conch shift territory by lunar cycles (closer to shore under full moon); competing theories about conch cemetery; fishers used to pierce bladders of small deepwater species after landing them; locating conch requires experience/ knowledge of substrates; studies conducted elsewhere don't apply to Vieques; Culebra fishers believe their mangroves are threatened.	Fajardo fishers appreciate Coast Guard safety training; problems with DRN enforcement; folk management: shift from place to place to allow resource to recover; license requirements are burdensome & Peñalize/ humiliate older, experienced fishers; Vieques fishing associations compete for state funds; inexperienced fishers in Vieques keep lobster with eggs, but experienced fishers don't.	Fishing centers are important family gathering places; fishing is important to the reproduction of the family; opposition to DRN promotes fisher solidarity; fishing landscapes lend ambiance to the coast; women and children more active in associations with seafood retail outlets (markets & restaurants); fishing as heritage; fishers give away species they cannot sell; wasting dead fish is immoral; inexperienced fishers give experienced fishers a bad name; Vieques fishers say they "sacrifice" to fish; Fishing and tourist sector are tightly integrated in Culebra through seafood sales and water taxi services; Culebra fishers promote marine protective measures in schools, among youth.	Fajardo fishers provide water taxis to tourists; seasonal fluctuations in earnings need consideration; Vieques unemployment leads to increased numbers of fishers; part-time fishers sell below market prices; island municipality fisheries have higher costs due to imports; indicates greater commitment to fishing; gentrification is raising housing prices in island municipalities beyond the means of fishers and other working people; there is a dynamic link between fishing and the construction industry in the island municipalities.	Fajardo marina development & expansion source of conflict; Ceiba fishers believe dredging permits given out unfairly; in Vieques conflicts among fishing associations stem from competition for state funds; experienced/ full-time fishers in Vieques oppose many inexperienced/ part-timers behaviors.

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Western Metropolitan Municipalities: ***Mayagüez*** ***Añasco*** ***Rincon***	Conch closure narrows habitat of juvenile fish that use shells for protection; Mayagüez fishers fish Bajo de Sico, Abrir la Sierra, and Tourmaline; Añasco fishers report fishing Tourmaline; Rincón fishers support Tres Palmas MPA; Rincón commercial fishers desire increased bag limits for recreational fishers.	Mayagüez fishers fish the western coral reefs; Añasco fishers movement to providing tours may increase human interaction with coral reefs; some Rincón fishers believe reefs should be protected for tourists, and advocate using less fuel-burning motors.	Water quality varies with distance from shore, from *agua sucia* (dirty water) to *agua verde* (green water) to *agua azul* (blue water); juvenile fish use abandoned conch shells for protection; decline in sugar cane production led to changing near shore ecosystems, due to lack of canal maintenance; flushing of fresh water from the hotels damages near-shore ecosystems; boating traffic noise pollution damages fish.	Regulations enacted without sufficient justification (communication problem); fishers are "frightened of panels and statistics; Rincón fishers attempting to professionalize the fishery through record keeping.	Mayagüez Virgen del Carmen celebration engages entire community while emphasizing family basis of fishing; fishing as therapy from occupational stress; Rincón fishers highly cooperative, assisting each other in times of crisis; commercial fishers train by apprenticeship in Rincón.	Virgin del Carmen celebration stimulates economic activity; "Market destruction is just as bad as habitat destruction"; Rincón fishers depend on repeat restaurant business, give consistent quality.	Mining of sand for construction in Rincón has destabilized shoreline; gentrification, far advanced in Rincón, has pushed some fishers from coastal *parcelas*; recreational fishers depress market by selling fish on west coast.

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Northwest: ***Aguada*** ***Aguadilla***	Aguada fish dealers finance fishers who must cross Tourmaline to fish;	Aguadilla fishers report aquarium fishing uses chemicals that stun fish and damage reefs.	Aguadilla fishers blame contamination on resource decline.	Fishers suggest managers should pay attention to long-lining in the area, as well as the aquarium fish trade.	Aguadilla artisanal boat builder supplies vessels all along the west coast;	Declines in garment manufacturing in this region have increased importance of fishing; fishing's role in local economy more noticeable on weekends than during week.	Aguada fishers oppose plans to open a Club Nautico based on its potential to disturb manatee populations and crab breeding grounds; Aguadilla fishers object to long-line fishers from U.S. mainland fishing their waters.

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Southern Metro: ***Ponce*** **Juana Díaz**	Caja de Muerto Island (PR MPA) is a favorite fishing location of recreational and commercial fishers; some divers in this region continue diving for conch during closure.	Thermal and idustriral pollution from energy development highly destructive in this region; shipping and anchoring behaviors seen as destructive to coral reefs; Cabo Rojo mangrove habitats produce ballyhoo for bait for Ponce marine suppliers; Hilton's destruction of mangroves destroyed land crab habitats; Juana Díaz fishers specialize in lobster because of proximity of productive reefs near Caja de Muertos.	Recreational fishers who target Caja de Muerto Island find it productive; agricultural practices destroy mangroves and reefs, yet they are discouraged from complaining about this because they are part of the PR DOA; sea grass, sand flats, and patches of reef between Ponce shore and Caja de Muertos are highly productive areas; conch shells provide habitat for octopus; Salinas water treatment plant is contaminating inshore habitat (5-6 miles from shore).	La Guancha fishers demonstrate ways that network-based fishing communities still maintain fishing identity while embracing other economic sectors; DRNA enforcement personnel need to work on people skills; La Playa fishers object to being lumped with farmers after CODREMAR; La Playa fishers object to size limits because of wasteful deaths of deep water species; La Play fishers find licensing requirements burdensome; La Playa fishers advocate participatory co-management; Juana Díaz fishers praise DRNA's turtle protective measures.	La Guancha is a favorite site of celebration on Puerto Rican independence day (July 25th); stone statues and murals at La Playa, Ponce, and in Juana Díaz, celebrate fishing heritage; fishers at La Playa share labor and pool resources for improving facilities; La Playa marketing strategies change during Lent;	Tourist and commercial fishing fully integrated at La Guancha; La Guancha focuses commercial & recreational fishing with tourism, as premier example of vertically integrating fishing with tourism; most charter boat activity in Ponce associated with hotels, foreigners.	La Playa object to being over regulated for minor infractions while Ponce Hilton destroys acres and acres of mangroves and Club Nautico destroyed habitat in building their facilities; shipping traffic interferes with fishing (e.g. tearing lines).

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Southeast: ***Naguabo*** ***Humacao*** ***Yabucoa*** ***Maunabo***	Conch closure causes derby fishing in Naguabo; Naguabo fishers opposed to seasonal closures; fishers believe they should be compensated for income lost to MPAs;	Naguabo divers excellent candidates for coral reef monitoring; construction is damaging mangroves; clearing of mangroves has hastened sedimentation and suffocating coral reefs; mangrove & coral reef declines go hand in hand;	Housing construction responsible for sedimentation, contamination; fishers dispose conch shells on reef to offer protection for juvenile species; size limits too strict, do not protect resource; fishers contrast "field" or experiential knowledge with knowledge based on landings data.	Coastal managers could look to Naguabo to see early tensions/ relationships with incipient tourist development; fishers participating in fish stock study believe information was used against them; Yabucoa fishers networked into island-wide fishery politics; Yabucoa fishers experimenting with new trap designs; Yabucoa fishers attempting to get law 278 changed; fishers believe that NOAA wishes to make a marine sanctuary of the entire Caribbean; fishers see contradictions between federal and local regulations; licensing seen as problem.	Shortages of fresh water due to cement mixing for construction; Naguabo fishers descend from boat-building and gear-making traditions, which they are attempting to teach youth; social network ties between Yabucoa and Humacao fishers directed toward the revision of fishing regulations; Maunabo has a land crabbing tradition (*jueyeros)*.	Popularity of area increasing housing costs beyond working people's means; despite high state level investment, fishing infrastructure is underutilized in Naguabo; restricted fish are imported and sold locally; declines in fishing pushing some younger fishers into drug smuggling; tourist traffic & marina maintenance at Palmas del Mar benefit fishing association; abandoned shipping infrastructure used by recreational fishers; imports and sportsfisher sales are undermining fish markets;	Coastal construction seen as problem by fishers in region; ships from the oil refineries cut trap lines and contaminate the sea with oil; trap fishers suspect divers of stealing from their traps.

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Southern Region I: ***Guayama***		Petrochemical development destroyed land crab populations and mangroves; lack of fish near petrochemical plant have caused a decline in the use of beach seines;	Pozuelo fishers have been engaging in lobster preservation methods since before regulations, leaving lobsters with eggs in traps to protect them from predators;	Indiscriminant licensing of fishers allows some who don't fish to apply for assistance after a storm, claiming they lost equipment; abandoned vessels in Pozuelo attest to failed state investment in fisheries; fishers believe they have been excluded from management; management meetings are too long, take time from fishing; fishers promote reporting landings data as a pathway toward tax exemptions	Long tradition of fathers teaching sons in Pozuelo	Private fish marketing is common in Guayama fishing communities;	Problems between local trap fishers and divers from neighboring municipalities; petrochemical industry has displaced fishers and contaminated nearshore environments;

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Southern Region II: ***Guánica*** ***Yauco*** ***Guayanilla*** ***Peñuelas***	Conch closure has negatively affected divers from this region; Guaypao fishers support closures, but believe the times need to be revised based on fishers' observations; Peñuelas fishers listed red hind as among their most important species.	Local fishers complain of outside fishers destroying reefs with *filetitos* (little gill nets); Guayanilla fishers fish the coral reefs and sandy cays along southern coast;	Fishers question the timing of the conch closuer; jet ski traffic has led to decline in baitfish; fishers know of mutton snapper aggregation locations; lobster are plentiful, but everything now preying on them: octopus, fish, fishers;	Fishers believe area and seasonal closures should be rotated, as fish change habits from year to year; fishers advocate for being allowed to fish one-third of the time during spawning aggregations;	*Sierra* among the most highly desired fish among fishers, though brings lower price at market; gray triggerfish and jacks important for household consumption; fishers in Guayanilla discouraging their children from fishing for a livelihood;	Tourism in an incipient state of development, with much potential; fishers compete with imports by focusing on freshness, quality; seafood sales brisk during Lent and summer months; most successful fishers in Guayanilla are divers; Peñuelas association members promoting cooperative membership.	Within Guánica fishing association, dispute over divers selling highly prized species to restaurants instead of association; municipality wants to move association to less desirable location; local fishers confronted beach seiners destroying near shore environments; petrochemical development has altered/ destroyed near-shore marine environments

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Northern Metro Region: ***San Juan*** ***Cataño*** ***Toa Baja***	Condado Lagoon seen as the least effective MPA because of continued pollution from shipping and industry; conch closure and declining conch populations have forced changes in San Juan fisher behaviors; fewer divers today than previously.	Fishers perceive contamination as primary problem with habitat in this region; dredging has suffocated reefs in this region; Cataño fishers who tried to remove sediment from coral reefs suffered skin disorders.	Both king mackerel and conch populations down from 25 years ago; disapprove of size limits as wasteful.	La Hoare fishers point to several sources of bay/lagoon contamination.	Fishing remains a family enterprise in the midst of the city; Cataño fishers are educating youth in public schools about importance of marine resources; Northern metro fishers perceived as older, with less recruitment of youth to the fishery.	Unemployment lowest in Puerto Rico, offering fishers alternatives to fishing full-time; urban traffic important to fish marketing, encouraging street vending; Cataño fishers well supported by municipality; gas prices have restricted fishing territories.	Fishing associations compete with space with cruise ships, tourism infrastructure;

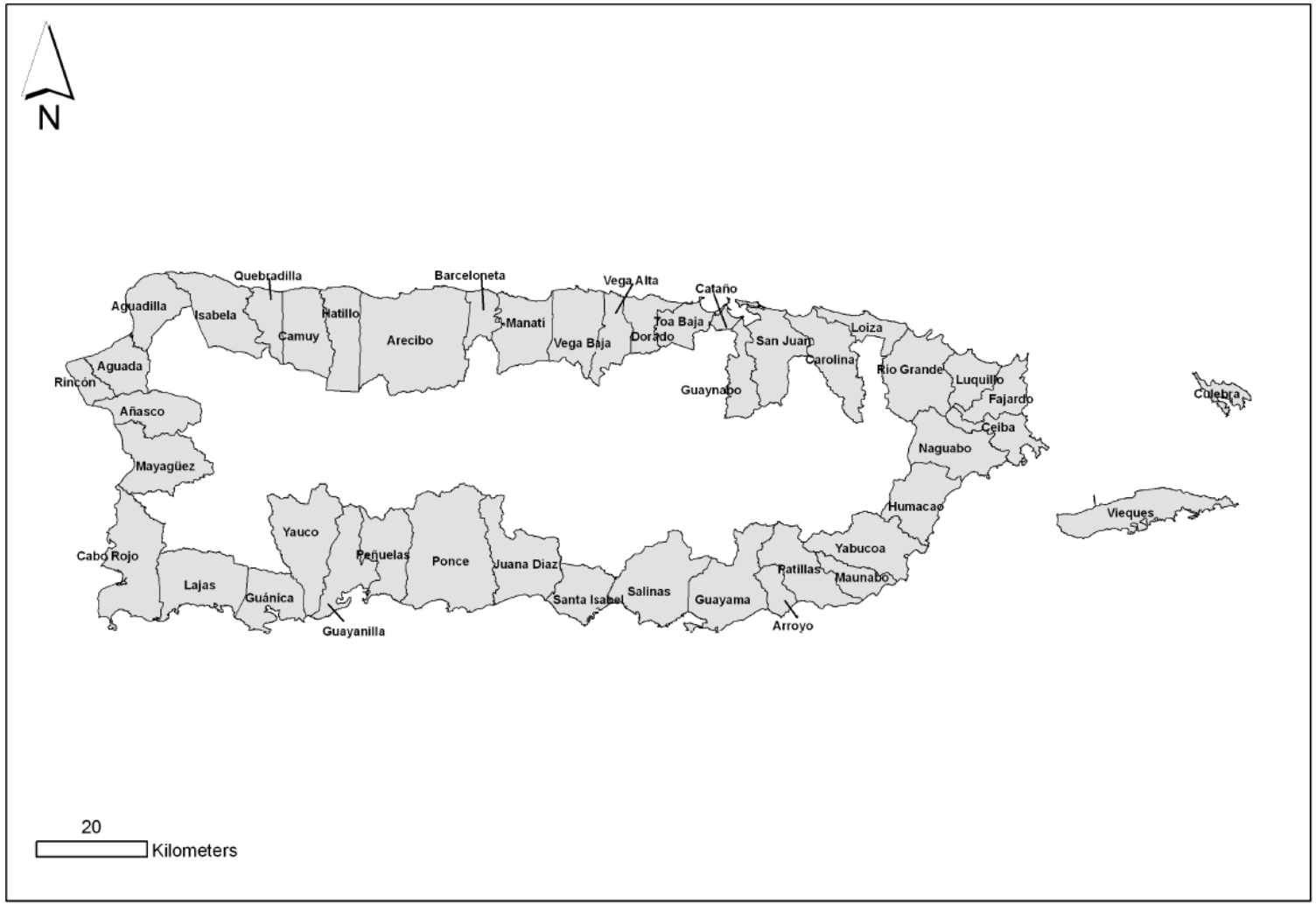
Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Southern Region III: ***Santa Isabel Salinas***	Fishers note rise in illegal fishing activities by youth in area, including poaching, taking small lobster, and flushing out octopus with bleach.	Decline of sugar industry has altered near-shore marine environments; region blessed with several sheltered mangrove bays, yet currently threatened by various activities; thermonuclear plant responsible for algal blooms and anoxic conditions (dead zones).	Fishers know well the migration habits of pelagics; some younger fishers mistakenly believe juvenile lobster are a different species than their adult counterparts; fishers here interpret DRNA data differently than DRNA.	Fishing centers are centers of resistance to fishing regulations/ DRNA needs to improve relations with local fishers; DRNA does not address pollution problems from coastal development or recreation; fishers object to imported seafood.	Boat building and social activity accompany political organization at Santa Isabel association, important place of occupational identity; fishers here have strong working class identity; lack of unity among fishers perceived as problem.	Close relations between tourism and fishing developing in this region; important land crab sales area; more than 40 restaurants specialize in seafood in La Playa, Salinas.	Space around association somewhat contested by both work and leisure interests; recent increase in divers has caused fear among trap fishers about theft from traps.

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Southern Region IV: ***Arroyo Patillas***	Arroyo fishers claim to respect the closures.	As divers and highly conservation minded fishers, Arroyo fishers good sources of information on substrates.	Patillas fishers knowledgeable about wide territories to the east and west of Patillas; marine ecosystems are more complex than the laws give them credit.	Fishers in Arroyo active politically, in part to get permits to dredge out the marina downtown; Arroyo fishers willing to take DRNA officials out on the water; Patillas fishers view size limits as wasteful.	Virgen del Carmen festival in Arroyo annually attracts thousands; Arroyo fishers teach youth fishing as vocation; native sailboat regatta takes place in Patillas.	Much subsistence fishing in Patillas, along with nascent charter boat industry; Patillas and Arroyo fishers cooperate with one another economically.	State provided vessels at Arroyo association the cause of much envy and misunderstanding.

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Western North Coast Municipalities: ***Carolina*** ***Loíza*** ***Rio Grande*** ***Luquillo***	Fishers consider their practices "artisanal" and not damaging to stocks; MPAs don't work because fish move out of closed areas; favor rotating closed areas from season to season.	Resort development is destroying wetlands and mangroves.	Cape Miquillo, site of new resort development, is an important bait area and area for shelter during bad weather.	Loíza fishers claim that "if they are going to arrest us for fishing, they better build larger jails;" fishers object to public hearings held in luxury hotels; fishers consider size limits wasteful.	Region's African past celebrated and used as source of solidarity; "in Loíza, fishing and folk art go together;" Luquillo woman fisher teaching gear construction to youth.	Lent in Loíza is a time of robust fish sales, leading to fish rationing among customers; supermarkets allowed to sell undersized fish; Rio Grande association provides sheltered location for recreational and other commercial fishers.	Resort development locus of fisher protest, particularly Hotel Paradisus & Isla Verde Hotels.

Region	MPA Issues	Coral Reef & Habitat Issues	Fisher Knowledge	Management Issues	Social & Cultural Issues	Livelihood/ Economic Issues	Conflicts
Eastern North Coast Municipalities: ***Arecibo to Dorado***	Dorado association members fish near Culebra MPA	Rivers along north coast often sources of contamination from industry.	Divers from Dorado exploit extensive territories as subsistence/ recreational fishers			Weekend recreational fishing traffic between Arecibo Club Nautico and Jarielito brisk; families sell fish larvae tamales;	Conflicts over limited access points into rough seas.

Map A. Puerto Rican Coastal Municipalities



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INTRODUCTION

"If you're going to write about fishermen, write with one hand over your heart."

—North coast Puerto Rican fisher, June, 2005

Out of context, uttered by itself, the above quote begs many interpretations. Is it a plea for truth? For pity? For understanding? Does it imply that most representations of fishers are untrue or unkind, and that by writing with your hand over your heart you are more likely to offer more accurate representations? Or could it be a challenge to the right-handed majority, asking them to write more slowly and carefully with their left hands while raising their right hands to their hearts? Could it be asking to consider how the left-handed minority lives?

Commercial fishing families in Puerto Rico certainly constitute an occupational minority. Between 1898 and the present, the population of full-time commercial fishers in Puerto Rico has fluctuated between 1,500 and 2,500, yet unnumbered thousands of recreational and subsistence fishers depend on the marine resources on and near the islands of Puerto Rico and similarly unnumbered hundreds of thousands of Puerto Ricans and others enjoy the fruits of the Caribbean sea as a significant component of tourist experiences. Further, fishing in Puerto Rico may be understood as a *moral economy,* rooted in households and families, rather than a capitalist enterprise, even in cases where fishers have modernized their fisheries and made significant attempts to professionalize fishing through more accurate record keeping, participatory co-management, improvements in marketing, and other measures. We expand on this in the section of this report on fishing communities, in which we argue that fishing communities are becoming increasingly non-place-based in Puerto Rico, instead being based on networks that interact regularly at significant coastal locations, on shared interests in coastal developments (often struggling against specific developments), and on knowledge of marine resources and environments.

It is important here to distinguish early in this report between types of fishing and their relationship to what we refer to as fishing communities—whether place-based, network-based, or knowledge-based. Here we address coastal fishing (as opposed to inland, freshwater fishing) in all its forms: from fishing as one's primary occupation and identity to fishing to supplement household food supplies to fishing recreationally. The bulk of the information in this report deals with commercial fishers and their communities—or those to whom fishing is important to their own and their families' livelihoods—primarily because these are the families and communities that MPAs, fishery regulations, licensing requirements, and other marine protective measures most directly impact. Yet we also describe here a vast and complex recreational fishing community in Puerto Rico, comprised of charter boat fishers, sport fishers from the U.S. mainland, and residents who fish primarily for recreation, most of whom consume at least some portion of their catch.

Recreational fishers appear here and there in the municipality profiles, but less frequently because they utilize marine resources less regularly than commercial fishers, usually on weekends, and our research took place through the entire week. Part of this, too, is due to confidentiality: that is, charter boat fishing operations are fairly thinly spread over Puerto Rico's coast. If we were to discuss them in detail in the municipality reports, they could be too easily identified. We devote a special section of this report to charter boat captains, however, because they are part of the much larger recreational fishing community. Most published accounts suggest that recreational fishers are growing in number and their communities

becoming more complex, particularly as they take on specific causes vis-à-vis new regulations, other users of marine resources, and so forth, becoming more politically organized and astute (Ditton and Clark 1994; Griffith, et al. 1998; Griffith and Valdés Pizzini 2002; Valdés Pizzini, et al. 1998). As such, they are adding to the number and elaboration of non-place based communities in Puerto Rico; in so far as they are involved in the gentrification of the coastal zone through their contributions to the demand for marinas and marina development, they are also involved in the complex processes by which place-based communities are becoming less and less common.

I.a. Objectives and Goals of the Current Work

This work emerges from the need, since the Magnuson-Stevens Act, to estimate the social impacts of proposed regulations, in this case primarily MPAs, on the fishing communities of Puerto Rico—a legal requirement that has been bolstered by the National Environmental Policy Act and Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations)*. In this report, our first objective has been to conduct community profiles of fishing communities in all coastal municipalities that have fishing communities, including the extent to which communities are fishery engaged or fishery dependent, as defined in the executive summary above. The specific factors that make a community fishery dependent are outlined in the section below entitled Puerto Rican Fishing Communities. The second objective has been to estimate the impacts on Puerto Rican fishers and their families of the 11 federal MPAs of Puerto Rico and the U.S. Virgin Islands. The overall goal of this study has been to combine these two objectives into a comprehensive synthesis of Puerto Rican fishing, including its contemporary composition, its history, cultural significance, the changing nature of fishing communities, and its relation to fisheries policy.

Briefly, to satisfy these objectives, we spent more than two and a half years, from November 2003 to July 2006, compiling information on Puerto Rican fishing and fishing communities. We have organized the work by first presenting an overview of contemporary fishing practices in Puerto Rico and subsequently focusing on its various specific dimensions, including its history, cultural significance, a discussion of Puerto Rican fishing communities, a statistical overview based on survey work conducted in 2004 and 2005, a discussion of the performance of MPAs, and a policy discussion. These general discussions are followed, in Volumes II and III, with regional profiles that give more detailed information at the local level, describing fishing practices and fishing families' concerns on a community-by-community basis.

This work then constitutes an initial step in a long relationship between NOAA Fisheries and the fishers of Puerto Rico. The report is designed to be a living document, one that can and must be revised and added to as new developments emerge. Its attempt to understand the internal dynamics of Puerto Rico's multifaceted fishers is also an early attempt at establishing effective communication and more democratic participation in the regulatory process.

I.b. Brief Overview of Puerto Rico

The islands of Puerto Rico—including the main island, Vieques, Culebra, La Mona and Monito, and Desecheo, and a number of smaller keys—lie in the Caribbean archipelago between the large island that comprises the Dominican Republic and Haiti, and the southeasterly curving chain of islands known as the Lesser Antilles, which extend from the small island municipalities of Vieques and Culebra, Puerto Rico, and the U.S. and British Virgin Islands to the cluster of islands known as Trinidad and Tobago. They cover a land area of nearly 9,000 square kilometers and have just over 500 kilometers of shoreline. The

largest or main island of Puerto Rico is considered one of the Greater Antilles with the Dominican Republic/ Haiti, Cuba, and Jamaica, but its small outer islands to the east have more in common, geologically, with the Lesser Antilles.

Situated well within the tropics, the islands enjoy a warm climate, with temperatures averaging 82º between November and May and higher in the summer; although summer trade winds moderate coastal temperatures and mountain temperatures can dip as much as twenty degrees lower than along the coast. They have in common with other Greater Antilles wet, lush northern environments and drier, more desert-like southern environments; the prevailing winds arrive from the northeast and whatever clouds they drive drop most of their moisture prior to crossing the central mountains. As with island societies generally, the islands of the Caribbean have been defined in part by highly transient populations, with substantial proportions of their residents involved in international migration streams and many of their coastal and mountain locations common destinations for tourists and temporary or seasonal residents. Jorge Duany views this phenomenon as so pervasive that he entitled his recent book, Puerto Rican Nation on the Move (2002), and Griffith and Valdés Pizzini, in their book on Puerto Rican fishing, focused on the movement between fishing and wage work that often involved migration to the U.S. mainland.

As a commonwealth, Puerto Rico has been part of the territories of the United States since 1898—a political relationship that many Puerto Ricans often either forget or choose to downplay when they identify themselves. As a former Spanish colony, Spanish is the first language of most Puerto Ricans, although the knowledge and use of English is widespread as well. Puerto Ricans tend to consider themselves Puerto Ricans first and U.S. citizens second, an identity that derives from cultural rather than political nationalism. There are around 3.5 million inhabitants of Puerto Rico, with 1.4 million living in the San Juan metropolitan area; another perhaps two million live on the U.S. mainland, with New York, Chicago, and Miami having particularly large populations of Puerto Ricans. Families typically have ties to one or more regions across the United States through migration.

Puerto Rico's economy has changed from one dependent primarily on tropical agricultural crops like sugar, coffee, and tobacco to a more mixed economy of shipping, military spending, tourism, financial and insurance services, manufacturing, construction, and *chiripas* (temporary, informal jobs). Special tax exemptions made Puerto Rico attractive to many U.S. manufacturers from the 1970s through the 1990s, attracting in particular pharmaceutical and medical supply manufacturers as well as petrochemicals. The tax exemptions were replaced in 1993 with tax credits tied to wages that companies paid their employees, as well as additional incentives to pharmaceutical and hi-tech industries. On the heels of the phasing out of tax exemptions came the signing of the North American Free Trade Agreement, after which Mexico became a major competitor with Puerto Rico in the low-skill, labor-intensive manufacturing sector. Thus while many pharmaceutical and hi-tech (e.g. medical instruments such as pacemakers) manufactures remain in Puerto Rico, others, such as garment manufactures and tuna processors, closed their factories as these lower-labor cost overseas opportunities emerged.

Despite these economic developments, the 1990s were robust years for Puerto Rico's economy, paralleling growth in the United States as a whole—growth fueled in large part by the development and expansion of computer technologies. This growth slowed in the second half of 2000 and was dealt a severe blow after the terrorist attacks of 2001. Tourism—a particularly important economic sector for Puerto Rican fishing families—was particularly disrupted by the terrorist attacks, with many mainland U.S. citizens refusing to travel by air. Today, Puerto Rico's Gross Domestic Product is $72.37 billion and its per capita income $18,500. Nearly half, 44.6 percent, continue to live below the poverty level, however, with average hourly wages of $8.08 well below those in the rest of the United States. An

average of 29.5 percent of household income derives from transfer payments. The employed labor force concentrates in manufacturing (42.1%), finance, insurance, and real estate (17.1%), trade (11.6%), services (9.9%), government (9.6%), transportation and public utilities (6.9%), construction and mining (2.4%). Agriculture and fisheries currently employ less than 1% of the people of Puerto Rico (www.topuertorico.org/economy.shtml).

Puerto Rico's economy is also relatively heavily dependent on the United States government for transfer payments. Recent estimates suggest that transfer payments constitute 22% of personal income in Puerto Rico (Enchautegui and Freeman 2005). Correspondingly, unemployment is high, with slightly less than a third (31%) of its population employed. Unemployment increased through the last half of the 20th century and into the 21st, although in most cases this was accompanied by rising per capita incomes and reductions in percentages of people below the poverty line—likely due to transfer payments. Government funding of lifestyles in Puerto Rico is not restricted to transfer payments, but permeates Puerto Rican life, a phenomenon that has created a highly politicized society. Political party affiliation determines many disbursements of state funding, including financing fishing infrastructure, and any management alternatives proposed in Puerto Rico must take into account not only the political will that developed them, but also the likelihood that a change in political leadership may influence enforcement efforts or the extent to which the government continues to recognize existing management efforts as legitimate. Currently, there are two principal political parties in Puerto Rico—the People's National Party (PNP) and the People's Democratic Party (PDP)—and a third, smaller political party, the People's Independence Party (PIP). The primary issue differentiating these parties from one another is the question of the status of Puerto Rico vis-à-vis the rest of the United States: the PNP favors statehood; the PDP favors its current Commonwealth status; and the PIP favors independence.

Against this economic background, commercial fishing remains a viable economic and cultural niche in the islands, providing direct employment for around two thousand fishers and their families and generating or bolstering indirect employment in seafood markets, restaurants, fishing and diving stores, marinas, and other sectors. Fishing, too, is a critical component of Puerto Rico's tourist industry, supplying fresh fish to a variety of coastal restaurants. Finally, subsistence and recreational fishing provide households and communities with high quality seafood.

I.c. Brief Overview of Puerto Rican Fisheries

The commercial fisheries of Puerto Rico are considered primarily artisanal, or small scale, with vessels ranging in size from 18 to 20 feet but most around 20 to 25 feet in length, made of wood and fiberglass. Numbers of commercial fishers range from around 1,500 to 2,500, with many not listed in official statistical sources such as the fishery census or licensing data. Actual numbers of commercial fishers may be much higher, however, as many who fish commercially are unlicensed. During workshops held in July of 2006, most fishers attending the workshops disputed the 1,500 to 2,500 figure, claiming it was higher.

Of the 1,133 interviewed at 69 landing centers in the most recent, 2002 census, 63.5% reported fishing fewer than 40 hours per week. This includes about one quarter who reported fishing fewer than 20 hours per week. Around one quarter (27.2%) reported fishing 40 hours per week, or full time, and around 10% fished over 40 hours per week.

Nearly all of the 43 coastal municipalities have *Villa Pesqueras*, or fishing associations, and some have more than one, although the number of officially recognized associations and landing centers has changed over time. In 1985, for example, Gutiérrez Sánchez, McCay, and Valdés Pizzini reported that there were

88 landing centers but only 34 *Villas Pesqueras*. Of the 88 landing centers, however, only 40 had facilities for storing fishing gear, and, they indicated that, "some of these facilities are modern but others are deteriorating or abandoned" (1985: 2). Ten years later, Matos (1997) showed a map with 100 fishing centers. Of those interviewed in 2002, under half (44.5%) belonged to fishing associations. The observation that Gutiérrez Sánchez, McCay, and Valdés Pizzini made about fishing locations remains relevant today, with some centers thriving and others either abandoned or in the process of being abandoned.

As these comments suggest, fishing effort is unevenly distributed geographically, with little activity taking place along the north coast and the west and southwest coast witnessing the highest fishing activity. Cabo Rojo and Lajas continue to be significant fishing centers, but Rincón has been increasing its significance by modernizing its fleet. Fishers in Aguadilla tend to be highly politically active, occupying leadership roles for Puerto Rico as a whole. Other important fishing communities include Fajardo and Vieques in the east and Ponce and Peñuelas in the south. The importance of these communities varies through time, however, with changes in fishing association administration, trends in alternative employment, marine resource declines, and other factors. These changes recommend continued monitoring of the islands' fisheries.

Despite the apparent flux of landing centers, one remarkable fact about Puerto Rican commercial fishing is its evident stability over time. We know from several sources that fishers come and go from fisheries throughout their lives, that fishing on the one hand absorbs the unemployed and poor during difficult economic times and on the other subsidizes individuals working part-time or full-time in the formal economy, yet the *official* number of commercial fishers has fluctuated little over the past century (Jarvis 1932; Matos 1997: 12; Matos and Torres Rosado 1989: 2; Pérez 2005: 12-13; Wilcox 1904). As just noted, however, local fishers contest official figures as being too low.

Based on recent landings data, important gear types in Puerto Rico are bottom lines, fish pots, gill nets, and SCUBA gear, with SCUBA increasing every year, largely at the expense of fish pots. Hook and line rigs account for slightly over a third (35.4%) of all gear used from 1999 to 2003. Fish and lobster pots account for 27.8% during the same period, SCUBA 16.7%, and gill and trammel nets 16%. The most important species are several deep-water snapper species (red, yellowtail, mutton, lane, etc.), accounting for 27.9% of 1999-2003 landings, and lobster (10.6%). Matos-Caraballo (2005: 4) reports that the most important commercial species is yellowtail snapper. Other important species, culturally and in terms of landings, are king mackerel (3.0%), boxfishes (3.9%), triggerfish (3.1%), and red hind (2.6%).

Fish are marketed through a variety of channels, including *Villa Pesqueras,* private dealers, out of fishers' homes, through mobile street vending, and at roadside stands. Fishers and their families also add value to fish through the production of seafood products that are sold from a variety of restaurant types, stands, and other venues. Annually fishers sell between 3.0 million and 4.3 million pounds of fish, generating revenues of over $7,000,000 (Matos-Caraballo 2005: 4). Matos-Caraballo reports, however, that after the implementation of new fishing regulations in 2004, commercial fishers across Puerto Rico, at the urging of their fellow fishers, stopped reporting landings. He estimates that "approximately 50% of the fishers stopped [submitting] their trip tickets" (2005: 6).

In addition to the commercial fishery, Puerto Rico's recreational fisheries have been increasing over the past two decades. Currently, there are around 167,000 recreational fishers in Puerto Rico, around 30,000 of whom come from other parts of the world. This figure has more than doubled since the late 1980s.

Marinas, yacht clubs, and Club Nauticos currently hold between 20 and 25 fishing tournaments per year, most of which target Blue Marlin and other billfish.

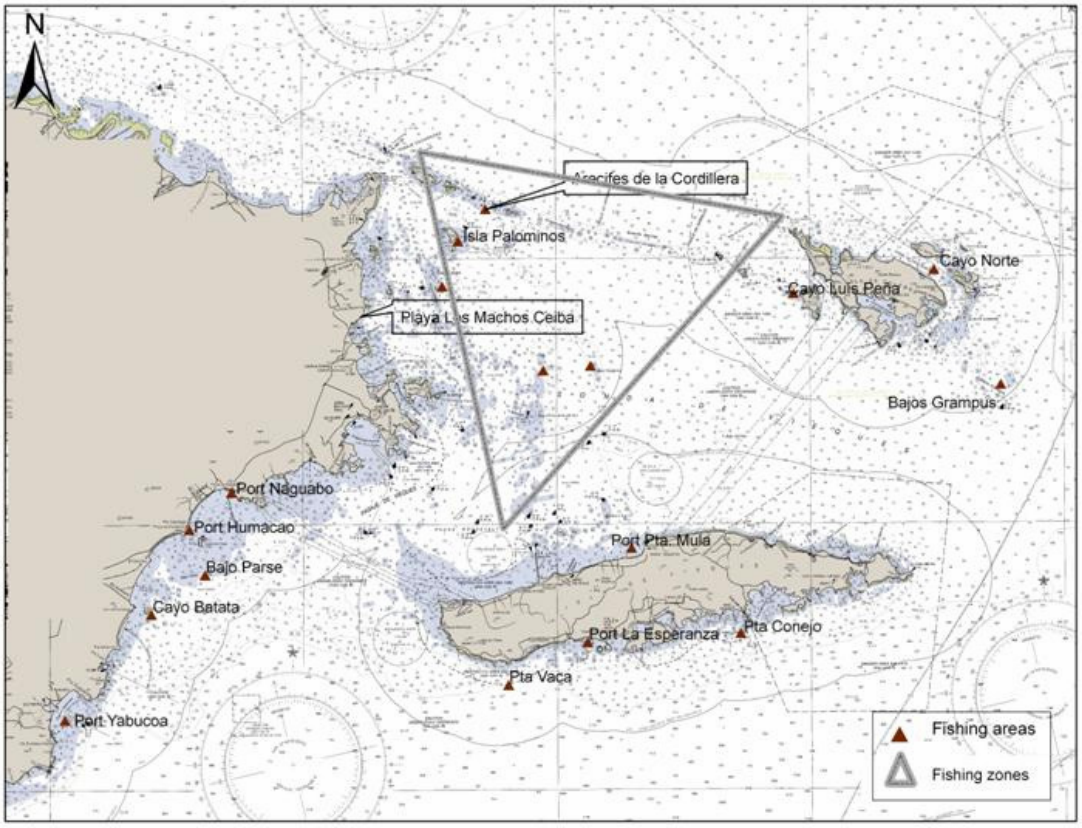
I.d. Important Fishing Territories in Puerto Rico

In the maps presented on the next few pages, we show some of the most productive and popular fishing territories in Puerto Rico. Briefly, Map I.1 shows one of the most productive areas that is frequented by fishers from Fajardo, Ceiba, Culebra, and Vieques primarily, but also by fishers from the southern half of the east coast (Naguabo to Yabucoa) and by fishers from Patillas and Arroyo. Dorado fishers, east of San Juan, also mentioned that they fished in this region.

This is a rich, triangular-shaped area that extends from the coastlines of Fajardo and Ceiba to the channels between Vieques and Culebra. It has a variety of substrates, including coral reefs, and it is home to several deepwater snapper-grouper species as well as a region of pelagic species. Lobster and conch also inhabit these waters.

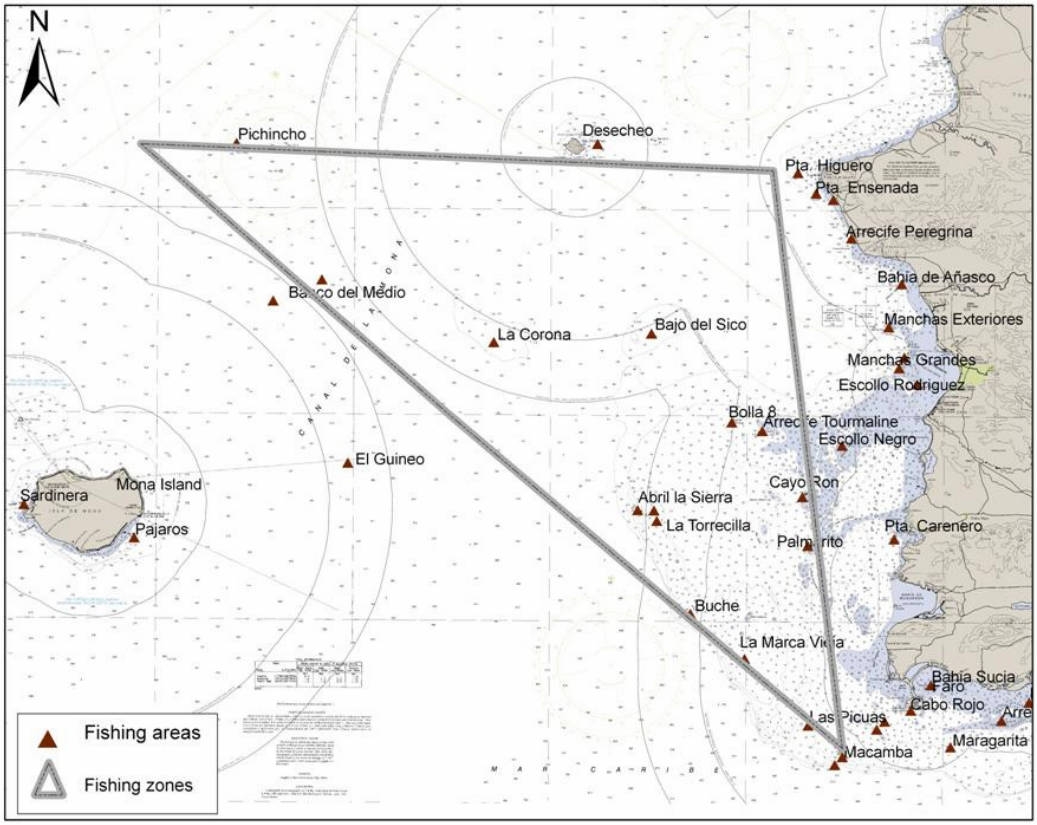
Equally important, these waters are subject to crowding from recreational boating traffic as well as international shipping, ferry traffic, and fishing, with several pleasure crafts coming and going from eastern Puerto Rican ports like Fajardo and Humacao and from the Lesser Antilles. Several small islets off the coast of Fajardo are popular tourist locations for day trips, sunset cruises, and the like.

Map I.1. Popular Eastern Fishing Grounds



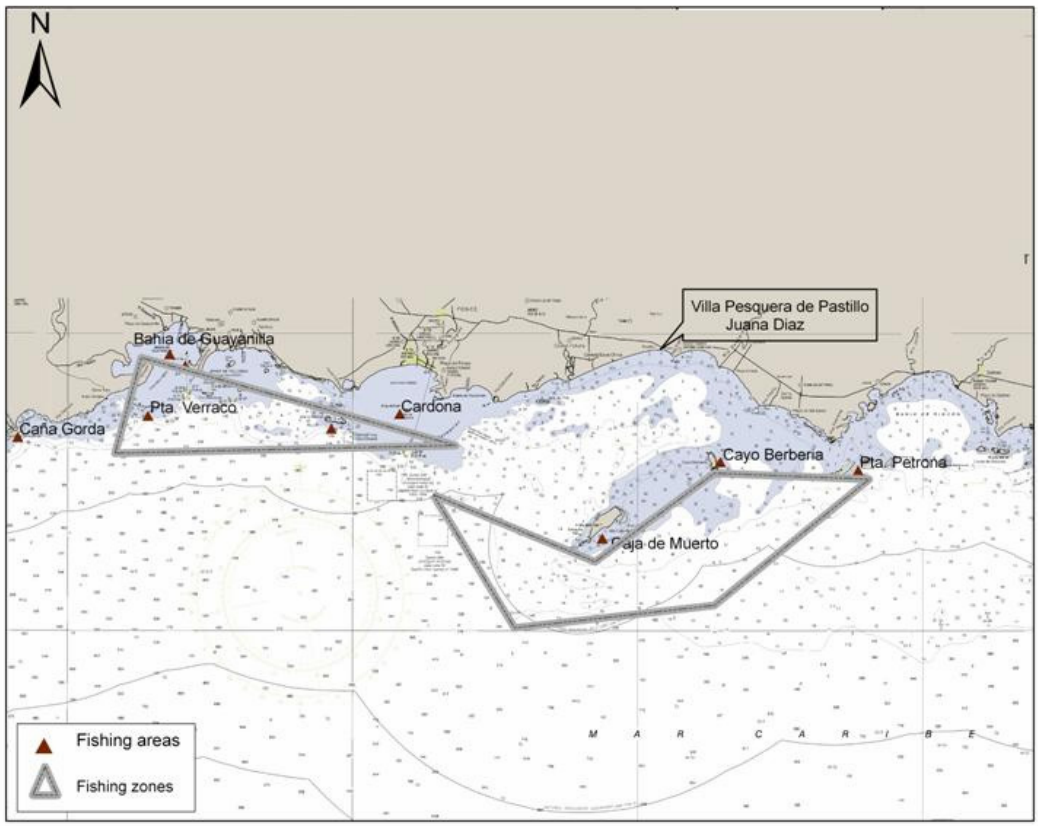
Map I.2 depicts the fishing grounds for Puerto Rico's most productive fisheries and some of its most innovative. Fishers from Cabo Rojo and Rincón historically, have fished the grounds between Desecheo and La Mona.

Map I.2. Western Fishing Territory



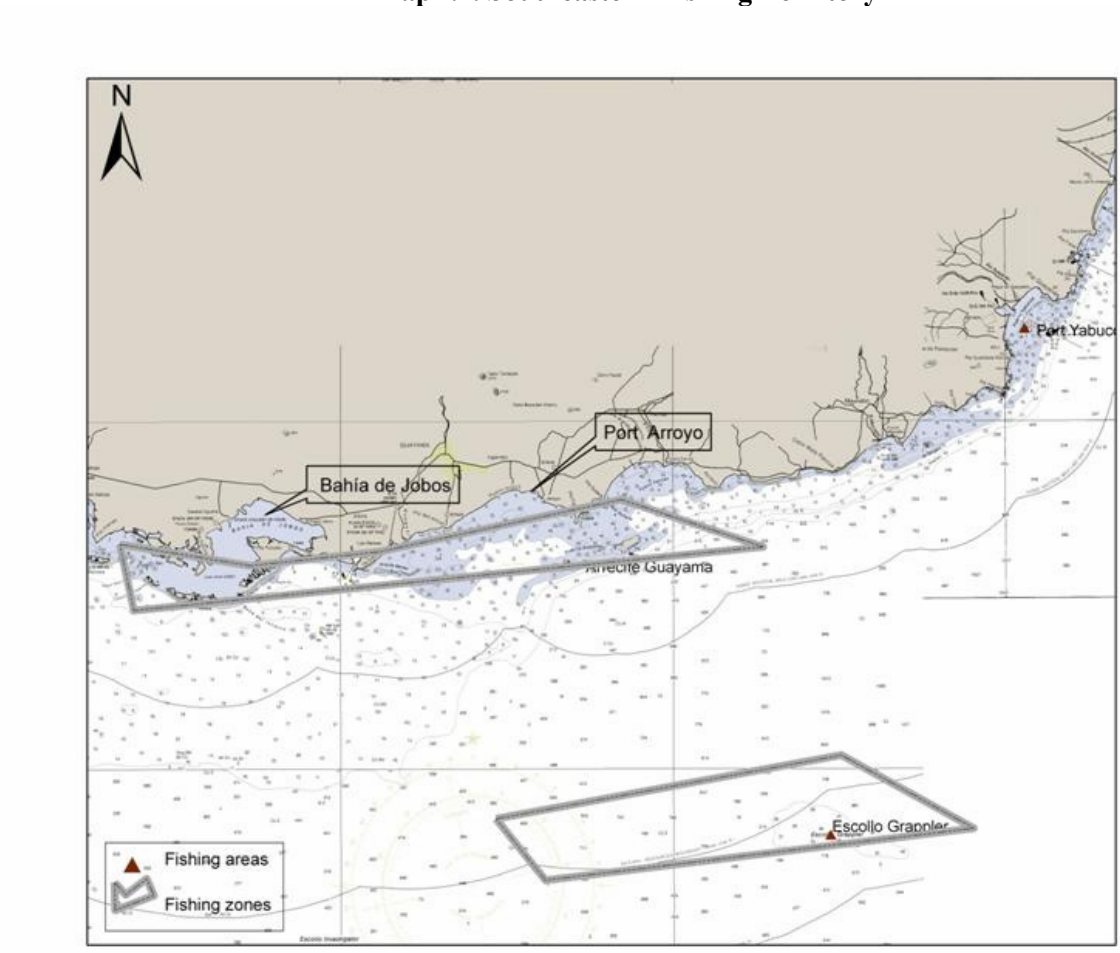
Map I.3 depicts a southern coast location that is particularly popular among fishers from Ponce and nearby municipalities. It includes the island called Caja de Muertos, which is a favorite among recreational as well as commercial fishers.

Map I.3. Southern Fishing Territory, Including Caja de Muertos



Finally, Map I.4 depicts an important fishing territory for the fisheries of southeastern Puerto Rico, which include the trap fisheries of Pozuelo, Guayama.

Map I.4. Southeastern Fishing Territory



I.e. Current Gear and Species: the Landings and Fisher Census Data

The following tables present data on Puerto Rico's fisheries (e.g. landings, gear types, species landed), showing how they vary by municipality. In Table I.1 we have grouped the municipalities into the regions discussed above. Table I.2 shows gear and species for all of Puerto Rico. In Table I.3 we rank the municipalities according to pounds landed and revenue the fisheries generated.

First, the following table shows the major gear types and species landed in each municipality[4]; in most cases these groupings (which are separated by bold facing and distinctive fonts) reinforce our decisions to group municipalities as we have. In most cases, however, particularly with regard to species, Puerto Rican fishers use a wide variety of gear types and target multiple species; rarely, for example, did more than one or two species account for more than 10% of the landings, and in many cases the third most important species listed below accounted for less than 10% of the landings. These data suggest that Puerto Rican fishers engage in multispecies fisheries as a matter of course.

Table I.1. Three Most Important Gear and Species by Municipality (grouped by regions and showing percentages of use & landings), 1999-2003*

Municipality	1st Gear	2nd Gear	3rd Gear	1st Species	2nd Species	3rd Species
San Juan	Bottom Line 66.2	Gill net 13.7	Cast net 6.7	Yellowtail Snapper 15.0	Jacks 8.0	Lane Snapper 6.4
Cataño	Gill net 51.2	Bottom Line 34.5	SCUBA gear 5.7	Jacks 7.9	Mojarras 6.9	White Grunt 5.5
Toa Baja	Gill net 57.6	Fish pot 14.7	Bottom Line 12.6	Jacks 7.9	Mojarras 6.9	White Grunt 5.5
Mayagüez	***Bottom Line 56.9***	***Fish pot 20.5***	***SCUBA gear 6.2***	***Yellowtail Snapper 12.6***	***Lane Snapper 11.1***	***King Mackerel 7.5***
Añasco	***Bottom line 57.5***	***Fish pot 29.0***	***Beach seine 4.5***	***Silk snapper 41.0***	***Lane Snapper 9.6***	***Lobster 6.0***
Rincón	***Bottom line 50.9***	***Troll line 16.6***	***Fish pot 14.5***	***Queen Snapper 28.6***	***Silk Snapper 25.1***	***Dolphin 5.1***
Ponce	Bottom Line 73.4	Troll line 8.2	Long line 8.9	Yellowtail Snapper 18.1	Lane Snapper 13.5	Snappers (generic) 9.1
Juana Diaz	Fish pot 64.2	Lobster pot 18.2	SCUBA gear 11.8	Lobster 32.2	Lane Snapper 17.5	Other fishes 7.5
Santa Isabel	***Gill net 22.8***	***Fish pot 21.7***	***Long line/ SCUBA gear 20.6***	***Lane Snapper 22.2***	***Lobster 9.3***	***Yellowtail and Mutton Snappers 8.7***
Salinas	***Fish pot 32.1***	***Gill net 25.0***	***Bottom line 16.3***	***Lane Snapper 15.7***	***Yellowtail and Mutton Snappers 9.5***	***White Grunt/ Lobster 9.0***
Guayama	Fish pot 76.4	Gill net 15.1	Bottom Line 6.2	Lobster 9.0	White Grunt 8.4	Lane Snapper 8.3
Patillas	***Fish pot 39.9***	***SCUBA 27.5***	***Bottom Line 21.6***	***Lobster 11.8***	***Lane Snapper 6.8***	***Parrotfish 6.0***
Arroyo	***Gill net 39.3***	***Fish pot 22.3***	***SCUBA gear 17.3***	***Parrotfish 15.1***	***Lobster 10.4***	***Ballyhoo 7.0***

[4] The table provides data on 41 of the 43 coastal municipalities; Yauco fisher data is included in the data for Peñuelas, as Yauco's coastline is short and there is no landing center there, and Quebradillas did not report landings for 1999-2003.

Municipality	1st Gear	2nd Gear	3rd Gear	1st Species	2nd Species	3rd Species
Peñuelas	SCUBA gear 73.7	Skin diving 13.3	Bottom Line 6.4	Lobster 26.0	Hogfish 16.3	Octopus 11.8
Guayanilla	Gill net 77.5	Bottom Line 11.7	Fish pot 5.9	White Grunt 12.1	Mutton Snapper 8.6	Lane Snapper 8.4
Guanica	SCUBA gear 37.7	Bottom Line 37.3	Gill net 11.6	Lobster 14.0	Yellowtail Snapper 12.0	Hogfish 9.0
Isabela	***SCUBA diving 36.7***	***Bottom Line 34.7***	***Fish pot 15.2***	***Lobster 20.7***	***Nasau Grouper 14.1***	***Silk Snapper 12.1***
Camuy	***Bottom Line 78.2***	***Troll Line 9.2***	***Cast net 5.3***	***Yellowtail Snapper 18.1***	***Mutton Snapper 10.5***	***King Mackerel 9.2***
Arecibo	***Bottom Line 43.8***	***Fish pot 35.1***	***Troll Line 6.1***	***Silk Snapper 32.9***	***King Mackerel 8.7***	***Lobster 8.0***
Barceloneta	***Fish Pot 37.8***	***Bottom Line 21.3***	***Troll Line 10.7***	***Silk Snapper 14.3***	***Triggerfish 8.8***	***Lane Snapper 7.1***
Manatí	***Bottom Line 55.3***	***Gill net 35.8***	***Cast net 4.9***	***Herrings 5.7***	***White Mullet 5.6***	***Jacks 4.9***
Vega Baja	***Bottom Line 41.7***	***Fish pot 19.2***	***Gill net 14.6***	***Silk Snapper 10.2***	***Red Hind 7.4***	***Bar Jack 5.7***
Vega Alta	***Bottom Line 40.0***	***Gill net 26.0***	***Fish pot 13.6***	***Silk Snapper 10.3***	***Bar Jack 6.4***	***Red Hind 6.2***
Dorado	***Gill net 26.9***	***Bottom Line 26.9***	***Fish pot 20.6***	***Silk Snapper 10.0***	***Triggerfish 6.8***	***Schoolmaster 6.4***
Carolina	Bottom Line 61.6	Gill net 25.9	Troll line 6.1	Jacks 8.0	White Mullet 7.6	Yellowtail Snapper 7.6
Loíza	Bottom Line 63.0	Gill net 18.4	Beach Seine 10.5	Silk Snapper 10.5	Vermillion Snapper 8.5	Yellowtail Snapper 6.6
Rio Grande	Bottom Line 71.6	Gill net 18.1	Cast net 3.3	Yellowtail Snapper 11.1	Vermillion Snapper 9.9	White Grunt 9.3
Luquillo	Gill Net 42.0	Bottom Line 23.9	Fish pot 11.5	White Grunt 10.3	Lane Snapper 7.2	King Mackerel 6.2
Fajardo	***Bottom Line 49.6***	***Fish Pot 31.1***	***SCUBA gear 12.3***	***Yellowtail Snapper 17.9***	***Lobster 7.7***	***King Mackerel 5.4***
Ceiba	***Fish Pot 64.9***	***SCUBA gear 17.3***	***Bottom Line 10.9***	***White Grunt 12.5***	***Lobster 7.7***	***Boxfishes 5.4***
Vieques	***Fish Pot 38.0***	***SCUBA gear 28.9***	***Bottom Line 24.5***	***Lobster 15.4***	***Yellowtail Snapper 8.7***	***Triggerfish 6.5***
Culebra	***SCUBA gear 73.2***	***Fish Pot 13.1***	***Bottom Line 13.0***	***Nasau Grouper 17.2***	***Lobster 15.4***	***Triggerfish 15.1***
Naguabo	Fish Pot 45.9	SCUBA gear 28.6	Bottom Line 12.6	Lobster 18.7	1st class fish 16.1	3rd class fish 13.7
Humacao	Fish pot 47.5	Bottom Line 36.0	SCUBA gear 13.2	Lobster 13.7	Yellowtail Snapper 9.3	White Grunt 7.8
Yabucoa	Bottom Line 63.5	Fish pot 25.0	n.a.	Yellowtail Snapper 12.7	Lane Snapper 10.8	White Grunt 10.8
Maunabo	Gill net 29.3	Fish pot 22.4	Bottom line 12.6	Lane Snapper 12.3	White Grunt 11.9	Lobster 9.3
Lajas	***Gill net 32.3***	***Fish pot 24.1***	***Bottom line 17.8***	***Lobster 8.2***	***White Grunt 7.8***	***Lane Snapper 6.5***
Cabo Rojo	***SCUBA gear 32.7***	***Fish pot 24.1***	***Bottom line 17.8***	***Lobster 17.8***	***Boxfishes 9.8***	***Lane Snapper 6.7***
Aguada	Bottom Line 32.9	Troll Line 32.8	Fish pot 21.1	Silk Snapper 13.0	Skipjack Tuna 8.5	King Mackerel 7.6
Aguadilla	Bottom Line 48.0	Troll Line 45.5	n.a.	Silk Snapper 12.9	Skipjack Tuna 10.0	King Mackerel 9.9

Source: Puerto Rican Landings Data, 1999-2003;

**In cases where there is more than one gear or species in a cell, it indicates a tie or nearly a tie.*

These data, though helpful in determining the most important gear and species used on a regional basis, should not mask the fact that, through the year and from year to year, Puerto Rican fishers use a variety of gear and land hundreds of different species. Landings data from 1999 to 2003 for the entire island list 20 different gear varieties and 243 different species. However, only five gear types account for over 90% of the landings and 11 species account for over half the species landed; most species landed account for under 1% of the landings. The top few are listed in the table below.

Table I.2. Important Gear and Species for All Puerto Rican Landing Centers, 1999-2003

Gear	Percent Reporting
Bottom Line	29.2
Fish pot	26.8
SCUBA Diving	16.7
Gill net	13.9
Troll line	5.1
Trammel net	2.1
Skin diving	1.7
Long line	1.2
Beach seine	1.1
Lobster pot	1.0
Cast net	.9
Rod & reel	.2
Land crab trap	.1
Species	
Lobster	10.6
Yellowtail Snapper	7.1
Lane Snapper	6.6
White Grunt	5.4
Silk Snapper	4.4
Mutton Snapper	4.2
Boxfishes	3.9
Snappers (generic)	3.3
Hogfish	3.3
Triggerfish	3.1
King Mackerel	3.0

In addition to important gear and species, we have ranked the 41 of the 43 coastal municipalities by the last five years of the landings data (1999-2003), indicating as well the coast (south, north, east, or west) of

each municipality.[5] The information on coastal location (north, south, east, or west) is important because fishing effort is unevenly distributed over the island. In addition, these rankings need to be considered in light of the number of landing centers reporting landings in each municipality, as well as ethnographic information about the coastal regions of the municipalities. Some landing centers have reported landing zero pounds for many years, while others have reported a disproportionate amount of the catch in one municipality. In Loíza, for example, three of its four landings centers accounted for less than 2% of its total landings. We include in our table only those landing centers that have reported landings at least once from 1999 to 2003. The municipalities are divided into quartiles (with one extra in the final quartile), differentiated by bold or non-bold print.

Table I.3. Rankings of Municipalities by 1999-2003 Total Landings

Municipality	Pounds	Av. Price Per Pound	Revenue**	N. Centers	Coast
1. Cabo Rojo	2,224,608	$2.346	$5,218,930	7	West
2. Lajas	992,900	$1.991	$1,976,863	3	South
3. Vieques	806,070	$2.392	$1,928,119	2	East
4. Aguadilla	720,229	$1.480	$1,065,939	4	West
5. Guánica	686,113	$2.338	$1,604,179	3-4*	South
6. Fajardo	646,146	$2.264	$1,462,874	3-4*	East
7. Naguabo	634,526	$2.539	$1,611,061	2	East
8. Rincón	588,329	$2.491	$1,465,527	2	West
9. Juana Díaz	545,830	$2.458	$1,341,650	2	South
10. Ponce	486,517	$2.164	$1,052,823	1-2*	South
11. Guayama	**464,378**	**$2.283**	**$1,060,175**	**3**	**South**
12. San Juan	**460,159**	**$2.129**	**$979,678**	**3**	**North**
13. Mayagüez	**439,678**	**$2.138**	**$940,032**	**3**	**West**
14. Humacao	**410,334**	**$2.625**	**$1,077,127**	**3**	**East**
15. Aguada	**405,182**	**$1.64**	**$664,498**	**2**	**West**
16. Ceiba	**352,671**	**$2.374**	**$837,241**	**2**	**East**
17. Salinas	**319,765**	**$2.408**	**$769,994**	**3**	**South**
18. Guayanilla	**275,080**	**$1.443**	**$396,940**	**1-2***	**South**
19. Peñuelas	**261,975**	**$3.174**	**$828,889**	**1**	**South**
20. Santa Isabel	**220,437**	**$2.776**	**$611,933**	**3**	**South**
21. Arroyo	219,462	$2.233	$490,059	1	South
22. Arecibo	210,453	$2.501	$526,343	1	North

[5] Neither Quebradillas nor Yauco reported any landings from 1999-2003.

Municipality	Pounds	Av. Price Per Pound	Revenue**	N. Centers	Coast
23. Loíza	187,722	$1.894	$355,545	1-4*	North
24. Vega Baja	180,571	$2.479	$447,635	1	North
25. Yabucoa	173,852	$2.155	$374,651	1-2*	East
26. Añasco	171,520	$2.748	$471,337	1	West
27. Patillas	132,164	$3.092	$408,651	1-2*	South
28. Cataño	150,760	$2.378	$358,507	1	North
29. Rio Grande	132,164	$2.114	$279,395	1-2*	North
30. Carolina	125,321	$2.224	$278,713	1	North
31. Maunabo	**124,104**	**$2.245**	**$278,613**	**1**	**South**
32. Culebra	**106,612**	**$2.345**	**$250,005**	**1**	**East**
33. Barceloneta	**94,935**	**$2.226**	**$211,325**	**2-3***	**North**
34. Vega Alta	**85,384**	**$2.167**	**$185,027**	**1**	**North**
35. Dorado	**85,001**	**$2.797**	**$237,748**	**1**	**North**
36. Manatí	**54,378**	**$2.054**	**$111,692**	**1**	**North**
37. Isabela	**48,016**	**$2.686**	**$128,971**	**1-2**	**North**
38. Luquillo	**43,988**	**$2.212**	**$97,302**	**1**	**North**
39. Camuy	**22,548**	**$2.123**	**$47,869**	**1**	**North**
40. Hatillo	**13,536**	**$2.603**	**$35,234**	**1**	**North**
41. Toa Baja	**9,731**	**$2.070**	**$20,143**	**1**	**North**

Source: Puerto Rican Landings, 1999-2003.
**=indicates one or more landing centers reported 0 landings in one or more years.*
*** =determined as average price x total landings*

A quick examination of table I.3 illustrates that most of the municipalities reporting low levels of landings are on the north coast, while western and southern municipalities dominate the upper quartiles. That landings constitute only one dimension of fishery dependence, however, will become evident from the ethnographic data. For example, although Cataño is in the third quartile, its single *Villa Pesquera* is one of the most modern and developed, in part because of its proximity to the seat of Puerto Rican government. The same could be said of Toa Baja. The San Juan, Cataño, and Toa Baja associations, combined, reported the highest landings on the entire north coast.

I.f. Tourism and Fishing in Puerto Rico

Tourism accounts for between five and ten percent of Puerto Rico's GDP, with an estimated 60,000 to 65,000 employees catering to nearly 4,000,000 tourists annually. Tourists spend around 2.5 billion dollars each year in Puerto Rico. It is unknown what percentage of those tourists visit the islands specifically for its fishery resources—either to enjoy the seafood that Puerto Rican fishers provide or to experience fishing as sport or recreational fishers themselves, chartering fishing boats or participating in tournaments. Official accounts of Puerto Rican tourism, however, note that direct tourist expenditures tell only part of the story of tourism's impact on the economy:

> "The current [2003] 5.5% share of the GDP suggests that tourism activity has a relatively small impact on general economic activity. However, its importance is much greater, in terms of employment and income multipliers, than what this figure would suggest. Nonresident as well as resident expenditures in tourism provide links, directly and indirectly, to such economic activities as transportation, communications, trade, service, restaurants, entertainment, and many others" (Government Development Bank 2003: 20)

In addition, historical data suggest that tourism is a growth sector, with direct tourism expenditures up from 1.9 billion dollars in 1996 to over 2.5 billion dollars today. Its annual growth rate has averaged 1.6% (Government Development Bank 2003: 20). In anticipation of this growth, from 2003 to 2005, hotels around Puerto Rico added 1,646 new rooms at a cost of approximately 1.2 billion dollars.

In many parts of this work, we describe ways in which fishers across Puerto Rico have taken advantage of tourism. Tourism is one of Puerto Rico's most important industries: annually, between 3,000,000 and 4,000,000 tourists visit the islands from the U.S. mainland and elsewhere, but internal tourism is important (though less well tracked) as well (Garcia-Moliner, et al 2002). Most notably, tourism benefits Puerto Rican commercial fishers through seafood restaurants and other retail outlets. However, all tourist traffic in Puerto Rico is not alike, and much of the tourism in Puerto Rico is extremely detrimental to fishing and marine resources, creating problems with crowding on the water, destroying mangrove forests, privatizing coast lines, and leading to problems of access to marine resources. Given the legal mandates described in the opening paragraphs of this report, it is incumbent upon fishery managers to delineate among different types of tourist development, recognizing which are helpful to fishing communities and which infringe upon fish stocks, habitats, and fishing ways of life.

I.f.1. Seafood restaurants as a link between the fisheries of Puerto Rico and the tourist sector

Enjoying seafood is one of the most valuable parts of visiting Puerto Rico's coast and central to the tourist experience. It is also one of the most important ways in which commercial fishing is dynamically linked to the tourist sector, a point perhaps most eloquently expressed in the comment, heard again and again among commercial fishers across the island, "We defend ourselves with fresh fish." That seafood is important to Puerto Rican tourism is clear from promotional materials about the island as well as from observations, particularly on weekends, of the seafood restaurants across the island. One of Puerto Rico's major tourist magazines, *Places to Go*, reads, for example:

> "No visit to eastern Puerto Rico is complete without a stop at the rustic kiosks on Route 3 in front of Luquillo Beach. Here you can sample the entire gamut of Puerto Rican cooking, from such Creole snacks as cod fritters (*bacalaítos)* or sweet plantain wrapped around seasoned meat *(pionónos)* to complete fish dinners…"

We view seafood restaurants as so critical to the fisheries of Puerto Rico that we include them in the index of dependence we created to compare fishing communities across Puerto Rico in terms of dependence and engagement. All major coastal waterfronts have seafood restaurants, and our dependency index adds to a community's dependence score for possessing one or more of the following four types:

1. The enclosed, air-conditioned, and usually fairly fancy and expensive places in permanent structures of concrete or wood.
2. The open-air, smaller places, generally run with family members, that have a handful of tables, a bar, and are usually built of wood. These places usually have menu items as well as items, such as seafood empanadillas and pieces of fish, that are kept warm in glass boxes fitted with lightbulbs.
3. Kiosks, or small stationary stands that usually specialize in a few food items.
4. The ambulatory or mobile places that line the roads or are set up at the beaches on weekends, some specializing in such things as *pinchos de tiburón y marlin* (Shark and Marlin Shishkababs).

As important as seafood sales are to the fisheries of Puerto Rico, they become more important when considered in light of the family basis of Puerto Rican commercial fishing. When *Villas Pesqueras* add seafood restaurants to their facilities, it not only signals their reaching out to the local community and to visitors in a way that can add value to their catch and create increased dependence of the community on fresh fish and fishing: adding a seafood restaurant is usually a step toward more direct involvement of non-fishing family members of fishers in fishing operations. Generally, wives and children of fishers manage and work in these restaurants, sharing the same space with fishers, listening to and taking part in their conversations, and in the process becoming more familiar with all the issues facing fishing in Puerto Rico. This deepens the commitment of family to the fishery while expanding the ties to the resident and visiting community, and at the same time reinforces the idea of fishing as a moral enterprise, a moral economy whose commerce brings family and community together to provide high quality protein in a pleasing, seaside environment.

Equally important, incorporating seafood wholesale, retail, and restaurant sales into fishing enterprises is the principal way in which fishers can add value to their products. In several places across the island, we have documented the success that fishers have had with their seafood markets and restaurants, particularly in high tourist areas such as La Guancha, Ponce, where literally thousands of tourists visit every weekend. However, fishing families need not invest in elaborate restaurant facilities as some have, but can further process their seafood by making seafood pastries for sale from roadside stands, kiosks, or other less elaborate venues.

I.f.2. Puerto Rico's Recreational Fisheries

Detailed information on the recreational fishing sector of Puerto Rico, like information on recreational fishing across the United States, has a much shallower history than information collected on commercial fisheries. Early observers of fishing in Puerto Rico, such as Norman Jarvis, mentioned the existence of recreational fishing, but systematic data collection has been conducted only for the past few years, since Puerto Rico was added to the Marine Recreational Fishing Statistics Survey (MRFSS) in 1999. In the late 1980s, however, the National Marine Fisheries Service sponsored comprehensive research on the recreational fisheries of the U.S. Caribbean territories, funding studies that surveyed recreational fishers

and inventoried recreational fishing infrastructure in Puerto Rico and the U.S. Virgin Islands (Griffith, et al. 1988; Valdés Pizzini, et al. 1988).

Based on these data bases, as well as our current research, there is no doubt that recreational fishing constitutes an important social, economic, and cultural activity in Puerto Rico's coastal areas. We include this discussion of recreational fishing in Puerto Rico in our general discussion of the links between fishing and tourism because it constitutes an important leisure activity that attracts, annually, around 30,000 fishers from outside Puerto Rico and occupies the leisure time of around five times that many local anglers. Marinas and Club Nauticos around Puerto Rico host between 20 and 25 fishing tournaments annually, up from under 15 only a decade and a half ago, attracting hundreds of anglers from across the island and from abroad (Clark, Ditton, and Chaparro 1994). Tournaments tend to be important tourist attractions as well as fishing competitions, often including supplemental excursions for golfing, boating, sightseeing, or other common tourist activities. Our information here draws primarily on the ethnographic work and focuses on the general contours of recreational fishing for coastal Puerto Rico as a whole. In the following chapter we offer some information on the history of recreational fishing and later, in Chapter V, we present more detailed data on recreational fishers from a survey of Puerto Rican fishers.

I.f.2.a. Recreational Fishing Effort in Puerto Rico

According to the MRFSS, sport or recreational[6] fishers in Puerto Rico outnumber commercial fishers by over 100 to one, yet they land around the same number of pounds as the commercial catch (see table I.4). Their level of effort is far lower than commercial fishers, each recreational fisher taking, on average, around 7 to 8 trips per year, or less than one per month. Their presence may seem greater, however, in that recreational fishing and recreational boating share the same spaces—marinas and Club Nauticos—and recreational boating is among the coast's most visible activities. In addition, the DRNA registers all recreational vessels in Puerto Rico, but our information suggests that relatively few of these are used for recreational fishing. Nevertheless, the number and rates of increase in recreational vessels in Puerto Rico suggests that recreational activities directed toward the sea—boating, diving, fishing, etc.—are increasing as well. From 1995 to 1996, for example, recreational vessels increased from 35,931 to 44040, or an increase of 8,118 vessels (>20%).

Yet only a small percentage of recreational boaters are also recreational fishers. Interviews at marinas and Club Nauticos revealed that generally less than 10% of people who use marinas and Club Nauticos around the island engage in recreational fishing on a regular basis. In some cases this was considerably less: the operations manager at Puerto Del Rey, one of the largest marinas on the east coast, estimated that, at the most, 50 of the 1,200 boaters who use their marina fished recreationally, or less than 5%. In their study of recreational boaters who trailer their vessels, Appeldoorn and Valdés Pizzini (1996) found that 41 (13%) of the 312 boaters they intercepted reported fishing recreationally.

[6] The line between recreational and sport fishing is not well-defined, but the term recreational refers to fishers who fish primarily as a leisure or casual activity, catching a little food as well, while sport fishers tend to target game (hard-fighting) fish, participate in tournaments, and often belong to associations or clubs that advocate on behalf of sport fishers. Whether Puerto Rican fishers make similar distinctions is a question we cannot answer here, but the term *pescador deportiva* (sport fisher) is more common in Puerto Rico than the term *pescador recreativa* (recreational fisher).

Nevertheless, the linkages that exist between recreational boating and recreational fishing that occur at marinas and Club Nauticos, particularly in the context of tournaments (discussed in more detail below), create the sense that recreational fishing is an upper class activity and that, further, the culture of recreational fishing is substantially distinct from that commercial fishing. While this is clearly not the case with casual, shore-based fishers, marinas and Club Nauticos are the spaces of the wealthy, generally gated and guarded, where services and slip fees tend to be high-priced. At the Club Nautico de Oeste, too, golfing and tennis facilities supplement the marina, and their offices are air conditioned, with state-of-the-art communications, computing, and other equipment. The Club Nautico de San Juan has similar administrative offices, as do the other marinas we visited.

Commercial fishers, by contrast, usually work out of working waterfronts that are cluttered with gear, engine parts, and other signs of economic activity. Commercial fishers, too, often affiliate themselves with the working class in Puerto Rico (Griffith and Valdés Pizzini 2002). Further, they often object to marina development as a source of contamination and as a force in raising slip fees and reducing coastal access. These attitudes and differences make it difficult for alliances to develop between recreational and commercial fishers, though both groups tend to favor the conservation of marine resources and the two groups share many of the same attitudes toward regulatory personnel.

Despite the fact that recreational boaters outnumber recreational fishers, the numbers of recreational fishers are large. The Marine Recreational Fishing Statistical Survey reported over 200,000 (combining local and visiting fishers) in 2003 and 167,000 in 2004, who together landed between 2.2 million and 3.8 million pounds of fish (see table I.4). These figures represent substantial increases over the past decade and a half. In 1989, for example, Schmied estimated that there were only 81,000 resident recreational fishers in Puerto Rico, fishing from around 23,000 vessels (CFMC 2002). Recreational fishers tend to land between two and three million pounds annually, taking primarily food fish from the grouper-snapper complex as well as dolphinfishes, tuna, and other pelagic species. Near shore, they also land shellfish. Shore fishing is most active during August, June, and October and least during active in January and March. In its recent assessment, the Caribbean Fishery Management Council estimated that, in 2000 and 2001, recreational fishers landed between 125,000 and 150,000 pounds per year of spiny lobster and around the same number of pounds of queen conch (CFMC 2002: 220). Dolphinfish and tuna dominate the catch outside of Puerto Rican waters, in the EEZ.

Table I.4. Puerto Rican Recreational Fishing Statistics, 2003 and 2004

Variable	2003	2004
Number of Puerto Rican Fishers	185,000	141,000
Number of fishers from outside Puerto Rico	35,000	26,000
Pounds Harvested	3,768,000	2,214,000
Number Harvested	1,527,000	887,000
Number Released	150,000	249,000
Number of trips	1,111,000	1,055,000

Source: Marine Recreational Fishing Statistics Survey, 2004

Recreational fishing effort has not increased steadily over time, however, but varies from year to year. In 2001, an estimated over a quarter of a million recreational fishers fished in Puerto Rican and surrounding waters, nearly 90% of whom were resident fishers. These fishers landed fewer pounds than in 2003, however, only 2.8 million pounds as opposed to nearly 3.8 million in 2003. During these years, the recreational finfish catch was only slightly more than 40% of the commercial catch in the islands. Today

(at least in terms of official numbers) they are more in line with one another, which is due principally to recent declines in commercial landings.

In addition to fluctuating through time, recreational fishing effort is unevenly distributed across the islands of Puerto Rico, although recreational fishers commonly use public, *Villa Pesquera*, and other infrastructure, as well as natural shore sites, to fish recreationally. During our ethnographic work, we also found that recreational fishers commonly used shipping infrastructure formerly used by the sugar industry to fish. Again, however, not all bridges, piers, or other such locations attract fishers. Bridges over river mouths along the north and west coasts, in Arecibo, Dorado, Carolina, and Mayagüez, for example, regularly attract recreational fishers, but similar bridges along the east coast do not; instead east coast fishers tend to fish from public piers, as those in Punta Santiago, Ceiba, and the Downtown harbor of Fajardo.

Fishers we interviewed during the ethnographic phase of our study ranged from families fishing casually during a weekend picnic to fathers and sons fishing together to fishers who regularly participate in tournaments. A handful of fishers we interviewed said that they fished primarily for relaxation or therapy, caring little about whether or not they actually caught fish and throwing back much of what they catch. Two brief profiles follow:

Recreational fisher # 1:

One of the recreational fishers we interviewed, José, we intercepted at the Club Náutico of San Juan. He is a scuba diver first and a rod & reel fisher second, but when asked what species he caught most they seemed mostly rod & reel fish: sierra, marlin, shark… He is a young man, perhaps in his early thirties, single, and he maintains recreational vessels for a living—hence his presence at the marina, where he was working.

He said that he lives for fishing, and his work schedule and proximity to the water at the marina allows him to fish more often than most recreational fishers, ten to fifteen days every month, mostly directly off the north coast. He hasn't had any problems with the MPAs, in that he never fished in areas that are currently closed, and he doesn't fish for those species that are prohibited or for which there are seasonal closures.

He owns a small vessel, a Boston Whaler with a 40 hp motor, which he purchased in San Juan. He maintains it himself. He also purchases baitfish from local commercial fishers. He wasn't aware of any new licensing system coming into effect for Puerto Rican recreational fishers.

One of the more interesting comments he made was that he believed that both the coral reefs and mangroves were recovering from earlier times, although the fish resources have yet to catch up to the improvement in the other marine resources. Mangroves were nearly completely decimated, he said, so they had nowhere to go but up, and growth in coral he has noted from his diving.

Recreational fisher # 2:

This man, middleaged, is married with two children, and primarily a sport fisherman, fishing for tarpon and barracuda for the joy of the catch. He works for the government, he said, but didn't say exactly in what capacity. He usually doesn't fish during the week, and in fact usually only fishes two to four days per month, but when we spoke with him he was on vacation.

Because he fishes mostly for sport, he releases much of what he catches. When he catches food fish he gives most of it to friends or neighbors; his family consumes some, but they aren't great fans of seafood.

He hasn't experienced problems with the MPAs, although he believes that overfishing has been occurring and that fishing resources, which are in poor shape, need to be protected. He sites nets and improved fishing technologies as the most important causes of declines in fishery resources. He did acknowledge the role of contamination (particularly industrial pollution) and construction in the destruction of habitat.

His reasons for not having any problems with MPAs are due to his lack of experience with them. He never fishes in the Laguna Condado or around Culebra, but fishes mostly along the shelf on the north coast, trolling for game fish.

Just as recreational fishers come from a variety of walks of life and fish for different motives, recreational fishing in Puerto Rico is not concentrated in any one region or represented by any one dominant type. In their late 1980s report, Griffith, et al. (1988: 19) reported high recreational activity in Fajardo, the San Juan/Carolina/Loíza area, Cabo Rojo, Lajas, and Ponce; they listed as medium areas Salinas, Humacao, and Arecibo; municipalities with low recreational fishing activity included all others. It should come as no surprise that the high and medium municipalities are also home to some of the largest and most elaborate marina facilities on the island, again attesting to the strong link between recreational boating and recreational fishing.

Because of the overwhelming importance of recreational boating at marinas and Club Nauticos, it is difficult to estimate the amount of employment recreational fishing generates in Puerto Rico. Clark, Ditton, and Chaparro (1994) report that tournament fishing provides around 200 part-time jobs in Puerto Rico annually. These are some of the only jobs, along with people who own and staff charter boats, discussed below, that can be attributed directly to recreational fishing. Normally, Club Nauticos and marinas provide full-time employment for only a handful of year-round workers, including harbormasters, security guards, marina managers, clerks, secretaries, and maintenance personnel. Marinas and Club Nauticos we visited typically operate with only between 4 and 6 full-time staff, supplementing their full time staff with a few part-time employees. Of course, the extent to which these individuals owe their jobs to recreational fishing, as opposed to recreational boating, is open to question. Clubs and marinas do, however, also provide settings for restaurants, bars, marine supply stores, dive shops, and so forth, whose business depends, in part, on recreational fishers.

I.f.2.b. Tournament Fishing in Puerto Rico

Central to sport fishing in Puerto Rico has been tournament fishing, particularly at prominent marinas and Club Nauticos. Table I.5 lists sportfishing tournaments held in 2005, showing that the majority target marlin. Of all recreational fishing activity, tournament fishing has been studied in some depth. Clark, Ditton, and Chapparo (1994), for example, conducted a survey of Puerto Rican billfish tournament fishers to estimate their real and potential economic contribution to the Puerto Rican economy. They estimated that billfish tournament fishing generated over $40,000,000 in economic value; however, $18,000,000 of this figure derived from their estimate of "consumer surplus," or the amount that tournament fishers reported they would have been willing to spend to participate in billfish tournament fishing.[7] The actual

[7] Consumer's surplus was calculated based on responses to the question, "If the price of goods and services were to increase so a billfish fishing trip cost $[Bid Value] more than usual, would you pay the higher price rather than stop

value, derived from expenditures, was $21,320,579 for non-resident tournament participants and $4,459,270 for resident participants, for a total of $25,779,849. As is obvious from these figures, non-resident tournament participants spend considerably more than resident participants in billfish tournaments, in part reflecting their status as tourists as well as participants. In addition to point of origin of tournament participants (resident vs. non-resident), Clark, Ditton, and Chapparo found that three other factors influenced the amount of expenditures per tournament: a) number of fishers; b) number of non-participants; and c) length of stay.

As noted earlier, many tournament organizers add tourist activities such as golf or sightseeing to tournament fishing, which may serve to increase both the number of non-participants and their length of stay. Some tournament organizers seem to have arranged their tournaments with this in mind more than others. For example, while the blue marlin tournament in La Parguera lasts only three days, focusing primarily on fishing, the billfish tournament sponsored by the Club Náutico of San Juan lasts eight days and includes two days of preliminary activities (a boat parade and commodore's party), one day off for golf, and four days of fishing. They advertise "Ladies activities for your significant Other!" and spice up the tournament with daily meals, cocktails, and other amenities (see www.sanjuaninternational.com).

From interviews at Club Náuticos and marinas, it is clear that tournament activity represents the height of recreational fishing annually at these locations. The marina manager at the Club Nautico of San Juan, which has around 400 members, reported that they take great pride in the fact that they sponsor the oldest blue marlin tournament in the world. Begun in 1953, posters on the walls of the club chronicle the history of the tournament. They surround a stairway that winds up from a statue of a blue marlin and passes one of the largest blue marlin ever caught—an approximately 480-pound stuffed fish mounted on the wall. In addition to the marlin tournament the club sponsors a dorado tournament. During the blue marlin tournament they practice catch and release, something that is necessary to get permits from NOAA and other agencies. Many who fish in these tournaments, however, believe this practice results in waste.

Despite the fact that the Club Nautico of San Juan sponsors only two tournaments, these occupy the heart of recreational fishing at the club. Every year, they have around 100 boats per tournament, with 4 persons per boat. The club provides most of the fishing boats and, as just noted, they offer a package of other activities.

The tournament has many sponsors, including influential local businesses such as local distilleries and news organizations, and is done in conjunction with the International Game Fish Association and the Billfish Foundation. It has an entrance fee of $500 for boat owners, $750 for a local angler, and $1,750 for an international visiting angler. It gives away upwards of $250,000 in prizes; last year the winning vessel took $48,000 of that.

Several things are notable about this tournament. First, it—like recreational fishing generally—is clearly a powerful male event. Second, it is expensive, especially because the $1,750 for the international angler (which would include U.S. citizens from the mainland) would have to have plane fare and hotels attached—a package of around another $1,500—for a total of over $3,000 for a little more than a week. This is clearly beyond the reach of most of the people of Puerto Rico and even most of the population of the United States.

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fishing for billfish?" Bid values were given in $75 increments over a range from $75 to $750. We believe that it is important to point out that, rather than a true accounting of value, consumer's surplus is a measure based on responses to a hypothetical situation, and thus should be viewed with caution.

The tournament also bills itself as a conservation event—a way of raising money for conservation causes: in this case, specifically, for the conservation programs of the International Game Fish Association and the Billfish Foundation. When questioned about whether or not the tournament personnel had problems with the *relgas*, those interviewed said that they had "Almost no problems," adding that they were careful to apply for all the permits they required and that they always received them. In addition, as mentioned above, they practice catch and release, which is "good," at least symbolically, in the eyes of regulators.

Table I.5. Tournament Fishing In Puerto Rico, 2005

Site/ Sponsor/ Location	Time of Year	Type of Tournament
1. Ponce Yacht Club	May	Multispecies
2. Club Nautico de Parguera	May	Blue Marlin
3. Arecibo Outboard Motor Club	June	Blue Marlin
4. Association Pesca Deportiva Dorado	June	Blue Marlin
5. Club Nautico de Vega Baja	July	Blue Marlin
6. Club Nautico de Arecibo	August	Blue Marlin
7. Cangrejos Yacht Club	August	Blue Marlin
8. Club Nautico de Rincón	August	Blue Marlin
9. Club Nautico de San Juan	August	Blue Marlin/ multispecies
10. Caribbean Game Fish Marina	September	Rodeo
11. Club Nautico de Boquerón	September	Blue Marlin
12. Marina Boquerón	September	Blue Marlin
13. Club Deportivo de Oeste	September	Blue Marlin
14. Club Nautico de Mayagüez	September	Blue Marlin
15. Arecibo Outboard Motor Club	October	Sailfish
16. Club Nautico de Arecibo	November	Blue Marlion
17. Congrejos Yacht Club	November	Sail fish
18. Congrejos Yacht Club	January	Dorado
19. Club Nautico de Arecibo	January	Dorado
20. Congrejos Yacht Club	April	Tarpon
21. Club Nautico de Boquerón	March	Dorado
22. Ponce Yacht & Fishing Club	March/ April	Light tackle
23. La Guancha, Ponce	April	Dorado
24. Club Nautico de Parguera	April	Dorado

Source: www.associaciondepescadeportiva.com and interviews with sport fishers in Boquerón.

Tournaments are also important recreational fishing events in the communities where they are held. In La Parguera, where the Club Náutico has been sponsoring tournaments for over three decades, tournament fishing attracts sponsors from predictable businesses, such as boat sale companies and marine supply stores, but also from local banks, kitchen supply companies, plumbers, insurance agencies, pharmacies, lawyers, grocers, restaurants, and others. In addition, well-known national and international companies also sponsor and buy ad space in the tournament booklet, which features records from past tournaments, scenes of winning crews, and a welcoming letter from the mayor of La Parguera.

The 2006 La Parguera tournament booklet is interesting for another reason as well: the tournament is dedicated to a major local tournament fisher, and two full pages in the 32-page booklet picture and

describe him. The description emphasizes his long history of recreational and tournament fishing, his active work as a force behind the Club Náutico's continued vitality, and, perhaps most importantly, his introducing young people to fishing as a way of steering them clear of negative influences such as drugs. We find this important in its attempt to establish tradition in recreational fishing by linking it to important local figures, to the passage of generations, and portraying it as a positive influence in Puerto Rican society. Anthropologists have long argued that the conscious invention of tradition is important in enhancing the cultural value and significance of sites, activities, events, and so forth.

Interviews with two full-time employees at the Club Nautico of Parguera again confirmed that, despite the tournament's importance, the club is primarily a recreational boating club. Of its 220 members, they estimated that only between 15 and 20 fish recreationally, although more than that may participate in tournaments. The two tournaments they organize, a dorado tournament in April and a marlin tournament in May, have become important to the club and the community. Smaller than the tournaments in San Juan, they are also less likely to attract international or non-resident fishers, generating less income for La Parguera. The dorado tournament attracts around 40 vessels, with 4 to 5 fishers per vessel, and the marlin tournament only 30 vessels. Last year's Blue Marlin tournament attracted only one non-resident fisher, from Santo Domingo, Dominican Republic.

By contrast, the Blue Marlin tournament at the Club Nautico de Oeste, which has 650 members, attracts slightly more participants than the San Juan tournament. The marina manager there reported that last year (2005) they had 104 vessels, with between 4 and 5 people per vessel. They supplement this large tournament, which occurs in September, with two smaller tournaments, one for wahoo and one for dorado, each of which attracts only around 25 vessels. In some years these are combined into a single tournament. Last year's blue marlin tournament attracted vessels from as far away as Africa, and was filmed by ESPN. The activities director of the club also arranges an annual golf tournament and, like San Juan, they supplement the tournament activities with golf and tennis.

While the principal species that recreational fishers target during tournaments is blue marlin and other billfish, the species most commonly landed is dolphinfish (Rodrigues-Ferrer, Rodrigues-Ferrer, and Lilyestrom, 2003). In the four years from 1999 to 2002, tournament landings of dolphinfish totaled 26,291.88 kg, while tournament landings of blue marlin totaled 16,590.36 over the same time period. Other important species were wahoo, king mackerel, and barracuda (Rodrigues-Ferrer, Rodrigues-Ferrer, and Lilyestrom, 2003: 616).

I.f.2.c. Sport Fishers' Attitudes toward Regulations

In terms of regulations, portrayals such as the one in the La Parguera tournament booklet help support or legitimate management decisions such as the 1988 Fishery Management Plan (FMP) for Atlantic Billfish, which closed billfishing to commercial fishing: "The FMP sought to prevent the development of a domestic commercial market for Atlantic billfish, other than swordfish, by including a 'no sale' provision. The result of the FMP was to reserve the entire fishery for recreational anglers *because of the tradition of use by recreational anglers*, their practice of releasing a large percentage of their catch, and the economic value of the recreational fishery" (Clark, Ditton, and Chaparro 1994: 48, emphasis added).

In general, sport fishers we interviewed reported few problems with MPAs, although the emphasis on tournament fishing among Club Members have led some to criticize state intervention in tournaments.

Specifically, as noted above, some fishers were critical of the catch-and-release program for blue marlin (the key tournament fish), considering it a foolish regulation on much the same grounds as commercial fishers view the prohibitions against keeping deep water species foolish: because it results in waste. After fighting billfish for sometimes many hours, the fish will usually die. Sometimes its sail or fins have been damaged beyond repair or it is beyond resuscitating, although some fishers reported that they routinely make attempts to resuscitate the fish by dragging them along the boat after successfully reeling them in. Nevertheless, often these measures are fruitless, many believe, summing it up in the statement that, after being caught, billfish in tournaments become *carnada de tiburones* (shark bait).

Other regulations are too recent to evaluate their impact. Although Puerto Rican recreational fishers over the age of 12 have had to have a license for some years, the DRNA began implementing a recreational fishing license for sale in July 2006, selling them directly from around 60 sites around the island as well as through Internet sales. They will sell them for $20.00/ year, $7.00/ week, and $3.00/ day. The latter may generate between $90,000 and $210,000 per year in revenues, assuming each of the 30,000 or so visiting recreational fishers (see table below) buys a temporary license. For locals, the licenses may generate around $3,260,000 for the state. DRNA officials hope that the license will serve primarily as a sampling tool, making the tracking of recreational fishing behavior a much simpler process (right now they make around 100 phone calls to find one recreational fisher).

I.f.3. Charter Boat Fishing in Puerto Rico

Another tourist-related, fishing-supported business in Puerto Rico is charter boat fishing, which has been slowly growing since the late 1980s. In the 1930s, Norman Jarvis lamented its underdevelopment (1932). In their report on recreational fishing in Puerto Rico, Griffith, et al. (1988) note that charter boat fishing was confined largely to the San Juan metropolitan area, with some limited charter boat fishing conducted from the western municipalities as well. Since that time, charter boat fishing has spread to several municipalities, although it still is relatively undeveloped compared to other tropical and temperate areas such as Florida, Texas, Georgia, and the Carolinas.

In their study of charter boat fishing in Puerto Rico and the U.S. Virgin Islands, Garcia-Moliner, et al (2002) documented 28 charter boats operated by 19 captains in Puerto Rico, with seven of the operations having more than one boat. During the peak summer season for charter boat fishing, additional boats operate in and around Puerto Rico and the U.S. Virgin Islands, although this seems to be most common in St. Thomas. Unfortunately for this study, most of the data about charters (e.g. average number of trips per vessel, lines fished, etc.) that Garcia-Moliner, et al (2002) include in their report does not differentiate between U.S. Virgin Island and Puerto Rican charters.

The charter boat industry is the economic sector where tourism and commercial fishing are most closely aligned. Most charter boat captains advertise in hotels and other tourist venues (both physical and virtual), using brochures and websites, and they also maintain links with recreational fishing and tourism through their participation in sportfishing tournaments (usually as captains) and through close personal connections with owners of marine supply stores. In Ponce, for example, the owner of one of the most popular marine supply stores routinely points tourists and residents to charter boat captains he knows, as well as carries packages of ballyhoo that are packaged specifically with charter boat captains in mind.

In some cases, charter boat captains come from commercial fishing families and the charter boat captains we interviewed all got along well with resident commercial fishers. Those we interviewed were all

Puerto Rican. The CFMC (2002) suggests that most charter boat captains from the mainland United States operate out of the U.S. Virgin Islands. Griffith, et al. (1988) also found this to be the case.

Charter boat captains we interviewed learned their craft from friends or relatives that were commercial fishers. Most said that they purchased bait from commercial fishers. Their principal problems with commercial fishers were with foreign long-lining fleets, who had cut into their business by taking pelagic species from Caribbean and nearby waters. One reported that, "In the late 70s to 80s an American guy went to the states to get five long-lining fishing vessels to come down [to Puerto Rico]. These vessels had over 35 miles of line and they stayed out for a week at a time. Each vessel would come in with enough fish to fill 15 refrigerated trailer vans to ship to the states. They were filling 75 vans per week."

Another commented to one of his clients, "Wahoo were everywhere out there but now it's hard to find," and the client said, "Well, let me give you a clue. I was at Aruba and I bought 50,000 pounds of Wahoo filet and I was only one buyer. There was a ship there loaded with nothing but Wahoo."

Yet another said, "The drop in yellowfin tuna is due to the fishing done by Japanese and Taiwanese during the 1980s. Today there is pressure from the *palangreros* (long-liners)."

We interviewed a total of 9 charter boat fishers across the island. We discuss them as a group here, as opposed to including them in the municipality studies, because they are so thinly distributed across the island that to discuss them in the municipality studies would be to identify them, violating confidentiality. Table I.4 presents the results of these interviews.

From this table, it is obvious that this industry targets primarily pelagic species and tend to seek their clients among people staying at the hotels and resorts, taking advantage of the busy winter tourist season. Most reported that their business during the summer months dropped to around half of what it is during the winter months. Summer is the principal time that resident Puerto Ricans tour the coasts, and all but one reported that very few of their clients are Puerto Ricans.

All of those we interviewed were licensed captains and most had their "Six-Pack for Hire" licenses as well, which enables them to use their vessels as water taxis. This is in line with their tendency to offer a range of services, including taking divers out to coral reefs or for night dives, taking tourists to phosphorescent bays, and offering recreational sunset cruises and other boat rides. In this sense, the charter boat industry overlaps with those commercial fishers (as in Fajardo) who use their vessels for similar purposes, as well as with the recreational boating industry.

Regarding fishery regulations, a few complained of the costs of licensing, one complained that the regulations on cast net sizes (from 12' to 8') made it harder to get bait, and others complained of what they perceived as the poor performance of the Department of Natural Resources, but others viewed the current regulations as important to preserving fish stocks. Most believe that there are problems with the fishery resources they target, citing primarily overfishing of key species, such as Marlin and Wahoo, for commercial sale outside of Puerto Rico. Others, however, pointed to water quality problems, sedimentation, lack of food fish close to the coast, and global warming.

The following table shows the characteristics of those charter boat fishers we interviewed. They share several characteristics with those included in the Garcia-Moliner, et al (2002) study, including the species they target, average numbers of trips per year, and seasonal factors.

Table I.6. Characteristics of Charter Boat Fishing in Puerto Rico (n=9)

Variable	Responses
Years of Experience	15 to 49 years (average = 24.75)
Busy Season	October or December to May (resort high season)
Fishing Territories	1. Southeast (off coasts of Yabucoa, Humacao) 2. 20 miles off west coast/ La Mona 3. North of Fajardo, Luquillo 4. *Bola de Fuche* (Culebra) 5. In shore Cabo Rojo 6. Desecheo/ Mona-Monito 7. South of South-Southwest coast (Ponce to Cabo Rojo)
Species targeted	1. *Dorado* (Dolphin—*Coryphaena hippurus*) 2. *Aguja azul* (Blue Marlin—*Makaira nigricans)* 3. *Peto* (Wahoo—*Acanthocybium solanderi*) 4. *Atún* (Yellowfin Tuna—*Thunnus albacares)* 5. *Sierra* (King Mackerel—*Scromberomorus cavalla)* 6. *Sábalo* (Tarpon-*Megalops atlantica)* 7. *Picua* (Barracuda—*Sphyraenidae)*
Trips Per Year	20 to 500/ year (average = 190/ year; 15-20/month)*
½ Day Cost **Full Day Cost**	$275 - $750 (average = $526) $400 - $1,500 (average = $960)
Home Location of Clientele, in order of importance	U.S. Mainland Europe South America Puerto Rico
Locations of Advertisements	Internet Travel and Port Magazine Compañia de Turismo *Que Pasa* (local tourist magazine) Resort Hotels Marine Supply Stores Flyers & Brochures

*High figures are those that charter with multiple boats

I.g. Methods

This work is based on a combination of ethnographic, survey, economic, and GIS mapping methodologies that were accomplished by a multidisciplinary team from December 2003 to July 2006. We discuss these methods here not only as background to the report, but also as guides to coastal managers as means to improve methods of communication with fishing populations. Team members visited the 41 coastal municipalities listed in table I.1. and I.3. as well as Quebradillas and Yauco (the two municipalities that do not report landings data), using several different data collection protocols at different phases of the research (see Appendix A). In general, initial site visits were oriented toward cultural mapping, taking photographs, and brief interviews and later site visits involved more in-depth interviewing and, in some cases, administering standardized surveys. Secondary source data were collected from Puerto Rican

libraries and bookstores, government agencies and websites, and university connections and collections, including the University of Puerto Rico Sea Grant College Program.

The survey work began later than the ethnographic work, in the spring of 2004, and lasted into the fall of 2005. The later start was due to a lengthy process of survey development, pretesting, obtaining OMB clearance, and developing a list of intercept sites. The survey instrument, shown in Appendix A, was developed by the research team in conjunction with NOAA Fisheries scientists and a separate research team conducing a parallel study in the U.S. Virgin Islands. We discuss the survey methodology in more detail in part VI, but here point out that it was based on two sampling methods: random sampling from the commercial fisher census and intercept sampling. The latter was necessary because recreational fishers are not listed in any directory that was available to us. Thus, we developed a list of intercept sites based on early ethnographic observations and lists of Club Nauticos.

I.g.1. Research Design and Approach to Fieldwork

The early phases of this project were designed to identify fishing communities and collect general data on the current state of Puerto Rican fishers and these communities. As in former studies of fishing communities, we moved from less structured to more structured methods as the project progressed, beginning with open-ended ethnographic work before narrowing our inquiry with the use of cultural mapping inventories, survey instruments, cognitive tests, and so forth. In addition to using the OMB-approved survey reproduced in Appendix A, which our field team helped to design, here we describe in somewhat more detail the methods employed to produce this work:

Cultural mapping. Oriented specifically toward identifying fishing communities, cultural mapping consists of structured observations similar to the marine infrastructure inventories we produced during the late 1980s (Griffith, et al. 1988; Valdés, et al. 1988). In those studies, we traveled along the coasts of Puerto Rico and the US Virgin Islands, noting the infrastructure (e.g. launching ramps, boat slips, etc.) that existed, how it was used, its condition, and other features on forms that assured we collect the same set of information at each location. Griffith performed similar work in North Carolina (1999) and, with Dyer, in New England (Griffith and Dyer 1996). In this study, working in municipalities, we noted the distribution of fishing associations (*Villas Pesqueras*), lockers, docking, and launching facilities, sportfishing clubs (*Clubs Nauticos*), marine suppliers, seafood markets, and so forth. Through brief interviews with 2 - 3 individuals at each site, we noted, for example, the numbers of fishers who use the site, the times of day the site is active, principal gear utilized and species caught, existence of markets and seafood restaurants, and so forth. The cultural mapping data served multiple purposes: in addition to enabling us to update our information about the distribution of fishing communities and their linkages to non-fishing sectors of Puerto Rican economy and society, this work was also useful for sampling purposes. Moving from place to place across Eastern Puerto Rico, the cultural mapping will assure that we conduct our open-ended interviews (discussed below) in several communities of the region. For the cultural mapping, we anticipate spending, on average, one day in each of the 26 municipalities; time will vary because some municipalities, such as Guayama, have several complex fisheries while some of the municipalities along the northern coast have relatively little fishing activity, in part due to a lack of sheltered shoreline.

Transect walks. These are walks with fishers through areas that possess special significance to fishers and their family members. They are designed to enhance interviews and point out linkages between various fisheries and other sectors of Puerto Rican society and economy as fishers explain their significance. For example, we had presidents of associations and seafood dealers “walk” us through

their freezers, a process which has led to descriptions of networks among fishers, seafood dealers, street vendors, and other marketing outlets. We performed these in conjunction with the cultural mapping phase of the research.

Open-ended interviewing. We conducted open-ended interviews with different stakeholders, initiating this phase of the project concurrently with the cultural mapping. The types of stakeholders interviewed are included in table I.7; the numbers of interviews varied by the internal complexity of the populations, with more interviews being conducted among those groups that are more complex. Some of the subject areas we were interested in during these interviews were:

- Seasons that the community members are most involved in fishing.
- Gear and species targeted.
- Approximate numbers of fishing households in the community.
- Distribution of fishing households across the municipality.
- Movement between fishing and non-fishing sectors of the economy among fishers.
- Common occupations (e.g. welding) or industry sectors (e.g. tourism) that fishers engage in, in addition to household-based fisheries.
- Linkages between fishers and suppliers of fishing equipment, ice, vessels, etc.
- Celebrations involving fishers (e.g. blessings of the fleet, sportfishing tournaments, etc.)

Table I.7. Work Accomplished by Municipality

Municipios	CulturalMapping/ Transect Walks	Stakeholder Interviews	Background Literature	Photos
Arecibo	Club Nautico, recreational fishing areas near harbor & river mouth Jarealito	Isabela association President	Toro Sugrañes	+
Hatillo	Observed/ Photos	Isabela president	Toro Sugrañes	+
Camuy	Observed/ Photos	Isabela president	Griffith & Valdés Toro Sugrañes	+
Quebradillas	Observed/ Photos	Isabela president	Toro Sugrañes	+
Isabela	Villa Pesquera Jobos	Villa President, local handywoman for Corporate group, restaurant owner & wife.	Griffith & Valdés Toro Sugrañes	+
Aguadilla	Crash Boat Barrio Higuey El Tamarindo	Crash Boat	Griffith & Valdés Toro Sugrañes	+
Aguada	Barrio Espinal Independent Association/ Guanquilla	Barrio Espinal/ pescaderia/ commercial fishers	Griffith & Valdés Toro Sugrañes	+
Rincon	Villa Pesquera Club Nautico Parcela Estela	Colmado owner; 6 fishers who sell in Aguada based here Pescador & CFMC member	Griffith & Valdés Toro Sugrañes	+
Añasco	**Tres Hermanos** La Puerte Barrio La Playa	Tres Hermanos. La Puente. DRNA person. Sister of Villa Administrator.	Toro Sugrañes	+
Mayagüez	Mayaguez front, small landing areas (Joyuda)/ Virgen del Carmen festivities El Dockey El Maní El Seco	El Dockey (administrator) El Maní . Local shell artisan. Fishery scientist.	Toro Sugrañes	+
Cabo Rojo	Puerto Real La Mela Otro Associacion (near casetas) Combate Boquerón	Puerto Real (5 pescadores), restaurant owner. Combate Villa Administrator Dive boat captain	Griffith & Valdés Valdés	+
Lajas	3 Associations Seafood dealers Papayo Parguera	Pescaderia, commercial fisher. Restaurant owner. Association fishers.	R. Brusi dissertation. Valdés Griffith & Valdés	+

Municipios	CulturalMapping/ Transect Walks	Stakeholder Interviews	Background Literature	Photos
Guánica	Guánica Assn. Jacinto/ Gulligans Playa Santa Ensenada	Restaurant owner, pescadors (3). Association fisher/ diver. Boat repairs.	Griffith & Valdés	+
Yauco*	n.a.	Peñuelas fisher	n.a.	n.a
Guayanilla	El Faro, Ensenada	Pescador, dealer Boat repairer, El Faro	R. Pérez dissertation.	+
Peñuelas	El Boquete/ Tallaboa	Pescador, Assn president, Yauco fisher	R. Pérez (2005)	+
Ponce	Punta Las Cucharas La Guancha La Playa	Pescador (P. Cucharas) Pescadores/ administrator (3) La Guancha Marine supply DRNA Recreational fisher.	Toro Sugrañes	+
Juana Díaz	Patillas	Pescadores Trap manufacturer Wife of fisher	Toro Sugrañes	+
Santa Isabel	Playa/ Malecon Club Nautico	Association members (2)	Toro Sugrañes	+
Salinas	Playa/ Playita Aguirre Las Mareas	Pescadores (4)	Toro Sugrañes	+
Guayama	Barrancas Pozuelo	Pescadores (4)	Toro Sugrañes	+
Arroyo	Arroyo Downtown (Marina & Association)	Pescadores (3)	Toro Sugrañes	-
Patillas	Patillas Bajo Guardarraya	Pescadores (2)	Toro Sugrañes	-
Maunabo	Punta Tuna	Recreational fishers (2) Fisher Association member	Toro Sugrañes	+
Yabucoa	La Puntita Lucia Shell Refinery Canal (recreational fishing site)	Focus group (2) with fishers from Yabucoa & Humacao	Toro Sugrañes	+
Humacao	Punta Santiago Palmas del Mar	Recreational fishers (2) Pescadores (3) Restaurant owner (1)	Toro Sugrañes	+
Naguabo	Húcares Playa Naguabo	Association Divers (2)	Toro Sugrañes	+
Ceiba	Los Machos	Focus group with 5 fishers 2 fishers	Toro Sugrañes	+
Vieques	Isabel Segundo Esperanza	Association presidents Pescadores DOA extension agents		+
Culebra	Fishing Association	Association officials	Iranzo	+

Municipios	CulturalMapping/ Transect Walks	Stakeholder Interviews	Background Literature	Photos
Fajardo	Maternillo Mansion del Sapo Sardinera Las Croabas/ Atlantic Caribe Marina Puerto Chico	Pescadores (8) Recreational fishers (2) Marina	Toro Sugrañes	+
Luquillo	Luquillo waterfront	Association official (1)	Giusti-Cordero Toro Sugrañes	+
Río Grande	Espiritu Santos Villa Pesquera	Association official (1)	Giusti-Cordero Toro Sugrañes	+
Loíza	Vieques	Association officials & pescadores (3)	Giusti-Cordero Toro Sugrañes	+
Carolina	Piñones		Giusti-Cordero Toro Sugrañes	-
San Juan	La Princesa La Hoare	Association officials (2)	Toro Sugrañes	+
Cataño	Centro Agropequario	Association officials (2)	Toro Sugrañes	+
Toa Baja	Villa Pesquera Arroyo Boat yard	Boat yard employee	Toro Sugrañes	+
Dorado	Downtown recreational fishing Rio de la Pla Villa Pesquera Recreational Tournament site Mameyal	5 recreational fishers Association officials/ members (3)	Toro Sugrañes	+
Manatí	Observed		Toro Sugrañes	-
Vega Baja	Villa Pesquera Club Nautico	Association members (2)	Toro Sugrañes	+
Vega Alta	Cerro Gordo Marine Supply Store	Association members (2)	Toro Sugrañes	+
Barceloneta	Palmas Las Altas La Boca	Recreational fishers (2)	Toro Sugrañes	+
Overall Region		DRNA (Mayaguez lab) Unemployed/ displaced factory workers	Census/ reports, Landings data. Nonplace-based community literature. 6 websites NMFS Rec. Fish Inventory. Artisanal Boat-making study.	
Totals	**93 locations**	**135 (+/-) Ethnographic Interviews**	**20-30 sources****	**>300**

*Yauco has very little coastline, which is why many of these fields are not applicable.
**estimate of sources that deal with Puerto Rico directly.

Other methods we utilized included group interviews/ focus groups, the use of visual cues (e.g. maps, photos), collection of background data from local repositories, and the recruitment and training of local research assistants.

I.h. Organization and Content of this Report

As noted earlier, this report has three parts: 1) this introductory section, which includes: (a) an executive summary; (b) introduction; (c) a brief history of Puerto Rican fishing; (d) the cultural significance of fishing; (e) our understanding of Puerto Rican fishing communities and their relation to the notions of dependence and engagement; (f) a presentation and analysis of the survey data; (g) a chapter on the performance of MPAs; and h) a policy discussion that addresses impacts of regulations on Puerto Rican fishing communities and the relationships between Puerto Rican fishers and coral reefs; 2) the regional profiles, which describe fishing centers and communities, present capsule histories (for which we are particularly indebted to Toro Sugrañes's 1995 Historia de Los Pueblos de Puerto Rico), profile fishing practices and concerns, and discuss current problems and opportunities facing fishers in each region; and 3) the appendices and references.

In the regional profiles, we have attempted to standardize the information with the presentation of landings, census, fishing census data, and information from the ethnographic interviews, but the narratives in each municipality occasionally wander off in new directions. This is due, primarily, to the fact that fishers often guided the investigators toward some areas of investigation to the exclusion of others, reflecting salient issues in those municipalities at the time the fieldwork was performed. Yet it is also due to the interests of the principal investigators and their research assistants who, despite being provided data collection instruments, were given the freedom normally granted ethnographic researchers and, as such, focused on some issues but gave scant or no attention to others. An additional source of variation comes from the attempt to alter the narrative structure slightly, experimenting with different styles of presentation in order to keep the reading as interesting as possible.

HISTORICAL OVERVIEW OF PUERTO RICAN FISHING

II.a. Fishing, Smuggling, and Caribbean Coastal Adaptations

Puerto Rico endures and enjoys a relationship with the rest of the United States that has incorporated Puerto Ricans into U.S. society and economy unevenly. Following the Spanish-American War, during which the United States invaded Puerto Rico and acquired its territory from Spain, Puerto Rico became an ethnographic curiosity in the United States while continuing to serve as a strategic location in the sea lanes of the New World and as a source of tropical agricultural products and relatively inexpensive labor (Duany 2002; Buitrago Ortíz 1973; Picó 1986). Yet U.S. interest in Puerto Rico and other Spanish territories in the Caribbean predate the Spanish American War by nearly a century. According to Picó, both Thomas Jefferson (president from 1801-1809) and James Monroe (president from 1817-1825) expressed an interest in acquiring Puerto Rico early in the 19th century, and in 1852 the United States expressed an interest in purchasing the Dominican Republic's Samaná Bay, across the Mona Passage from Puerto Rico's western shore (1986: 223).

U.S. interest in Puerto Rico and the Greater Antilles ultimately stems from their proximity to the Continental United States and, as just noted, their strategic positions for the military and for international shipping. "The sea," Griffith and Valdés Pizzini wrote, "has always been more valuable to the Puerto Rican economy as a link to the rest of the world. Fishing is of small significance compared to defense, shipping, tourism, and other commercial and strategic uses of surrounding waters." (2002: 40). Despite this, fishing has been a part of Puerto Rico's coastal landscape for as long as humans have occupied its islands, usually deeply intertwined with other economic pursuits.

Early Arawak and Taino peoples used coastal and marine resources to round out their diets and produce ceremonial and utilitarian objects. Archaeological investigations in Ponce in 1975, after Hurricane Eloise unearthed several antiquities, determined that pre-Columbian peoples inhabiting Puerto Rico's southern coast possessed advanced astronomical knowledge, indicating a sophisticated seagoing tradition combined with an advanced calendar, the former critical to long-distance fishing and the latter to a developed agricultural system (Vidal Armstrong 1986). Archaeological and ethnohistorical accounts describe complex Arawak and Taino cropping systems both contemporaneous with early European settlement and predating that settlement by two millennia. At the same time, marine resources, including fish and crustaceans of the sea and mangroves, provided critical protein to supplement diets otherwise rich in maize and a variety of fruits, root crops, and vegetables. Of the Taino, Picó (1986: 24) writes: *"No hay duda alguna de que los sembrados de yucca y de maíz podían alimentar grandes poblaciones, pero sabemos también que podían cazar roedores, reptiles y pájaros que, junto con la pesca, proveían el complemento necesario de proteínas para su dieta"* ("Without a doubt, from yucca and maize fields they could feed large populations, but we know as well that they could hunt rodents, reptiles, and birds that, together with fishing, provided the necessary complement of proteins for their diet"—authors' translation, emphasis added).

Picó also suggests that, among the Taino, fishing, like hunting, was primarily a male activity. If so, it was probably highly valued, given that most male activities among most people prior to the 20th century were more highly valued, socially, than tasks performed by women. More importantly, in the absence of large game animals in the Caribbean, as in insular societies generally, sources of protein have been particularly prized, reducing the physiological stress associated with protein deficiency.

Price (1966) reports that slave fishers in the Caribbean were given freedoms not accorded other slaves for similar reasons: fisher slaves provided high quality protein to their owners' and overseers' households. Such freedom allowed them to participate in the underground economy, where they engaged in contraband trade, assisted fugitive slaves, and spread information from plantation to plantation along the coast, including information about slave rebellions (Cecelski 2000). Nearly all histories of coastal Puerto Rico point out that smuggling has always played a role in Caribbean coastal economies. This shouldn't surprise us, as the coastlines of many insular societies are also international or territorial boundaries, where contraband trade flourishes.

Such activities were responsible for lingering views of coastal communities as sites of lawlessness and danger, views that were enhanced by Puerto Rican historians' tendencies to contrast the coastal lowlands with the mountainous interior: one the site of plantation agriculture, slavery, smuggling, the miasmas of mangroves, and associated with people of African descent; the other home to hardworking *jíbaros* who descended from Spanish colonial stock to produce for the subsistence security of their families (Duany 2002).[8] These distinctions continue to influence local perceptions of coastal peoples when they feel threatened by forces larger than themselves. In Loíza, for example, long portrayed as one of the most African of coastal municipalities in Puerto Rico, during a dispute involving the destruction of wetlands by a large resort compex, one local fisher said, *"Nos quieren sacar de la pesca porque somos negros y pobres!"* ("They want to force us out of fishing because we are black and poor!").

Portrayals of Puerto Rico's coastline as locations of danger and lawlessness dramatize and misrepresent lifestyles that are in reality complex and as much oriented toward feeding their families and securing a decent living as are the proverbial *jíbaros* of the highlands. Guitsi's dissertation on the history of Loíza points out that historians, anthropologists, and others writing about Puerto Rican history often portray "dead time" in sugar cane production—the season between harvests—as a time of poverty and relative idleness (1994). Yet it was during this period every year that fishing, along with several other economic pursuits, rose to the surface of coastal economic activities. Combined with making charcoal in the mangrove forests, hunting, gathering, and peasant farming, fishing enabled families to survive the season that sugar workers routinely referred to as *la bruja*—the witch. Fishing's status as one of multiple livelihoods mirrored the complexity within the fisheries themselves—of gear, species, fishing territories, catch sharing and marketing arrangements, patterns of consumption, and, perhaps most importantly, the extent to which households and communities inserted themselves into fishing lifestyles, appropriating the symbols and festivals surrounding fishing as their cultural heritage (Valdés Pizzini 1987).

Norman Jarvis, in his 1932 overview of Puerto Rico's fisheries, lists sixty species of "principal varieties of Puerto Rican food fish" harvested by five primary gears: fish pots, trolling lines, hand and trawl lines, gill nets, and haul seines. Even while capturing large numbers of species with a variety of gears, Puerto Rican fishers still engaged in alternative pursuits. Jarvis reports that:

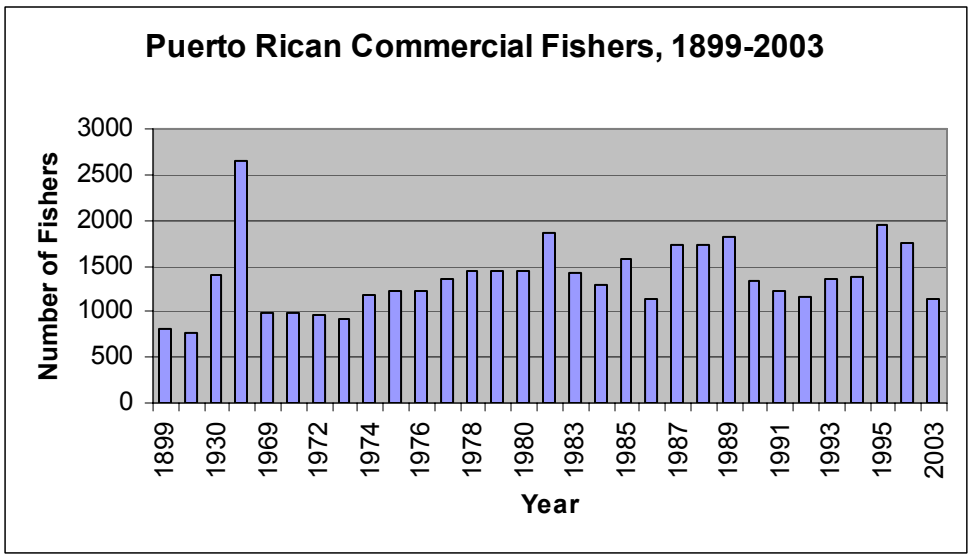
> "The great majority of fishermen in Puerto Rico depend on plantation work, employment in the sugar centrals, or stevedoring at the docks and landings as much or more than they do on fishing. Fishing is followed as a sole occupation only where other work can not be obtained or the demand for fish is fairly extensive. Regular fishermen are found in considerable numbers only at Culebra Island, Las Cabezas (near Fajardo), Puerto Real, Cataño, Palo Seco, Guanica, Aguadilla,

[8] *Jíbaros* are rural working people that have been reified in Puerto Rican cultural history as the hard-working, self-sufficient peasants of the highlands; a statue honoring the *jíbaro* stands next to the principal interstate connecting Ponce and San Juan.

Vieques Island, Mayagüez, and Guayama. The majority of the regular fishermen in the San Juan district are blacks from the British West Indies or the Virgin Isles. There are numbers of men who state that they fish all year, but in several instances the writer has found that this was done in the intervals between loading ships, or to supplement other irregular employment" (1932: 14).

Jarvis claims to have interviewed 80% of the island's 1,403 fishermen in 34 coastal communities. Graph II.1 suggests that this number would prove to be relatively stable over time. In the communities Jarvis studies, comparing his observations to scant few previous accounts, he came to believe that fishing practices hadn't changed significantly since the U.S. occupation of 1898. Operating under this assumption, despite his own reservations about the quality of previous data on the fisheries, Jarvis devoted much of his report to recommending methods of either modernizing fishing and fish handling practices or making more efficient use of marine resources. He lamented that few crustaceans besides land crabs and lobsters were used, and he was particularly critical of fish handling.

Figure II.1. Numbers of Puerto Rican Commercial Fishers*



Source: Cummings and Matos-Caraballo (2003): Table 1

At the time of his survey in 1931, Puerto Rican fishers used sail and rowboats primarily, although the occasional motorboat caught his attention as well, which he said were "not especially adapted for fishing, but they can cover a greater fishing area and are not affected by the weather to the same extent as other craft in use" (1932:5). Half of the catch, he reports, was taken with fish pots, 30% with hooks and lines, and the remainder with haul seines (*chinchorros,* or beach seines), gill and other nets, forks (harpoons), and fish weirs (ibid.). He gave three reasons for the popularity of fish pots:

"1. The fish can not easily be robbed from the traps by predatory fish.
2. It can be used without bait, or if bait is used the amount required is much less than that needed for hand-line and trawl-line fishing.
3. Pots require less attention than other types of gear" (1932:6-7).

Jarvis praised many of the fishing vessels he observed and much of the gear, deeming them "well constructed" and in line with what he had observed in other parts of the Caribbean. He focused the bulk

of his criticism on fish handling practices, commenting that repeated sales of rotten or stale fish undermined consumer confidence in seafood and served to limit demand. This, in turn, limited fishing. Eight of his twelve final recommendations involved improving fish handling methods. His descriptions of fish markets and fish vendors in San Juan were particularly scathing, referring to the fish market displays as unappetizing and the market stalls themselves as in poor condition. The markets in Ponce and Mayagüez fare little better, and the interior he believed to be poorly supplied by itinerant peddlers riding horses and mules. Jarvis placed a high value on ice and refrigeration, praising its use whenever he came upon it and condemning fish handling practices in its absence.

Some of the cooling facilities and practices he encountered were associated with imported fish. In the 1930s, imported fish was treated with more care than fresh local catch, which may have been due to the privileging of North American products. Though Fajardo, Mayagüez, and Puerto Real fishers used ice regularly, neither Culebra nor Vieques fishers had access to ice (unless landing fish in Fajardo) and across much of the main island ice was too expensive for fishers to use. As a result, Jarvis argued, Puerto Ricans considered the consumption of local fish risky, with a high probability of food poisoning. Evidently much of the island's population agreed. Based on official statistics (which doubtlessly underreported consumption of local fish), imported cured, canned, and frozen fish were consumed at a per capita rate of about six times that of locally caught fish, though total per capita fish consumption still fell short of that found in the U.S. Virgin Islands, a fact Jarvis attributes to fish poisoning episodes. His explanation is one of mutually negative reinforcement:

> "Blame for the consumption of fish in such condition that it is liable to cause food poisoning must be apportioned among fisherman, dealer, and consumer. The fisherman will not clean his fish or give it a proper handling in the boats. The dealer does not maintain a sanitary establishment or pay attention to the keeping fish in good condition. His is often unwilling to throw out fish known to be stale and will sell such products, if possible, without regard to the effect it may have on future sales. The customer refuses to accept gutted fish, believing that this is a method of concealing inferiority. Another popular concept held by the consumer is that ice is used for the same reason, to hold fish already stale from further decomposition" (Jarvis 1932: 25).

Jarvis's attention to fish handling practices included conducting his own fish curing experiments. He salted, dried, and smoked hogfish, capitán, barracuda, red snapper, king mackerel, and other species. Although his cured products were of as high a quality as cured imports, he was uncertain about the extent to which his methods would catch on and persist. If today's preservation methods are any indication, Jarvis's observations regarding cooling and ice were more acceptable to local fishers than his experiments with curing: across the island, at nearly every Villa Pesquera and private seafood dealer, freezers have become a more than a mere tool of preservation, occupying a critical position in relations among fishers and fish dealers as well (Valdés Pizzini 1985).

Towards the end of his report, Jarvis raised the subjects of freshwater fishing and sportfishing. While he saw little hope of developing many inland fisheries, he viewed sportfishing as an untapped opportunity, suggesting an early association between the developing tourist trade and the island's marine resources. Particularly troubling to him was the contrast between the rich sportfishing resources in the waters between Fajardo and the two outer islands of Vieques and Culebra, and the relative lack of "comfortable accommodations" in the east (1932: 38). As such, the little sportfishing there was, was based in San Juan, and that remained poorly developed—little more, he noted, "than a line in an advertising folder" (1932: 37). With little optimism, he opens his conclusion with the following negative statement:

> "It is believed that there has been little if any development of the fishing industry of Puerto Rico during the past 30 years. While considerable progress has been made in fish handling in the last 30 years elsewhere, conditions in Puerto Rico are essentially those prevalent before the introduction of ice or refrigeration; that is, local methods are 100 years behind the times" (1932:38).

Other historical accounts of fishing aren't nearly so negative. In his detailed examination of the Piñones region of Loíza, on the north coast, Guitsi (1994) describes fishing and other coastal livelihoods to challenge the idea that rural sugar cane workers were wholly dependent upon, and shaped by, sugar production.[9] Combined with the high seasonal fluctuations of work in the cane, the proximity of many sugar plantations to coastal and marine environments such as mangrove forests, river mouths, lagoons, and near shore substrates made possible the development of fishing, cottage manufacturing, and gathering activities tied to the sea. His work is important because he focuses on the 1920 to 1950 period of peak sugar production, when presumably the working class culture formed around the industry was absorbing and transforming other coastal plain livelihoods. Yet the seasonal and sporadic nature of work in the cane, tapering off in mid-summer and by September and October falling to two to three days per week for only a select portion of the work force, forced most sugar cane workers and their families to seek alternative incomes, many peasant in nature, for periods of up to six months (July through December): "The Puerto Rico Minimum Wage Board (1942) estimated that the sugar centrals; demand for labor declined as much as 60% during *tiempo muerto* (dead time). During the last weeks of the *zafra* (harvest), after both *primavera* (spring or early) and *gran cultura* (full-grown) cane had been cut, the work shaded off into *tiempo muerto* as laborers worked only 2-3 days per week" (1996: 764).

The seasonal, peasant-like dead time activities that Guitsi describes include charcoal production, small-scale animal husbandry, the gathering of *jueyes* (land crabs) and oysters, and fishing. Though census figures do not report large numbers of fishers, Guitsi argues that fishing was neveretheless important:

> "The census collector's identification of a 'primary' occupation also created important difficulties: for instance, an absense, or near-absence of certain vital categories from the 1910, 1920, and 1936 census; in particular, "fishermen". Only 3 fishermen were identified in any of the three census years, in 1936. This reflects the fact that few *piñoneros* lived primarily from fishing, but at the same time obfuscates the important point that fishing (and *jueyes*) were a major form of subsistence; indeed, fish were often sold to passing merchants. This is a striking absence, in a locale with important fishing and marine-gathering resources. The seasonal character of fishing is similarly obscured" (1994: 772).

Perhaps the lack of fishermen showing up in the census was partly responsible for stalling state investment in Puerto Rican fishing. Despite the fact that among Jarvis's 1932 recommendations to improve fishing vessels, gear, and fish buying and distribution (all prescriptions for investment in fisheries), the insular and federal governments did not invest in fishing in a concerted way until several years later, and then usually in conjunction with other state-funded projects, such as building the military bases in Vieques and Ceiba.

Pérez's dissertation on the fisheries of Guayanilla, on Puerto Rico's south coast, includes an important and critical overview of state investment in fisheries. These initially came in the form of critical

[9] Griffith and Valdés Pizzini (2002) note that it is difficult to consider fishing historically without reference to sugar production. Sugar took up much of the coastal plain from early colonial days to the mid-20th century, and sugar production was carried on by not only large plantations but also small, household, peasant operations.

descriptions of the islands' fisheries, such as Jarvis's, but eventually led to stock assessments, the collection of landings data, licensing, and a census of fishers—all oriented toward more sophisticated surveillance methods to track fishing activity and marine resource health. Pérez refers to this as a "knowledge apparatus that involved the creation of several public agencies to deal with the fisheries' problems and the approval of various laws to regulate fishing practices" (2003: 77). He lists twelve agencies that developed between 1934 and 1990 to play a role in the islands' fisheries:

Table II.1. Programs, Agencies, and Government Levels Associated with Puerto Rican Fisheries Development, by Year

Agency or Program	Government Level	Year Founded
1. Division of Fish & Wildlife	Puerto Rico Department of Agriculture and Commerce	1934
2. Laboratory for Fisheries Research	U.S. Department of Interior	1941
3. Agricultural Company	Puerto Rico Department of Agriculture and Commerce	1945
4. Fishermen's Credit Agency	Puerto Rico Department of Agriculture and Commerce	1958
5. Program of Minimum Facilities in Fishing Village	Puerto Rico Department of Agriculture and Commerce	1963
6. Commerical Fisheries and Development Act	U.S. Department of Commerce	1966
7. Agency for Community Action	Puerto Rico Department of Agriculture	Early 1970s
8. Caribbean Fishery Management Council	U.S. Department of Commerce	1976
9. CODREMAR*	Puerto Rico Department of Natural and Environmental Resources	1979
10. Puerto Rico Sea Grant Program	U.S. Department of Commerce	1989
11. Program for Fisheries Promotion, Development, and Administration	Puerto Rico Department of Agriculture	1990

*Source: Pérez, 2003, pp. 64-65 and 2005: 54 (slightly adapted).*Corporation for the Development & Administration of Marine, Lacustrine, and Fluvial Resources of Puerto Rico/ Corporación para el Desarrollo y Administración de los Recursos Marinos, Lacustreas y Fluviales de Puerto Rico*

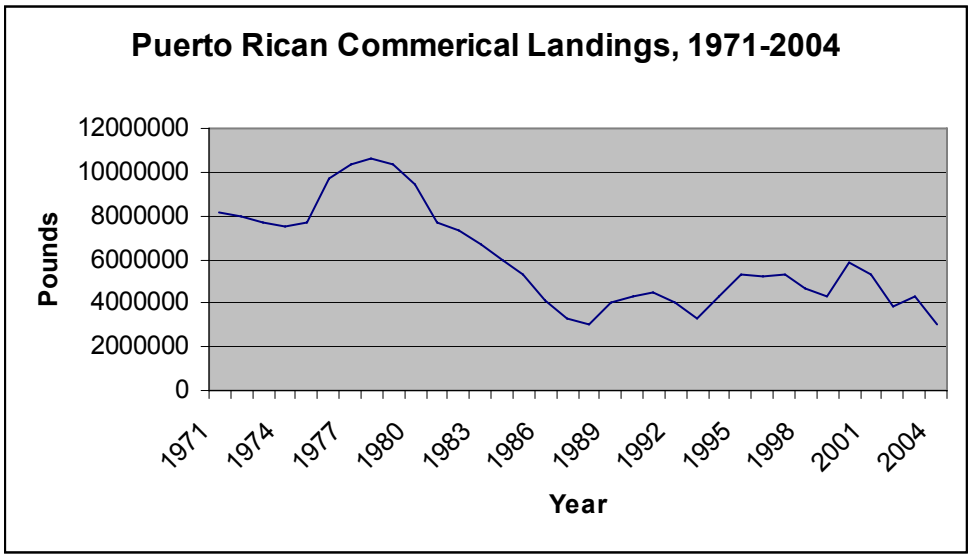
At least two dimensions of fisheries development are obvious from this table: first is the multiplicity of agencies, from federal and local governments, that have become involved in Puerto Rican fisheries; second is the continuing presence of the Department of Agriculture in the fisheries, creating an association between fishing and farming in Puerto Rico. Pérez argues that from the beginning of government involvement with fisheries, fisheries development was inextricably bound to agriculture, agrarian reform, and rural poverty. Yet fisheries development thus always played second fiddle to agricultural development. Fishers across the island today continue to lament the dominating force of agriculture in the research and funding agendas of the Department, arguing on the one hand that funds routinely get channeled away from fishing to agriculture but that, on the other, the same arguments that apply to agriculture in terms of subsidies and other forms of compensation for lost income, to compensate for imports, etc., do not apply to fisheries. In Naguabo, for example, fishers complained that when regulations cut into farming incomes, farmers are often compensated, but when regulations result in income losses to fishers, compensation rarely occurs.

After failed attempts to establish large scale, highly capitalized Puerto Rican fishing fleets during the years immediately following World War II, fisheries development, in the 1950s and 1960s, adopted the

path whose legacy is most apparent today: investment in the infrastructure that became *Villas Pesqueras*. "From 1958 to 1964," Pérez writes, "the Fishermen's Credit Agency distributed more than 900 loans worth over $500,000, a decent amount of money that provided motors to approximately 65% of the fishing boats registered in the island. In the fiscal year 1975-76, it approved some 249 loans at a value of more than $402,568" (2003: 89). Other funds were used to buy large (51-foot), technologically sophisticated vessels for some fishers. Again, however, the most far-reaching investment was in fishing centers: "By the 1970s, the three programs [Fishermen's Credit, the Agency for Community Action, and Minimum Facilities in Fishing Villages] helped the Puerto Rican government to construct the basic infrastructure in thirty-two fishing communities across the island and to disburse approximately $2,000,000 among the small-scale fishermen" (Pérez 2003: 89).

Despite these investments, fishing continues to be an occupation in Puerto Rico that is largely artisanal and must be, in most fishing households, supplemented by alternative sources of income. Graph II.2 shows that catches have declined since the late 1970s, fluctuating between 3,000,000 and 6,000,000 pounds per year during most of the past twenty years. The central theme of Griffith and Valdés Pizzini's work on Puerto Rican fishing, reflected in their title, Fishers at Work, Workers at Sea (2002) was that movement between fishing and wage work more common among Puerto Rican fishers than specializing in fishing as a full-time occupation. This does not mean that there are no full-time fishers in Puerto Rico, nor that fishing in Puerto Rico is secondary to other occupations or, equally important, secondary to other sources of identity. On the contrary, many fishers fish full-time for much of their lives and consider fishing the primary source of their identity even when they spend part of their productive years involved in other pursuits. Often, the income from these other pursuits is used to subsidize fishing.

Figure II.2. Puerto Rican Commercial Landings, 1971-2004*



Source: Adapted from Matos-Caraballo (2005)

Work in other sectors of the Puerto Rican economy may account for the relative stability of official numbers of commercial fishers over time, as seen in Graph II.1. The movement into and out of fishing may result in only active fishers being counted in any one year, although during workshops held with commercial fishers in June 2006, fishers nearly unanimously questioned official statistics, suggesting they were an undercount. In any case, if the number of fishers has remained relatively stable over time, those

who participate in commercial fishing are landing fewer and fewer fish (see Graph II.2), a factor that might discourage entry into the fishery and encourage those who remain to continue seeking occasional employment outside fishing.

The vast majority of Puerto Rican fishers have other occupational experience. Surveying fishers in the mid-1980s, Guittierez-Sanchez, et al. (1985) found that over 90% of fishers had had jobs outside of fishing at some time during their lives, and our survey work this past year found that between 40 and 45% of commercial fishers listed other occupations that supplemented fishing incomes. Most worked in the construction and repair industries, as carpenters, welders, mechanics, and the like, but the list of other jobs included over 60 different occupations ranging from professional work to manual labor. Fishers who participated in the June 2006 workshops also confirmed that most Puerto Rican fishers supplement fishing with wage work, a phenomenon that may increase during periods of rising expenses (e.g. increasing fuel costs beginning shortly after the second war with Iraq).

Thus far, this discussion applies principally to the islands' commercial fishing fleets, long considered small-scale or artisanal in nature. Yet they are not alone in their reliance on marine resources in Puerto Rico. Two additional parts of the development trajectory of Puerto Rican fisheries have been: 1) development and eventual decline of large-scale tuna processing in Mayagüez; and 2) the continued growth of marine recreational and subsistence fishing and Clubes Nauticos around the island. We mention them briefly here because the former once was an important part of the history of Western Puerto Rico and the latter is becoming an increasingly important part of profiles of fishing communities.

II.b. Tuna Processing in Mayagüez, Puerto Rico

The tuna canneries did not engage local fisheries as much as they provided processing facilities for U.S. tuna fishing fleets that roamed the high seas. Canning tuna for such household name brands as Bumble Bee and Star Kist, from 1962 to the end of the 20th century, they provided employment to thousands in the area, many of them in the neighborhood known as El Maní, on the north edge of the Mayagüez metropolitan area, also the site of a *Villa Pesquera*. At one time, for example, Star Kist provided employment for 5,000 people. With the changes in 936 tax laws and the development of processing centers with access to cheaper labor outside of the United States, principally in Mexico, Puerto Rico lost its competitive edge. They began phasing back operations in the 1990s, dropping employment levels by over half and finally closing the plants permanently.

Even when the canneries were employing large numbers of people, jobs were often insufficient to meet household expense needs. According to an ex-tuna worker, even after working for Star Kist for over 30 years, he still purchased a taxi to supplement his tuna plant income. Still working at the plant in 2000, making $5.90 per hour, he began feeling more and more certain that his job would be lost, sending him into unemployment and the ranks of those performing *chiripas* (odd jobs), working in construction, scavenging aluminum and other recyclable materials, and so forth. He mentioned that El Maní, with layoffs in tuna combined with similar downturns in the textile industry, had become a neighborhood where unemployment was high and where people mixed these activities with collecting welfare payments, drug dealing, and other methods of surviving.

II.c. Recreational, Sport, and Charter Boat Fishing in Puerto Rico

Section II.f. above described the contemporary recreational fishery in Puerto Rico, including its links to tourism and the growing importance of charter boat fishing. Here we place this in as much historical perspective as possible, keeping in mind that information on the history of Puerto Rican fishing has not received the same amount of attention as commercial fishing. This is partially due to the paucity of research funding for recreational fisheries until the late 1970s.

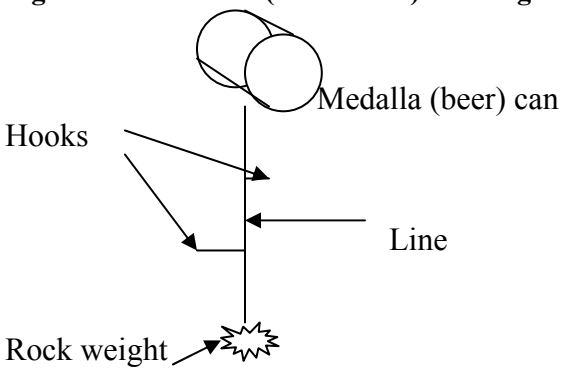
Historically, recreational fishing has occupied an interesting, intermediate kind of position in Puerto Rican fishing. On the one hand, many Puerto Rican recreational fishers interviewed over the years have stated that their principal motive for fishing has been to provide food for their families; on the other, many of the locations and activities of recreational fishing are the same locations and activities of the rich. Thus recreational fishing has long been intertwined with subsistence fishing, associated with the hungry and poor in Puerto Rico, as well as with the sailing, yachting, boating, marina crowds whose high levels of conspicuous consumption have been prominently displayed in ports throughout the Caribbean for many years.

This history of recreational fishing in Puerto Rico, however, has been poorly documented. Jarvis, we noted above, lamented the lack of a well developed charter boat industry, but seems to have paid little attention to casual recreational or subsistence fishing activities. In addition, as just noted, the National Marine Fisheries Service paid little attention to saltwater recreational fishing until the 1970s, in Puerto Rico and elsewhere. Yet in the late 1980s, NMFS funded two related studies on recreational fishing in Puerto Rico and the U.S. Virgin Islands: a survey of recreational fishers and an inventory of recreational fishing infrastructure (Griffith, et al. 1988; Valdes Pizzini, et al. 1988).

These studies found great regional variation in recreational fishing across the islands of Puerto Rico, with some areas (e.g. Fajardo) possessing virtually all kinds of recreational fishing services and types of recreational fishers (professional/ charter, boat, shore, fishing club members and non-members, etc.), others with medium levels of recreational fishing development (e.g. Salinas), and still others possessing few recreational sites and attracting few recreational fishers (e.g. Camuy). Other important findings were that marine recreational fishing facilities in Puerto Rico were inadequate to meet the demand for recreational fishing, that small-scale commercial fishers assisted 40% of recreational fishers (usually through bait sales), and that the charter boat industry outside of San Juan was poorly developed. In some cases, informal charter services had emerged, technically illegal, to meet the demand, but these generally operated irregularly.

The studies also found that a large proportion, around 45%, consume 100% of the fish they catch, while slightly more than a quarter of recreational fishers sell some of their catch and that the proportion of fishers who consume 100% of their catch decreases with age. This suggests that recreational fishing in the 1980s was an important source of income, both as a food for the family and as a source of cash through fish sales. It also suggests that as recreational fishers age, they are more likely to explore different methods of disposing of their catch: selling it and giving it away as well as consuming it themselves. The studies also found that the most popular fish pursued among recreational fishers were meat fish (e.g. snapper, grouper) rather than sport fish (e.g. tarpon, marlin), adding some weight to the connection between subsistence fishing and recreational fishing. That 71.6% fished with handlines (among other gear) also suggests that many recreational fishing used low-level technologies that required little financial investment. Such gear are still in use today, as the following illustration, seen in Barceloneta in the summer of 2005, shows:

Figure II.3. Medalla (Local Beer) Can Rig Used by Fisher at La Boca, Barceloneta



As with other studies of recreational and sport fishing, these studies found differences between club and non-club members in terms of their fishing activities and other characteristics. Members of *Clubes Nauticos* (about one-third of those surveyed) were more likely, for example, to participate in tournament fishing. We also know from other sources that club members are often involved in political disputes over access to marine resources, as in the case chronicled in Griffith and Valdés Pizzini (2002), when a recreational fishing club in Vega Baja becomes involved in a dispute over a ramp.

II.d. Recent History and Continuing Links between Fishing and Other Occupations

Since the decline of the sugar industry in Puerto Rico, fishing has undergone changes vis-à-vis its relationship to other sectors of the economy and has witnessed, as well, internal changes such as changing fishing styles, gear varieties, and so forth. Despite state investment in fishing, few fishers in Puerto Rico use fishing as their sole source of income throughout their lives. Building from the findings of Guitirrez, et al (1985) that over 90% of fishers have worked in other occupations at some point in their lives, Griffith and Valdés Pizzini examined the movement between fishing and other kinds of work in their recent work (2002). Their work shows that most fishers, through the course of their lives, supplement fishing incomes with work in other sectors of the Puerto Rican and mainland U.S. economies, including sugar cane production, migrating to the U.S. mainland for agricultural work, working in Puerto Rico's 936 companies or factories on the U.S. mainland, or taking part-time, seasonal jobs in construction and public works. At the same time, they are careful to point out that fishing is an area of the economy and of their lives that they return to again and again, finding it both a source of income and identity and a kind of therapy.

This is in line with Guitsi's work in Loíza mentioned earlier, where fishing was part of a complex of coastal occupations that became most important during dead time in the sugar industry. Since the demise of the sugar industry, beginning around the mid-20th century, the range of occupational alternatives facing Puerto Rican fishers has changed and has, we argue, contributed to changing fishing styles and gear types. One of the principal occupational alternatives that emerged during the last days of sugar was migrant agricultural work on the U.S. mainland, principally in the Northeastern United States. As early as 1946, a labor contracting organization, Glassboro Services, was founded specifically to recruit and place Puerto Rican labor in agriculture in New Jersey and other states in the Northeast (Griffith and Kissam, et al. 1995). Joining forces with the Puerto Rican Department of Labor, over the next twenty years Glassboro

and other labor contractors managed to recruit and place thousands of Puerto Rican workers throughout U.S. agriculture; by 1970, however, the numbers began to decline, from 18,884 in 1970 to around 2,500 twenty years later.

Fishers were part of this migration. Fishers interviewed in the Griffith and Valdés Pizzini study told of life histories that first combined sugar with fishing, later combined migration to the U.S. mainland for agricultural work with fishing, and still later, as manufacturing, construction, and public works spending increased in Puerto Rico, combined work in these sectors with fishing. During the latter part of the 20th century, as these broader economic changes were taking place, shifts in gear use were taking place within fisheries. Specifically, traps were becoming increasingly less and less common of a gear type, although it is difficult to link this specifically to broader economic changes. Declines in trap fishing have been due to a variety of sources, including problems with losing traps due to weather or other factors, having traps stolen, the time and monetary costs of trap construction as opposed to other gear, and problems with storing traps while leaving fishing to work in the wage labor sector. These last two problems with trap fishing may account for their declines in tandem with increasing migration to the U.S. mainland and with increasing participation in wage labor generally. That is, compared to other gear, the start-up time with trap fishing is longer than that of other gear, as traps often need to be constructed or cleaned prior to use and need to be stored during idle periods.

As traps have declined, two other gear varieties have risen in importance: nets (especially gill and trammel nets), and diving with SCUBA gear (Matos 1997; Valdés Pizzini, et al. 1992). Although cast nets and beach seines have been important since Puerto Rico was a Spanish colony, and perhaps even prehistorically (see Valdés 1987), gill and trammel nets did not become popular until after World War II. Prior to this time their use was irregular and often the source of user conflicts, in part because they were typically used in river mouths and near-shore environments, where crowding led to their interfering with hook-and-line rigs and other gear (Valdés Pizzini, et al. 1992). As the fishing fleet became motorized after the war, and more fishing territories were accessible, crowding became less of a problem and stationary nets increased. From 1930 to 1970, the number of nets in Puerto Rico doubled, but from 1970 to 1990, the number tripled, with government sources counting record highs of 708 gill nets and 507 trammel nets in 1990 (ibid.). Later that decade, Matos counted 1,385 gill nets and 861 trammel nets, showing yet more dramatic increases in the first five to six years of the 1990s. They remain important gear today.

Among the most noticeable changes that has taken place in the past two decades, however, has been the increase in the use of SCUBA equipment, a development that has been a source of particular dismay among trap fishers and that has contributed to the continuing decline of trap fishing. Matos found that, between 1988 and 1995-96, SCUBA divers increased from under 20% of commercial fishers to over one-third, or 36%, essentially doubling their numbers. While many fishers specialize in diving, it has become more common for fishers to sift diving equipment into their other gear varieties, in line with the mulitgear character of Puerto Rican fishing in general (Griffith and Valdés Pizzini 2002). It is possible, for example, to dive while soaking other gear such as nets, and diving allows more targeted catch as well as the catch of highly desired species—lobster and conch in particular.

CULTURAL SIGNIFICANCE OF FISHING IN PUERTO RICO

III.a. Identity and the Festivity of the Virgen del Carmen, Patron Saint of Fishers

Pfizer is one of the largest pharmaceutical companies in the world and the producer of the popular drug Viagra, the bread and butter of their plant in Barceloneta, on Puerto Rico's north coast. It is also the only pharmaceutical company in the top hundred spenders in advertisement for the Hispanic market in the United States. Despite its great run in Puerto Rico, Pfizer will leave the island soon, looking for a more profitable venue. Yet even now, on the eve of their departure, the company continues to pour television ads underscoring Pfizer's role in the health of the Puerto Ricans, highlighting the quality of life in the island. One of their ads begins with the archetypical image of the islands' fishers: two men with naked chests carrying a pole heavy with fish against the background of a beautiful sunset. They are not alone. The number of ads using a fisher or fishers as an essential leitmotif is countless. Medalla, the local light beer (whose cans are often used by hand line fishers in their rigs—see figure II.3), is one of the companies that appropriates the image of the fishermen to incorporate them into the visual lure of the good life, life in the context of nature.

The reasons for this are unknown, but we speculate that fishers are among the last users of the environment, those humans still making a living in full contact with nature. In the eyes of many people living in postindustrial societies, that is both virtuous and desirable. Despite government efforts to relocate them, a good number of fishermen (and their communities) still inhabit the marginal areas of the mangrove forests, close to the water and the cays used for their subsistence. That aspect of the poor life of the fishers was desired by the upper classes that started to move to the coastal areas or bought second homes in that area. La Parguera is a text book case of how fishers were removed from the water only to find their former space illegally occupied by upper and middle class individuals (Llanes 2000), eager to live the lives of fishers, in close contact with the sea.

After the demise of the sugar cane industry and the collapse of many local crops, the number of people with an employment linked to the earth and the environment dwindled. However, agriculture left a sour taste in the mouth of the Puerto Rican workers who found themselves bitterly exploited in the sugar cane industry (see Steward et al 1950, Giusti 1994) or quickly abandoning the poor working conditions of the coffee plantations. In fact, as we write this report, volunteers are urged to help in the harvest of coffee beans, since there is scarcity of workers, some of which were recruited in the past from the Dominican Republic (see Pascual Morán and Figueroa 2000). Fishers thus remain as a class of workers whose days are spent in contact with nature, jointly working and deriving pleasure through the notion of fishing and the sea as therapy (see Griffith and Valdés Pizzini 2002). Fishers are also among the few people without bosses, living the life that they want, and, apparently, the life that other people want. Some fishers we interviewed were in fact recreational fishers posing as the real thing. We suspect that a number of people we interviewed over the last 15 years were in fact recreational fishers, dressed as commercial fishers and occupying the space of the former: *Villas Pesqueras*, their lockers, their social clubs, their seafood markets and restaurants, their piers.

In Ponce's La Guancha, for example, most of the fishing association members are part-time fishers providing a range of services to the heavy recreational fishing, boating, sunbathing, and tourist traffic that visit its facilities every weekend. Fishers here have partially domesticated a school of *sabalo* (tarpon) that tourists can feed with fish that the association members provide. A second association in Ponce, La Playa, is also composed of a mix of full-time and part-time fishers, and they have memorialized the

fishing tradition with elaborate mosaic steps leading into the bay. Written in colorful tile, flanked by larger memorials of the Virgen del Carmen and tiled vessels made of concrete, these steps outline the history of La Playa, emphasizing its ties to the sea, and portray the faces and names of fishers from the community.

Through such activities and memorials, fishers have been a vehicle for the revival and revision of old traditions and festivities in the coastal zone. In the late seventies, a local real estate broker decided to develop the Fish Festival in the municipality of Puerto Real, Cabo Rojo. Together with local entrepreneurs and local people committed to the betterment of their community, they "created" the *Festival del Pescao* (Seafood Festival) as a major festivity during Lent, prior to the Holy Week. This is the period of the year when Puerto Ricans consume great quantities of fish to adhere to the long-standing Catholic tradition of fasting and the prohibitions of eating meat. Although the religious character of this tradition is no longer of primary importance, the custom of buying and eating fish remains a powerful force driving the market.

In Cabo Rojo, the original idea was to congregate a large number of people from the region and the island in a major festivity using as an attraction the best Puerto Rican artists and a myriad of craftsmen and kiosks with food and fish.[10] Fishers worked very hard to bring the rarest species including a plethora of sharks and rays to show to the visitors. The assemblage of dead sea fauna was the main attraction, as large crowds surrounded the large tables with the sea critters. Everyone asked the presenter, a member of one of the key fisher families, to state the name of the animal, to open its mouth, and show it again and again. At the end of the day, the creatures went back to the large freezer of the biggest fish-house that was one of the sponsors of the event.

With improved roads, travel from San Juan to Cabo Rojo had been reduced to two and a half hours. Local entrepreneurs believed that the festival could attract more visitors as well as potential buyers in an increasing second home market. The Festival del Pescao grew into a well-oiled machine and a very successful activity drawing thousands of people every year, disrupting the quiet life of the community for a full weekend in the month of March. Business for the sponsors boomed, and the number of people from the San Juan Metropolitan Area buying properties also increased. In 1986, Cabo Rojo's main realtor became realtor of the year for Puerto Rico, an amazing feat for anyone living in a coastal municipality 80 miles from San Juan. The festival fever swept through the region and the island, as other communities started their own festivals devoted to land crabs, or *jueyes* (*Cardisoma guanhumi*); *chirpe* (*Mercenaria mercenaria*); blue crabs, or *cocolías*; and mangrove oysters (*Crassostrea rhizophorae*), as was the case of Boquerón, also in Cabo Rojo, and home to the most important real-estate broker.

It was in the early 1980's when the coastal communities started to show the early signs of change in the configuration of the settlements, as middle and upper class families started to move in or buy houses from the local people to fix them as second or vacation homes. Condominiums also started to appear in a landscape painted with salt flats, salt works, abandoned cane fields, pastures with a handful of cattle, dilapidated houses, and poor *parcelas* (Valdés Pizzini et al 2006). Gentrification was indeed about to become a pervasive social and economic process in the coastal landscape of Puerto Rico (Valdés Pizzini 2001).

Coastal communities were rapidly changing, and the old way of life based on fishing, maritime occupations, and coastal activities was fading away. However, coastal communities remained active in

[10] Interview with Luis Acosta Doitteau, Cabo Rojo, 1983.

underscoring their own importance and fueling, revitalizing, and revising their traditions. Some of these traditions had a linkage with the long history of the community of maritime laborers in which fishing had an important role. During fieldwork for the fishing community profiles, our team members had the opportunity of attending the celebration of the Virgen del Carmen (Virgin of Mt. Carmelo), which is on the second Sunday of July. This is a traditional celebration of fishing communities, as this particular Virgin is the patron saint of fishers. It derives from the fishing and maritime tradition of Spain, and it was brought to the New World, incorporated into the local practices, and stimulated by the representatives of the Catholic Church. Marian cults devoted to the Virgin Mary have been popular in the Mediterranean for hundreds of years (Wallace 1963). The cults of the Virgen del Carmen, St. Peter, also a fishers' saint, and St. Telmo, patron saint of sailors and mariners, have been an essential component of maritime communities throughout that region.

A recent manifestation of the festivity in the community of Palamós in Catalonia, Spain, reveals some key aspects of the cult (Grassot and Martí 2001).[11] The commemoration of the Virgen del Carmen, the Mother of God, is an old tradition that was disseminated in the Mediterranean in the XIV century, after the arrival of the Carmelite order. It is called the Mother of God because the image is carrying the infant Jesus. In the 18th century the festival became an essential component of maritime communities, and was well entrenched in the local culture at the time that the Gremio de la Gente de Mar (the Seamen' Guild) was established by Phillip II. The Guild was the organization that structured maritime occupations and also gave rights to those workers to fish in the water using their vessels. The Guild provided the Spanish Navy with a substantial amount of technical support throughout the myriad of maritime occupations, without having to recruit and pay those involved in this collaboration. In exchange, they could fish freely in Spanish waters. Members of the Guild and the brotherhoods of fishers (in Catalonia they were called *confrarías*[12] followed the cult of the Virgen del Carmen as part of their religious belief of having a saint protect them from the perils and risks of facing the open sea.

The celebration has a secular and a religious component. The religious component is characterized by a mass followed by a procession that carries the image of the Virgin through the streets of the town and into the fishermen's area; afterwards, the statue is taken in the largest boat in a procession in the nearby waters. In the past the image was carried in a large fishing boat with sails, most likely a sloop used to trawl the net called the *bos*. Today, the image is carried in a large traditional sailboat instead of a working vessel devoted to the use of longlines, traps, or nets. The local priest leads the procession, along with members of the *confraría* and their families. The bearers of the image and the followers belonging to religious organizations and groups are dressed in the uniforms of their organization. Often the bearers are dressed as sailors in the Navy. During the dictatorship of Francisco Franco, the fascist leader encouraged these festivities, insisting that the participation of the military become a crucial component. This wasn't difficult: since the XVIII century, the celebration of the Virgen del Carmen has been associated with the Spanish Navy and the Gremio de la Gente de Mar.

The secular portion consists of music, dance, and songs after the procession, or in some cases through the days prior to the procession. In the case of Palamós, the fishers and their *confraría* occupy the center of the event—its protagonists. In fact, by opening the event to the public, the people at large participate in commemorating the working space of fishing. During the procession, fishers allow a large number of people to come to the building of the "*confraría*," walk in the esplanade and the landing area, and ride in

[11] Our Catalonian colleagues Joan Lluís Allegret and Miquel Martí were kind enough to provide the information discussed here about the commemoration of La Verge del Carme de Palamós.
[12] *Confrarias* or *cofradías* became the equivalent of fishermen cooperatives and associations in the Mediterranean.

their boats during the procession. Grassot and Martí (2001) cite a number of sources and descriptions of the activity in previous years that, jointly with the wealth of photographs, give the reader an idea of the magnitude of this event. The depictions emphasize the "extraordinary phenomenon" of the procession in the bay, marked with an "unchallenged beauty and elegance." The gallant and beautiful dresses of the people, the flowers used in the procession, the flags and ribbons, and the movement and rhythm of the vessels—all mark the movement and atmosphere of festivity. It is a day in which the space of labor is transformed into a space of feast (2001:25). The multitude, the crowded vessels in the bay, and the almost haphazard and hasty manner in which the procession moves out into the sea gives the observer the impression of a buzzing activity, filled with life, faith, and enthusiasm (2001:26).

Palamós is an important harbor and landing center in the Costa Brava of the Mediterranean Sea. Costa Brava is also an important tourist area, experiencing the common demographic trend of increased population in the coastal zone. Catalonia has a vibrant fishing sector employing more than 6,000 people. Although in the past fishers were considered a marginal group, they are not anymore due to their identity as an occupational group who work in constant contact with nature, and have a unique way of life, as heir of a tradition kept alive after many generations (Allegret and Martí 2001:20). All fishers are not devoted to that activity on a full-time basis, since most depend on other agricultural and service work to maintain a decent living. Catalonian fisheries, similar to our conceptualization of the Puerto Rican fisheries (see Griffith and Valdés Pizzini 2002), serve as a "labor refuge in times of crisis" (Allegret and Martí 2001:20). For Allegret and Martí, Catalonian fishermen are an essential component of the identity of that country, and carriers of important traditions. Fishing techniques, *confrarias*, festivities, and the language are part of that legacy. As in Puerto Rico, a relatively small number of workers are still fishers, and fishing remains a minority occupation in one of Spain's most advanced economies. [13] In some communities, fishing constitutes but a fraction of the economic activity. But in all coastal communities, the festivity of *La Verge del Carme* is the way in which fishers highlight the importance of their way of life and underscore the fact that they belong to a community of people with an identity of their own (Grassot and Martí 2001:18). In that sense, Grassot and Martí argue, the procession becomes a symbolic trajectory through "the village" and the festivity a collective endeavor, in which their own space of labor becomes a space filled with joy. The calendar marks an important date for the fishers, as well as for the rest of the community (2001:18).

In Puerto Rico, the festival was associated with brotherhoods and those related to maritime occupations since the XVIII century. Mulattoes were in charge of the festivity of the Virgen del Carmen, and it is possible that by 1796, the date when the new regulations of the Guild came into effect, the festival was well integrated into the liturgical calendar of this particular group. Unfortunately, little is known about the incorporation of the liturgical cycle of commemorations and festivities and the process of labor in Puerto Rico. However, Fernando Picó in his book Libertad y Servidumbre (1979), on the structure of agricultural labor in the highlands in the nineteenth century, reveals the well oiled machine of the Catholic Church and the many ways in which the liturgical calendar was synchronized with the production cycle in forests and small farms. Picó matches the key dates in the liturgical calendar with the cycle of coffee production and the subsistence plots. The cycle is thus divided into the Christological and the Saints. The former covers the period from Christmas (December) to Corpus Christi (June), while the latter starts with John the Baptist (June 23), who is the patron saint of the island of San Juan, the original name of the island of Puerto Rico. The difficult times of the heavy rains and the hurricanes are covered by the adoration of the saints and the festivities of the Marian cults. Some of the manifestations of the

[13] We are considering Spain as a country formed by other countries and "autonomous governments," such as Catalonia.

Virgin Mary that are the focus of these festivities are Carmen, Asunción, Monserrate, and Rosario (Picó 1979:135). Natural events, diseases, floods, and loss of income and savings characterize the period. In the coastal areas, it is also the times of hurricanes and floods in the wetlands, and the end of the sugar cane harvest, with the advent of "*la bruja*" ("the witch") or "death period" on the plantations. In Picó's view, the saints and the Virgin accompanied rural folk into the months of despair, filled with uncertainty, tragedy, and hunger. They were the arbiters between the poor and the weather, between the poor and the oppression of the landholders. Religious festivities associated with the cult of the Virgen María and the saints started after Corpus Christi and were prevalent throughout the rainy season. These *fiestas de devoción* (festivities of devotion) for the saints and the Virgin, carried by brotherhoods and guilds, as well as by other religious groups, were prominent during the period.

That is, as well, the spatial and temporal context of the festivity of La Virgen del Carmen. Statues of the Virgen are ubiquitous around Puerto Rico's coast. In many coastal communities, people repeat a similar tale: that the statue was beached in their community, or survived a shipwreck in other versions, and was carried ashore to be placed in an sanctuary in order to adore her and thank her for saving the lives of the mariners and fishers.

The work of religious historian Arturo Dávila provides some insight to the historical trajectory of the cult in Puerto Rico. According to Dávila, the local tradition is as old as the sixteen century and quickly found its expression in local brotherhoods (*cofradías*) engaged in a number of rites. An inventory of churches in the nineteenth century finds only a handful of churches that do not have an image of the Virgin. The expansion of new townships (municipios) in the coast also saw a dramatic expansion of the cult from 1850 to 1898, as documented for Naguabo (east coast), Arecibo, Barceloneta, Palo Seco and Cataño (north coast), Ponce Playa (south coast), among others (Dávila 1982). Most notably, in many coastal towns, the Virgen del Carmen replaced the patron saint in key local festivities, soon to become dominated by the procession along the coast and the other associated activities. For example, in Vieques, the saint Santiago and the Immaculate Conception gave way to the Virgen del Carmen in a celebration that lasted one full month. Other towns like Arroyo and Guayama experienced the same process. According to Dávila, Guayama has a small settlement named Carmen from which the dwellers engage in a procession with the image of the Virgen, in a pilgrimage to the main church in town.[14]

Dávila does not make the connection between the adoration of the Virgen del Carmen and the Seamen's Guild. However, the information he provides from his analysis of the documents suggest that members of the guild were indeed involved or at least related to the cult in more than one way. Dávila describes the participants of the cult as "artisans, bearers of small occupations, workers involved in the rough occupations of the sea, and the harbors" (Dávila 1987:12). That list covers those who might be involved in one way or another in the guild, and thus its connection with fishing in the nineteenth century. The "congregations" and brotherhoods were composed throughout the West Indies by "people of color" and, apparently, these brotherhoods had a similar composition in Puerto Rico. In 1860 a new *cofradía* was born: *los caleteros* (stevedores) in the city of San Juan, composed by mulattoes (*morenos*) following the cult of the Virgen del Carmen with an image brought from Barcelona, in Catalonia, that remains in the San Juan Cathedral (1987:15). Dávila does not describe the festivities but provides information that allows us to speculate on the magnitude of the event. Members of the working class, living in a poor quarter of the city (San Francisco), the brotherhood was nevertheless powerful enough to have its own

[14] Dávila also documents the pervasive character of the festivity in other areas of the island, including highland towns where the cult is strong and has produced a local iconography of wooden carvings and the importation of images from Catalonia.

chapel in the old San Francisco Church, with an image bought in Spain from one of the renowned artisans of Barcelona. Devotion must have been great, as well as the socioeconomic strength of the group. We don't have more information, except that their activities (presumably processions in the bay) were also similar to those of their counterparts in Cataño and Palo Seco, across the bay.

Two additional speculations are provided here before moving to other aspects of the cult, including the ethnographic descriptions of the procession during our fieldwork. First, stevedores became an important group around the turn of the 20th century and eventually became members of one of the most powerful labor unions in the island: Unión de Trabajadores de los Muelles, who played a critical role in labor disputes in the 1930's. Second, San Juan also had a rich maritime tradition in which mulattoes presumably had an important role. One of the key entrepreneurs in the maritime sector in the eighteenth century was Don Miguel Henríquez, who dominated the trade in the latter part of the century. This linkage between ethnicity, locality, and maritime occupation must have had an impact in the cultural manifestations of the cult and its members' identity.

Puerto Real, which is in the municipality of Cabo Rojo, was one of the sites visited by our team working in the profile of fishing communities. The trajectory of the cult of the Virgen del Carmen in that community has been documented elsewhere (Valdés Pizzini 1985, 2006 forthcoming). A handful of facts are important here. The community was embedded in the structure of the Seamen's Guild in the nineteenth century (see also Ramos Ramírez and Acosta 1984). The harbor was the hub of maritime activities in the region and then an important fishing center with members of the Guild. The festivity and cult were well structured from 1920 to 1950, as stated by various informants we interviewed in the 1980's. As in Catalonia, the festivity had both secular and religious components. During the secular phase, which lasted a week, dance, music, food, and drinks enlivened in the streets of Puerto Real. Houses were decorated with bright-colored ribbons and flowers. They tried to bring the best artists with the help of the fish dealers. Fishers and their families participated in the event in many ways, including the procession. On the Sunday of the celebration, the town's priest came into town to give mass, bless the image, and lead the procession to the harbor. From the harbor, the fleet engaged in a roundabout on the bay following the largest vessel, which carried the image, its bearers, and the flower offerings. The image was then returned ashore and taken back to the chapel. The secular festivity continued throughout the day, and in the evening all the activities ended.[15]

In the 1930's, when the community was engaged in an aggressive expansion of the fleet and there was an increased capitalization of the fleets and the proletarianization of the labor force, the fishermen remained aloof from the cult. The activity continued, nevertheless, with the devotion of the local women and members of the Catholic Church who kept the tradition alive. Puerto Real was also changing as Puerto Ricans became more detached from the Church in the 1960's and 1970's. Catholicism lost ground to other sects, such as Pentecostalism and Protestantism. Apathy, secular orientations, and other religious alternatives eroded the old traditions in Puerto Real.

However, in the 1980's, the cult remained active. Despite minor participation from the fishers, it was nevertheless an important component of their culture, as its followers claim that it was an important part of their identity as members of coastal communities. In fact, the activity started to be appropriated by non-fishers who were linked with fishing through kinship and affinity. It was those community members who revived the secular portion of the festivity, with the Festival del Pescao. In fact, by design, they

[15] We describe similar processions that we observed during the summer of 2004 in Mayagüez in the Western Metro regional profile below.

separated the sacred and the profane and moved the profane portion of the cult to yet another timeline in the liturgical cycle: Lent. It substituted the popular carnivals and festivities prior to the Holy Week, and provided a venue for the selling of fish and foodstuffs in the community. Both events remained separated, and no linkage between them was attempted by community members. In our view, fishing provided cultural substance to the identity of the rest of the community members, a membership that was underscored in the festivity of the Virgen del Carmen. The old fisher families continue to promote the cult, as evidenced every year.

It is possible to argue that fishers throughout the shoreline of Puerto Rico are conscious of the importance of the cult in reaffirming their identity and emphasizing the importance of coastal peoples and fishing as a unique way of life. Aguadilla, for example, has been an important landing center and a locale of members of the Seaman's Guild since early in the nineteenth century (see Torres 1967). Three photographs and a leaflet from the festivity of 1916 show a large amount of people in the harbor during the celebration. The Virgen del Carmen is dubbed as the patron saint of sailors, and one of the surviving photos has a caption that indicates that the priest (probably Basque) and the town policeman were heading the procession, accompanied by a crowd of followers.

Nestor Rodríguez Escudero, a writer from Aguadilla, wrote a brief account of the event in which the fishermen are not mentioned but sailors are. Apparently, the festivity in Aguadilla was embedded in the local maritime culture of stevedores and workers serving the busy harbor, which handled the goods for the local companies as well as the vast amount of sugar exported from the Coloso sugar central mill in Aguada. The landscape and seascape he depicts is filled with steam boats, workers, and sailboats carrying salt, coconuts and cargo from other harbors in the island. The shore was buzzing with economic activity and filled with dark, barefoot, muscled men. These same men took the image of the Virgen del Carmen and carried it from the church to one of the warehouses in the harbor in a procession followed by devotees and people from town on the Saturday afternoon. Devotees remained singing and praying until the morning where the image was transported to a *barcaza* (barge) used for cargo but adorned with wild flowers, palm leaves, and bloomed branches of *flamboyán* (royal poinciana). The *barcaza* was tugged by a motorboat that led the seaborne procession of small boats.

We give credit to Rodríguez Escudero's description, as he was a well versed writer in the life and times of the local fishermen. He knew them well, and had direct contact with their livelihood. He also knew the customs and whereabouts of the fishers in the region, as presented in his collection of short stories Litoral y otros cuentos (1962), one of few Puerto Rican literary narratives devoted to fishers and people of maritime occupations. While Rodríguez Escudero described that particular festivity, it may be that other fishermen locations in the town of Aguadilla had their own festivity, as it is evident in other towns of the island, such as Mayagüez. In his stories he described the importance of la Virgen del Carmen in the lore of the fishermen, and thus knew well the importance of the cult among them.

A recent description in an English newspaper on the history of the Aguadilla celebration reveals many of the well structured patterns of narratives, processes, and origins of the celebration, as documented here. The timing of the resurgence of these traditions is specific to the localities; however, they appear to have been gaining in popularity over the last 30 years. This may be related to an interest in revitalizing traditions in the face of change in the coastal zone. A few newspaper quotes speak to the endurance of the tradition:

> "She is a dainty figure with a serene expression. But boy, can she ride the rouge seas. The fishermen of Aguadilla will hail their protector this weekend in the patron saint

> celebration of Virgen del Carmen, the woman who guides them safely to and from the high seas after a night of fishing.
>
> And unlike the usual drunken Saturnalia that patron saint celebrations have turned into, this three-day fete has little, if any, party-hardy purpose.
>
> There is only one artistic act –Los Pleneros de Ponce—and that takes place Saturday afternoon in Aguadilla's Barrio Higuey.
>
> Other than that, fishermen, their families and the overall townsfolk take great seriousness in honoring la Virgen del Carmen. The celebration dates back to 1886, according to Professor Alba Martínez of the University of Puerto Rico's Aguadilla campus.
>
> The boat of seaman Jorge el Griego capsized while trying to enter Aguadilla Bay and he desperately invoked la Virgen del Carmen for protection. He was spared.
>
> In gratitude he raised money among his fellow sailors in Aguadilla's Barrio Tamarindo and donated the money before an altar with the image of the virgin.
>
> Fervent followers took great care in keeping with the religious ceremony during the July celebration and held many masses and processions with statues of the virgin.
>
> According to Martínez, it was Elisa Carracosa de Amel, a devout follower of the virgin and the wife of a wealthy Aguadilla merchant who brought an image of the virgin from Barcelona and donated it to the Aguadilla Church, where it still stands.
>
> By 1917, the celebration included a trek into the Aguadilla Bay. A statue of the virgin was placed on a boat and headed a procession out to sea.
>
> The image was then returned to church. The celebration waned after the 1940s Aguadilla's maritime commerce became important.
>
> Yet there has been a resurgence lately, now the celebration takes place not only in heart of Aguadilla but in its seaside bay Tamarindo, Playuela and Higuey. Member each community hold their own celebration join in the colorful procession out to sea, when dozens of fishing vessels accompany the ness of the virgin out and into the bay."[16]

Aguadilla fishermen, like many others, remember specific events in their lifetime in which they were in danger and had no other option than to invoke the Virgen del Carmen. Such is the history told by Felix Morales Blas to a journalist in the San Juan Star a few years ago. Morales is also one of the most important boat builders and artisans of the west coast (see López 2004) and one of the leaders of the fishermen in the west coast of Puerto Rico, and his crafts are emblematic of West Coast *yolas* (fishing skiffs)—as colorful as they are cultural, descending from a tradition as rich as the festival of the Virgen del Carmen.

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[16] Melba Ferrer, Aguadilla to hail Virgen del Carmen: Century-old festival regaining popularity. The San Juan Star, Thursday July 89, 2000.

III.b. The Cultural Significance of Fish in the Puerto Rican Diet

While the Virgen of Carmen celebrations collect together masses of people every year to honor the cultural significance of fishing, a less spectacular but perhaps more important role of fish in Puerto Rican and Caribbean cultural has to do with its place in the Puerto Rican diet. We have already noted that fish are particularly important among Catholics during Lent, and our interviews with fishers about their marketing practices confirm that this is one of their most brisk seasons for seafood sales, contrasting it in particular with the Christmas season, when the tradition of consuming large amounts of pork cuts into their sales. Outside of religious festivities and celebrations, however, fish have been important and culturally significant in Puerto Rican diets since the early days of European colonization.[17] We noted above that Price (1966) argued that fish and fishing were important components of diets of propertied classes, and that the indentured servants and slaves who provided fish to their tables were given freedoms unknown to most of their peers.

More importantly historically and today, however, was the trade in dried and salted fish that accompanied the growth of slavery across the Caribbean.[18] Salted cod from the large fisheries of New England and Canada was an important imported good during the plantation era, when cheap sources of protein were necessary to feed a growing enslaved population (Vickers 1994; Wolf 1982). One of the infamous triangles of trade during this period was a route that included Caribbean and southern products such as sugar, tobacco, and cotton traded through Caribbean and southern ports for salted cod from New England which had been traded for salt from the mines at either Cadiz, Spain or Liverpool, England (O'leary 1981). The involvement of the Spanish in this trade, as producers of salt as well as salted fish, inevitably drew Puerto Rico, a Spanish colony, into the trade. These traditions laid the groundwork for a cultural association of fish with work and the working classes of Puerto Rico, at the same time locally caught fresh fish was seen as both a luxury good among the upper classes and as an important source of income and food during dead seasons in coastal agriculture.

Fish in Puerto Rico today continue to invoke these cultural senses: on the one hand a high-priced, luxury food enjoyed by tourists and coastal visitors by the thousands, and on the other a fairly low-cost, high quality protein commonly sold to working people. The ubiquity of lamp-warmed glass cases around Puerto Rico's coast, out of which restaurants and stores sell reasonably priced seafood pastries (of boxfish, shrimp, conch, lobster, shark, etc.), along with fried king mackerel steaks and other fish, attests to the importance of seafood in the diets of working people. These glass cases are often an important component of mobile food stands that set up near factories and other working places where they are frequented by Puerto Ricans from all walks of life.

In these contexts, king mackerel—*sierra*—deserves special attention. Not only is *sierra* served in these settings routinely, generally at a low cost of under $2.00 per steak (4-5ounces), but many fishers we interviewed across Puerto Rico cited *sierra* as one of their most important species, reporting that they leave other fisheries in order to fish for *sierra.* Landings data, however, do not support the fact that it is as important a species as various kinds of snapper, yet the frequency with which fishers mention it as important to them underscores its cultural significance. We suspect that this derives from the role that

[17] Indeed, even prior to European colonization, the Taino who occupied the islands depended heavily on fishing and land crabs for protein, as the Caribbean tends not to have large mammals that might otherwise provide protein.
[18] In Jamaica, a dish known as akee-and-salt fish still uses dried salted cod as one of four ingredients; it is considered one of Jamaica's national dishes.

fishers play in their communities as sources of food for neighbors and others who are, like them, working class people; that they are very cognizant of their positions within the working classes of Puerto Rico has been documented again and again in the literature on Puerto Rico, as well as the fact that they express pride in feeding members of their communities (Benedetti 1995; Griffith and Valdés 2002; Pérez 2005; Volumes II & III, this work)

PUERTO RICAN FISHING COMMUNITIES: A TYPOLOGICAL DISCUSSION WITH REFERENCE TO DEPENDENCE AND ENGAGEMENT

IV.a. Deterritorialized Communities

Early in the 21st century, led primarily by social scientists, NOAA Fisheries funded several studies, including the present one, designed to profile fishing communities around the United States. These profiles have been directed toward two ends: 1) determining how much different coastal communities were dependent on or engaged in commercial, recreational, and subsistence fishing; and 2) predicting, based on measures of dependence and engagement, how new regulations, such as Marine Protected Areas and seasonal closures, would affect fishing livelihoods. Again, as we noted in the executive summary, according to the Magnuson-Stevens Act,

> "Substantially dependent implies that loss of access may lead to some change in the character of the community, perhaps a major change, or may even threaten its existence. Substantially engaged, on the other hand, implies a level of participation in commercial, recreational, or subsistence fisheries that includes social and economic networks that are directly and indirectly associated with these fisheries (such as the harvesting and/or processing sector)" (NOAA, 2004; see, 63 FR 24235, May 1, 1998).

In this work, we pay particular attention to the notion of *community* as it applies to the fishing populations of Puerto Rico. We define a community as a group of people living and working together, exchanging services and goods, who share some common interests while diverging at times according to different class backgrounds, where many also share a common cultural and linguistic background. Communities are social fields, comprised of overlapping networks of kin, neighbors, friends, co-workers, and others who interact with one another regularly. Communities may be place-based, network-based, knowledge-based, or may transcend specific geographic locations, although many community members usually share attachments to a specific place.

As with most social scientific research, addressing the issues surrounding community, dependence, and engagement has produced theoretical, methodological, and other insights that may also be useful to fishers and fishery managers. By-products of these profiles include, for example, describing the ways that fishing families interact with marine ecosystems such as coral reefs, discovering ways that fishing families protect marine environments, and understanding the knowledge base of fishing families and communities and its relationship to marine policy and science.

Paralleling regional fishery management bodies around the country, these profiles have been regional in nature, conforming more or less to the jurisdictions of the councils that develop fishery management plans and other recommendations to regulate fisheries. Beginning from state actions and structured around preexisting state-defined regions, the work of profiling fishing communities became, in several regions, exercises in imagining communities—characterizing and representing natural resource communities that the state assumed were more or less tied to specific geographical locations, places, or regions, as opposed to communities that transcend geographical place and are bound, instead, by common interests, common knowledge bases, occupational or ethnic identity, mobilization around specific crises, events, ceremonies, practices, or other factors.

In Puerto Rico, for example, we were asked to consider how fishing communities were dependent on or engaged with fishing and fishing communities. In reality, however, most coastal communities in Puerto Rico include many people who have little to no involvement in fishing beyond enjoying, at times, local seafood. This is even more the case with coastal municipalities. Municipalities in Puerto Rico, like counties in most of the continental United States, boroughs in Alaska, and parishes in Louisiana, are political units that, in a study such as this, are primarily useful in that many government agencies aggregate data at this level. Yet in all of Puerto Rico's coastal municipalities, the social, economic, and cultural contributions of fishing are entangled in masses of other occupations and activities—hence the title of this report.

NOAA Fisheries' effort to profile fishing communities occurs on the heels of several dislocating processes, social and natural, that have undermined fishing families' attempts to rely on fishing as a way of life. Demographic changes in coastal regions, most happening coincidentally with real estate development and other landscape altering projects (e.g. dredging, beach replenishment, inlet stabilization), which have compromised commercial, recreational, and subsistence fishers' access to marine resources. Gentrification has increased property values, taxes, and the cost of boat storage space while its protagonists often simultaneously press for aesthetic changes to working waterfronts (Griffith 2003). Yet gentrification is a complex process, not always spearheaded by the rich; in La Parguera, for example, Brusi (2003) outlines a process in which working class, fishing families colonized a coastal area as squatters to remain in their community. Seafood imports, particularly of inexpensive cultured shrimp through national supermarket and discount chains, have negatively affected domestic fish markets while sensitizing domestic palates to frozen instead of fresh fish. Destruction, pollution, and suffocation of wetlands, rivers, and oceans have damaged water quality in nursery areas with detrimental consequences to fish and shellfish populations. Finally, overfishing, real and perceived, has stimulated or fueled the efforts of managers and environmentalists to reduce fishing effort, alter gear, create marine protected areas, and redistribute fish stocks among competing fishing groups (most notably commercial and recreational fishermen).

Such processes result, nearly everywhere, in reorganizing communities that were formerly viewed, by residents and visitors, as fishing communities. Places like Gloucester, Massachusetts, home port for large numbers of groundfish fishermen, became destinations for artists, whale-watching companies, and others seeking access to the sea at the same time NOAA implemented measures to cut the number of days at sea in half (Doeringer, Moss, and Terkla 1986; Griffith and Dyer 1996). Across the South Atlantic and Gulf States, former fishing communities like Ocracoke, North Carolina, McClellansville, South Carolina, Brunswick, Georgia, and Cedar Key, Florida, have witnessed immigrations of wealthy seasonal residents and marinas changing from commercial to recreational uses.

Similar dislocating processes are occurring across Latin America and the Caribbean in peasant communities, whose members have been marginalized by neoliberal economic policies such as NAFTA and disrupted from within by emigration. From an anthropological perspective, this is historically relevant, in that the study of peasants, in the 1980s, helped to lift the anthropology of fishing folk out of a period of theoretical stagnation, primarily moving our analyses away from modernization theory and its tendency to embrace neoclassical economics and toward more accurate analyses of fishing families as embedded in household or domestic economies. Durrenberger's studies of shrimpers in Mississippi and Alabama, building on Pollnac's work with Doeringer, Moss, and Terkla (1986) in New England, were particularly notable in focusing on the domestic production of fishing families instead of abstract questions of economic rationality, entrepreneurship, or efficiency. Most importantly, these and other studies pointed to the importance of family in fishing and fishing-support activities (e.g. processing and

marketing) and in such factors as organizing crews, forming and running fishing associations, transmitting knowledge and experience, holding community events such as blessings of the fleet, and political activism. Even as fishing families find themselves surrounded by new, non-fishing residents, or pushed away from coastlines through gentrification and other such processes, ties of family continue to be primary forces in binding people together into communities based on fishing.

In many ways, recent fishery policy developments and social scientific theories about fishing have become more and more cognizant of the importance of placing fishing families and fishing communities into wider social, economic, and cultural fields. That NOAA Fisheries has created and filled several social scientific positions with anthropologists in just the past few years, along with its extensive attempts to define terms such as fishery *dependence* and *engagement,* suggest that policy makers understand the importance of the broader contexts in which fishing takes place. No longer is it possible to develop effective fishery regulations without the active, sustained, and meaningful participation of fishing families; those cases where regulations and enforcement strategies have been developed without significant fisher input, such as those released in March of 2004 in Puerto Rico, have generated opposition, suffered from a lack of legitimacy, and initiated new rounds of policy formulation. Indeed, the response to the new regulations in Puerto Rico were so vehement that DRNA officials agreed to establish an advisory council to evaluate and perhaps rewrite the regulations they developed.

Work on the impacts of fishery regulations has benefited from social scientific work on fishing families and fisheries around the country and the world that elucidate the ways fishers interact with the state,[19] respond to new laws governing access to marine resources, and deal with other developments taking place in coastal environments. Over the past two decades, fisheries social science has shifted from an emphasis on the tragedy of the commons and modernization to more detailed empirical work that has focused on: 1) the importance of fishing households within broader kinship/ ethnic units and fishing communities (including the seasonal or periodic movement between fishing and non-fishing occupations); 2) fishers' uses of locally-defined and managed or folk conservation methods; and 3) traditional or experiential knowledge that fishers possess to determine not only when and where to fish but also to aid in adapting to new developments in the marine or regulatory environments (Acheson 1987; Durrenberger 1995; Durrenberger and King 2000; Maril 1995; McCay 2000; Dyer and McGoodwin 1994; Griffith 1999; Johnson and Griffith 1995a). These interrelated fields of inquiry have influenced recent developments in marine resource management as well as affected our abilities to predict how fishers may respond to new regulations.

One of the underlying assumptions of both the tragedy of the commons and modernization approaches to fisheries was that fishing operations, like capitalist enterprises, were organized to maximize profits or returns on labor, time, and other economic inputs. While it is clear that many fishers desire to catch as much fish as they can, several factors constrain their abilities to maximize their catches and behave as predictably as capitalist firms. First and perhaps foremost is that most fishers do not operate as independent businesspeople, but instead usually as members of fishing households or families and occupational communities. Some of the earliest work that recognized this was done by a team of economists who relied extensively on the work of anthropologists (Doeringer, Moss, and Terkla 1987). Examining New England's groundfishing fleets, they found that many fishers failed to leave fishing even under conditions of declining yields. They concluded that the desire to keep family members employed was at least as important, and often more important, to these families than profit margins, adding that "the

[19] Throughout this report, we utilize the word "state" to refer to any government entity, rather than individual states like Iowa or Maine.

adjustment processes [to declining yields] proved more diverse than capitalist arrangements typical of larger scale enterprises" and that "the family and kinship arrangements in the labor market can motivate effort, loyalty, and flexibility among the work force that are hard to attain under more capitalistic employment relationships" (1987: 127-28).

Building on these observations, Durrenberger (1995) drew upon the literature on peasant farming in Asia and elsewhere, including Chayanov's Theory of Peasant Economy, to argue that the size, composition, and character of fishers' households influence fishing effort, target species, and other interactions with the marine environment.[20] Just as Durrenberger was able to apply peasant studies to the fishers of the U.S. Gulf coast, peasant studies provide a good deal of additional insight into other factors that motivate producers whose production is deeply embedded in family life and cultural tradition. For example, production accomplished under domestic economic relationships is often considered a moral enterprise, especially when conflated with the reproduction of the family's way of life and subsistence security (Scott 1976; Nash 2001; Striffler 2001). During our ethnographic work in Puerto Rico, two days after Puerto Rico's Department of Natural Resources announced its new regulations, in March of 2004, members of our field team visited a prominent fisherman and fish dealer on Puerto Rico's Southwest coast whom we call Miguel.[21] We happened upon him at a good time, while he was waiting for a man from the University of Puerto Rico's Sea Grant College Program to arrive and listen to his opinions about the new regulations. It was a lively time of day for him as well, around eleven in the morning, when fishers who had landed their catches during the night visited to sell him *dorado* (dolphin or mahi mahi), *colrubia* (yellowtail snapper), and *sama* (mutton snapper). His position as a fish dealer, as well as an active fisherman and head of a fishing family, made him especially well-connected to the local fishing associations, the community at large, and to other fishers from neighboring villages and municipalities. Thus his views on the new regulations were particularly interesting to us.

He began by simply saying that the regulations were not designed with fishers in mind, something that fishery scientists on the island later agreed with. Instead of following with a point-by-point critique of the regulations, he instead launched into an oral history of his time on the water and the importance of fishing to his family and his way of life. Miguel had been fishing commercially for 40 years, raising three children from the fruits of this work, training one to follow in his footsteps, and contributing to his broader family's welfare by using his nephews as *proeles* (crew) on his boats. He was, in short, making a moral argument for his claim to fishery resources and using this argument to justify his direct participation in the design and implementation of new regulations over marine resources. He saw commercial fishing as a crucial part of his family and his community, and he mentioned more than once that his interest in preserving the resource for future generations derived directly from the fact that his son and his nephews were taking over the operation from him. His opposition to the new regulations, he was arguing, needed to be considered in the light of the place of fishing in his life and the place of his life in fishing.

Peasant studies also point to the propensity for domestic producers to defend the resources upon which they depend through various means, including working through legal channels, peaceful protest, civil

[20] Working with detailed census data in early 20th century post-revolutionary Russia, Chayanov argued that peasants alter their labor investments in production based on the ratio of consumers to workers in the household. His "drudgery curve" showed that the subjective value that peasants attached to labor rose as the ratio of consumers to workers rose, reaching the equilibrium point when there was one consumer for each worker in the household.

[21] With the exception of public officials, authors, and others who are well-known, the names used throughout this report, for the purposes of confidentiality, are pseudonyms.

disobedience, and violence (Scott 1985; Wolf 1969). Certainly recent events in Vieques illustrate that Puerto Rican fishers are willing to engage in all of these forms of dispute to protect their resources (Griffith and Valdés Pizzini 2002; Benedetti 1997; Fabían Maldanado 2003). The actions of viequenses, however, were only the most noteworthy of instances of civil disobedience among Puerto Ricans protecting coastal and marine resources, and one that extended far beyond the fishing communities of Vieques, eventually drawing most Puerto Ricans into the protest. During our ethnographic research, we encountered many other instances of fishers using various means to protest or inhibit coastal development that threatened nursery areas and their livelihoods. Based on this, we argue here that participation in conflicts over coastal marine resources is a sign of willingness to sacrifice to protect such resources and a reflection of dependence on those resources.

Finally, like peasants, Puerto Rican fishers find themselves, with few exceptions, in subordinate class positions vis-à-vis the dominant and more powerful classes of Puerto Rico, whose capital resources have financed many of those coastal developments that threaten fish stocks and fishing livelihoods. Class relations in Puerto Rico, as elsewhere, however, are complex and rarely merely instrumentalist in nature, with state powers always backing wealthier classes. We noted earlier that Puerto Rico is a highly politicized society, and in this context politicians often take up constituents' causes whether or not constituents can contribute to their political campaigns. This has been a source of power within Puerto Rican fisheries and has at times hastened or altered processes of internal social differentiation or class formation within the fisheries. Nevertheless, fishing families have become differentiated within the fisheries by their relationship to the tourism and other leisure uses of the coast, by their access to the infrastructure of fish marketing (e.g. freezers, marketing structures, marketing relationships, etc.), by their relations with the state, and by their relations among one another.

Within fisheries social science, work paying attention to their domestic economic relations and other peasant-like attributes laid the foundation for expanding the context of fishing to include more than the vessel, gear, species targeted, etc. and consider, for example, relationships among harvesting and processing, non-fishing employment of household members, gear and territory conflicts, and other factors that link fishing families to wider social realms. Such an approach clearly influenced Griffith and Valdés Pizzini in their study of Puerto Rican fishing families (2002). Focusing explicitly on the movement between fishing and non-fishing employment by members of fishing families, they found that networks of interlinked fishing households, often spanning two generations with links through marriage (e.g. fathers-in-law fishing with sons-in-law), were effective in adapting to changes in the marine environment, responding to political and economic developments affecting their access to marine resources, and developing the human capital necessary to shift among different gears, fisheries, and territories.

Others have found that similar networks typically pool traditional and experiential ecological knowledge to develop folk theories about resource changes and, at times, develop folk conservation efforts (Dyer and McGoodwin 1994). The acknowledgement that fishers possess vast stores of knowledge about the marine environment, combined with local conservation efforts, have helped pave the way for fisheries co-management, in part because experiential local knowledge offers some hints about how fishers respond to environmental and other changes in the marine environment. Griffith and Johnson (2003) have found that fishers tend to place their traditional ecological knowledge into larger contexts that include not only natural phenomena such as lunar phases, salinity levels, and wind direction, but also aspects of the social environment, such as regulations on season and area closures. Because of this, learning about fishers' experiential knowledge and perceptions of the marine environment can assist in predicting how fishers are likely to respond to new regulations.

Additional insight into fishers' behaviors and their responses to new regulations comes from biographical work on fishers' lives, such Linda Greenlaw's The Hungry Ocean (1999) or Susan West's Fish House Opera (written with anthropologist Barbara Garritty-Blake—2003). These texts offer emic (insider) perspectives on fishing, as well as knowledge of the marine and social environments that fishers negotiate, that are difficult to glean from typical methods of observing and collecting data in fishing communities. In addition, recent popular texts on fishing and oceans can provide background regarding common ways that fishing and fishing communities are portrayed to the general reading public (Earle 1995; Kurlansky 1997; Safina 1997).

Together, the above observations point to several important methodological considerations, including collecting information on the experiential knowledge that directly influences marine resource use and paying attention to existing conservation methods (even those that fishers may not view explicitly as conservation, as in the case where shifting from one species to another, due primarily to market demands, reduces pressure on one of the species). Clearly, too, these aspects of fishing in Puerto Rico need to be placed within a broader temporal context in order to estimate, based on past experience, how fishers have responded and are likely to respond to MPAs, closures, and other regulations (see Valdés Pizzini 1990).

IV.b. Puerto Rican Fishing Communities

Fishing communities without discernable boundaries—otherwise known as non-place-based communities—are becoming more common in Puerto Rico. As we noted earlier, these can include network-based communities, or those comprised of a number of fishers who work together from specific locations but who live in different neighborhoods or different municipalities, or knowledge-based communities, or communities that consist of fishers and fishing families who possess knowledge about specific fish, fishing grounds, habitats, and other attributes of the marine environment, and who use that knowledge to form cooperative ties.[22]

Despite the presences of other types of fishing communities, the place-based communities that exist serve the entire population of fishers by underscoring the legitimacy of the fishing way of life. Equally important are those fishing associations and other fisher gathering locations, small and large, that provide locations where fishers can discuss issues and problems, share information about marine resources, develop and refine their knowledge bases, and devise strategies to address regulatory, marketing, and other problems. These locations are unevenly distributed across Puerto Rico, varying from region to region according to ecological conditions, government investment in fisheries, relationship to the tourist sector, and trajectories of coastal development (e.g. petrochemical ports, recreational marinas, private resort or condominium construction, etc.). Table II.5, in the introduction to this report, lists the communities and sites we visited during our ethnographic work, including information on those we interviewed as well.

Puerto Rican commercial fishing communities share a number of characteristics that can help us assess the extent to which they may be fishery-engaged or fishery-dependent and, by extension, their susceptibility to shifting regulatory and natural resource environments. Those fishing communities where families consider fishing a central part of their identity and their livelihood are likely to share all the

[22] These cooperative ties can be used for daily survival resulting from the sharing of information or the exchange of goods and services, or they can be used for alliances to challenge the state, other fishing groups, etc. In other words, the cooperation common in knowledge based communities can be either relatively benign or relatively active and heated.

characteristics we discuss below while those communities where fishing, though present, is more marginal to families' identities or livelihoods are likely to include fewer of the characteristics we discuss here. These characteristics are both material and symbolic and their number, density, and quality influence how deeply enmeshed fishing and fishers are with broader social, political, and economic settings. This discussion develops a typology of fishing communities in Puerto Rico while considering the notion of community in light of the concepts of dependence on and engagement with Caribbean marine resources. It draws on the social scientific literature on peasant communities and on more recent writing about non-place-based communities known as diasporas, transnational communities, or transnational social fields.

The literature on peasant communities is relevant for the reasons discussed earlier—their domestic economy, the moral nature of their production, their involvement in conflicts, etc.—but also because peasants depend directly on natural resources. These resources usually consist of land and water but in some cases open access resources such as grazing lands, communal farm lands (e.g. *ejidos* in Mexico) or marine fisheries—yet peasants often have to defend those resources, communally and individually, from encroachment from within and outside their communities. Peasant communities, too, have always been involved in larger social and economic processes that have challenged them to transcend, in a number of ways, whatever parochial tendencies their communities may instill.

Perhaps most important, peasants have been instrumental in social scientific understandings of community, particularly in anthropology but also in fields such as political science and economics, in part due to the importance of the peasant war in Vietnam (Wolf 1969). Anthropological work on closed and open peasant communities, combined with well-known long-term research projects and studies in Asia, Africa, and Latin America (e.g. the Harvard Chiapas project, the Cornell Peru/ Vicos project), enabled understandings of place-based communities with rich civil-religious traditions, distinct cultural identities, and economies that, though often marginal, were tied to specific farm lands, water sources and resources, and other natural resources such as forests, grazing lands, or mineral deposits.

An unfortunate drawback of much of this work was that it ignored peasant interactions with merchants, bureaucrats, soldiers, and others who were not part of their communities, at times portraying these communities with such blinders that they failed to predict major civil insurrections and wars. Few North American anthropologists working in southern Mexico and Central America, for example, had much to say about the forces that led to the particularly bloody civil war in Guatemala in the late 1970s and 1980s, or similar forces underlying the rise of Subcommander Marcos and the Zapatista rebellion in the mid-1990s in Chiapas.

Few anthropologists could be accused of this today, as studies of the social problems that have led to civil wars, refugee and migration flows, class struggle, and other dislocating processes have moved to the center of the social sciences. Once again, peasants and former peasants, as the subjects of social scientific research, may be providing similar theoretical services today as they earlier provided research on fishing folk and our understandings of community. In this case, many people from peasant backgrounds, forced to migrate for work to survive, have been experimenting with new community forms that are only partially tied to specific places. Anthropologists studying migration have called these forms transnational communities or, more recently, transnational social fields (Glick Schiller 1999). This work builds on the idea that communities need not be physically bounded by territory, however much sentimental or symbolic attachments depend on the existence of specific places with familiar characteristics. The fact that Basch, et al. (1994) chose the title Nations Unbound for their seminal statement on transnational social fields highlights this point of departure, just as Glick-Schiller's more recent definition—"social

fields [of] unbounded terrains of interlocking ego-centric networks"—continues to emphasize a people adrift across social space (1999: 97).

As such, one could legitimately ask how these ideas could possibly apply to communities, such as farmers and fishers, that are intimately tied to *places* whose natural environmental conditions and ecological relationships are generally confined to relatively small geographical spaces. We contend that the relevance of transnational theory to such communities derives from recent trends that have forced those who exploit natural resources—fishers, farmers, foresters, pastoralists, and hunters-gatherers—to increasingly reconceptualize their communities as social fields with various kinds of ties to natural resources as well as other social landscapes more or less divorced from natural resources. Our focus here is Puerto Rican fishing communities, but the argument could extend to any group dependent on a circumscribed set of natural resources that has been undergoing changes of the kind we have documented in Puerto Rico (Griffith and Valdés Pizzini 2002). According to a Puerto Rican fisher from the southern coast:

> "The distribution [of where the fishermen live] has changed. They used to live almost exclusively in the barrios right next to the beach, but now they are disseminated among many barrios. Before, all the fishers would live in 'La Playa' (the beach). That is over. The fishing families would all live in the same place, and everybody knew where to find them."

Thus, the literature on transnationalism/diasporas is relevant primarily because of what scholars observing transnational social fields and the behaviors of migrants can tell us about communities with fluid ties to geography. Transnational migrants remain attached, at least sentimentally, for varying amounts of time, to specific places, but their social fields encompass two or more places and engage a wide range of political and economic actors in each setting, including migrants and others who touch and shape their lives. Employers, school teachers, government agency personnel, representatives of justice (from lawyers and clergy to police and sitting judges), merchants, and bankers are a few of the kinds of people whom migrants interact with regularly and who influence their schedules, their ability to communicate with their natal communities, their well-being, and other dimensions of their lives. Similarly, fishers and their families, especially when living in neighborhoods away from the coast, interact with several kinds of people with few ties to marine environments. Ties emanating from these relationships bind them to local government, commerce, and social institutions like churches and may undermine or enhance their ties to marine resources.

In the study of both transnationalism and peasants, attention to the role of the state has always been important. Sending states have capitalized on transnational migrants as sources of remittances and as extensions of sovereignty into the new territories, encouraging their citizens living overseas to gain dual citizenship and advocate for improved international relations between sending and receiving states. Remitted earnings address balance of payments problems, help households meet consumer needs, finance employment in migrants' home communities, pay for education, and are invested directly in community infrastructure (e.g. soccer fields, improved roads to regional capitols). Political candidates from sending nations often campaign in receiving nations in neighborhoods or cities with high concentrations of their compatriots (Guarnizo 2000; Glick Shiller 1999). Finally, states may promote cultural and educational exchanges that more deeply intertwine sending and receiving communities (Grey and Woodrick 2002).

Peasant interactions with the state revolve around several activities: taking advantage of subsidies to direct production (as with *Villas Pesqueras*); securing titles to land; gaining access and usufruct rights to water, common grazing lands, or forests; paying taxes; appealing to the courts in land and other disputes;

and, probably most notably, participating in warfare, revolt, and revolution (Popkin 1979; Scott 1976; Wolf 1969). Recently, peasant interactions with states include their (generally negative) involvement in neoliberal trade policies and their subsequent responses to falling commodity prices and privatization of communal lands. Responses include international migration, the formation of cooperatives, and participation in third-party certification or fair trade initiatives. Each of these involve states at many levels, even when participation is filtered through Non-Governmental Organizations (NGOs).

The state plays an important and contradictory role in the composition of Puerto Rican fishing communities as well as the opportunities and behaviors of fishers. On the one hand, the state has developed fish landing centers and programs to assist commercial fishers such as the *bona fide* fisher program, and local municipal governments occasionally consult with fishing families in the development of working waterfronts or offer other forms of support. On the other, municipal and insular governments often support, through permitting, subsidies, tax holidays, or other mechanisms, coastal development projects that destroy nursery areas, infringe on or privatize fishing territories, and threaten fishing lifestyles. More directly, state and quasi-state agencies, such as the Departamento de Recursos Naturales (DRNA) and the Caribbean Fishery Management Council (CFMC), manage marine resource by various measures, controlling access to many of the principal species of fishing and shellfish upon which fishers depend. As many of the municipality reports and much of the survey data presented here make clear, this often leads to complaints and disputes over specific management measures, especially those which do not take advantage of fishers' knowledge bases or which seem, to fishers, senseless or immoral (e.g. the waste of fish pulled from a great depth).

Part of the process of managing marine resources includes managing fishing populations, which in turn involves representing them in an ethnographic and sociological sense. Over the past few years, as noted in the paragraphs opening this discussion, this process has entailed developing and attempting to standardize research protocols designed to *profile* fishing communities and assess their *dependence* on and *engagement* with marine resources. We emphasize these words because NOAA uses them to develop a kind of typology of fishery-dependent and fishery-engaged communities, and these designations have become important tools in the regulatory process.

The specific components of community profiles and measures of engagement and dependence, presented below, were developed by social scientists within and outside of NOAA, and are included in solicitations for research projects designed to profile fishing communities in different regions of the country. The "minimum data" needed to profile fishing communities are classed in two categories (see table IV.1 below): socioeconomic and sociocultural, and include general groupings of more specific elements. The "indicators" of dependence and engagement (outline 1) are, in part, lists of things you can count grouped into the four categories of fishing activity, economics, social activity, and cultural activity. For the indicators, however, no guidance has been given regarding what the threshold number of pounds is that differentiates a dependent from an engaged community, presumably because these indicators were developed to be used in a variety of settings (i.e. what constitutes a significant catch in New Bedford, Massachusetts certainly differs from what constitutes a significant catch in Cabo Rojo, Puerto Rico).

Table IV.1. Minimum Data Elements for Community Profiles

General Socioeconomic Variables	Specific Dimensions of Variables
Community and coastal county labor market	• Labor dynamics, malleability, annual rounds • Employment/ unemployment • Alternative Occupations • Income
Public investment in marine infrastructure	
Fishing dependence business	• Industry structure • Employment/ seasonal employment • Sales/ revenue • Seasonality • Form of ownership (e.g. owner/owner-operator vs. corporate)
Residency	• Non-resident but based in the community for fishing and related occupations • Resident in the community
Demographic Variables	• General community and coastal county population: e.g., age, education, ethnicity, gender • Fishery-specific: e.g., age, education, ethnicity, gender
General Socioeconomic Variables	**Specific Dimensions of Variables**
Cultural role of fishing	• History • Cultural events, including tournaments • Religious and secular icons (e.g. blessings of the fleet; fishermen's memorial) • Ethnicity • Kinship and family
Fishing related organizations and their roles in the community and fishery	• Commercial fishing associations a) vessel and business organizations b) fishermen's associations • Fishermen's wives associations • Angler's associations and clubs • Unions • Training institutes
Governance	• Fishermen's participation in community and county government • Fishermen's participation in resource management • Industry structure
Fishing-related programs and services	• Extension programs • NGOs • Health and Safety • Coast Guard

Source: NOAA Fisheries, RFP WC133F-04-RP-0045SKC, 2003

Indicators that Define Fishing Community [(*) = required elements]

1. Level and Type of Fishing Related Activity
    A. Substantial Dependence
        - Pounds landed and processed, by species (*)
        - Number of vessels primary or homeported (*)
        - Access to fishing and related infrastructure outside the community
        - Method of harvest—gear, etc. (*)
        - Types of fishing—commercial, recreational, subsistence, charter, etc. (*)
    B. Substantial Engagement
        - Amount and types of infrastructure (docks, fishing-related businesses, etc.) (*)
        - Number of and types of permits (*)
        - Number of households with fishing or related employees resident (*)
2. Economic Role and Importance
    A. Substantial Dependence
        - Level and percent of fishing and related income (*)
        - Economic vulnerability—amount & source of pressure and competition for fishing and related businesses (*)
        - Available alternative employment (*)
    B. Substantial Engagement
        - Level and percent of fishing and related employment (*)
        - Diversity of target species, gears, vessel sizes (*)
3. Social Role and Importance
    A. Substantial Dependence
        - Amount of local public and private organization budgets allocated to fishing and related planning and support
        - Dollar value (in a range) of in-kind services invested by community organizations, government bodies, and business groups in support of fishing and related businesses/ activities
        - Willingness of fishermen to engage in available alternative employment (*)
        - Perceived level of social capital (social networks, community support, etc.) (*)
    B. Substantial Engagement
        - Number of members of fishing organizations also members of other local/ civic organizations (*)
        - Number of column inches devoted to fishing and related topics in local newspaper
        - Number of fishing and related organizations, their membership size, and their effectiveness in achieving results (*)
4. Cultural Role and Importance
    A. Substantial Dependence
        - Perceived relationship of fishing to quality of life (*)
        - Level of community activity (festivals, planning meetings, etc.) related to fishing and related businesses (*)
        - Level of fish sharing (*)
        - Percent of local diet based on local fish (*)
        - Level of fish use for ceremonial events (*)
        - Presence of treaty rights related to fishing (*)
        - Confidence in fishery future (sees self, children, others having a fishing future) (*)
    B. Substantial Engagement
        - Number of and types of concerns expressed by fishermen, fishermen's spouses, etc about care and use of the oceans and its resources (*)
        - Number of and types of concerns about production orientations that reveal concerns beyond direct utility toward commercialization (*)
        - Percent of population that considers the community to be a "fishing community" (*)
        - Presence of community markers related to fishing (*)

These templates, in as much as they serve to organize and guide research, direct our attention toward some behaviors (perhaps at the expense of observing others) as well as confine our analyses to patterns of behavior primarily *within* the fishing community. Yet no one can conduct research among commercial fishers today without hearing about conflicts over a range of issues, including territorial conflicts between different groups of fishers or between fishers and the state, conflicts over environmental degradation and destruction of wetlands, or conflicts over coastal real estate development and historical or traditional access to marine resources. That fishers become involved in conflicts over marine resources, demonstrating a willingness to fight for them, reflects their dependence on fisheries. Nor can we ignore the fact that fisheries research since the early 1990s has made the point that fishing in many parts of the world, including Puerto Rico, is based in family and household/ domestic economies; as such, "kinship and family," currently included in "cultural role of fishing" in Table IV.1, could as easily be included under socioeconomic variables.

These two dimensions of fishing populations today—their involvement in coastal conflicts and their basis in domestic economies—are what make the literature on transnationalism and peasants relevant to a consideration of fishing communities, in Puerto Rico and elsewhere. Working with the list of elements and indicators above, with reference to central tenets of transnational and peasant studies, it is possible to develop a typology of Puerto Rican fishing communities that enables us to predict the likely impacts of MPAs, seasonal closures, and other regulatory developments. We would hope this would also enable a better appreciation of how the places described in the profiles fit within broader patterns of fishing and life in Puerto Rico.

Most Puerto Rican commercial fishing communities are one of two types, place-based and network-based, which correspond to peasant communities on the one hand and transnational social fields on the other. Place-based fishing communities are similar to peasant communities in that they are physical locations with distinct, identifiable structures and infrastructure; institutions such as churches, post offices, municipal governments, and schools; community calendars that include rites of intensification ceremonies (festivals, such as the Virgin of Carmen ceremony, that reinforce residents' sense of belonging to the community); and, perhaps most importantly, senses of community membership that derive principally from attachment to natural resources. Place-based communities are distinguished physically from network-based communities, separated from other areas within municipalities by physical location, such as small coastal towns that sit apart from other towns, or by infrastructure. Thus, for example, Punta Santiago, in Humacao, is a small coastal town that sits by itself, a place-based fishing community, as is Puerto Real in Cabo Rojo. The downtown harbor region of Mansion del Sapo, Maternillo, and Puerto Real, in Fajardo, also a place-based fishing community, is separated from the main town by a single road that winds through the three neighborhoods. People in place-based fishing communities live in houses and neighborhoods that are adjacent to one another yet may also adjoin other houses and neighborhoods that include people who do not identify themselves as part of the fishing community, just as peasant communities sometimes include people such as magistrates, soldiers, and others who do not engage in peasant farming and do not identify with a peasantry.

Network-based fishing communities have significant physical locations—which usually consist of landing centers, marinas, or other locations where fishers gather—but not all their members live in the same neighborhoods or same area. In rare cases they live in different municipalities and constitute a community only by their joint affiliation to a fishing association. In this sense, network-based fishing communities are similar to interest-based, occupational-based, or other non-place-based communities and thus share similarities with transnational social fields. Generally, various activities, events, and practices (e.g seafood festivals, Virgen del Carmen celebrations, regular sharing of food and drink, etc.) reinforce

membership in and allegiance to the community, and the knowledge that members of these communities possess and pool is often a key factor in defining community membership. The fishers who fish from La Guancha in Ponce, for example, constitute a network-based fishing community, as do the fishers from La Puntita in Yabucoa, Palmas Del Mar in Humacao, and Crashboat in Aguadilla. Network-based communities are becoming more common in Puerto Rico and gentrification and leisure capital development force more and more fishers from coastal locations.

The importance of knowledge bases within these community types cannot be underemphasized, suggesting a third community type among Puerto Rican fishers: knowledge-based communities. Knowledge-based communities in Puerto Rican fishing include members of both place-based and network-based communities, but generally cut across municipality lines and include all those who fish a specific territory with a specific gear or who become involved in a dispute against a common opponent for a common purpose. Thus fishers involved in the dispute against the Navy in Vieques, which included fishers from Vieques and nearly all other eastern municipalities, as well as some from as far away as Dorado—all of whom fish the waters between Vieques, Fajardo, and Culebra—could be considered a knowledge-based fishing community.

IV.b.1. Fisheries-Dependent and Fisheries-Engaged Communities in Puerto Rico

Rationale for the Development of an Index of Dependence

Place-based, network-based, and knowledge-based fishing communities in Puerto Rico can be either fisheries-dependent or fisheries-engaged. To assess dependence and engagement in Puerto Rican fishing we include in the table below those data elements and indicators that our ethnographic and other work have shown to be important. While we call this an index of dependence, we view the distinction between dependence and engagement as one of degree rather than kind (see definition at the beginning of this chapter). Hence, the index represents a gradient from substantially dependent to substantially engaged. Given that this is an ordinal measure, which we discuss more below, it is difficult to assign a particular score in which a community shifts from fishery dependent to fishery engaged, yet clearly most of those with scores above 19 are fishery dependent, just as those with score below 10 are fishery engaged. The value of the index, however, lies not in its ability to label each community fishery dependent or fishery engaged based on its score, but to give an indication of what a fishery dependent community looks like and to give some indication where it lies in relation to other fishing communities.

We have created an index of 8 items, along with a scoring system, that includes the data elements and indicators that NOAA fisheries' scientists (and their consultants) have deemed most appropriate to profiling fishing communities and that are relevant to Puerto Rico. Again, the items we included in the index were based on our experience with Puerto Rican fisheries and our understanding of the kinds of social and economic phenomena that are important indicators of an active fishing population. Data for this index come from principally from the ethnographic work on this report, but we have also drawn on landings data and other secondary sources. This index, we argue, reflects the degree to which a fishing community is entangled with other businesses, cultural events, and practices in their coastal environments. As such, it is as much a reflection of how much fishing families rely on their community as how much a community depends on fishing as a central component of its character. The items in the index, scoring system, and the relation of the items to relevant minimum data elements and indicators are as follows:

- Community type: Place-based or network-based. The former are highly likely to be fisheries-dependent, the latter to include a mix of fisheries-dependent and fisheries-engaged communities; thus we assign place-based communities a score of 2 and network based a score of 1. This relates to Table IV.1's variables related to residency.
- Ratio of full-time (bona fide) to part-time fishers (from either the ethnographic work, the fisher census, or both): This item in the index reflects the "labor market" and "fishery dependent business" variables in Table IV.1 above, in that a higher ratio of full- to part-time fishers reflects lower seasonality, lower unemployment within fisheries, and so forth. We can assume, too, that most part-time commercial fishers will be involved in alternative occupations. Because it represents so many of the data elements and indicators in the table and outline above, we computed the ratio as follows:

$$I_s = \frac{\boldsymbol{N}\mathbf{ft}}{N} \times 10$$

  Where I is the indicator value at site *s, Nft* is the number of full-time fishers at the site, and N is the total number of fishers at the site. *A* ratio of 0 means that all the fishers from this location fish part-time.[23]
- Ties to Tourism: 1 point for each *type* of seafood restaurant supplied by local fishers (e.g. mobile, kiosk, casual, elegant), 1 for each other service provided to tourists (e.g. "six-pack" for hire, bait sales, allowing the use of *muelle* and facilities for recreational fishing, storing recreational vessels in yards or at association facilities). The nature and extent of ties to tourism indicate a level of community integration, reflecting such indicators as levels of social capital, economic vulnerability, levels of community activities related to fishing, etc. Links to tourism also indicate the wider community's dependence on its fisheries as a source of fresh fish in local, varied seafood restaurants, on fishers for transportation services, and so forth.
- Involvement in coastal conflict: 3 points if directly involved in conflict/ dispute; 1 point if indirectly involved.
- Ties to state: 1 point for each tie that enables improved fishing capability (e.g. the acquisition of fishing vessels in Rincón). This reflects the area of governance as well as local public and private support of fishing in the community.
- Fishing Infrastructure: 1 point for each active *Villa Pesquera* (includes freezers, lockers, pier/*muelle*, etc.), 1 for a *Club Nautico*, 1 for a functioning seafood market, 1 for each functioning seafood restaurant (at the association), 1 for boat building/ repairing on site, 1 for fishers experimenting with new gear designs or possessing special knowledge about gear manufacturing, etc. Minimum data elements these relate to are public investment in marine infrastructure and fishery related organizations; indicators they relate to are amount and types of fishing infrastructure, public and private support, etc.
- Ceremonial Infrastructure/ activity: 1 for holding a Virgen del Carmen festival or other festival (seafood, blessing of the fleet, etc.), 1 for a Virgen Del Carmen Statue, 1 for a Virgen Del

[23] Coming up with this figure often meant examining the census and ethnographic data in extreme detail, because in many communities informants had difficulty giving accurate estimates of the numbers for full-time and part-time fishers. This entailed examining the distribution of fishers who responded to the census, based on specific landing centers or addresses, determining what proportions of fishers from specific communities fished less than 40 hours per week, and then applying that percentage to the total number of fishers for that community, based on the ethnographic work.

Carmen Chapel, 1 for every other piece of ceremonial infrastructure on public display (e.g. fisher statues in Parguera or Juana Díaz, mural in Loiza, historical plaza in La Playa, Ponce, etc.).

- Rank in the landings data: We scored the landings data on a range from 1 to 5, based on the following formula from the Work Environment Index (WEI) developed by researchers at University of Massachusetts (Heintz, Wicks-Lim, and Pollin 2005):

$$I_i = \frac{X_i - min\ \{X\}}{max\ \{X\} - min\ \{X\}} \times S$$

Where I_i is the indicator value for the municipality *i,* X_i is the 1999-2003 landings data for that municipality, *S* is the maximum value in the index (in this case, 5), *min {X}* is the minimum for landings data and *max {X}* is the maximum. The maximum amount reported by a single landing center in our list, from 1999 to 2003, was 655,891 pounds, in La Parguera, and the minimum was 2,371, in El Faro. While the WEI uses a range of from 1 to 10, we selected a range of 1 to 5 for this indicator so that the landings data did not overwhelm the other components of the index. That is, the other indicators will generally score no more than 5.

We emphasize that any one of the above items in the index is fallible, either because we did not thoroughly canvas the community during our ethnographic work or because one or another of the community's features are hidden or difficult to observe readily. When we combine these elements, however, threats to the accuracy of the index are reduced. We also note that we have not scored all of the sites we visited, because in some cases our visits to the site were too cursory or brief, or we were not able to interview any knowledgeable fishers about the site. A complete list of the sites we visited, which constitutes a nearly complete list of all important fishing sites in Puerto Rico, can be found in Table I.5 in the introduction to this report.[24]

Table IV.2. Dependence/ Engagement Index for Puerto Rican Fishing Communities

Community	Type	Ratio	Ties to Tourism	Conflict	State Ties	Fishing IF	Ceremonial IF	Landings Ranking	Total Score
La Parguera, Lajas	2	5.0	7	3	1	5	2	5.00	**30.00**
Puerto Real, Cabo Rojo	2	3.0	5	3	0	8	3	4.74	**28.74**
La Guancha, Ponce	1	3.15	8	0	1	6	2	3.68	**27.98**
La Playa, Ponce	2	6.59	5	0	1	4	4	3.68	**26.27**
Punta Santiago, Humacao	2	6.45	7	0	1	6	2	1.76	**26.21**
Pozuelo, Guayama	2	2.86	7	3	0	7	2	1.58	**25.44**
La Estela, Rincón	2	6.15	5	0	2	5	2	3.61	**25.31**
Downtown Harbor, Fajardo	2	5.00	6	3	0	4	3	2.27	**25.27**
Las Croabas, Farjardo	2	6.25	6	3	0	3	1	2.38	**23.63**

[24] We consider this a "nearly complete" list because we may have overlooked one or more sites, although we consider the list in table I.5 comprehensive in the sense that it includes all place-based fishing communities and all of the most important sites that serve as focal points for network-based fishing communities. It likely does not include all recreational fishing sites, primarily because recreational fishing can be accomplished from nearly any bridge or other infrastructure.

Community	Type	Ratio	Ties to Tourism	Conflict	State Ties	Fishing IF	Ceremonial IF	Landings Ranking	Total Score
Esperanza, Vieques	2	3.65	5	3	1	4	1	3.76	**23.41**
Húcares, Naguabo	2	4.47	5	1	1	4	2	3.68	**23.15**
Playa/ Playita, Salinas	2	6.36	5	3	0	3	2	1.75	**23.11**
El Seco, Mayagüez	2	3.89	6	0	1	4	3	2.35	**22.24**
Isabel Segundo, Vieques	2	3.65	4	3	1	4	1	2.36	**21.01**
Vieques, Loíza	2	3.3	4	3	1	5	1	1.39	**20.69**
Patillas Bajo	2	7.00	4	0	1	4	1	1.44	**20.44**
El Boquete, Peñuelas	1	10.00	4	0	0	3	0	1.99	**19.99**
Puerto Arroyo	2	1.90	5	0	2	4	3	1.66	**19.56**
Guayanes/ La Puntita, Yabucoa	2	6.33	2	3	1	4	0	1.05	**19.38**
Sardinera, Fajardo	1	4.41	5	3	1	3	1	.24	**18.65**
Combate, Cabo Rojo	2	5.00	3	0	0	4	0	4.56	**18.56**
Los Machos, Ceiba	1	5.93	2	3	0	4	0	2.36	**18.29**
Crash Boat, Aguadilla	1	2.37	3	0	1	5	2	3.40	**17.77**
GuaypaoEsperanza, Guanica	2	8.57	0	3	0	2	1	.72	**17.29**
Palmas, Humacao	1	5.26	3	3	0	4	0	1.01	**17.27**
Malecon, Guanica	1	5.0	4	3	0	1	0	3.06	**17.06**
Playa, Santa Isabel	2	4.06	2	0	1	4	1	.88	**15.94**
Culebra	2	1.66	6	1	1	3	0	.80	**15.46**
Cerro Gordo, Vega Alta	2	6.66	3	0	0	3	0	.63	**15.29**
Barrancas, Guayama	2	3.50	2	3	0	2	1	1.66	**15.16**
Punta Tuna, Maunabo	2	7.00	3	0	0	2	0	.93	**14.93**
Playa, Guayanilla	2	3.5	4	0	0	1	2	2.07	**14.57**
Pastillo, Juana Díaz	2	5.38	0	0	0	3	1	2.91	**14.29**
El Maní, Mayagüez	2	4.68	1	0	0	2	3	.54	**13.22**
Espíritu Santo, Río Grande	1	1.15	3	3	0	4	0	1.00	**13.15**
Rio de La Pla, Dorado	2	1.42	6	0	0	2	1	.63	**13.05**
Cataño Centro Agropecuario, San Juan	2	3.66	2	0	2	2	0	1.38	**13.04**
Río Cíbuco, Vega Baja	1	2.5	2	3	0	4	0	.12	**12.62**
Barrio Espinal, Aguada	2	2	3	0	0	2	0	3.08	**12.08**
La Hoare, San Juan	1	1.85	1	0	2	4	0	1.57	**11.42**
Papayo, Lajas	2	5.45	1	0	0	1	1	.87	**11.32**
Luquillo	1	2.5	2	3	1	0	1	.32	**10.82**
Bahia Salinas, Cabo Rojo	2	2.80	3	0	0	2	0	3.62	**10.42**
Tres Hermanos, Añasco	2	2.00	2	2	0	0	3	1.29	**10.29**

Community	Type	Ratio	Ties to Tourism	Conflict	State Ties	Fishing IF	Ceremonial IF	Landings Ranking	Total Score
Boquerón, Cabo Rojo	1	.66	4	1	0	3	0	1.10	**9.66**
Punta Sardina, Isabela	2	0	2	0	1	2	2	.29	**9.17**
Princesa, San Juan	1	3.75	1	0	0	2	0	1.38	**9.13**
El Docky, Mayagüez	1	1.33	1	0	0	1	3	.40	**7.73**
Las Mareas, Salinas	2	0	4	0	0	1	0	.23	**7.23**
Cana Gorda, Guanica	1	0	3	0	0	2	1	0	**7.00**
Jarielito, Arecibo	2	.93	0	0	0	1	0	1.59	**5.52**
El Faro, Guayanilla	2	0	2	0	0	0	0	0	**4.00**
Punta La Cuchara, Ponce	2	0	0	0	0	0	0	0	**2.00**

We need to keep in mind that this is an ordinal measure, or a ranking. In other words, we cannot say that a community or site that receives a score of 10 is half as dependent on fishing as one that receives a score of 20 any more than we can say that 10º Fahrenheit is half as cold as 20º Fahrenheit. We can assume that fishing is probably more important in a community that receives a score of 20 as compared to one that receives a score of 10, but we cannot know *how much* more important. Because of this, too, in cases where scores are within a point or two of one another, it would be difficult to say that fishing is that much more important in the one community over the other. The map below (Puerto Rico Fishing Communities and Dependency Scores) illustrates the regional variation in dependence. Because many of the communities cluster together, the map is intended primarily to give the broad contours of dependence without focusing on any single community. Those who to view more detailed maps, where communities' dependence scores are depicted relative to other communities, to the characteristics of the coastline, and so forth, can refer to the maps in Volumes II and III. Table IV.3., following the map, presents a complete list of fishing communities in Puerto Rico.

Despite whatever lingering problems this index may have, the rankings that emerge from the table conform, in most cases, to our intuitive understandings about these sites and communities, based on years of ethnographic work. We field tested the index by visiting communities where we knew fishing to be central to the community identity and seeing whether or not all the elements the index would predict were, in fact, present, and found that they were. This table thus gives a sense of what more dependent or more engaged fishing communities look like in Puerto Rico. Those at the high end, such as Puerto Real, Puerto Real, Fajardo's Downtown Harbor, are place-based, with relatively high ratios of full-time to part-time fishers, multiple ties to tourism, elaborate fishing and cultural infrastructure, and of course high landings. Generally they are involved in conflicts of some sort, and often have close ties to the state. Those at the low end can be either place-based or network-based, yet they tend to have no or poorly developed fishing and cultural infrastructure, few ties to tourism, and comprised mostly of part-time fishers whose landings are predictably low.

Map IV.1. Fishing Communities and Their Dependency Scores for Puerto Rico

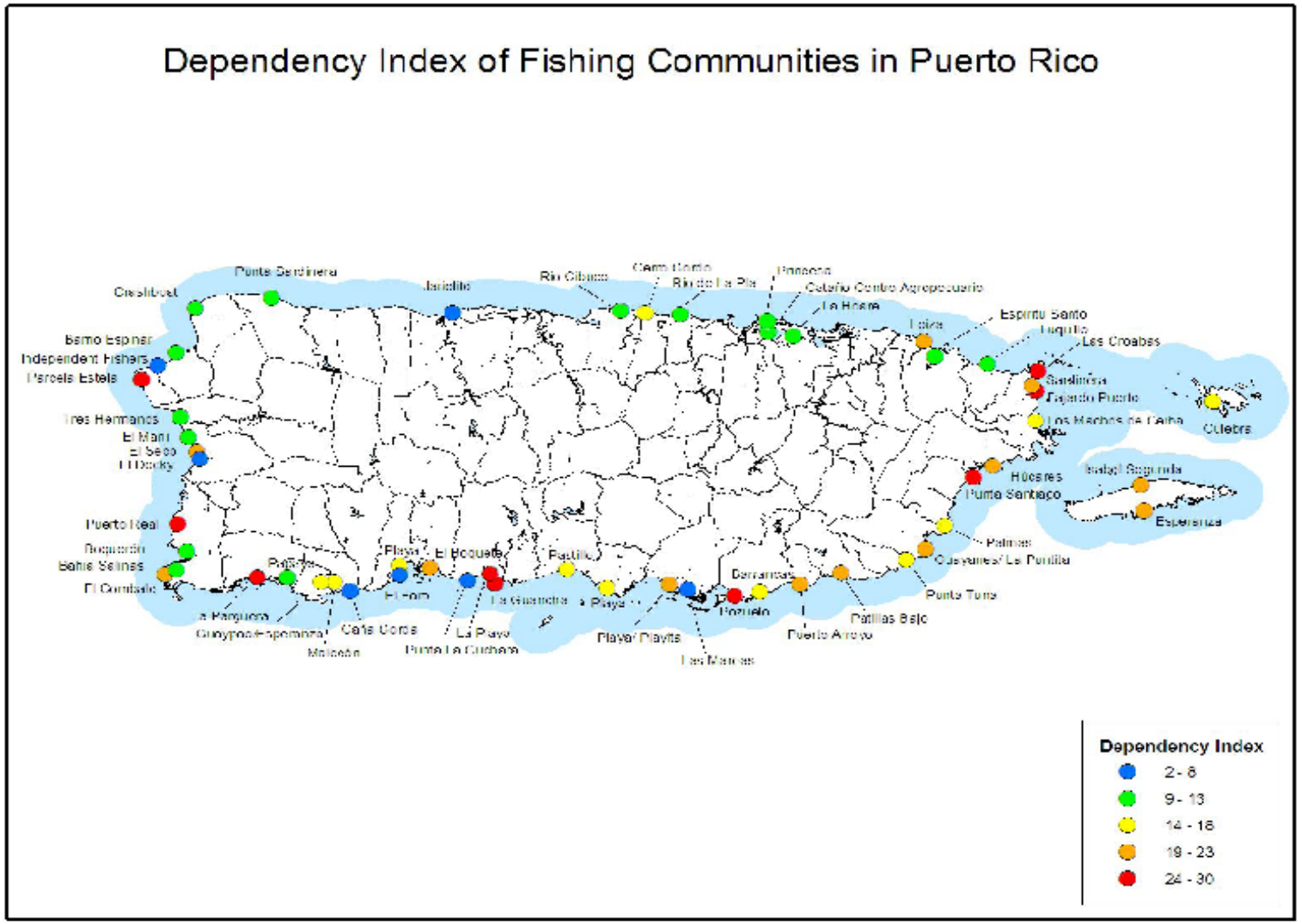


Table IV.3. lists, to the best of our knowledge, all the fishing communities in Puerto Rico, indicating our level of research effort in each. Given the entangled nature of fishing communities in Puerto Rico, combined with the greater importance of fishing in some communities than others, it was inevitable that our research coverage was uneven across Puerto Rico's coast. The list is based on a combination of direct observation through field visits, previous research, DRNA data on landing centers, and maps.

Table IV.3. Fishing Communities and Landing Centers of Puerto Rico

Community Name	Assigned Score	Visited In Study	Needs Research*
1. Punta Sardina, Isabela	X	X	
2. Terranoya, Quebradillas			X
3. Peñon Amador, Camuy			X
4. Puerto Hermino, Camuy		X	X
5. Punta Maracayo, Hatillo		X	X
6. Pueblo, Hatillo			X
7. Jarielito, Arecibo	X	X	
8. Las Palmas Altas, Barceloneta		X	X
9. Punta Manatí, Barcelonta		X	X
10. Boca California, Manatí		X	X
11. Puerto Nuevo, Vega Baja 12. (Rio Cíbuco)	X	X	
13. Cerro Gordo, Vega Alta	X	X	
14. Mameyal, Dorado 15. (Rio de la Pla)			
16. Palo Seco, Toa Baja		X	X
17. La Puntilla, Cataño 18. (Centro Agropecuario)	X	X	
19. Princesa, San Juan	X	X	
20. La Hoare, San Juan	X	X	
21. La Coal, San Juan		X	X
22. Vieques, Loíza	X	X	
23. Ancones, Loíza			X
24. Parcelas Suarez, Loíza			X
25. Mediana Baja, Loíza			X
26. Palmer, Río Grande 27. (Espíritu Santo)	X	X	
28. Luquillo	X	X	
29. La Croabas, Fajardo	X	X	
30. Sardinera, Fajardo	X	X	
31. Downtown Harbor, Fajardo	X	X	
32. Pueblo, Culebra	X	X	
33. Esperanza, Vieques	X	X	
34. Isabel Segundo, Vieques	X	X	
35. Los Machos, Ceiba	X	X	
36. El Corcho, Naguabo			X
37. Húcares, Naguabo	X	X	
38. Punta Santiago, Humacao	X	X	
39. Punta Candelero, Humacao	X	X	

Community Name	Assigned Score	Visited In Study	Needs Research*
40. (Palmas)			
41. Buena Vista, Humacao			X
42. La Puntita, Yabucoa	X	X	
43. Punta Tuna, Maunabo	X	X	
44. El Faro, Maunabo			X
45. Bajo, Patillas	X	X	
46. Guardarraya, Patillas		X	X
47. Playa, Arroyo 48. (Puerto Arroyo)	X	X	
49. Jobos, Guayama		X	X
50. Barrancas, Guayama	X	X	
51. Pozuelo, Guayama	X	X	
52. Playa, Salinas	X	X	
53. Las Mareas, Salinas	X	X	
54. Central Aguirre, Salinas		X	X
55. Playa, Santa Isabel	X	X	
56. Cortada, Santa Isabel		X	X
57. Pastillo, Juana Diaz	X	X	
58. La Playa, Ponce	X	X	
59. La Guancha, Ponce	X	X	
60. Punta La Cuchara, Ponce	X	X	
61. Tallaboa, Peñuelas 62. (El Boquete)	X	X	
63. Bahia, Guayanilla 64. (Playa)	X	X	
65. El Faro, Guayanilla	X	X	
66. Bahia, Guanica 67. (Malecon)	X	X	
68. Salinas Providencia, Guanica		X	X
69. Guaypao, Guanica	X	X	
70. Caña Gorda, Guanica	X	X	
71. La Parguera, Lajas	X	X	
72. Papayo, Lajas	X	X	
73. Puerto Real, Cabo Rojo	X	X	
74. El Combate, Cabo Rojo	X	X	
75. Bahia Salinas, Cabo Rojo	X	X	
76. Boquerón, Cabo Rojo	X	X	
77. El Seco, Mayagüez	X	X	
78. El Maní, Mayagüez	X	X	
79. El Docky, Mayagüez	X	X	
80. Tres Hermanas, Añasco	X	X	
81. Parcela Estela, Rincón	X	X	
82. Barrio Espinal, Aguada	X	X	
83. Guaniquilla, Aguada		X	X
84. Higuey, Aguadilla			X
85. Tamarindo, Aguadilla			X
86. Crash Boat, Aguadilla	X	X	

A SURVEY OF FISHING IN PUERTO RICO

As part of our overview of fishing communities in Puerto Rico, we conducted a survey covering all the municipalities of the main island, using a survey instrument that we developed and pre-tested during the summer of 2004. Survey development, pre-test, and the OMB clearance package were done in conjunction with NOAA fisheries personnel and a research team conducting a sister study in the U.S. Virgin Islands. Our survey was translated into Spanish and reworked slightly due to initial interviews/ additional pre-tests that we conducted in Puerto Rico, given the cultural and linguistic differences between Puerto Rico and the other U.S. Caribbean territories (see Appendix A: Research Protocols & Survey Instrument).

V.a. Sampling and Interviewing

Two groups of university undergraduate students, briefed on current fishing practices by Dr. Valdés Pizzini and overseen by Dr. Pérez Lugo, both of the University of Puerto Rico, Mayagüez, administered the survey: one based in the west and one in the east. They visited the field in pairs to interview fishers, in most cases specializing on a specific region to become familiar with the distribution of fishers' households and places they might intercept fishers. Early visits to coastal communities were necessary both to familiarize research assistants to fishers and to familiarize fishers to the idea of participating in a survey. The latter was particularly important, given the contentious environment that surrounds fishing and fishing regulations in Puerto Rico today. This environment has led many fishers to withhold information such as landings data from official collection, and there was ample reason to believe that we would encounter opposition to surveying at this time. Our response rate, however, was quite high when we were able to contact the person selected (in 122 cases, the person's contact information was not accurate or was obsolete).

Once field researchers familiarized themselves with the areas, we provided interviewers with lists of randomly sampled fishers from the Puerto Rican census of fishers as well as a list of sites where they were liable to intercept recreational or subsistence fishers. The potential respondent universe included commercial, professional recreational (charter boat fishermen), recreational, and subsistence fishers across Puerto Rico, although we allowed fishers to self-identify themselves. In some cases, fishers whose names we obtained from the Puerto Rican fisher census identified themselves as recreational fishers; in other cases, fishers we intercepted at popular recreational fishing locations identified themselves as commercial fishers. The following attributes of these populations recommended a multi-method approach to sampling:

1. The numbers of commercial fishers captured in the Puerto Rican census have fluctuated from around 1,500 to 2,500 since the early years of the census, although the most recent census included only 1,132 records. Both the fluctuating numbers and the low recent count reflect common patterns of moving in and out of fishing in response to such factors as alternative, non-fishing employment opportunities, particularly in construction, migration to the U.S. mainland for work or family reasons, declining catches, and other causes, and other factors. In addition, the census may be more likely to include full-time fishers, those affiliated with associations, and other highly visible fishers but to overlook those who fish more casually. While the census is an important sampling tool, random sampling from the census alone would yield a biased sample.

2. There is no current list of all recreational and subsistence fishers in Puerto Rico, and it is unlikely that many of these individuals are included in the fisher census or other official information sources. Vessel licensing data, for example, includes too many individuals who are only recreational boaters and have little or nothing to do with fishing.
3. The numbers of professional recreational fishers (charter boat captains) are very low, highly visible, and a majority of them were easily captured during an ethnographic phase of the project.
4. Fishing activity varies through the year, with the first five months of the year highly active, the summer and autumn months (hurricane season) often the slowest, and November and December moderately active (in part because holiday demand for poultry and pork reduce the demand for fish).

Given these attributes of the fishing populations of Puerto Rico, we combined random sampling from the census of fishers with intercept sampling. Intercept sampling is the most common sampling method used for recreational fishers. It consists of intercepting fishers at common recreational fishing locations: Clubs Nauticos, marinas, piers, bridges, and other coastal infrastructure that allow fishing. We determined where these were during the ethnographic phase of the research and randomized the times we visited these areas, concentrating primarily on weekend visits. Combining these methods, we believe we have produced a sample population that is normally distributed, or one in which 68.26% of all those surveyed fall within one standard deviation of the mean and 95.44% within two standard deviations, or a confidence interval of 95% (Bernard 2002: 172; Norusis 2002: 236).

This sampling strategy resulted in 439 successfully completed interviews, part of which have been selected at random and part through an intercept method; for portions of this report, we focus exclusively on those randomly selected, believing that they are a more accurate representation of Puerto Rican fishers. Regardless of how they were sampled, survey respondents were paid $10.00 for participating. Of the 439 total interviewed, 269 were randomly selected from the census of fishers, with a handful of these identifying themselves as primarily recreational fishers.[25] This figure constitutes between 7% and 14% of the total number of commercial fishers in Puerto Rico, depending on whether or not one places the total at 1,500 or 2,500. In either case, this represents a solid cross-section of the population. Table V.1 presents additional data regarding the sampling.

[25] Although 439 individuals were surveyed, the total number for each table presented in this section is rarely 439, but less, due to missing data.

Table V.1 Survey Response Success

Variable	Number
Estimated Total Population	
> Commercial	1,500
> Recreational	167,000
Number Targeted	450
Number of Contacts	671
Number Completed	439
> Number Randomly Selected	269
> Number Intercepted	170
Reasons for Non-Response	
> Unable to contact	122
> Unable to arrange time	76
> Refusal to participate	21
> No longer fishing or other	13

V.a.1. Data Quality Issues

Survey data are usually problematic, for the simple reason that they provide a cross section of a population based on brief interactions with respondents about whom we usually cannot know things such as their propensity to misrepresent facts, remember incorrectly or selectively, or their state of knowledge about a specific phenomenon. We held a small focus group with five of those involved in the data collection and data processing to address problems with the interviewing and with the questionnaire, and we present some of the results from that discussion here to assist in the interpretation of the results. First, the interviewers acknowledged that the field settings in which they worked were often settings of conflict and, occasionally, hostility. These field conditions derive from widespread perceptions among fishers in Puerto Rico (in line with fishers elsewhere) that state regulations will eventually displace them from fishing entirely. Specific complaints included the recent changes to the licensing system, which they view as too costly and complex, the failure of state agencies to deal with marine resource contamination or destructive fishing practices (e.g. reef fishing for octopus with Clorox), recreational divers stepping on reefs, the destruction of habitat (particularly mangrove forests), size limits on local species but not on imports, and the heavy-handed enforcement of the *Departamento de Recursos Naturales* (who, some claimed, will circle and board their boats repeatedly and intentionally scare away fish).

One of the problems of the questionnaire was that it attempts to capture a complex activity that changes through the week and through the year with a series of mostly closed questions. Questions about how many days they fish in a given month, for example, were often answered with *"depende"*—it depends: on weather, primarily, but also on other jobs, fuel prices, the availability of crew, and so forth. Asking about the "targeting" of species was also problematic, suggesting that many fishers do not target single species but instead engage in multispecies fishing. This is especially the case with the use of gear such as traps, which catch a variety of species, or where fishing takes place over coral reefs, where several species are liable to take the same bait with the same or similar gear. Only divers can truly target species.

Some fishers declined to participate in the survey because they believed their responses would fall on deaf ears among regulators, and that it was, in short, *"no vale la Peña"*—not worth the trouble. Interviewers were instructed not to be confrontational, but to elicit data and refrain from questioning respondents when

contradictions within the questionnaire occurred (e.g. a fisherman calling himself recreational but then selling 100% of his catch to a fishing association).

We have broken down the discussion of the survey data into several components, given the varied nature of fishing in Puerto Rico. The first section, an overview, gives basic statistics about the survey data itself: regional distribution of the interviews, the ways in which they were selected (intercepted vs. randomly from the census), the distribution of the survey respondents over types of fishing groups (e.g. commercial, recreational, crew, captain, etc.), and so forth. Following this, however, we examine a few variables with reference to the entire sample, some of which are better considered in light of subsamples of, say, recreational vs. commercial fishers. We reserve most of our discussion of the section of the survey on MPAs, however, for the policy section at the end of this report.

V.b. Overview of the Data: Regional Distribution, Sample, and Types of Fishers

Table V.2 presents the distribution of recreational and commercial fishers by sampling method, showing clearly that many more commercial fishers were picked up by the random technique while many more recreational fishers were included via an intercept sample. This was expected, of course, but it is interesting that 3% of those sampled from the fishery census labeled themselves recreational fishers. During our focus group with interviewers, there was a general consensus that these individuals were very likely calling themselves recreational because they did not report commercial fishing income on their taxes.

Table V.2. Sample Type by Commercial vs. Recreational Status*

Sample	Commercial Fishers	Recreational Fishers
Random	256 (58.6%)	13 (3%)
Intercept	54 (12.4%)	113 (26%)
Total	**310 (71%)**	**126 (29%)**

Pearson's chi-square = 197.963; df = 1; p< .001[26]
*Missing data for 3 fishers.

The sampling scheme resulted in uneven representation across the regions, with some areas overly represented and others, such as Lajas, underrepresented.[27] While this would be in line with the uneven regional distribution of fishing effort around Puerto Rico, it is clear that it was influenced by interviewer bias (e.g. some interviewers being more zealous than others) and other sources of bias. Table V.3 shows the distribution of interviews by municipality, listing the municipalities in the order they appeared in Table I.1, which ranks them by landings.

[26] Generally, $p < .05$ is considered statistically significant.
[27] Vieques and Culebra were not included in the survey work.

Table V.3. Interviews by Municipality

Municipality	N. Interviews	Percent	Municipality	N. Interviews	Percent
1. Cabo Rojo	29	6.8	22. Arecibo	3	.7
2. Lajas	9	2.1	23. Loíza	11	2.6
3. Vieques	0	0	24. Vega Baja	17	4.0
4. Aguadilla	24	5.6	25. Yabucoa	11	2.6
5. Guánica	4	.94	26. Añasco	10	2.3
6. Fajardo	33	7.7	27. Patillas	2	.47
7. Naguabo	12	2.8	28. Cataño	8	1.9
8. Rincón	15	3.5	29. Rio Grande	7	1.6
9. Juana Díaz	2	.47	30. Carolina	5	1.2
10. Ponce	19	4.4	31. Maunabo	6	1.4
11. Guayama	14	3.3	32. Culebra	1	.23
12. San Juan	24	5.6	33. Barceloneta	7	1.6
13. Mayagüez	33	7.7	34. Vega Alta	5	1.2
14. Humacao	31	7.3	35. Dorado	5	1.2
15. Aguada	12	2.8	36. Manatí	2	.47
16. Ceiba	4	.94	37. Isabela	22	5.1
17. Salinas	6	1.4	38. Luquillo	2	.47
18. Guayanilla	2	.47	39. Camuy	4	.94
19. Peñuelas	3	.7	40. Hatillo	1	.23
20. Santa Isabel	7	1.6	41. Toa Baja	4	.94
21. Arroyo	6	1.4	Other	5	1.2
			TOTALS	**427**	**100**

In designing the survey instrument, we were sensitive to the fact that there are many different kinds of recreational and commercial fishers, ranging from boat or shore fishermen to *proeles* (commercial fishing crew) to captains of commercial vessels or charter boats. We developed a list of these categories based on our ethnographic work and familiarity with Puerto Rican fishers, asking fishers to identify themselves according to one of 11 categories. The majority self identified themselves as commercial fishers. Table V.4 presents these data.

Table V.4. Types of Fishers Interviewed

*("Actualmente, que tipo de pesca realiza mayormente?")**

Type of Fisher	Number Interviewed	Percent
Commercial Vessel Captain	257	58.9
Commercial Crew	36	8.3
Charter Boat Captain	3	.7
Charter Boat Crew	2	.5
Dive Boat Captain	10	2.3
Dive Boat Crew	2	.5
Recreational Vessel Captain	46	10.6
Recreational Vessel Crew	22	5.0
Shore Recreational Fisher	19	4.4
Subsistence Fisher (fishes for food)	14	3.2
Fishes for Supplemental Income	7	1.6
Other	18	4.1
Total	**436**	**100**

*Actually, what type of fishing do you do most often?

We collected very few demographic statistics, in hopes of keeping the interview short, avoiding issues of a private nature, and keeping the questions focused on fishing. These data are included in the following table, which show that the majority of those interviewed are married and living in households that range in size from around 2 to 5 individuals, where between 0 and 3 people earn income from fishing.

Table V.5. Marital Status and Household Characteristics

Marital Status	Percent
Married	66.0
Single, never married	18.9
Divorced	8.2
Widowed	3.0
Other	3.9
Mean Household Size	3.24 (sd = 1.577)
Mean Number who Earn Money from Fishing	1.30 (sd = 1.153)

V.b.1. General Results

In this section we examine data we collected for the entire sample, prior to conducting work of a more comparative nature and focusing on groups within the larger data set. One of the early questions we asked concerned learning about fishing, in part to address the commonly held notion that fishing in Puerto Rico is a family enterprise. Table V.6 seems to confirm this.

Obviously, most respondents learned to fish from their fathers, although many learned from friends. While we asked specifically about who had taught them fishing *as a profession or occupation,* recreational fishers answered this question as frequently as commercial fishers, perhaps viewing fishing as more than a mere leisure activity (e.g., one that can yield food or income). This would be in line with historical information about fishing, which suggested it was critical to coastal livelihoods during dead

times in the sugar industry, as well as with the common complaint by commercial fishers that, during downturns in the economy, those who know fishing fall back on it for additional income.

Table V.6. Person who Introduced Respondent to Fishing
*("Quién lo introdujo a la pesca como profesión u ocupación?")**

Person	Number Interviewed	Percent
Father	202	47.1
Mother	5	1.2
Spouse	2	.4
Brother	7	1.6
Sister	1	.2
Son	5	1.2
Cousin	5	1.2
Friend	92	21.4
Father or Mother-in-law	15	3.5
Other	95	22.1
Total	**429**	**100**

*Who introduced you to fishing as a profession or occupation?

Respondents used a variety of gear types for many species. We cannot list them all because there are too many species to fit into tables neatly. As noted earlier, Puerto Rican fishers fish multiple gear types for multiple species. Survey data reflect this. Table V.7 shows the percentage of fishers who reported using from 1 to 7 gear types, comparing the entire sample with the commercial and recreational groups. A majority of the commercial fishers (63%) use at least three gear types and over one-third use at least 4 types, while a majority of recreational fishers use at least two types and over one-third use three types.

Table V.7. Number of Gear Types Reported by Commerical and Recreational Fishers (n=439)

N. Gear Used	Percent of Total Reporting	Percent of Commercial Fishers Reporting	Percent of Recreational Fishers Reporting
1	98.9*	99.0	99.2
2	80.2	85.2	68.3
3	56.5	63.2	39.7
4	32.8	37.4	20.6
5	18.9	21.6	11.1
6	5.0	6.1	1.6
7	2.1	2.6	.8

*Total lower than either of the two groups due to rounding error.

Even though commercial fishers, as predicted, use multiple gear types, it is notable that the proportion of recreational fishers using three or more gear types is also fairly high. The most common gear type listed, for the total sample, was "hooks and lines," listed by 25.8% as their first gear, followed by traps (12.4%), trammel and gill nets (10.1%), beach seines (9%), and SCUBA gear (8.8%). The most common two species listed as their first most important species were *chillo* (silk snapper—14.1%) and *langosta* (lobster—12.1%), with other common species being *colirubia* (yellowtail snapper—9.1%), *sierra*

(kingfish or king mackerel—5.5%)[28], *arrayo/ arrayado* (lane snapper—4.6%), *carrucho* (conch—4.3%), *mero* (grouper—4.1%), but like the landings data, fishers listed dozens of species, most accounting for less than 1% of the catch. Table V.8. examines these data in somewhat more detail, matching specific gear to the three most important species targeted by those who use that gear type. We emphasize, however, that in some cases the gear and species seem not to match (e.g. silk snapper captured by beach seine or kingfish with SCUBA gear). This is due to the fact that, just noted, that fishers use multiple gear types and they reported as their 1st Species one that they do not normally catch with their principal gear.

Table V.8. Principal Gear by Principal Species Captured (n=439)

Gear Type	1st Species	2nd Species	3rd Species
Hooks & Lines	Silk Snapper	Yellowtail Snapper	Kingfish
Traps	Lobster	Conch	Silk Snapper
Gill net/ trammel net	Snappers (variety)	Snook	Lobster
Beach seine	Silk Snapper/ other snappers	Lobster	Tuna
SCUBA gear	Lobster	Conch	Kingfish

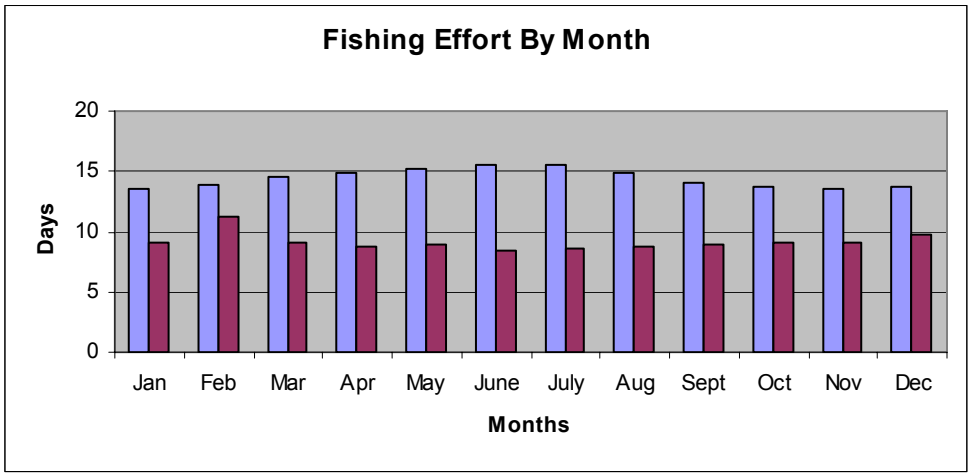
Given the changes affecting marine resources from a variety of sources, we were interested in examining whether or not gear types and species captured had changed over the five years prior to the interview. Few had. The same five principal gear types show up in more or less the same proportions in the population, and the species they capture, as one would expect, were not radically different five years ago than today either. Four out of five surveyed said they had made no changes, and the 20% who did make changes most commonly (56%) said that they had improved or modernized their equipment. Other reasons given for the change were changes in the marine environment, including contamination (15%), changes in fishery regulations (14%), increased expenses associated with fishing (6%), and other, more personal reasons (health, family problems, etc.).

V.b.2. Fishing Seasons

What times of year do Puerto Rican fishers most often fish? The data indicate that the summer months are most active, although fishing effort across the entire population does not change greatly through the year. Although we found no statistical difference in the number of days per month, our ethnographic interviews suggested that there are distinct spikes and troughs in fishing activity through the year, and we note that these should be taken into account by managers as they put fishing regulations into place. The regional profile of Lajas, for example, gives more detailed information on annual rounds. Figure V.1 shows the mean (long bars) number of days of fishing effort and the standard deviation (short bars) by month.

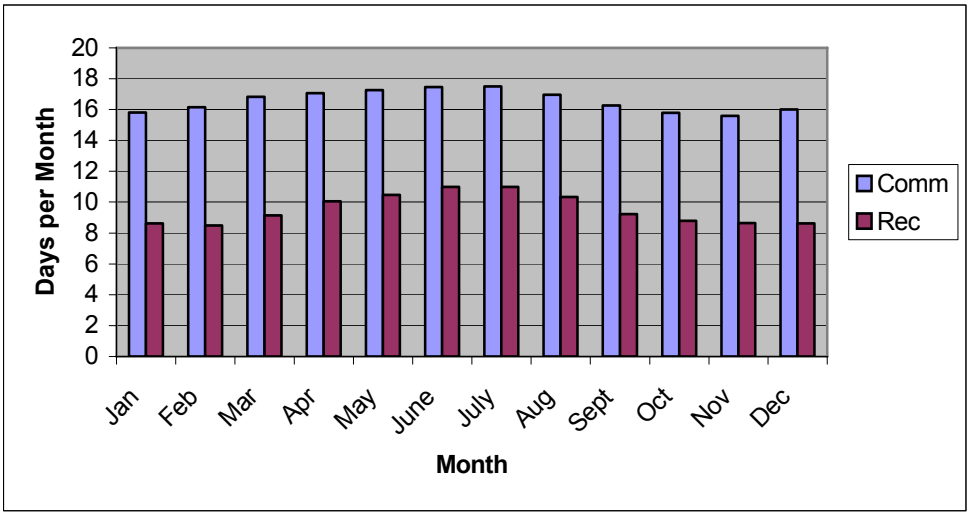
[28] There is some confusion over the type of mackerel that fishers refer to when they use the word *sierra*. Some Puerto Rican fishers insist it refers to king mackerel (*Scomberomorus cavalla*) and others to a cero (*Scomberomorus regalis*). Kingfish seems to be used generically. Erdman uses the term for both species.

Figure V.1. Days of Fishing Effort by Month (N=439)



By showing the standard deviation (short bars), we can get a sense of the range of fishing effort across this entire population. That is, although the mean number of days hovers between 12 and 16 through the year, the standard deviation means that the range for, say January, where the mean is 13.61, is more like from 4 days per month to 23 days per month (13.61 – the s.d. of 9.151 to 13.62 + 9.151). These figures are higher, by about two to three days per month, for those who reported that they were commercial fishers, and lower for recreational fishers by about three to five days per month. Statistical tests[29] for comparing means show that the differences are significant.

Figure V.2. Effort by Commercial vs. Recreational



[29] Analysis of variants (ANOVA) were computed to determine statistical significance. Month by month F-ratios ranged from 57.174 in December to 74.019 in March (df = 1), and in all cases were significant at the p<.000 level: in other words, highly significant. As noted earlier, a probability level of <.05 is usually significant.

V.b.3. Fishers' Other Activities

It is well documented that fishers in Puerto Rico engage in other occupations in addition to fishing. We again confirmed this in our survey, with 56% listing at least one other income-generating activity, 13.7% listing two activities, and an additional 5% to 6% listing three or more activities. This should not be surprising for recreational fishers, but the proportions for commercial fishers were only slightly lower: 47.1% listing one, 14.5% listing two, and between 4% and 7% listing three or more.

The kinds of work fishers perform is concentrated in the working classes: primarily construction work, *chiripas* (temporary jobs, which are often in construction), factory work, mechanics, and so forth, although those interviewed listed over 220 occupations, or approximately one for every two interviews. When employed outside of fishing, most often commercial fishers reported that they squeezed work into the times that they could not fish, when fishing had been poor for some time, or the opportunity arose. *"De vez en cuando,"* (From time to time) characterizes how fishers talk of working. The most common *amount* of work done outside of fishing was 20 days per month, although only 10% of the fishers said this, with most (around 70%) working less.

V.b.4. Levels of Satisfaction with Fishing

The following table shows relatively high levels of satisfaction among both commercial and recreational fishers with fishing. Over 60% of both groups are either satisfied, satisfied enough, or extremely satisfied with fishing, with satisfaction levels slightly higher among commercial than recreational fishers. It is interesting, however, that so many of the recreational fishers, over one-third, said that they were either not very satisfied or dissatisfied with fishing. This may be a response to perceived problems with the resource, which may make fishing less satisfying today than it may have been in an earlier era.

Table V.9. Level of Satisfaction by Commercial vs. Recreational Status

Level of Satisfaction	Percent of Commercial Fishers	Percent of Recreational Fishers
Extremely satisfied	12.9	15.3
Satisfied enough	22.7	14.5
Satisfied	31.1	33.1
Not very satisfied	24.3	28.2
Dissatisfied	8.4	6.5
Cannot answer	.6	2.4

We also asked respondents how difficult it might be to find work outside of fishing. Table V.10. shows that commercial fishers seem more pessimistic about the prospects of working outside of the fishing industry than recreational fishers, although neither group seems particularly optimistic, perhaps responding to Puerto Rico's extremely high unemployment rates. Nevertheless, 60% of the commercial fishers, compared to 40% of the recreational fishers, view moving from fishing into other sectors of the economy problematic.

Table V.10. Perceived Difficulty of Finding Work Outside Fishing by Commercial vs. Recreational Status

Level of Difficulty	Percent of Commercial Fishers	Percent of Recreational Fishers
Extremely Difficult	20.3	10.6
Difficult Enough	39.9	29.3
Not very difficult	19.6	29.3
Easy	10.1	17.9
Cannot answer	10.1	13.0

V.b.5. Ties with the Community

We asked several questions about economic ripple effects of fishing, including whether or not vessels, equipment, bait, and other inputs were locally purchased and maintained. The following tables illustrate that, first, of the 439 interviewed, between 77% and 88% have boats, equipment, etc. that require purchase or maintenance. In all cases but electronic equipment, the majority purchases these locally—in some cases over 90% purchase or maintain inputs locally.

Table V.11. Percentages of Fishing Inputs Purchased or Maintained Locally

Variable	Percent
Boat constructed locally? (n=371)	61.2
Boat maintained locally (n=371)	95.9
Service motor locally (n=368)	93.2
Fishing equipment purchased locally (n=385)	76.4
Electronic & navigational equipment purchased locally (n=338)	43.8
Bait purchased locally (n=379)	62.3

V.b.6. Crew Variables

With regard to the crew variables—relations between captains and crew, numbers of crew, and difficulty finding crew—we examined only those who identified themselves as commercial fishers (including charter boat captains and crew). First, most use between one and two crew members (mean = 1.80; median = 2.00), usually drawing on friends or family. The largest percentage (49.4) fish with friends, followed by those who fish with fishing partners (16.2), with children (11.9), and with brothers (7.9). Overwhelmingly, crew members are Puerto Rican, with a small minority, under 1%, from the Dominican Republic. In terms of their ability to find adequate crew, a little over half (51%) reported that it was difficult or very difficult, while a little more than one-third (37.2%) reported that it was easy or very easy (the remainder either didn't or couldn't answer).

V.c. Disposition of Catch

The data on disposition of catch, elicited and reported in percentages, should be considered with some caution. Prior to the administration of the survey, researchers familiar with the fishing industry suggested that asking for percentages would be problematic, for two reasons: one is that it's difficult to recall,

accurately, proportions that shift through the week and season; the second is that many fishers have low levels of education and are not familiar with percentages. During interviewing, interviewers confirmed that many fishers had problems with these questions.

Due to these problems, the data elicited suffer from a variety of gaps. Many respondents, instead of giving percentages, merely gave pounds. We thus present the information in narrative form, rather than focusing on specific statistics, because presenting the statistics in a table would be misleading, probably grossly inaccurate, and hence irresponsible. In this section of the questionnaire, we asked two sets of questions: one about what proportions of the catch was consumed at home, sold, given away, given to crew members, and so forth.; and the second, for those who sold fish, what proportions went to fishing associations, private markets, street vending, and so forth. In both cases, the answers given were sometimes in percentages, sometimes in pounds, and sometimes in other forms (e.g. "four to five fish"). While this vagueness may be troubling from the perspective of statistical analysis, it reflects the reality of a phenomenon that shifts through the week, season, and year.

V.c.1. Uses of Catch

When asked about home consumption, the four most common responses were that they consumed 5% of their catch (13.4% reported this), 10% (14.4%), 50% (6.6%), and 100% (15.5%). Among those who did respond with percentages, about one-third (32.9%) responded that they consumed between none and one-third of their catch; 8% responded that they consumed between one-third and two-thirds of their catch, and the remainder (around 60%) consumed between two-thirds and all of their catch.

Those who responded to the question about selling their catch (69.5% of those interviewed) were more likely to give their answers in percentages, although not always. Only 13% of these said that they sold 100% of their catch, although those who answered this question were more likely to sell most of their catch than just a small portion. Only around 4% sell between none and one-third of their catch, 7% sell between one-third and two-thirds, and the remainder, 89%, between two-thirds and all of their catch.

Only one in five interviewed answered the questions about giving catch to the crew and to the community, and these were split more or less evenly between those who answered in pounds and those who answered in percentages. In terms of fish to the crew, those who answered in pounds gave ranges from three to twelve pounds, with the most common being in the middle range of between 5 and 8. Those who answered in percentages most commonly gave between 10% and 50% to their crew. Most commonly, when fishers gave to the community, they gave between 5% and 10% of their catch, or rarely more than 10 to 20 pounds. Under 6% answered the questions on giving fish to other alternatives (e.g. customers, other uses such as to recreational fishers for bait).

V.c.2. Marketing

Of the questions about the marketing of catch, only one, about selling to the association, was answered by more than 14% of those interviewed and to most only a handful (under 10%) responded. Regarding sales to fishing associations, answered by about one-third of those surveyed, slightly less than one-quarter (22.5%) said that they sold between 90% and 100% of their catch to the association. About 5% sold between 50% and 90% of their catch to the association, and the remainder sold under 50%.

Data on the disposition of catch, though sketchy, underscore the fact that fish marketing and disposing of catch is a complex process in Puerto Rico, involving several alternatives and changing through the year. In La Parguera, one fisher told us that he occasionally gave fish to a neighbor woman who occasionally gave him a cup of coffee. In Punta Las Cucharas, we encountered a fisher who had fished all morning to provide *pulpo* for octopus salad for a birthday party that afternoon. By such examples, irregular yet significant, we can understand how it may be difficult to relate the commerce of gift and market exchange that characterizes the destinies of fish in Puerto Rico.

V.c.3. Conditions of Marine Resources

Among the goals of this research has been to assess fishers' views of the resources with which they interact on a daily, weekly, or seasonal basis. As such, we asked survey respondents to consider the health of three part of their coastal/marine environment at four different time periods, on a scale ranging from dead or absent to healthy. The three environmental components were coral reefs, fishing resources, and mangroves, and the time periods were ten years ago, five years ago, now, and five years in the future. The following tables present these data, illustrating a relatively pessimistic view of the future for all three environmental components, with 65% believing that coral reefs will be dead or nearly dead, 70% believing there will be no or few fishery resources, and 61% believing that the fate of the mangroves is no better than reefs or fishery resources. These data also suggest, however, that most of the decline in the health of these resources, in fishers' minds, occurred between 10 years ago and 5 years ago. While around two-thirds perceived these resources as healthy ten years ago, this figure fell to around one-fifth between ten years ago and five years ago and fell to around one in ten after that. That these perceptions exist and are this widespread is, perhaps, a place to begin in the process of promoting participatory management in Puerto Rico, bringing stakeholders together on the basis of shared beliefs regarding resource problems. Clearly, that these problems are perceived to exist could be an important component in re-establishing the legitimacy of the state and fishery managers.

Table V.12. Condition of Coral Reefs (n=381)*

Time	Dead/ Absent	Nearly dead	More or less healthy	Pretty healthy	Healthy	Don't Know
10 years ago	1.6	1.6	7.3	19.4	64.8	5.3
5 years ago	2.6	7.9	31.1	32.2	20.8	5.4
Today	18.5	31.6	21.5	13.3	10.9	4.2
5 years from now	47.6	17.4	11.5	7.8	10.9	4.8

*Figures are percentages

Table V.13. Condition of Fishery Resources (n=421)*

Time	Dead/ Absent	Nearly dead	More or less healthy	Pretty healthy	Healthy	Don't Know
10 years ago	.5	1.0	7.4	16.9	73.2	1.2
5 years ago	1.7	7.8	35.2	34.0	20.2	1.2
Today	16.1	39.1	23.7	11.6	9.0	.5
5 years from now	47.7	23.1	11.4	7.1	9.1	1.6

*Figures are percentages

Table V.14. Condition of Mangroves (n=371)*

Time	Dead/ Absent	Nearly dead	More or less healthy	Pretty healthy	Healthy	Don't Know
10 years ago	1.9	2.4	5.9	15.9	70.4	3.5
5 years ago	2.7	6.5	31.0	34.5	21.2	4.1
Today	19.8	29.0	22.5	14.4	11.4	2.9
Five years from now	45.4	16.0	12.0	9.5	12.6	4.5

*Figures are percentages

In terms of the perceived causes of declines in the health of marine resources, contamination or pollution emerged as the principal culprit, often in combination with construction activity, boating traffic, and trends in coastal development that result in municipal, chemical, or other sources of pollution. It was not uncommon for respondents to list multiple causes, saying, for example, that the coral reefs suffered from "the abuses of contaminants, hurricanes, and little consciousness about their health" or from "contamination, boating traffic due to tourism, and aquatic sports"—offering, in other words, complex responses that included multiple sources of degradation, some beyond the control of humans (hurricanes), some due to factors that are critical to the Puerto Rican economy (tourism), and others due to a perceived lack of "consciousness" or attention by individuals, by government officials, or others. Overall, however, contamination emerged as a cause of resource decline in over 107 responses (27.5%), followed by construction and boating traffic.

Finally, we asked fishers two questions about their economic situation: one about what percent of their income derived from activities other than fishing and a second about how their economic situation today compared to their economic situation five years ago, in part to see whether or not it reflected the health of the marine resources that, in some cases, are so much a part of their lives. Responses to the first question were confounded by the unfamiliarity with percentages among much of the population. Regarding the second question, table V.15. shows that although a sizeable number report worse circumstances, the majority reported they were the same and over 20% reported they had improved.

Table V.15. Economic Condition Today vs. 5 Years Ago (n=436)*

Economic Situation	Percent
Much better	5.7
Better	15.1
About the same	42.0
Worse	28.3
Much Worse	8.3

*Three respondents could not say.

V.d. Focus on Recreational Fishers

As we noted elsewhere, much recreational fishing takes place across the island from coastal shipping and storage infrastructure reminiscent of earlier eras in Puerto Rico's economy and from bridges, public piers, ferry terminals, and from the piers that serve Puerto Rico's commercial fisheries. In this sense, Puerto Rico's recreational fishers are less dependent on government-sponsored developments to ply their crafts, instead adapting to existing infrastructure. While we sampled at CNs, we also intercepted fishers at these

other sites during both the ethnographic and survey phases of the project. The following analysis thus represents a larger group than merely CN members.

V.d.1. Recreational Fishing Gear & Species Preferences

As with the general population of fishers, recreational fishers were introduced to the craft most often by their fathers (40.2%), friends (28.7%), or some other, unspecified person (22.1%). The following table shows that most frequently they use hooks-and-line rigs, including hand lines and rigs with poles, but that SCUBA equipment are also important. These three gear types represent nearly two-thirds of all recreational fishers, with a minority using traps, nets, or other rigs that catch large numbers of fish at one time. Those who fish with the most popular gear catch primarily species from the snapper-grouper complex, including, most frequently, silk snapper (14%) and yellowtail snapper (12%). Recreational SCUBA divers, on the other hand, tend to heavily target shellfish: lobster (23.1%) and conch (15.4%).

Table V.16. First Gear of Choice Among Recreational Fishers (n=125)

Gear Type	Percent who Use Now	Percent who Used 5 years ago
Hooks & Lines*	40.0	41.4
Cane pole	14.4	12.9
SCUBA gear	10.4	10.3
Fish Traps	5.6	5.2
Beach seine	4.8	6.9
Gill net	4.0	5.2
Cast net	3.2	2.6
Multihook rigs	3.2	.9
Other	5.6	6.0

*Respondents distinguished between cane poles and hook & line rigs.

We noted earlier that a little over two-thirds of recreational fishers use two gear types and around one-third use three gear types, yet in the secondary and tertiary gear categories the same principal gear appears as most important: hooks & lines. Nets and traps become more important in the secondary gear category, tying for the second most common secondary gear named, and in the tertiary gear category free diving is the second most common fishing style mentioned. Overall, however, the recreational fishery is primarily a hook & line fishery. This has not changed significantly in the past five years, nor have the species captured with these gear types. Indeed, over 80% reported that they had made no change to their fishing operations in the past five years.

Of the 17.4% who did mention making changes to their fishing in the past five years, the majority (15 of the 21 reporting changes, or around 71%) reported modernizing their equipment. Of the others, two simply reported "other," one said there had been changes in the resource, one said changes in fishing regulations changed his fishing, one blamed rising expenses associated with fishing, and the final person blamed personal problems.

V.d.2. Employment and Household Characteristics

Beyond the quarter or so of the recreational sample who either did not answer the question about their occupation or answered that they were retired, recreational fishers in Puerto Rico do not cluster in any

specific occupation or class, but come from many walks of life, from teachers, physicians, and other professionals to skilled workers such as masons to government employees, firemen, police, unskilled laborers, and the self-employed. Nearly every industrial sector—medical, legal and other professional services, education, manufacturing, construction, agriculture, government, transportation, business—was represented in the list of occupations recreational fishers gave. We elicited 76 different occupations, with few occupations represented by more than one person; at the same time, declining percentages reported more than one occupation, with only 12% listing two, 4% listing three, and only one individual, under 1%, listing four. Clearly, this range of backgrounds among our informants suggests that recreational fishing touches several segments of Puerto Rican society and likely satisfies needs ranging from leisure to supplemental food.

Recreational fishers are not remarkably different from the total population in terms of their household characteristics, except that slightly fewer are married and slightly more are single. Their households are neither appreciably larger nor smaller than the total either. Interestingly, however, nearly half the population reported that they earned some income from fishing, confirming that selling fish may not be uncommon among recreational fishers in Puerto Rico. Many times during our ethnographic work commercial fishers complained that recreational fishers sold portions of their catch, often at reduced rates simply to cover some of their trip costs, and that this practice depressed the market price for fish.[30]

Table V.17. Recreational Fishers' Marital Status and Household Characteristics (n=126)

Marital Status	Percent
Married	60.0
Single, never married	24.8
Divorced	8.8
Widowed	2.4
Other	3.2
Mean Household Size	3.37 (sd = 1.614)

Supplemental income from recreational fishing may be important in some households, however. About one-quarter of the recreational fishers household do not have individuals working, and the mean number of people working in the households was 1.35 (s.d.=1.294). Among the retired or unemployed, fishing may provide not only necessary high quality protein but may also add to incomes that are otherwise low and usually fixed.

V.d.3. Economic Ripple Effects of Recreational Fishing and Fishing Partners

Around 70% of the recreational fishers interviewed have vessels; of these, 60% reported that their vessels were purchased or constructed locally and nearly 90% (87.6%) report that their vessels are maintained locally. In so far as maintenance might include storage, we noted in the ethnographic work that boat storage has become a large source of revenue for coastal communities generally and for some fishing households in particular. Stored recreational boats have become a ubiquitous part of eastern La Parguera, where most of the fishing families have their homes. Table V.18 shows that similar percentages apply to motor maintenance and fishing gear purchases, but that recreational fishers purchase bait and electronic gear locally with less frequency.

[30] Another explanation for this finding may be that some commercial fishers identified themselves as principally recreational because they feared that identifying themselves as commercial might jeopardize their receipt of government assistance.

Table V.18. Use of Local Business for Vessels, Gear, and Services among Recreational Fishers

Local Ripple Effect	Percent Reporting	Percent Using Locals
Vessel Construction	71.4	87.6
Vessel Maintenance	70.6	87.6
Motor Maintenance	70.6	87.6
Fishing Gear	80.1	86.1
Electronic Gear	65.1	48.8
Bait	80.1	68.3

Recreational fishers tend to fish with between 2 and 3 others (mean = 2.3; sd = 1.338). Overwhelmingly, recreational fishers fish with friends rather than family, with nearly 70% reporting "amigos" or "amigas." The second most common category was "fishing partner" (7.6%) and the third siblings (4.3%). No other kind of relative was reported by more than one or two respondents.

V.d.4. Recreational Fishers' Views of Marine Resources and Protective Measures

The above section presented data for the entire sample regarding respondents' views of the health of three types of marine resources: coral reefs, fishery resources/ fish stocks, and mangroves. These data suggested that only around 11% of respondents viewed coral reefs as healthy, less than 10% viewed fishery resources as healthy, and a little more than 11% viewed mangroves as healthy. The following tables show that recreational fishers do not deviate greatly from the general population, seeing more or less precipitous declines in the health of all three types of resources over the past ten years and the cascade continuing into the future, if perhaps less rapidly.

Table V.19. Recreational Fishers' Perceptions of Condition of Coral Reefs (n=100)*

Time	Dead/ Absent	Nearly dead	More or less Healthy	Pretty healthy	Healthy	Don't Know
10 years ago	1.0	1.9	3.8	21.2	61.5	10.6
5 years ago	2.9	3.9	33.0	32.0	18.4	9.7
Today	15.4	33.7	24.0	6.7	12.5	7.7
5 years from now	40.0	22.0	12.0	7.0	11.0	8.0

*Figures are percentages

Table V.20. Recreational Fishers' Perceptions of Condition of Fishery Resources (n=119)*

Time	Dead/ Absent	Nearly dead	More or less Healthy	Pretty healthy	Healthy	Don't Know
10 years ago	0	2.5	2.5	13.4	78.2	3.4
5 years ago	2.5	8.4	38.7	24.4	22.4	3.4
Today	14.9	45.4	18.2	9.1	9.9	2.7
5 years from now	45.0	25.2	11.7	5.4	9.9	2.7

*Figures are percentages

Table V.21. Recreational Fishers' Perceptions of Condition of Mangroves (n=101)*

Time	Dead/ Absent	Nearly dead	More or less Healthy	Pretty healthy	Healthy	Don't Know
10 years ago	2.9	2.9	3.8	15.2	67.6	7.6
5 years ago	2.9	8.7	30.1	33.0	17.5	7.8
Today	20.0	31.4	21.9	10.5	11.4	4.8
Five years from now	41.6	18.8	10.9	10.9	10.9	6.9

*Figures are percentages

Perceived causes for the declines in coral reefs were also similar to the general population, in that, most often, over 25% of the time, recreational fishers cited contamination deriving from construction, boating traffic, industrial pollution, or poor waste and water treatment practices by municipalities or hotels. Contamination was also cited frequently as a source of problems with fish stocks, but other causes included overfishing, abuse of or lack of knowledge of regulations by fishers, the taking of small fish, and the use of certain gear, such as nets, that captured protected species indiscriminately. Finally, regarding mangroves, construction of coastal hotels and other coastal development, and its resulting contamination, emerged as the overwhelming causes of mangrove destruction. Included in this list was the mining of sand for construction projects, something that was mentioned in the ethnographic work as well. Again, these responses were not very different from the general population.

Regarding the MPAs, the following table shows the percentage of recreational fishers familiar with the various MPAs. It suggests relatively low levels of interaction with MPAs by recreational fishers, particularly regarding those in the U.S. Virgin Islands. No fishers we interviewed had ever fished the USVI MPAs.

Table V.22. Recreational Fishers' Familiarity with MPAs

MPA	Percent Familiar with MPA
Boya 8/ Tourmaline	21.4
Bajo de Sico	15.9
Abrir la Sierra	17.5
Mona/ Monito	15.9
Desecheo	16.7
Canal de Luis Peña	20.6
Laguna Condado	15.1
St. John's Park	0
Hind Bank	0
St. James Marine Reserve	0
Grammanik Bank	0

In terms of MPA functions, a majority of recreational fishers in general agreed strongly that each of the MPAs served its purpose of protecting fish stocks, but their responses were more mixed when it came to the social and economic impacts of MPAs. Few (usually around 10%) said that MPAs adversely affected them personally, but more (usually around 30%) agreed that MPAs would have detrimental consequences for communities that depended on fishing. These results are similar to those for the total population, which we present in our policy discussion.

V.e. Focus on Subsistence Fishers

While only 14 fishers identified themselves as fishing exclusively or primarily for food, this section of the report focuses on 68 fishers who reported that 100% of their catch provides food to their household. This is an important subgroup because of the high levels of unemployment in Puerto Rico and the importance of fish as a high quality source of protein that may be secured with little energy expenditure. While we are not arguing that these 68 fishers are necessarily poor, unemployed, or in desperate need of supplemental food, we do suggest that those who use their catch exclusively to feed their families offer insight into the business of fishing specifically for food.

V.e.1. Recreational Fishing and Gear & Species Preferences

Fathers and friends, for this group, were no less important as mentors in fishing than they were for the total sample or the other two groups of fishers. Forty percent of subsistence fishers listed fathers and 33.8% listed friends, with another 20% listing "other," and other relatives mentioned by only around 6% of the group. These figures were nearly identical to those mentioned by recreational fishers, as are the gear types they prefer to use. Subsistence fishing is done primarily with hooks and lines and cane poles, and has not changed much over the past five years.

Table V. 23. First Gear of Choice Among Subsistence Fishers (n=68)

Gear Type	Percent who Use Now	Percent who Used 5 years ago
Hooks & Lines	39.7	40.6
Cane pole	20.6	17.2
SCUBA gear	5.9	6.3
Fish Traps	1.5	3.1
Beach seine	5.9	6.3
Gill net	1.5	1.6
Cast net	2.9	1.6
Multihook rigs	4.5	4.8
Other	17.5	18.5

Target species included the several snapper-grouper species most commonly (reported by around 40%), which should not surprise us, given their preference as food fish, yet a few pelagic species also showed up in the list of most commonly caught species. Dorado (dolphin), in fact, was the most commonly mentioned (7.4%) fish—a fish which is both fun to catch and excellent eating, as well *sierra/carite* (king mackerel), which was caught 5.9% of the time. Missing from the list entirely was conch, and only one subsistence fisher reported landing lobster. Subsistence fishing is thus a fish fishery rather than a shellfish fishery.

The fishery has been remarkably stable over the past five years, too. Over 90% reported making no changes to their fishing styles or the gear they used. Those who had made changes had done so to modernize their equipment or because the resource or regulations had changed. Three-fourths of this group expressed some level of satisfaction with fishing, with 40% either very or extremely satisfied; only 4.5% were dissatisfied with subsistence fishing. It is, evidently, meeting most of the participants' expectations and desires.

V.e.2. Employment and Household Characteristics

Subsistence fishers were unevenly split over the question of whether or not it was difficult to find work outside of fishing, with around 30% saying it was, 60% saying it wasn't, and the rest having little or no idea. One quarter were either retired or unemployed, and the others clustered in no specific occupation: of the 51 remaining we elicited 43 occupations. Subsistence fishers did, however, seem to cluster more in working class, skilled or semi-skilled, occupations: construction workers, mechanics, maintenance or janitorial work, police, plumber, and so forth.

Slightly fewer subsistence fishers than recreational fishers are married, 55.9%, and slightly more, 13.2%, are divorced. Their households are not significantly larger or smaller than the other groups, nor are they any more likely to have a greater number of employed people, either in or out of fishing.

V.e.3. Economic Ripple Effects of Subsistence Fishing

Subsistence fishers are less likely to contribute to their local economies than either recreational or commercial fishers. Table V.24 shows that most who have vessels purchase them elsewhere, although they tend to have them and their motors serviced locally. Still, the levels are below those that we find among the other groups.

Table V.24. Use of Local Business for Vessels, Gear, and Services among Subsistence Fishers (n=68)

Local Ripple Effect	Percent Reporting	Percent Using Locals
Vessel Construction	64.7	36.3
Vessel Maintenance	63.2	81.3
Motor Maintenance	63.2	79.0
Fishing Gear	78.0	88.7
Electronic Gear	58.8	42.5
Bait	73.5	78.0

Subsistence fishers do not differ from recreational fishers regarding their fishing partners, fishing with between two and three individuals and in most cases (75.6%) with friends. Slightly over 10% (12.3%) fish alone, although this figure may actually go as high as 26%, if we include those who didn't respond to the question ("How many people normally fish with you during a typical fishing trip?"). That is, if they fish alone they might not have considered the question applicable to them.

V.e.4. Subsistence Fishers' Views of Marine Resources and Protective Measures

A majority of subsistence fishers, slightly over 60%, in line with recreational fishers, viewed coral reefs, fishery resources, and mangroves as healthy 10 years ago but then perceived a precipitous drop from 10 to 5 years ago in their health and other, less precipitous drops from 5 years ago to today and from today to 5 years in the future. These are in nearly complete alignment with responses of recreational fishers, as are the reasons they give for the failing health of marine resources (e.g. contamination, boat traffic, etc.). Similar comments apply to their views of MPAs.

V.f. Focus on Commercial Fishers

In this section we focus on the 256 fishers who satisfied two criteria. First, they self-identified as commercial fishers—including captains and crew—and, second, they were selected randomly from the fisher census. We believe that this sample constitutes an accurate representation of all Puerto Rican commercial fishers, constituting roughly between 10% and 20% of the total population. Most of those interviewed (87.8%) identified themselves as vessel captains, while the remaining 12.2% identified themselves as crew. Commercial fishers do not deviate in any way from the overall sample in terms of who introduced them to fishing, with around half citing their fathers and around 20% each citing "other" or "friends"—these three categories thus make up 90% of the responses. Another 5% learned from in-laws, which is slightly higher than the total sample and which was a fishing relationship that Griffith and Valdés found to be important during their study (2002), particularly in cases where fishers married the daughters of other fishers and the daughters were themselves actively involved in fishing in some capacity (e.g. fishing, staffing a seafood market, making handicrafts from marine materials).

V.f.1. Gear & Species

As is common among small-scale U.S. fishers, Puerto Rican fishers use multiple gear types to target multiple species. Here we find that the majority of commercial fishers use at least three principal gear types and target a variety of species. Nearly 90% (84.8%) use more than one gear, 62.9% use more than two gear, 38.3% use more than three, and 22.3% use more than four. Table V.25 shows the use of the top three gear types during the survey year (2005) and five years prior to the survey (2000):

Table V.25. Gear Use among Commercial Fishers, 2005 and 2000

Gear	% 1st 2005	%2nd 2005	%3rd 2005	%1st 2000	%2nd 2000	%3rd 2000
Beach Seine	10.7	3.7	3.1	13.1	3.3	1.9
Gill net	14.6	13.4	7.5	13.9	13.4	9.0
Trammel Net	1.2	7.4	3.1	.8	7.2	3.9
Cast net	5.9	5.5	9.9	5.3	7.2	9.7
Lobster pot	2.8	4.1	6.2	2.4	5.3	6.5
Fish trap	15.8	13.8	9.9	15.9	12.9	9.7
Palangre*	13.5	13.5	15	13.4	11	14.1
Hook & line	18.2	19.8	23.6	17.1	22.0	22.6
Free diving	2.4	6.0	3.7	2.4	5.7	3.9
SCUBA	7.5	3.7	6.2	7.8	4.8	5.8
Spear	1.2	1.4	5.6	.8	.5	6.5
Cane pole	.4	0	0	.8	0	0
Other	5.9	7.8	6.2	6.1	6.7	6.5

*One of two varieties of long lines that is weighted with multiple hooks, its hooks arranged either parallel or perpendicular to the bottom, sometimes called a trot line (see Matos-Caraballo & Torres Rosaldo 1989).

Combining all the hook-and-line rigs, we find that such rigs are and were clearly in the majority, although nets and traps constitute important supplements to hooks & lines. This makes sense, of course, from a time input perspective, in that traps, gill nets, and trammel nets are stationary gear, allowing fishers to fish with hook & line rigs, SCUBA, or free diving while their other gear are soaking. *Palangre* rigs are also stationary gear, allowing time to use other hook & line rigs while they are soaking, and their popularity attests to the popularity of multiple-hook rigs in general among this population. Here they are cited as 1st

gear of choice among 13.5% of the population, and similar proportions list them as their 2nd and 3rd choices. This contrasts with the recreational sample, under 5% of which reported using multiple-hook rigs.

Examining these data in somewhat more depth confirms that fishers do seem to be using multiple gear at the same time. Over one-third (37.5%) of those who report traps as their primary gear report using hook & line rigs for their secondary gear, and another 32% reported hook & line rigs as their third gear. From our ethnographic work we know that fishers also shift among gear during the course of the year, as pelagic species come and go through the Caribbean or as the seasons for various species, or various MPAs, open and close.

Regarding the types of fish commercial fishers catch, at least 45% listed various snapper-grouper species as their first most commonly caught species, with silk, yellowtail, and lane snappers the most common (*chillo, colirrubia,*and *arrayado/ manchego*).[31] Of all the snapper-grouper species, grouper varieties were far less common than snapper varieties, with the generic name *mero* accounting for only 4.7% of the total (snappers, that is, account for slightly over 40% of the total). It is also interesting to note that only one fisher admitted to landing red hind, whose spawning aggregations underlie the creation of several of the MPAs off the Puerto Rican and US Virgin Island coasts. Other grouper species (e.g. Nasau) are also protected in these waters. These low reported landings of grouper may thus suggest that the restrictions against landing grouper have been effective. Two other commonly listed first species among commercial fishers are lobster/ *langosta* (13.7%), kingfish or king mackerel/ *sierra o carite* (7.4%), and conch/ *carrucho* (5.9%). There were no dramatic differences between the species fishers caught in 2005 and in 2000; during both time periods, snapper-grouper species predominate, followed by lobster, kingfish, and conch.

Certain gear types favor certain species or groups of species, of course. For example, if we focus only on those who listed SCUBA gear as their first gear of choice, landings of lobster and conch increase dramatically, to 36.8% and 26.3% respectively. Trap fishers also tend to catch more lobster, with 25% reporting it as their most commonly caught species, although over 40% continue to catch snapper-grouper varieties as well. Hook-and-line fishers, on the other hand, report little to no lobster or conch, but higher percentages of snapper-grouper varieties (58.6%). Finally, those reporting multiple-hook gear as their gear of choice (long lines or *palangre* rigs) overwhelmingly (76.3%) report capturing snapper-grouper species.

V.f.2. Levels of Satisfaction with Fishing, Views of Finding Work Outside Fishing, and Work Outside Fishing among Commercial Fishers

We present these data together because they may be, in some sense, reflections of one another: that is, satisfaction with fishing may reflect perceived and real occupational alternatives. On the one hand, some fishers who believe it is difficult to find work outside of fishing may be satisfied with fishing because, at

[31] These **particular** snapper species may not be exactly those fishers meant in response to this question. *Chillo,* for example, is often used generically, like *pargo*, to refer to several varieties of snapper (family *Lutjanidae*). In addition, species nomenclature varies from place to place across the island and the same fish can be called by different names in different places. We also say that "at least 45%" listed these species because a minority answered even more generically, saying they catch "fish/*pescado.*"

least, they have some work. Others, however, may feel trapped in fishing because of a lack of other occupational pathways.

We have already shown, in table V.9 above, that two-thirds of commercial fishers are satisfied with fishing, though only just a little more than 10% are extremely satisfied and just under one-third of the total just "satisfied." Table V.26 compares commercial fishers grouped by level of satisfaction in terms of their views of how difficult it is to find work outside of fishing. Although chi-square analysis finds that the proportions are not significant for the entire sample, the figures do suggest some interesting differences. If we confine our comparison to only the first column, we see that higher proportions of those dissatisfied with fishing believe that it is "extremely difficult" to find work outside of fishing, over 65% compared to only around half of those satisfied with fishing.

Table V.26. Satisfaction with Fishing by Perceived Difficulty to Find Work Outside of Commercial Fishing (n=228)

Satisfaction & Perceived Difficulty	Extremely Difficult	Difficult	Not Difficult	Easy
Extremely Satisfied	19.4	45.2	16.1	19.4
Satisfied Enough	16.7	51.9	20.4	11.1
Satisfied	15.4	52.3	24.6	7.7
Dissatisfied	26.7	50.0	13.3	10.0
Very Dissatisfied	38.9	22.2	27.8	11.1

Chi-square = 13.653; df = 12; p=.323 (not significant)

As with most commercial fishers in Puerto Rico, many of those in our sample, as well as those we interviewed in our ethnographic work, are currently working outside of fishing. Nearly half (46.5%) reported other work besides fishing, another 15% to 20% reported more than one additional occupation. The most commonly reported occupations were in the construction trades, listed by around 20% of those surveyed. This included masons, carpenters, welders, plumbers, cabinetmakers, painters, manual laborers, and those who listed merely "construction work" as their alternative activity. An additional 5% listed mechanical trades, associated with either auto or boat mechanics, and another 2 to 3% listed factory work. As this list suggests, fishers did not cluster in any particular occupation, listing a total of 63 primary occupations and another dozen or more secondary and tertiary occupations, although they did seem to work primarily in working class or blue collar type occupations, with only one, a dentist, listing a somewhat more lucrative profession.

At the household level, occupational multiplicity becomes more complex, but just slightly. When asked how many people in the household earned incomes from fishing and from other pursuits (including the person being interviewed), commercial fisher responses resulted in an average of 1.53 (s.d. = 1.07) for the first and .89 (s.d. = 1.035) for the second. This suggests that fishing occupies the time and effort of other household members in some cases, and that in fewer cases other household members contribute to household incomes with other jobs. In general, fishing occupies the core income source for most of the sample, yet we cannot discount the importance of other income, which may be subsidizing fishing operations. Specifically, around two-thirds (64.3%) of those interviewed reported only one person earning income from fishing, and slightly more than half, 56.5%, reported income from other sources contributing to household well being.

With average household sizes just over three persons (not significantly different from recreational or subsistence fishers), extrapolated to the total population of commercial fishers, these data suggests that commercial fishing supports, at least partially, between 4,500 and 7,800 people in Puerto Rico, depending on whether or not one accepts the 1,500 or 2,500 figure for the total number of fishers.[32] Because 56.5% of fishing households earn income from other sources, however, the number of persons wholly dependent on fishing are somewhat lower. If we extrapolate from the percentage of households that report income solely from fishing (43.5%), then we can estimate that between 2,035 and 3,393 Puerto Ricans depend completely on commercial fishing.

These figures do not account for the so-called ripple effects of this support: the extent to which fishing households purchase goods and services locally and, over generations, produce individuals who make additional socially beneficial contributions to Puerto Rican society, as police, fire personnel, teachers, scientists, and so forth. While we could make the same argument for nearly any job in Puerto Rico, we mention this here because fishers typically point to the success of their children as being a direct result of their ability to raise them on fishing. Along with Griffith and Valdés Pizzini (2002), during this work we encountered families of fishers that had produced highly educated, skilled individuals as well as a variety of productive members of society occupying positions in many sectors of the Puerto Rican economy.

V.f.3. Economic Ripple Effects of Commercial Fishing

Like recreational fishers, a majority of commercial fishers in Puerto Rico contribute to local economies through fishing-related expenditures. This is particularly true with maintenance, which is certainly more costly for commercial than recreational fishers. A lower proportion of commercial fishers have their vessels constructed locally,[33] however, and gear and bait purchases are, not surprisingly, lower.

Table V.27. Use of Local Business for Vessels, Gear, and Services among Commercial Fishers (n=256)

Local Ripple Effect	Percent Reporting	Percent Using Locals
Vessel Construction	92.0	70.6
Vessel Maintenance	92.5	98.3
Motor Maintenance	91.4	94.4
Fishing Gear	92.6	70.9
Electronic Gear	83.2	43.2
Bait	90.2	59.7

Clearly, many fishers make their own gear and capture their own bait, which accounts for this difference between recreational and commercial fishers. We know from previous research and from our ethnographic work that a large proportion of recreational fishers purchase bait from commercial fishers. During our research we encountered a few commercial fishers who specialized in catching and selling

[32] We calculated this quite simply, multiplying the mean household size by 1,500 (3.12 x 1500 = 4,680) or by 2,500 (3.12 x 2500 = 7,800). For the lower figures, we calculated these amounts with 43.5% of 1,500 and 2,500.

[33] This may be due to differing interpretations of the word "local," which may mean Puerto Rico to some yet the municipality or region for others. We do know from our ethnographic work that some boat builders build boats for fishers in municipalities some distance from them, and may not be considered local by respondents.

bait, including one that supplied a prominent marine supply store in Ponce, where many recreational and charter boat fishers bought bait.

V.f.4. Crew Dynamics among Commercial Fishers

In spite of the fact that the largest percentage (50%) of commercial fishers listed "friends" as their crew, they are more likely to fish with other family members than either subsistence or recreational fishers. Family members were the second most common category (30.6%), with son or daughter being the most common type of family member (12.9%). Another 16.7% listed "fishing partner." Overwhelmingly, crew are ethnically Puerto Rican, with under 1% mentioning Dominican crew.[34]

These statistics confirm that family still plays a powerful role in the reproduction of fishing households, with parents not only teaching children, as statistics we presented earlier show, but also, in many cases, working with them on vessels as crew. A few fishers, around 10%, fish alone, but most commercial fishers (around 70%) fish with either one or two other crew members and 16% reported fishing with three.

Finding reliable crew, unfortunately, can at times be difficult. Pretty close to two-thirds said that it was either very difficult or difficult to find crew, while another 28% said it was not difficult and around 8% said it was easy. The difficulty of finding crew may be due to the tendency for fishers to move among fishing and other occupations, choosing to fish or not to fish as a crew member depending on the employment opportunities outside of fishing. The fact that many jobs outside of fishing are *chiripas*, or odd jobs, makes it easy to move between the two regularly, without the paperwork and other hiring protocols associated with work in the formal economy.

V.f.5. Disposition of the Commercial Catch

We noted in an earlier section that deciphering marketing behavior was difficult because many of those surveyed did not understand percentages and instead offered responses to questions about the amounts they sold, consumed, gave away, etc. with statements like, "5 pounds," "a few fish," or "most." Over 10% of the commercial group did not even answer the question about how much they sold to the market, but those who did answer this question were more likely to answer in percentages than those who responded to questions about percentages they kept for household consumption, percentages for gifts, and so forth.

Among those who answered in percentages, the most common two responses were 100%, reported by 20.3% and 90%, reported by 20.3%. An additional 10.2% reported selling 75% of their catch. Overall, 75.8% of those who responded to this question said they sold 75% or more of their catch, which corresponds, roughly, to our sense of the disposition of catch from the ethnographic work. That is, it is probably the rare fisher who sells 100% of his or her catch. Most fishers we interviewed during the ethnographic phase of the project reported giving away some of their catch to neighbors, elderly, family,

[34] Ethnicity in Puerto Rico is a complicated phenomenon and something that asking direct questions about in a survey rarely elicits reliable data. The African consciousness of Loíza fishers, for example, does not translate into people classifying themselves, or others classifying them, as African American or black, as people have a tendency to do on the United States mainland. Instead, Puerto Ricans inevitably identify themselves as Puerto Rican or, sometimes, as "Hispanic" or "Latino."

etc. and we heard in several locations that fish consumption made up substantial portions of the diets of fishers and their families. We also witnessed a great deal of fish consumption among fishers during our fieldwork.

Another way to approach these data is to examine the proportions of commercial fishers who answered the different questions about disposition of catch, making the assumption that those who did not answer the question did not because it was irrelevant to their behavior. Table V.28 shows these percentages, demonstrating that nearly 90% answered that they sell fish to "the market," which includes more than one of the fish market's dimensions: from fishing associations to selling from one's house. Yet the ranking conforms, more or less, to our sense from the ethnographic work of how fish gets distributed around the island from commercial fishing. That is, based on our ethnographic work, we would have predicted that household consumption and for the support of associations are two of the most important ways that fish are utilized around the islands, and that fish given to crew, the community, and sold to restaurants would also rank highly (although we would have thought more would have responded giving fish to their crew). These figures nevertheless testify to the important role that fish and seafood play in Puerto Rico, most of it, as fishers report, being channeled toward socially beneficial ends.

Table V.28. Rank Ordering of Disposition of Catch Based on Percent Responding (n=256)

Catch Disposition	Percent Responding
Sells some or all fish to "the market"*	87.1
Uses some fish for household consumption	74.2
Sells some or all fish to association	39.1
Gives some fish to crew	18.4
Gives some fish away in the community	17.2
Sells some fish to restaurant(s)	15.6
Sells some fish from own house ("Hay pescado")	14.5
Sells some fish to fish dealer	12.5
Sells some fish along the highway	10.5
Other outlets**	<10/outlet

*This could include some of the other marketing outlets mentioned below (e.g. association, fish dealer)

**This included private fish market, large company or supermarket, selling from the pier, etc.

V.f.6. Commercial Fishers' Views of Marine Resources

Due to their daily or nearly daily interaction with marine resources, we believe that commercial fishers' understandings of coral reefs, fishery resources, and mangroves are very likely more highly developed and more thoughtful than those of either recreational or subsistence fishers. We do not mean to belittle the opinions of the other two groups about these elements of the marine environment, yet most anthropological and sociological work on commercial fishing families and communities would attest to the fact that commercial fishers' knowledge of the marine environment is highly sophisticated precisely because they depend on that knowledge to predict fish behavior, understand and respond to problems with marine environments, and stay in business. Quite simply, their survival depends on such knowledge, and there are selective processes at work that enable some fishers to continue commercial fishing while others cannot compete.

With this in mind, we present the same statistics for commercial fishers as we presented for recreational fishers above, in Tables V.19-V.21.

Table V.29. Commercial Fishers' Perceptions of Condition of Coral Reefs (n=226)*

Time	Dead/ Absent	Nearly dead	More or less healthy	Pretty healthy	Healthy	Don't Know
10 years ago	1.8	1.8	9.3	19.8	63.9	3.5
5 years ago	2.2	11.1	29.2	31.4	21.7	4.4
Today	19.3	30.5	20.6	16.6	9.0	4.0
5 years from now	44.1	14.7	12.3	8.5	10.0	10.4

*Figures are percentages

Table V.30. Commercial Fishers' Perceptions of Condition of Fishery Resources (n=248)*

Time	Dead/ Absent	Nearly dead	More or less healthy	Pretty healthy	Healthy	Don't Know
10 years ago	.8	.4	10.4	19.2	69.2	0
5 years ago	1.2	8.4	35.3	36.5	18.1	.4
Today	19.9	37.1	23.8	14.5	7.3	.4
5 years from now	48.1	21.3	11.5	8.1	8.1	2.9

*Figures are percentages

Table V.31. Recreational Fishers' Perceptions of Condition of Mangroves (n=218)*

Time	Dead/ Absent	Nearly dead	More or less healthy	Pretty healthy	Healthy	Don't Know
10 years ago	.8	2.7	6.4	18.7	68.9	2.3
5 years ago	1.8	6.4	29.8	37.2	21.6	2.2
Today	17.1	27.6	23.5	18.0	10.1	3.7
Five years from now	41.7	14.2	13.3	9.5	12.8	8.5

*Figures are percentages

Like recreational fishers, commercial fishers view marine resources as generally in poor shape, with most seeing the drop in resource health occurring most precipitously between 10 years ago and 5 years ago. Again, the most common reasons that commercial fishers cited for declines in marine resource health were contamination (22.6%) from construction and boating traffic, also implicating anchoring behavior in the destruction of coral reefs.

V.f.7. Impacts of MPAs on Commercial Fishers

We present data on the impacts of MPAs in the policy section that follows, yet here we present data only on the socioeconomic effects of MPAs among commercial fishers. This is because, nearly universally, fishers express strong agreement or at least some agreement that the biological objectives of the MPAs have been met, yet have more mixed feelings about the social and economic impacts. We asked survey respondents whether or not the MPA created problems for themselves specifically or for communities that depend on fishing, or whether or not they created opportunities for employment or investment. Table V.32 presents these data for those MPAs that fishers we interviewed were familiar with:

Table V.32. Percent of Commercial Fishers Who Agree or Strongly Agree with Social Impacts of MPAs

MPA	Creates Problems for Respondent & Family	Creates Problems for Community	Creates opportunities of Employment & Investment
Tourmaline(n=197/ 77%)*	**37.3**	**52.6**	**27.1**
Bajo de Sico (n=198/ 77%)	**36.2**	**53.5**	**20.7**
Boya 6 (n=56/ 22%)	**33.4**	**49.2**	**26.4**
Mona (n=209/ 82%)	**29.7**	**21.3**	**21.3**
Desecheo (n=199/ 78%)	**42.1**	**52.7**	**22.8**
Luis Peña (n=49/ 19%)	**26.6**	**37.8**	**43.6**
Condado (n=45/ 18%)	**31.1**	**35.0**	**24.3**
St. Johns (n=25/ 10%)	**32.0**	**36.0**	**21.7**
Hind Bank (n=21/ 8%)	**38.1**	**47.6**	**15.0**
St. James (n=25/ 10%)	**36.0**	**37.5**	**43.4**
Grammanik (n=21/ 8%)	**38.1**	**40.0**	**20.0**

*Refers to number & percent familiar with the MPA.

Extrapolated to the population of Puerto Rican fishers who fish off the west coast (approximately 50%), these figures suggest that between 250 and 300 fishing families have been negatively impacted by Tourmaline and Bajo de Sico.[35] Desecheo has been slightly more disruptive, creating problems for between 300 and 350 families, and La Mona slightly less, creating problems for around 250 families. We need to consider, however, that these negative impacts are not spread evenly over Puerto Rico, but are likely concentrated in the western municipalities. In fact, one third of those who reported being negatively impacted by Tourmaline were from Cabo Rojo, and another one-third from Rincón and Mayagüez.

As we move east, the MPAs seem to have affected fewer people, with Luis Peña and Condado causing problems for around 100 families each and the Virgin Islands MPAs negatively affecting between 50 and 100 families each. It is interesting that both the Luis Peña and St. James reserves are seen as being generally beneficial, with greater percentages saying that they created opportunities for employment and income (presumably through tourism) than believed they were causing problems. These were, however, the only two MPAs so designated.

[35] Assumes a figure of 2,000 total commercial fishers (x 77% who are familiar with the MPA = 1,540 x 37.3% who reported being negatively impacted = 574.42).

Fishers' Perceptions of the Performance of Marine Protected Areas of Puerto Rico and the U.S. Virgin Islands

In the first paragraphs of this report, we noted that our work was intended to profile the fishing communities of Puerto Rico with special attention to the ways in which they have been affected by Marine Protected Areas (MPAs). MPAs, according to the National Science Council, are specified territories in marine environments "designated for special protection to enhance the management of marine resources" (2001: 1). They are, in other words, fishery, habitat, and even cultural resources management tools, and they have been growing in importance worldwide over the past two decades. MPAs may be in force year-round, indefinitely, seasonally, or on a temporary basis (for example, until fishery managers perceive stock recovery). As such, MPAs are *part of* broader management regimes that include several other measures, including licensing requirements, reporting requirements (often tied to licensing), size requirements on specified species, gear modifications, and so forth. MPAs, however, constitute a departure from species-specific fishery regulations, emphasizing the importance of protecting habitat as well as the fish, shellfish, and other marine resources within the MPA. They reflect an ecosystem approach to management, rather than one that focuses on individual species whose stocks may be in decline at a given time, however much they may be justified as protective measures for specific threatened species. For example, several MPAs of Puerto Rico are designed to protect red hind spawning aggregations, yet they also protect other species that share territory with the red hind. It is this aspect of MPAs—their protection of fish stocks that may not be threatened—that many fishers oppose.[36] MPAs can be designated by federal or local agencies, with the burden of enforcement therefore falling to either federal or local enforcement agencies. Thus, just as fishing families and communities are intertwined with many other components of coastal society, MPAs are intertwined with many other management initiatives, levels of government, past performance of government representatives or agencies, and enforcement measures.

The location of MPAs, as with many fishery management measures, is nearly always a contested process, although at least two factors influence the extent of support for or opposition to an MPA: first, the more resource users believe their needs have been considered in the design of the MPA, the more likely they will support it; second, the more the scientific justification for an MPA coincides with resource users' knowledge of the marine environment being protected, the more likely users will support the MPA (Guerrón-Montero 2005; Berkes 1999; Blount 1999). In Puerto Rico, as in other locations where commercial fishers and others justify fishing on moral grounds, as a productive endeavor oriented toward socially beneficial ends, MPAs and other marine resource regulations, to be acceptable to resource users, must also not appear wasteful or misguided.

Opposition to MPAs usually reflects the failure of one or more parts of MPA development, including its specific design (size, shape, time of year, etc.), its objectives, its implementation, the education associated with implementation, and the manner in which it is enforced. Opposition to any one of these parts of

[36] This is both in line with and contradictory to a prevailing view of fishers toward the marine environment: on the one hand, fishers tend to possess a broad, ecosystem view of marine habitat, understanding the complexity of interactions among the components and the many factors that contribute to resource health and decline. This view would recommend protecting habitat instead of individual species. On the other, fishers understand well predator-prey relationships in an environment, and they may view the overprotection of individual species that may not be threatened as potentially upsetting the balance of predator-prey relationships, favoring some predators over others. The observation that fishers' knowledge tends to be highly localized is a step toward resolving this contradiction, however, in that, *within specific localities*, habitat protection and selective fishing practices may be beneficial.

MPA development is likely to undermine the legitimacy of the organization that developed and enforces regulations surrounding the MPA, as well as to promote the civil disobedience that resource users and their associates (e.g. fish buyers) may engage in as part of their opposition. Common problems that have undermined the effectiveness of MPAs include:

1) Stakeholders were not consulted or were consulted in a manner that was either cursory or not in line with their recognized modes of communication, argument, and debate;
2) Stakeholders' perceptions and knowledge were not taken into account in the development of the MPA;
3) Stakeholders perceive the biological knowledge used in the development of the MPA as flawed or irrelevant;
4) Stakeholders believe that the MPA is not being enforced evenly, fairly, or effectively;
5) The organization developing the MPA suffers from a general crisis of legitimacy because of past performance; or
6) MPA resources are critical to stakeholder ways of life.

In addition to problems such as these, there are a variety of costs associated with developing and implementing an MPA. These include costs to management, such as soliciting opinions about the proposed MPA, usually through public hearings, research into the MPAs biological and socioeconomic impacts, educating the public about MPAs, marking MPA boundaries and maintaining the markers, and enforcement. Yet individuals, families, and communities also bear costs associated with MPAs, such as lost revenue from prohibitions against landing specific fish, declines in tourism revenues, restrictions on coastal development, and the emotional problems associated with declining fisheries or tourist related businesses.

Although in many cases commercial fishers oppose the creation of MPAs (e.g. Valdés Pizzini 1990), fishers are not wholly opposed to either the idea of MPAs or specific MPAs that they have been involved in establishing. MPAs are in line with what have been called folk conservation methods that many fishers commonly practice to preserve fish stocks for future generations, often knowing or hoping that their own children and grandchildren are likely to take up fishing as a way of life. The commercial fishers of Ceiba, for example, reported that they routinely allow portions of the sea floor to recover from their fishing efforts, after the fashion of farmers letting fields lie fallow. In Culebra, the current MPA between the main island and Luis Peña key was encouraged and supported by local commercial fishers, who perceived stresses to marine stocks and coral reefs in that area over thirty years ago, yet the reserve was not established until 1999 (Desrosiers, et al. 2005). Rincón fishers reported supporting the reserve just off the coast of Rincón called *Tres Palmas* (Three Palms).[37] These few cases, along with the many reported in the literature from other areas (Blount 1999; Berkes 1999; Guerron-Montero 2005), illustrate that fishers are willing to work with regulatory agencies in the creation of MPAs and, equally important, in encouraging fellow fishers to abide by the prohibitions that MPAs establish, perhaps even assisting with enforcement efforts. Without actively involving fishers in MPA development, however, we are likely to witness what we have seen in Southwest Puerto Rico, where some of the most prominent fishers and fish dealers are encouraging civil disobedience toward MPA regulations that they perceived were established without serious consideration of their input.

[37] It should be noted that fisher support for *Tres Palmas* occurred only after initial attempts, forged largely by an outside organization (the Surfrider Foundation), failed because of a lack of active fisher involvement in the development of the MPA.

Puerto Rico and the U.S. Virgin Islands have 11 federal MPAs, each of which was created to protect habitats that were associated with species whose stocks biological analyses have designated depressed, threatened, or otherwise compromised, or to protect habitats that are important to the health and reproductive fitness of fish, shellfish, and other marine life such as manatees and sea turtles. The MPAs are:

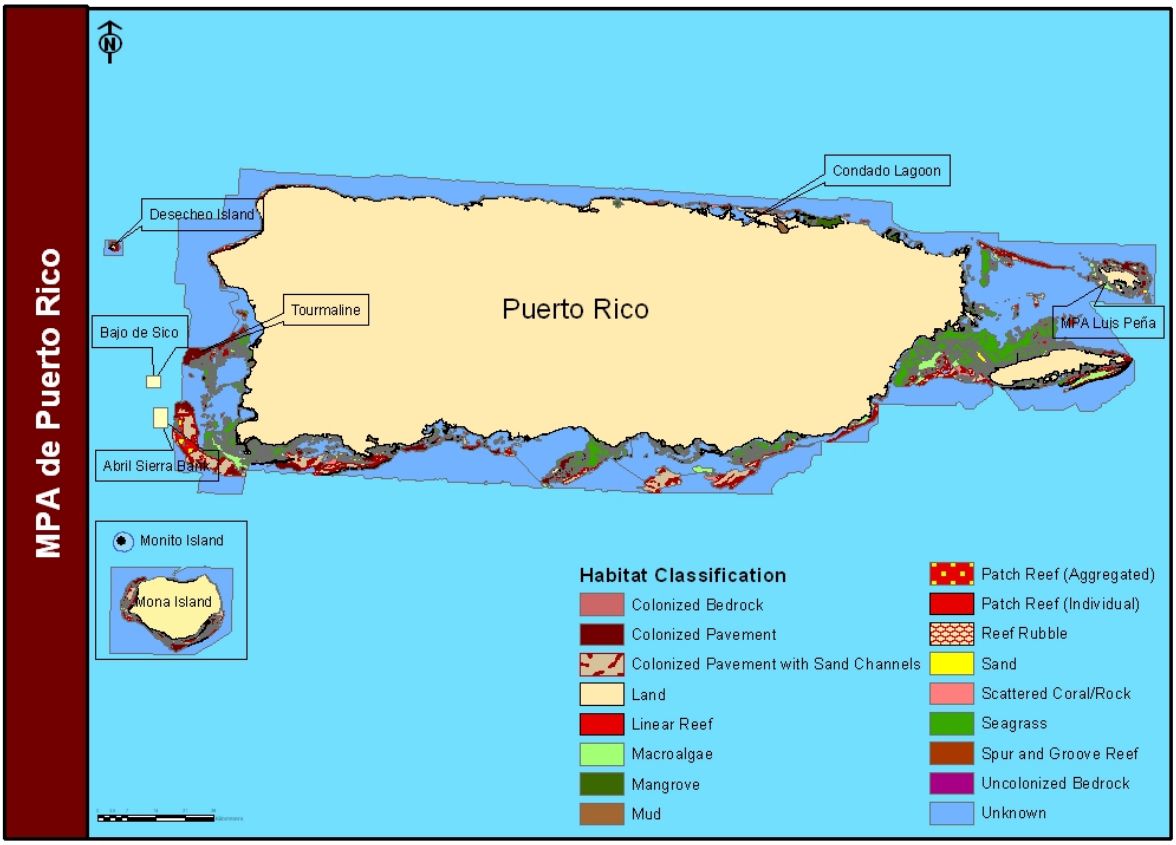
1. Abrir la Sierra Bank. Located off the west coast of Puerto Rico, near navigational buoy #6, this MPA is a seasonal closure designed to protect spawning aggregations of Red Hind (*Epinephelus guttatus*) that occur on the insular platform between December 1 and February 28. Red Hind are a particularly slow-growing, long-lived species, and their stocks have been depressed across the Caribbean. The substrate of Abrir la Sierra is predominantly a coral reef ecosystem, and it has been an MPA since 1996.
2. Arrecifes de Tourmaline. This is a coral and rock reef site, 27.769 square miles in size and seven and a half miles west of the border between Cabo Rojo and Mayagüez that, like Abrir la Sierra, was designed to protect Red Hind as well as the coral reef. It is a natural reserve, closed to fishing through the year.
3. Bajo de Sico Bank. Also west of Mayagüez, some of it over 9 nautical miles from shore and hence in U.S. federal jurisdiction, this MPA is near the edge of the shelf of the insular platform; fishing is prohibited from December 1 to February 28 to protect Red Hind spawning aggregations.
4. Desecheo: This is a small island and its surrounding waters 14 miles west of Puerto Rico, between Puerto Rico and the Dominican Republic, which has been used for military bombing, to establish colonies of rhesus monkeys, and as a stopover point for criminals ferrying illegal immigrants or drugs across the Mona Passage. Formerly the site of large bird colonies, particularly the Brown booby, seabirds have abandoned the island, but the surrounding reefs remain productive grounds. The MPA extends for one-half mile all around the island, covering 2.329 square miles, and is a marine reserve. The entire area is closed to the public at all times, primarily because unexploded military ordinance create a safety threat.
5. La Mona/ Monito: Formerly the site of heavy fishing activity that targeted fish aggregations, La Mona and La Monito are 42 miles west of Cabo Rojo; the larger La Mona is popular with tourists because of its sandy beaches, a feature that Monito lacks. Both islands are rocky and home to important bird colonies and turtle rookeries, particularly the Hawkbill's, the largest rookery in the Caribbean, as well as unique reptiles, amphibians, birds, and plants that occur no where else on earth. Its bird populations once supported a guano fertilizer industry. It is a natural reserve, 599.677 square miles, closed to fishing and other extractive activities.
6. Luis Peña Channel Marine Reserve. Located between mainland Culebra and Luis Peña key, this MPA was established to protect coral reefs and the several species of fish, shellfish, and other marine life such as sea turtles that feed in this area. It is a natural reserve, closed to fishing through the year.
7. Condado Lagoon: Located in the heart of San Juan's tourist district, this area is closed to fishing but, as noted elsewhere in this work, still contaminated with boating traffic and industrial runoff from the surrounding port.[38]
8. Grammanik Bank, St. Thomas: This is a seasonally closed area south of St. Thomas, off limits to fishing from February 1 through April 30.

[38] Condado Lagoon was the only MPA not listed on the inventory of MPAs maintained by the U.S. Government, which can be viewed at www.mpa.gov.

9. Cas Cay-Mangrove Lagoon/ St. James Marine Reserve: Cas Cay-Mangrove Lagoon has been protected as a complex ecosystem important to primary production, sheltering juvenile species of fish, lobsters, birds, and other animals with its extensive mangroves, salt ponds, lagoons, and cays. 1.127 square miles in size, it is a marine reserve and wildlife sanctuary, where fishing and other activities are prohibited year round. Nearby St. James Marine Reserve and Wildlife Sanctuary has many of the same environmental features of Cas Cay, but also has coral reefs that protect juvenile fish. It is 2.681 square miles in size.
10. Hind Bank Marine Conservation District (MCD): Around 20 fathoms deep, Hind Bank is a complex set of substrates that aggregate several species of importance to Caribbean fishers, including yellowtail snapper, red hind, yellowfin grouper, and others. Its 100-year old coral reefs are broken here and there with sandy bottoms. It was first closed during the Red Hind spawning aggregation period, December through February, but in 1999 it was converted to year round protection as a MCD.
11. St. John's Park: This is one of the largest protected areas in the Caribbean, covering 7,146 acres of land and 5,650 acres of water (22.489 square miles), with rich biological and cultural resources, including coral reefs, bays and estuaries that protect juvenile fish and shellfish, shipwrecks, slave plantations, and remnants of a subsistence culture with an historical continuity reaching to prehistoric times up through the post-Emancipation period. It has been a national park for several years. A national monument, the Virgin Islands Coral Reef National Monument, lies three miles south of St. John and includes 12,708 acres (19.67 square miles) of submerged coral reef. President Clinton established it in 2001 in recognition of its role in maintaining water quality through filtering mechanisms as well as in the health of fish and shellfish.

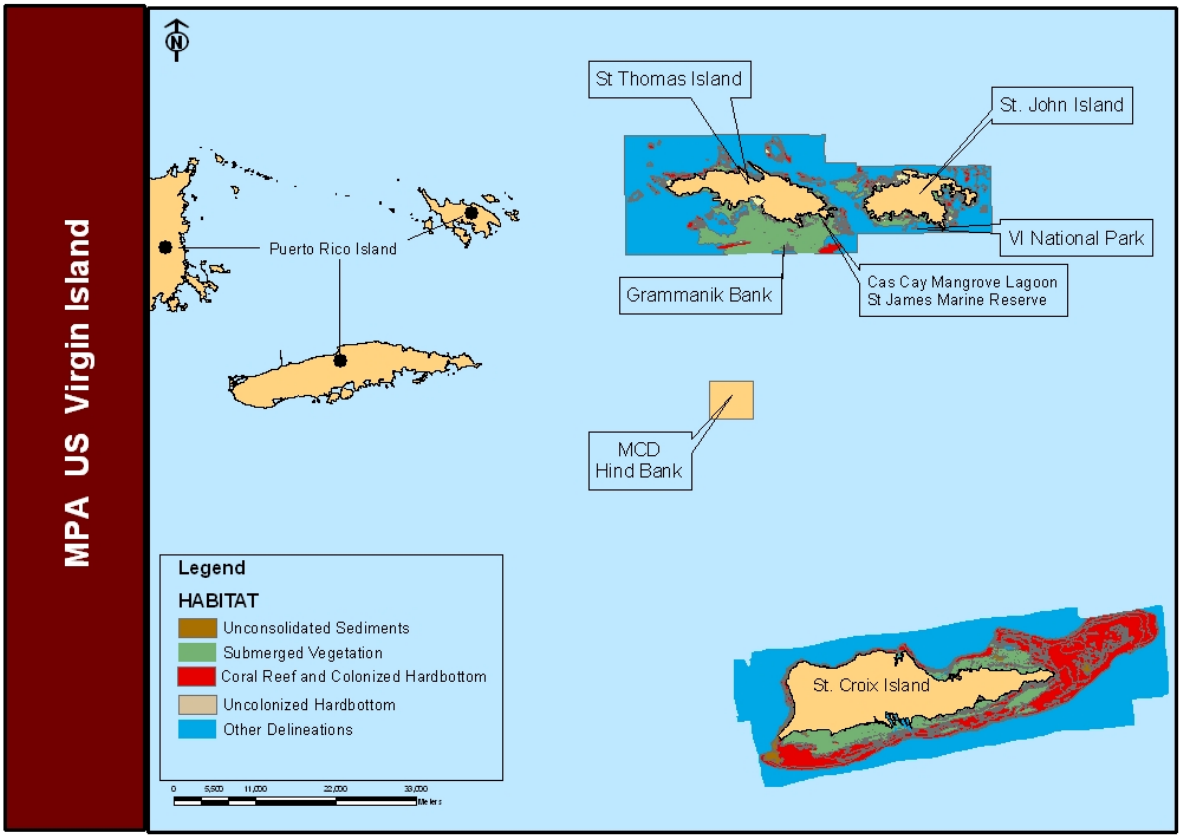
The maps that follow portray the MPAs in Puerto Rican and U.S. Virgin Islands waters, also showing the complexity of substrates that Puerto Rican fishers encounter today.

Map VI.1. Federal MPAs of Puerto Rico, with Mona/Monito as Insert



This map, based on data from NOAA Fisheries and the Caribbean Fishery Management Council, shows the approximate locations of the seven federal Marine Protected Areas of Puerto Rico, including the one in San Juan, one near Culebra, and five off the west coast of the island—site of many of the island's most productive fishing communities. The islands of Mona and Monito are farther off shore than this map depicts, to the west of Bajo de Sico. In addition, this map shows the various kinds of substrates and littoral environmental features common throughout the Caribbean. Six additional MPAs, closer to the U.S. Virgin Islands, may also influence Puerto Rican fishing practices, and so are also depicted below.

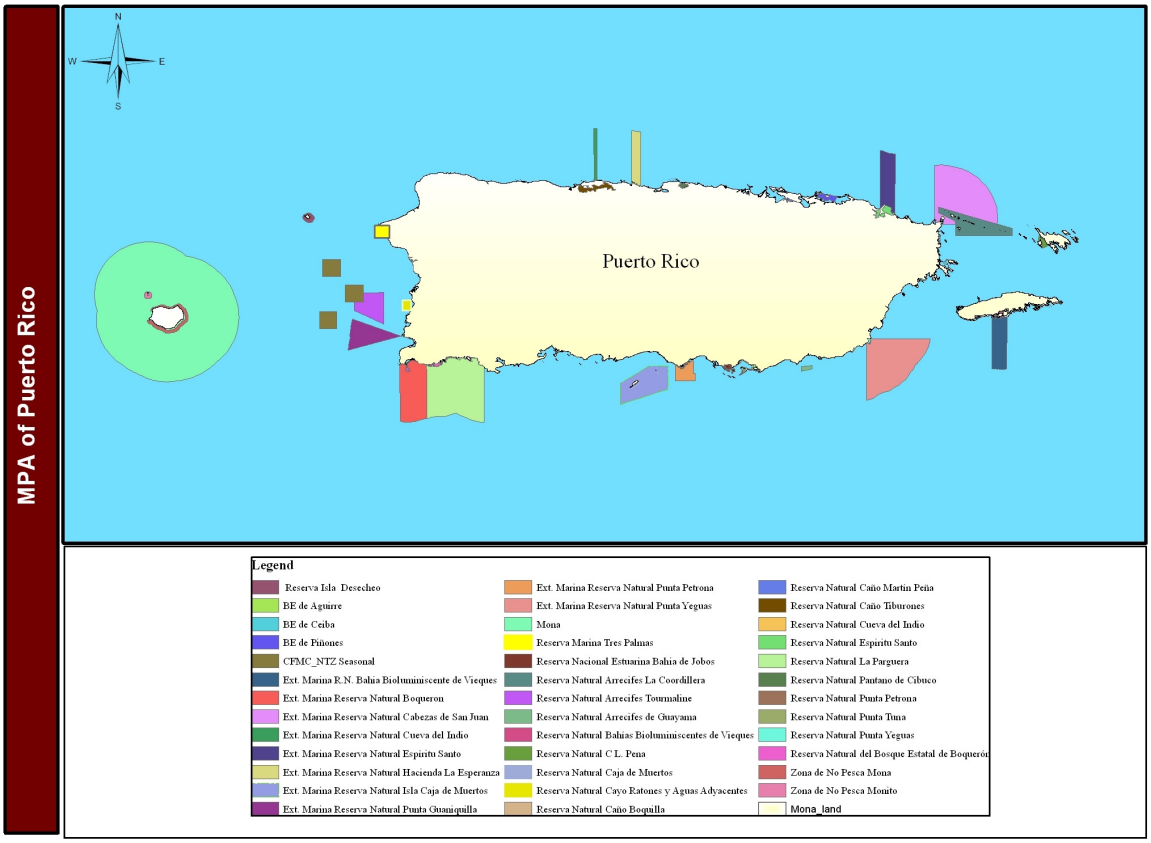
Map VI.2. MPAs of the U.S. Virgin Islands



The U.S. Virgin Islands MPAs include one known spawning aggregation location for red hind, Hind Bank, which is closed seasonally, and five other regions in which fishing is prohibited. These regions, as well as those in Puerto Rico, also affect navigation, in that fishers cannot cross these regions if they have fish on board their vessels. At times this causes increases in fuel costs and at other times it increases hazards, if circumnavigating the MPA means that they cannot get to shore as quickly as possible during a sudden storm.

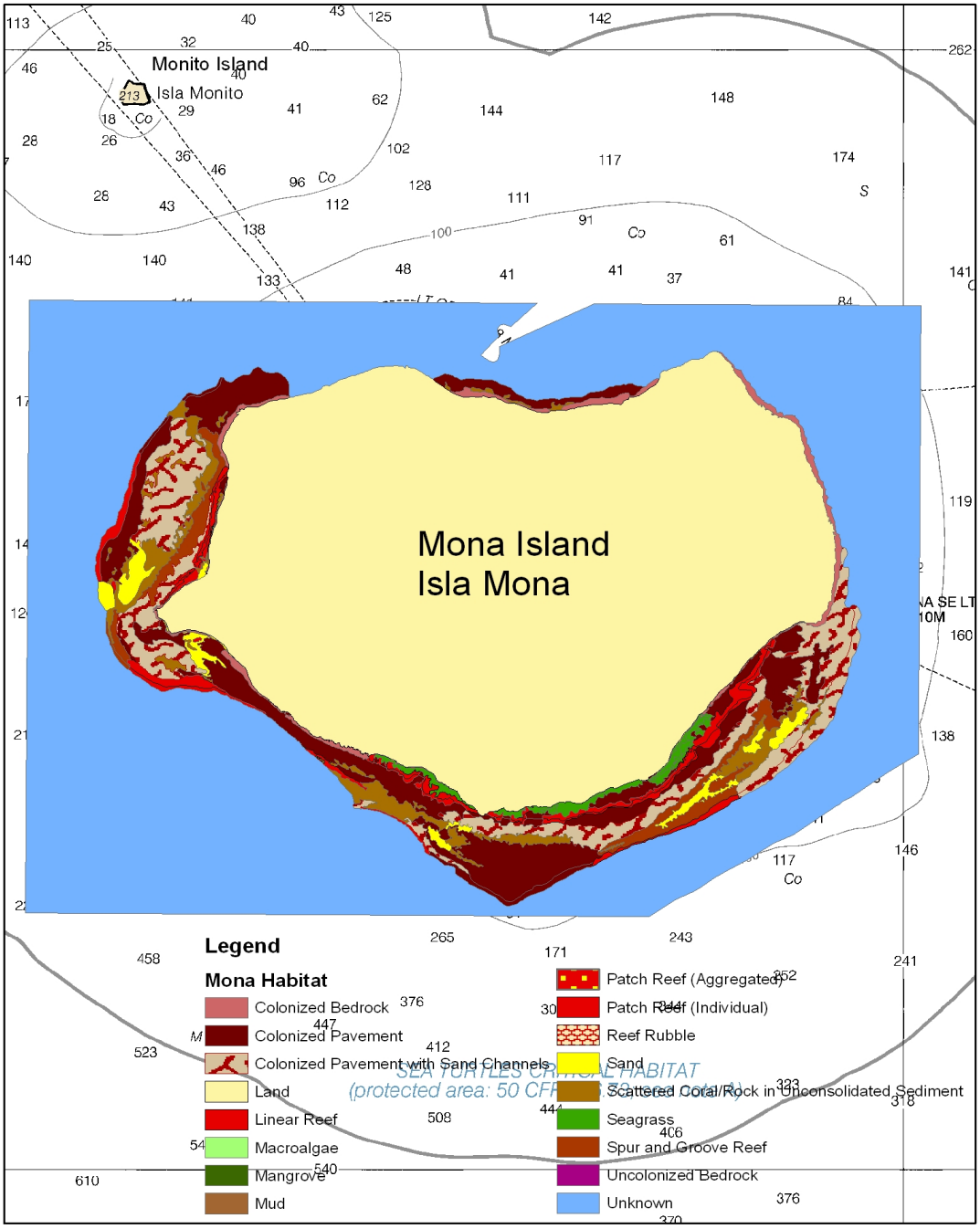
While our task was to assess the impacts of federal MPAs on Puerto Rican fishing, it is impossible to disentangle federal MPAs from those that have been developed and implemented by the local *Departamento de Recursos Naturales y Ambientales* (DRNA—Department of Natural Resources and the Environment). The map that follows shows these areas (as well as the federal MPAs). Those under the jurisdiction of the DRNA are all within 9 miles of Puerto Rico's coast, and are adjacent to some of the most important fishing communities in Puerto Rico.

Map VI.3. Federal and Commonwealth MPAs in Puerto Rico

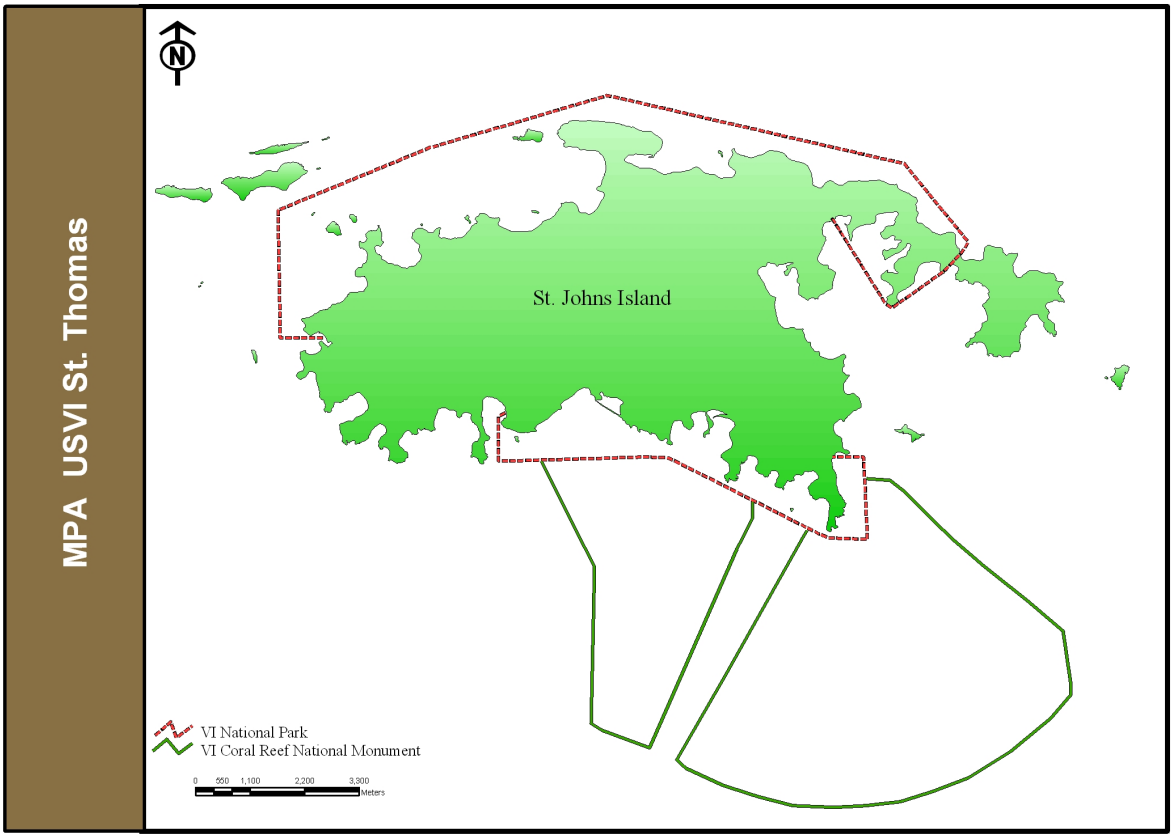


Briefly, those that are in areas where fishing is a particularly strong presence are those off the southwest, northeast, and Vieques (the large island to the east of the main island) coasts; in addition, the area off of the south central coast encloses an island called Caja de Muertos (Coffin Island), which is a favorite fishing spot among recreational and commercial fishers. The following close-up maps of the individual federal MPAs give additional insight into the nature of substrates in the U.S. Caribbean territories.

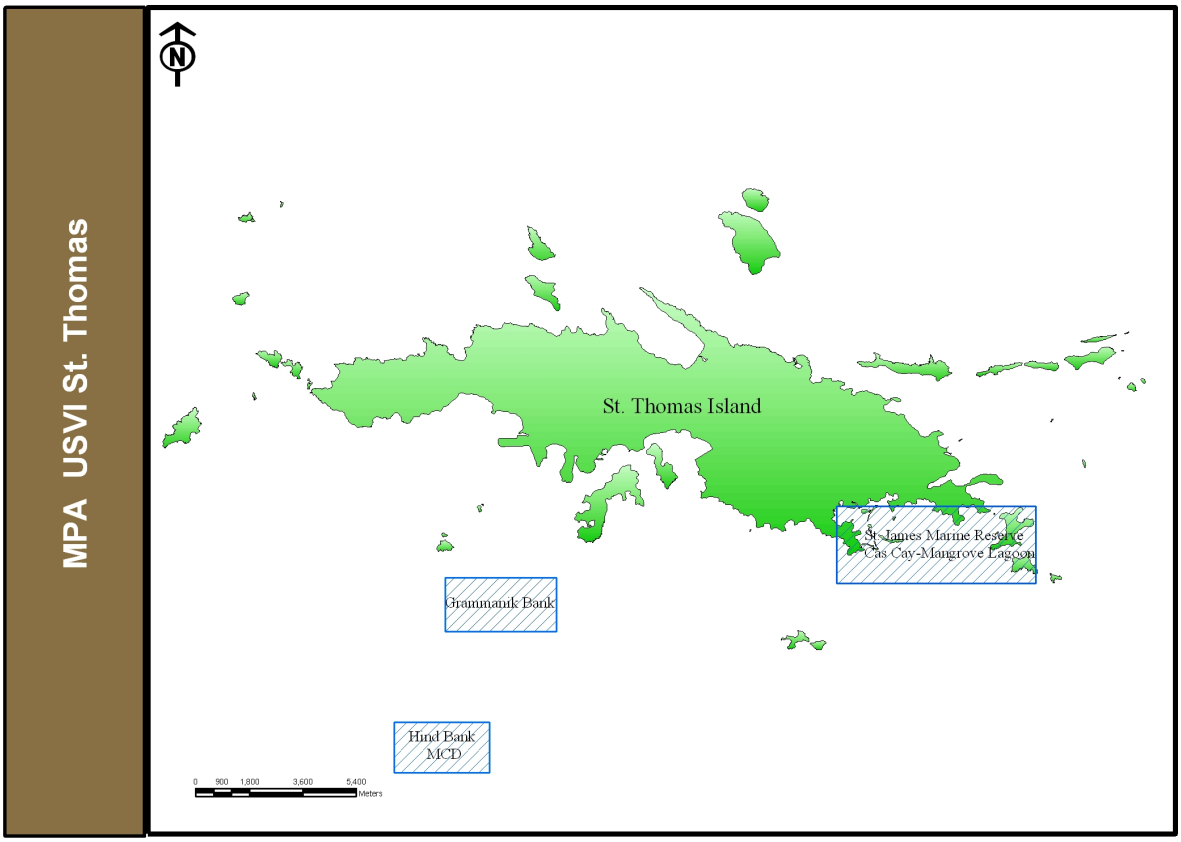
Map VI.4. Mona/Monito MPA



Map VI.5. St. Johns Island MPA



Map VI.6. St. Thomas MPAs



VI.a.1. Problems and Benefits of MPAs in Puerto Rico

Not all of these MPAs have received the same amount of attention from NOAA Fisheries, UPR Sea Grant College Program, marine biologists, or others associated with their development and implementation. Three of the federal reserves, however, were recently included in a study of Puerto Rico's MPAs: Luis Peña, Bajo de Sico, and Tourmaline (Desrosiers, et al. 2005). This study identified several problems that have attended federal MPAS, and a brief review of these problems may provide marine resource managers with clues about methods of improving MPA effectiveness.

Luis Peña MPA began in a way that nearly assured its success, with the wholehearted support of the local fishing community. In fact, as noted earlier, fishers had pressed for a marine reserve prior to the state's involvement, concerned primarily over two practices that threatened the reserve's coral reefs and fish stocks: 1) that increasing boating traffic was leading to damaging anchoring behaviors; and 2) that long-term bombing by the U.S. Navy had damaged substrates. While the project began with the support of the fishing community and a cooperative arrangement between locals and an NGO (CORALations) interested in protecting coral reefs, community support for the MPA has waned over time, primarily due to sporadic and poor enforcement efforts. Poaching from the MPA has become common and, in one case, a DRNA officer found fishing in the MPA received little punishment, further undermining the legitimacy of an

agency which already has poor relations with fishers across Puerto Rico; some poaching takes place inadvertently, as the MPA is poorly marked and fishing just inside its boundaries is possible without one knowing they are violating the law (or, poachers can claim they were unaware they were inside its boundaries). Overall, however, fishers believed that their role in co-management efforts was cursory and confined to early but irregular support for the MPA. Fishers believe that they could play a more active role in enforcing MPA regulations, which would enable more sustained involvement and more successful co-management.

Luis Peña has not been a total failure, however, and it is not too late for DRNA to utilize the MPA as a tool to engage local fishers in management efforts. Our ethnographic work found that Culebra fishers routinely use the MPA for educational purposes, teaching the school children of Culebra about the importance of coral reefs and other marine environments. In addition, they are willing to assist with monitoring efforts as long as DRNA demonstrate some responsiveness to their participation in enforcement efforts; these efforts would be aided significantly with clearer boundaries and more visibly posted information about the MPA. Culebra fishers believe that poachers are largely fishers coming from outside the community, and that the boating traffic that continues to damage the reef is also from outside the community. Many of these visitors simply are unaware of the MPA and its regulations.

A different set of problems and positive outcomes has attended the two MPAs *Tourmaline* and *Bajo de Sico*, in Western Puerto Rico. Both of these MPAs are located in the rich fishing grounds off the coast of Mayagüez, Rincón, and Cabo Rojo—three municipalities with serious and productive fisheries. They were developed in response to the CMFC's 1985 Reef-fish Fishery Management Plan to protect red hind spawning aggregations, as alternatives to other kinds of protective measures, including the size limits that many Puerto Rican fishers object to. Early input into the planning process for *Tourmaline* led to reductions in its size and to the establishment of two other MPAs to protect red hind: *Bajo de Sico* and *Abrir la Sierra*. The reduction was based on fisher knowledge as well as potential negative impacts, in that fishers argued that the area protected included too many other species and that parts of the protected area included sandy bottoms where fishermen could leave traps during stormy weather. Some problems continue, however. Our ethnographic work found that the areas occasionally increase the costs of fishing and pose threats to navigation, in that fishers with fish in their vessels are not allowed to cross the MPAs and circumnavigating them can lead to more time in stormy seas and increase fuel expense.

The council's consideration of fisher input into the design of the MPAs was a laudable effort and one that has contributed to fishers abiding by the regulations. This is particularly the case because through the formation of the MPA they avoided placing restrictions on size limits that too often result in wasted fish and that fishers particularly detest. However, an island-wide ban on catching red hind from December through February, along with other size limits, continues to result in wasting catch that is pulled from deep water.

As with Luis Peña, fishers also perceive enforcement of MPA regulations as a problem. While the Coast Guard regularly patrols the area, fishers believe that they concentrate more on drug trafficking and illegal immigration than on fishery regulations. The presence of the Coast Guard provides some deterrent, however, and fishers report that they comply with the MPAs, learning about them from word-of-mouth, but that their compliance is in part due to fear that if the closures fail that other, less palatable restrictions will be put into place.

The above assessments of MPAs dovetail well with our ethnographic work around Puerto Rico. In general, we found limited *direct* opposition to MPAs compared to, say, licensing requirements and size

limits, yet this apparent indifference toward MPAs was often mixed with criticism of them on the basis of fishers' observations and knowledge of marine life. The direct opposition we did encounter came from fishers and fish dealers who were actually encouraging their peers to violate MPAs as a form of civil disobedience, or a protest of the general way in which fishery policy is designed and fishery management takes place; these sentiments have certainly influenced the reporting of landings, fishery earnings, participation in the census, and other official attempts to track fishing behavior.[39] Clearly, this has been an unintended impact of MPAs.

Regarding fishers' criticism, fishers often disagreed with either the placement of MPAs or the times of seasonal closures, believing that they did not reflect the true spawning habits of fish or shellfish. They also pointed to the fact, noted earlier, that MPAs often unnecessarily protected species that were not endangered. Commenting on the seasonal closures off of Western Puerto Rico, the Executive Director of the Caribbean Fishery Management Council "pointed out the possibility of a 'Big Mamma' syndrome, where a reserve that favors one species causes that species to displace others and actually reduce the biodiversity and health of the ecosystem" (Desrosiers, et al. 2005: 71).

The issue of MPA enforcement raises a different and potentially more important set of issues. Many fishers we interviewed during the ethnographic phase reported that either they or fishers they knew routinely "risked" punishment to fish in MPAs or for species protected by seasonal closures. Although other fishers reported that they will report offenders, this did not seem to be as widespread as those who said they knew of offenders but didn't report them, or were offenders themselves. This suggests that there is widespread belief among fishers that violating marine regulations will result in few or no consequences. Once successful at evading enforcement personnel, barriers to fish sales could occur at the market level, yet we know that some fish dealers are willing to buy protected or undersized species from fishers as part of civil disobedience campaigns or simply because it is in their economic interests, and the interests of maintaining good relations with suppliers, to do so. As long as imports of protected and undersized species are allowed, fish dealers also suffer few to no consequences for buying these fish and shellfish.

The failure of enforcement efforts resonate all too well with fishers' general attitudes toward fisheries management in Puerto Rico. Again and again, we encountered the sense that there was a widespread crisis of legitimacy affecting coastal and marine managers. Their attitudes toward the DRNA enforcement personnel are particularly troubling, especially when enforcement efforts could serve as a common ground for both fishers and the DRNA. Fishers in Puerto Rico are on the water daily or nearly daily, monitoring not only the resource but also other fishers' and boaters' behaviors, and they could, with limited training, assist with enforcement if they believed their efforts would be worthwhile, if they believed that their views were being incorporated into management, and if they believed that the DRNA was truly interested in protecting marine resources. The latter becomes questionable to them when they witness widespread mangrove destruction and contamination of in-shore marine environments due to construction, industry, and other sources. If fishers and coastal and marine managers agree on anything, it is that these and other habits have in fact caused declines in coastal and marine resources. We take up this and other views toward MPAs and the marine environment in the following section.

[39] It is possible that the apparent declines in landings around Puerto Rico from 2002 to 2003 may be due to reporting error rather than actual declines in fish; this is unfortunate, given that the landings data are figured into the formula that biologists use to assess fish stocks.

VI.a.2. Consensus and Disagreement

Efforts to protect marine environments and fish and shellfish stocks and habitats in Puerto Rican waters have been met with ambivalent reactions among those who depend on fishing for some or all of their livelihood and identity. On the one hand, broad consensus exists among commercial fishers that fish stocks are currently threatened and need to be protected. On the other, fishers and regulators appear to disagree about the causes of fishery problems and certainly disagree about the methods they need to employ to address fishery problems.

The Puerto Rican fishery census, along with our 2005 survey, demonstrate this consensus, with the minority viewing fish as abundant or fishery resources in better condition today than in years past.

Table VI.1. Commercial Fishers' Opinions of Fishery Resources

Status of Fishery Resources	Percent from Puerto Rican Fishery Census (n=1061)	Status of Fishery Resources	Percent from Aguirre Survey (n=298)*
Better	3%	Abundance of Fish	8%
The Same	30%	Middle Range	39%
Worse	67%	Absence of Fish	53%

*In the Aguirre Survey, respondents were asked to rank the status of fishery resources on a scale from Absence (1) to Abundance (5). Here ranks 1 and 2 are combined in Absence box, 3 and 4 in middle range, and 5 in Abundance box. We include only commercial fishers.

Although everyone seems to agree that the fisheries resources are in difficulty straights, there is far less agreement on the causes of resource and habitat problems or, given certain causes, what measures should be put in place to address resource and habitat problems. Slightly more than 15% of commercial fishers in the fishery census reported that fishery resources were worse off because of overfishing. Instead, 37% listed pollution and 20% listed habitat destruction. In the Aguirre survey, a similar proportion, 38%, listed "contamination" as the cause of declines in fish stocks, including contamination leading to loss of fish habitat, with only 10% listing overfishing as a cause (most of those who listed overfishing designated particularly destructive gear types or fishing styles, rather than overfishing in general). Just under 7% surveyed listed fishery regulations as part of the problem facing fishery resources, as opposed to part of the solution.

Because most marine protective regulations are aimed at reducing fishing pressures rather than addressing pollution or other known causes of fishery resource declines, many commercial fishers we interviewed voiced the opinion that current management measures and enforcement practices are neither based on accurate information nor fairly applied. The DRNA and other regulatory agencies may have difficulty preventing contamination when polluters are out of their jurisdictions, yet the destruction of mangroves, the problems with recreational boating and diving, the pollution that comes from coastal construction may be within their jurisdictions.

Relations between commercial fishing families and the Department of Natural Resources are particularly poor, yet these are only symptomatic of a broader crisis of legitimacy facing the state when it comes to fisheries. In many fishers' minds, quite simply, the state has lost its moral authority to oversee the management of fisheries. This crisis of legitimacy hinders effective management of fisheries and undermines attempts to protect marine environments, threatening the existence of agency personnel interested in balancing the needs of fishing families with the protection of marine resources.

The regional studies that comprise Volumes II & III of this report present some clues as to how to proceed. Initially, it is important for NOAA Fisheries, the Caribbean Fishery Management Council, and the DRNA to reestablish legitimacy with commercial, recreational, and subsistence fishing populations. The current study is a step toward this goal, in that it solicits fishers' input regarding fishery regulations by assessing how they have impacted fishing families and communities. Yet more work could be done along the lines of participatory co-management, especially that which encourages the incorporation of the vast wealth of fishery knowledge about the habits of fish and shellfish, the ways that changing environments influence fish behaviors, and the alternative steps that might be taken to protect marine resources.

VI.b. Impacts of Fisheries Regulations on Puerto Rican Fishing Families and Communities

VI.b.1. General Themes Regarding Regulations: Fishers' Opinions

With the exceptions of a few loud and vehement voices, including the voices of active leaders of fishers, neither the ethnographic nor the survey phases of this research uncovered widespread opposition to or concern about the *specific* federal MPAs that are listed and mapped in the introductory sections of this report: Luis Peña, Condado, St. Johns, Hind Bank, St. James, Grammanik Bank, Tourmaline, Bajo de Sico, Abrir de Sierra, Mona/Monito, or Desecheo. However, neither did our research uncover widespread support for these MPAs; instead fishers seemed to view them with a kind of indifference and resignation, repeating several of the same themes regarding regulations in general, whether federal or local. While we examine responses to each MPA from the survey data below, we first present those general problems that fishers in Puerto Rico experience with regulations.[40] These are drawn from the regional studies in Volume II:

- Regulations do not take into account fishers' knowledge of the resource, particularly local knowledge about areas where fish congregate, times of fish aggregations, other habits of fish and shellfish.
- Regulations seem to have been designed for waters off the coasts of the South Atlantic and Gulf states. Fishers have not participated in, nor do they know of, many studies that have been conducted in the fishing grounds around Puerto Rico. In other words, regulations do not reflect *local* knowledge, and much fisher knowledge is highly localized.
- Regulations focus on fishing practices to the exclusion of protecting mangroves and other coastal habitats/nursery grounds. Among those who are responsible for the destruction of fish and shellfish habitats are resorts/ hotels (largely on the north coast and near large urban areas), factories and energy plants (primarily on the south and north coasts), recreational boaters/ marinas (all around the islands), general contractors constructing housing and housing developments (all around the islands), and owners of small, illegal *casetas* built in mangroves (primarily southwest coast).

[40] We emphasize that these are the opinions of fishers, as represented to the researchers for this project and as relayed as accurately as possible here, rather than proven facts. That is, specific opinions of fishers may be flawed (e.g. that there is little to no marine science being conducted in Puerto Rican waters), yet part of profiling fishing communities involves profiling their beliefs, regardless of whether they are factually correct, and understanding their beliefs—*their* reality—is a first step toward working with fishers to construct more amenable relations between fishers and marine resource managers and, possibly, toward effective co-management.

- MPAs present navigational problems, increasing the cost and risks associated with circumventing them after a day of fishing. Fishers in Aguada and Rincón, for example, complained that, as long as they are carrying fish, they need to go around rather than through Tourmaline, and that, during rough seas, this increases the risk of their being capsized.
- Seasonal closures can also increase the risks to fishers, in that they encourage "derby fishing"—or fishing intensely for species immediately prior to the closure and thus taking more risks at sea (see section on Vieques, in regional profiles). Divers are especially at risk of being afflicted with the bends during these times.
- Size limits on deep-water species lead to wasteful (and, many fishers believe, immoral) practices. Pulling deep-water species to the surface kills them, yet they have to discard them if they are under legal size limits, despite that they have little control over what takes their hooks or enters their traps. In addition, fishers believe that if Puerto Rican fishers are forced to abide by size limits, seafood importers should be forced to abide by them as well, yet they see undersized fish in *Pueblo* (Puerto Rico's large supermarket chain) and other seafood marketing outlets.[41]
- Violations of regulations are common, but enforcement of regulations is uneven and often heavy handed, focusing on specific groups of fishers (e.g. those of Puerto Real and other parts of Cabo Rojo) at the expense of ignoring others who may be damaging reefs or other habitats (e.g. recreational boaters, fishers, and divers who drop anchors or walk on reefs).
- The current licensing system is costly and flawed, in particular because it depends on records that many of the more experienced, elder fishers have never bothered to keep, have kept irregularly, or have deliberately withheld landings data for some purpose (e.g. fear of being taxed, resistance to the state).
- Fishers are not given credit for the many ways they attempt to protect resources themselves, preventing or assisting in the prevention of misuse of resources (e.g. the use of *filetito*—little gill nets—that damage coral reefs, designing traps to work more efficiently beside rather than on top of reefs, reporting violators).

This list presents those themes that emerged again and again during the course of our fieldwork; it is not exhaustive. In these themes, however, are the grains of how fishery managers might approach regulations or engage fishing families and communities in the crafting of marine policy. They also illustrate the extent to which fishers, even when coming from backgrounds of low levels of formal education, are people who think critically about marine resources and habitats, developing stores of knowledge that management could benefit from. Specifically, the following areas of fisher knowledge could assist managers in the ways designated:

- **Knowledge of the conditions of substrates, particularly coral reefs.** Fishers possess detailed knowledge bases regarding several kinds of substrates that are key to their understanding of fish habits and their ability to catch fish. These substrates include seagrass beds, sandy bottoms, coral reefs, etc. that often change radically with various kinds of events (e.g. hurricanes, bleaching, contamination incidents). Fishers often understand the cause and nature of these changes and are usually the first to witness changes in substrates that may interest fishery managers.

[41] Although fishers, to our knowledge, have not mentioned this, having size limits on local species yet failing to apply them to imports also serves to externalize environmental problems, passing on whatever problems attend the capture and sale of undersized species to those countries from which Puerto Rico imports fish. Similarly, it is conceivable that fish populations from Mexico, the north coast of South America, and other parts of the Caribbean (particularly the Dominican Republic and the British Virgin Islands) overlap with fish populations in Puerto Rico, and allowing the importation of undersized species from these areas directly impacts Puerto Rican stocks.

- **Knowledge of the habits of fish and shellfish**, including spawning times, the migration patterns and times of pelagic species, the abundance of some species relative to others, changes in the sizes or other characteristics of species, the influence of lunar cycles on fish, and the relationship between species health and abundance and specific coastal developments (e.g. sedimentation, mangrove cutting). Again, because changes in fish habits take place from season to season and year to year, and fishers are often the first to perceive these changes, closer coordination between fishers and biologists could track these changes more precisely and empirically, rather than relying on fishery science that may be dated or more relevant to areas outside the Caribbean.
- **Knowledge of the effect of various gear types of marine environments.** Fishers regularly experiment with gear designs in ways to make gear catch more effectively, be less prone to loss, easier to handle, etc. They also observe fishing practices of others and how these practices affect the environments they observe daily. Through this process they learn the ways that different gear types may be less or more harmful to substrates such as coral reefs.
- **Knowledge of the effects of anthropogenic practices on marine environments.** This is perhaps one of the richest areas of fisher knowledge, ranging from the ways in which the disposal of conch shells to the development of marinas affect the health of fishery resources. In this area, fishers often understand complex relationships that could be framed as hypotheses and tested in field settings by marine biologists. For example, many fishers of the West and South coasts suspect that changes in near-shore ecosystems are due to the decline of the sugar industry
- **Knowledge of the history of specific marine ecosystems.** Given the long-term interaction of fishers with the marine ecosystems of Puerto Rico, many fishers' knowledge has an historical depth that could be useful to managers in assessing how different marine environments have changed and are liable to change in the future based on past trajectories. Historical information from fishers could also enable improved understandings of the impacts of hurricanes, bleaching, earthquakes/tsunamis, or other major environmental crises on coral reefs and fish stocks, and the time it takes these to recover from large-scale trauma.
- **Knowledge of the optimal means of educating fellow fishers about rationale underlying different marine regulations.** While this is not knowledge about the marine environment, it is critical knowledge for management to have, given the current communication problems that exist between fishing communities and the DRNA and other regulatory agency personnel. Fishers could provide clues about how information is currently disseminated among themselves, how this might vary from place to place across the island, and what they consider credible sources of information (e.g. UPR Sea Grant).

These are only a few examples. Others are sure to emerge the more fishers believe that managers respect and value their knowledge. As in other areas of the U.S., where biologists and fishers assist one another in conducting studies of marine resources, fishers and managers in Puerto Rico need to work more closely together for an improved understanding of the marine environment. Puerto Rican officials may benefit, moreover, by paying attention to the variety of ways that participatory co-management and knowledge sharing has proceeded in other parts of the United States and globally. In North Carolina, for example, the state has implemented a Fisheries Research Program specifically to match university and agency scientists with members of the commercial fishing population to address current problems and issues facing the fishery. In more than one case, this program has been used to test hypotheses based on fishers' understanding of the function of the marine environment, such as the idea that dragging scallop dredges and other gear along the bottom in certain kinds of substrates, such as mud, increases productivity.

VI.b.2. Fishers' Opinions Regarding the Performance of MPAs

The following section presents the results of the survey data on each MPA. We asked several questions about the 11 federal MPAs listed and mapped earlier. These included:

- Does the MPA maintain or augment spawning aggregations?
- Does the MPA improve the quantity of fish within its boundaries?
- Does the MPA improve the quantity of fish adjacent to its boundaries?
- Does the MPA protect species exploited in vulnerable areas?
- Does the MPA restore or maintain the quality of habitat?
- Does the MPA create livelihood problems for my family and me?
- Does the MPA create social or economic problems for communities that depend on fishing?
- Does the MPA maintain or augment opportunities for investment or employment?

Tables VI.2 through VI.8 show the results of the interviews for seven of the eleven MPAs. We have only included those who had experience fishing in the MPAs, because most of those who answered had no idea what the MPAs were, let alone whether or not they were effective. This included the majority of those interviewed, especially regarding the U.S. Virgin Islands MPAs, where fewer than 5 fishers had any experience with these MPAs. We thus do not present tables on the four U.S. Virgin Islands MPAs. We begin with the western MPAs and Tourmaline, off the coast of Rincón.

Table VI.2. Fishers' Opinions Regarding Tourmaline (n=83)

	Strongly Disagree*	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Maintains Spawning Aggregations	4.9	1.2	3.7	4.9	80.5	4.8
Improves quantity of fishes inside	6.1	1.2	2.4	7.3	75.6	7.3
Improves quantity of fishers in adjacent area	3.7	2.5	2.5	7.4	75.3	8.6
Protects species in vulnerable areas	6.1	2.4	2.4	6.1	79.3	3.6
Restores or maintains habitat quality	9.8	4.9	0	6.1	75.6	3.6
Creates problems for my family and myself	42.7	8.5	11.0	7.3	26.8	3.6
Creates problems for communities	17.1	7.3	14.6	7.3	47.6	5.1
Creates employment / investment opportunity	31.3	5.0	11.3	3.8	25.0	23.9

*Figures are percentages

These figures suggest that, with regard to Tourmaline, most fishers believe that the MPA is effective in protecting fish stocks. The species they thought that the MPA protected, both inside its boundaries and adjacent to it, were primarily grouper and snapper species. Nearly everyone listed *chillo* and *colirubia,* for example, and several mentioned *mero.* When it comes to the MPAs' impacts on communities (the bottom three rows), responses are more mixed.

Between one-third and nearly three-fourths (if we include the "don't know" category) of those interviewed were not very sanguine about the MPAs creating opportunities for investment or employment, although between one-quarter and one-third agreed that this was possible. By contrast, over one-third of those interviewed agreed or strongly agreed that Tourmaline created problems for their family or themselves, and over half agreed that it created problems for communities. To our thinking,

these figures reflect an appreciation of the nature of fishing and its entanglement with coastal communities in Puerto Rico: restrictions on fishing are liable to hurt families and individuals, but more probable to hurt communities, given fishing's cultural importance and the importance of seafood in the lives of coastal residents.

Table VI.3. Fishers' Opinions Regarding Bajo de Sico (N=70)

	Strongly Disagree*	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Maintains Spawning Aggregations	5.7	2.9	5.7	4.3	78.6	2.8
Improves quantity of fishes inside MPA	5.9	2.9	2.9	4.4	75.0	8.8
Improves quantity adjacent to MPA	4.3	2.9	4.3	7.2	79.9	7.2
Protects species in vulnerable areas	4.3	4.3	4.3	5.7	77.1	4.3
Restores or maintains habitat quality	5.7	5.7	1.4	4.3	80.0	2.8
Creates problems for my family or me	40.0	11.4	12.9	10.0	22.9	2.8
Creates problems for communities	11.4	7.1	20.0	11.4	45.7	4.3
Creates employment / investment opportunity	32.8	4.5	13.4	6.0	23.9	3.0

*Figures are percentages

With the exception of the species listed under the improvement in quantity of fish inside and adjacent to the MPA, the survey results regarding Bajo de Sico are similar to those for Tourmaline: those interviewed perceived the MPA's value for fish stocks and habitat, but high percentages believed they had detrimental impacts on families and communities, with around one third indicating that the closures were hurting them directly. The species listed still included high proportions of demersal species, such as a variety of snapper and grouper species, but also more pelagic species, such as tuna and king mackerel. The following tables present nearly identical results for the Western MPAs, with but few minor differences.

Table VI.4. Fishers' Opinions Regarding La Mona/Monito (N=57)

	Strongly Disagree*	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Maintains Spawning Aggregations	0	1.8	3.5	5.3	80.7	8.8
Improves quantity of fishes inside MPA	0	1.8	1.8	3.6	82.1	10.7
Improves quantity adjacent to MPA	0	1.8	1.8	7.1	76.8	12.5
Protects species in vulnerable areas	1.8	1.8	1.8	5.3	86.0	3.5
Restores or maintains habitat quality	1.8	5.3	1.8	1.8	89.5	0
Creates problems for my family or me	48.2	7.1	12.5	7.1	25.0	0
Creates problems for communities	15.8	5.3	19.3	8.8	47.4	3.5
Creates employment / investment opportunity	29.8	5.3	8.8	8.8	26.3	21.1

*Figures are percentages

Table VI.5. Fishers' Opinions Regarding Boya 6/ Abrir de Sierra (n=73)

	Strongly Disagree*	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Maintains Spawning Aggregations	4.2	1.4	2.8	2.8	87.5	1.4
Improves quantity of fishes inside MPA	4.2	1.4	1.4	2.8	80.3	9.8
Improves quantity adjacent to MPA	2.8	1.4	1.4	7.0	80.3	7.0
Protects species in vulnerable areas	2.8	2.8	2.8	5.6	81.9	4.2
Restores or maintains habitat quality	5.6	4.2	0	4.2	83.3	2.8
Creates problems for my family or me	38.9	12.5	11.3	8.3	25.0	4.2
Creates problems for communities	13.9	8.3	18.1	9.7	45.8	4.2
Creates employment / investment opportunity	21.4	4.3	14.3	4.3	30.0	25.8

*Figures are percentages

Table VI.6. Fishers' Opinions Regarding Desecheo (n=73)

	Strongly Disagree*	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Maintains Spawning Aggregations	4.2	2.8	2.8	4.2	80.3	5.6
Improves quantity of fishes inside MPA	4.3	2.9	1.3	2.9	78.6	10.0
Improves quantity adjacent to MPA	2.9	2.9	2.9	5.8	75.4	10.1
Protects species in vulnerable areas	4.2	2.8	2.8	4.2	80.3	5.6
Restores or maintains habitat quality	2.8	7.0	1.4	4.2	81.7	2.3
Creates problems for my family or me	44.3	10.0	8.6	7.1	28.6	1.4
Creates problems for communities	17.1	4.3	25.7	4.3	45.7	2.8
Creates employment / investment opportunity	31.3	6.0	7.5	7.5	26.9	20.9

*Figures are percentages

Again, when asked about species these MPAs were benefiting, it was principally the deep water, snapper and grouper species that fishers listed. On the other hand, the few fishers who were familiar with the eastern MPAs were more apt to mention species such as conch, lobster, and even crab, along with some snapper species (e.g. yellowtail snapper).

Regarding the eastern and U.S. Virgin Islands MPAs, fewer fishers were familiar with them and those that had fished the MPAs were less enthusiastic about their importance in conserving fish stocks and habitat. Only 26 fishers were familiar with the reserve at Culebra, and those who believed it increased fish stocks within the reserve and adjacent to it pointed to snapper and grouper species but also lobster and conch. While the frequencies regarding beliefs about effects on communities and families are similar to those found regarding the western MPAs, more survey respondents, about two-thirds, seemed to believe the MPA would create investment and employment opportunities. This may reflect general fisher support for the Luis Peña reserve.

The other eastern MPAs were viewed with slightly different proportions. For Condado, in San Juan, where 30 fishers were familiar with the MPA, slightly more than 45% of those surveyed agreed or strongly agreed that the MPA created problems for themselves and their families, compared to only 41.6% who said it created problems for the community. Over one third seemed to believe that it could create employment or investment opportunities.

Table VI.7. Fishers' Opinions Regarding Reserva Natural Canal de Luis Peña, Culebra (n=26)

	Strongly Disagree*	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Maintains Spawning Aggregations	11.5	0	3.8	3.8	65.4	15.3
Improves quantity of fishes inside MPA	16.0	0	0	4.0	72.0	8.0
Improves quantity adjacent to MPA	16.7	0	0	8.3	70.8	4.2
Protects species in vulnerable areas	7.7	3.8	7.7	0	76.9	3.8
Restores or maintains habitat quality	8.0	4.0	8.0	4.0	68.0	8.0
Creates problems for my family or me	64.0	0	0	4.0	28.0	4.0
Creates problems for communities	45.5	0	4.5	4.5	40.9	4.5
Creates employment / investment opportunity	19.0	0	4.8	4.8	66.7	4.8

*Figures are percentages

Table VI.8. Fishers' Opinions Regarding Condado, San Juan (n=30)

	Strongly Disagree*	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Maintains Spawning Aggregations	18.5	7.4	0	14.8	51.9	7.4
Improves quantity of fishes inside MPA	12.5	4.2	0	4.2	58.3	20.8
Improves quantity adjacent to MPA	13.0	0	13.0	0	60.9	13.0
Protects species in vulnerable areas	14.8	7.4	7.4	3.7	55.6	11.1
Restores or maintains habitat quality	16.0	4.0	8.0	8.0	52.0	12.0
Creates problems for my family or me	37.5	0	4.2	12.5	33.3	12.5
Creates problems for communities	33.3	4.2	8.3	8.3	33.3	12.5
Creates employment / investment opportunity	25.0	0	25.0	4.2	33.3	12.5

*Figures are percentages

These last two MPAs fared less well in the minds of fishers as means to protect fish and habitat, with lower percentages strongly agreeing with the positive statements about their impacts. When we examine these fishers' responses to other parts of the interview—those in which they were asked to explain what they believed were the problems with the health of coral reefs, fishery resources, and mangroves—we begin to understand why these fishers rated these MPAs as less effective. Nearly 70% of those familiar with the Canal de Luis Peña, an MPA protecting a large coral reef, viewed contamination from boating traffic (including abuses from anchoring behavior) and from coastal construction as primary causes of declines in the health of coral reefs. Similarly, in terms of the Condado MPA, over 60% of those familiar with this MPA view contamination, from boating traffic, coastal construction, and industrial sources, as responsible for the declining health of marine resources.

Based on these tables, it is clear that those familiar with the MPAs view their impacts on fish stocks and habitat as positive while being disruptive to fishing families and communities. We believe that this reflects an astute recognition of the fact that fishing communities extend beyond the confines of fishing families themselves, including others who are dependent on marine resource to lesser degrees or who simply enjoy local seafood occasionally. Certainly the problems that fish dealers have with MPAs, voiced in the ethnographic interviews, supports the view that other businesses directly related to fishing and landings may be adversely affected by MPAs. That fewer people view MPAs as vehicles to employment or investment—or methods to maintain those at current levels through conservation of

stocks—certainly suggests that there may be room for educational initiatives that point out how and where this has been accomplished.

VI.c. Relations between Fishing Families and Coral Reefs

> *"Es como un pueblo."* ("It's like a city.")
> —*Cabo Rojo fisher, describing a coral reef (Benedetti 1997: 3).*

One goal of this study has been to document the reported ways that fishers interact with coral reefs in both beneficial and detrimental ways. Nearly all, if not quite all, commercial fishers we interviewed understand the value of substrates to their way of life. In the Caribbean, coral reefs are among the most important substrates they encounter. Because the Caribbean sea is characterized by low levels of phytoplankton and few large river systems to replenish stocks of nutrients, coral reefs and other fish-aggregating substrates are particularly important to Puerto Rican commercial fishers.

Nearly all commercial fishers are liable to have some interaction with coral reefs, but the extend of that interaction will vary regionally and by type of gear they tend to utilize. Divers probably have the most direct interaction with coral reefs, followed by trap fishers and net fishers, although all fishers may affect coral reefs with their anchoring behaviors or from fishing with hooks and lines over coral reefs. Regionally, fishers who interact with coral reefs most frequently are those who specialize in diving (e.g. Peñuelas, Patillas, Arroyo, Naguabo) as well as those who specialize in trap fishing (e.g. Guayama). Thus, collecting local knowledge about the condition of coral reefs or the roles of coral reefs in marine ecosystems would be accomplished most effectively in these locations. At the same time, educational efforts about coral reefs (e.g., bleaching events) would be most efficiently distributed if they focused on these locations over others. The following table compares divers and trap fishers regarding their views of coral reefs, showing that trap fishers are far more pessimistic than divers.

Table VI.9. Divers' and Trap Fishers' Views of Coral Reef Health

Percent* who believed that reefs were:	Divers	Trap fishers
Healthy 10 years ago	73%	70.7%
Healthy 5 years ago	25%	17.2%
Healthy Today	24.3%	3.6%
Will be Healthy 5 years from now	20.6%	3.7%

*Includes those who listed SCUBA diving or trap as first in their list of equipment utilized.

During our research, fishers reported several ways in which they interact with coral reefs. While it would take direct observation and additional research to know whether or not fishers' relations with coral reefs protect or damage them, the fishers reports that follow, along with our own observations, provide clues to areas that marine biologists and others may want to investigate more thoroughly, converting fishers folk theories and questions into testable research hypotheses. A list of some of fishers' views, interactions with, and relations with coral reefs follow:

- Boating Traffic and Coral Reefs. Many fishers we interviewed considered boating traffic, principally recreational boating traffic, as detrimental to coral reefs, primarily because of anchors. Recreational boaters, especially those diving or snorkeling, are liable to place their anchors directly onto coral reefs. Fishers who are sensitive to this are less likely to damage reefs in this way.

- Recreational diving traffic and coral reefs. Similar comments were heard from fishers about recreational diving: fishers reported that they had seen them standing on top of coral reefs, rather than swimming over them.
- *Filetitos*. In our work in Guánica, we encountered a group of fishers who said that they had defended coral reefs by discouraging, through direct confrontation, the use of *filetitos* (small gill nets), which snagged on coral reefs and caused damage.
- Conch graveyards. We noted in a few of the regional reports, especially those in the east and south, that fishers—principally divers—possess two theories regarding the discarding of conch shells: 1) that conglomerations of empty conch shells attract conch; and 2) that conglomeration of conch shells repel conch by giving them the impression of a conch graveyard. Whichever view a fisher holds it is likely to influence where they dispose of empty conch shells. Those who hold the first view are likely to leave them on or next to coral reefs, while those who believe the second are likely to leave them on sandy bottoms where they will be covered, or in grass beds where they will be hidden. An additional belief about conch shells was that they provided protection for juvenile fish and crabs, and that in this way they helped maintain the resource, regardless of where they were placed.
- Trap design and placement. Traps are a major gear that can affect coral reefs, both as working traps, as they sit on top of coral reefs, or as ghost traps, that continue fishing (and rolling) over coral reefs after they have been lost. Designing and placing traps in ways that are sensitive to coral reefs is something we encountered in both Fajardo and Yabucoa. There, fishers reported that they were careful to place their traps alongside coral reefs, on sandy bottoms, rather than on top of them.
- Use of Clorox on coral reefs. Some fishers reported that they had witnessed part-time fishers fishing for octopus, on coral reefs, with Clorox.

Bringing Fishers into the State: Policy Implications of the Community Profiles

The findings presented earlier and the regional profiles that follow have several implications for fisheries and marine resource policy in Puerto Rico. These address such things as the operations of regulatory bodies, communication between resource managers and resource stakeholders, and the future of fisheries in Puerto Rico, and they range from concrete proposals to those that address the philosophy of management. We emphasize that these are suggestions that emerge from the survey and ethnographic analysis and, to the best of our knowledge, reflect the current reality of Puerto Rican fishing. We do not claim that they are exhaustive, however. Other readers of this document may find additional recommendations that we failed to consider. Before discussing policy, however, we briefly reiterate the goals of our research and some of the project's principal findings, considering the policy implications of each finding. We conclude this chapter with a focus on the advantages and disadvantages of participatory co-management in a setting, like Puerto Rico, where network-based fishing communities are becoming more common, and suggestions for future research.

Project Goals:

Again, we point out that the specific goals of the research underlying the report were to:

3. Conduct community profiles to satisfy the legal requirements of the Magnuson-Stevens Act, particularly National Standard 8, the National Environmental Policy Act, and Executive Order 12898 in Puerto Rico;
4. Conduct a socioeconomic evaluation of the performance of the region's federal MPAs, including 'Reserva Natural de Canal Luis Peña' (Culebra Island, Puerto Rico), Laguna del Condado, the Marine Conservation District (US Virgin Islands), the seasonal closures off the west coast of Puerto Rico (Buoy 8/Tourmaline Bank, Buoy 6/Abrir la Sierra Bank, and Bajo de Sico) on the fishers, their families, and their communities of Puerto Rico. We also evaluated Desecheo. We emphasize that the notion of *performance* here refers to how they have performed vis-à-vis fishing lifestyles, and not how they have performed in a biological sense (except in terms of how fishers perceive their benefits to fish stocks and habitats).

In the course of this work, we have paid particular attention to the notion of *community* as it applies to the fishing populations of Puerto Rico, attempting to determine various communities' levels of dependence on, and engagement with, fishing. We define a community as a group of people living and working together, exchanging services and goods, who share some common interests while diverging at times according to different class backgrounds, where many also share a common cultural and linguistic background. Communities are social fields, comprised of overlapping networks of kin, neighbors, friends, co-workers, and others who interact with one another regularly. Communities may be place-based, network-based, knowledge-based, or may transcend specific geographic locations, although many community members usually share attachments to a specific place.

Our understanding of dependence and engagement derive from a combination of language from the Magnuson-Stevens Act, from NOAA scientists' lists of minimum data elements and indicators (see Table IV.1 and outline above), and from our sense of how well these applied to the Puerto Rican setting. Because the Magnuson-Stevens Act frames much of this work, we repeat their language here:

> "Substantially dependent implies that loss of access may lead to some change in the character of the community, perhaps a major change, or may even threaten its existence. Substantially engaged, on the other hand, implies a level of participation in commercial, recreational, or subsistence fisheries that includes social and economic networks that are directly and indirectly associated with these fisheries (such as the harvesting and/or processing sector)" (NOAA, 2004; see, 63 FR 24235, May 1, 1998).

We have emphasized that, in Puerto Rico, it is impossible to characterize any specific municipality and few communities as "fishery dependent," given that fishing families in Puerto Rico tend to be dispersed rather than concentrated and that, through occupational multiplicity and other activities, fishing families are entangled in several economic sectors of coastal and more distant environments. Despite this, we argue that fishing communities continue to occupy an important economic and cultural niche in Puerto Rican society, and that their entanglements with other sectors are in fact critical to this importance, enhancing the economy, society, and culture of the region in many ways.

VII.a. Policy Implications of Project Findings

Here we draw together the principal findings from our ethnographic and survey work, paying less attention to findings that derive from landings data, the fisher census, and other official sources of information about the fisheries of Puerto Rico. The findings from the ethnographic and survey work are, we believe, the original contributions of this report, along with the detailed descriptions of the communities in Volumes II and III. We arrange these findings in line with their arrangement in the Executive Summary above, following each finding or set of related findings with implications for policy.

VII.a.1. Profiles of Puerto Rican Fisheries

1. Seasonal Variation in Fishing Effort. Commercial fishing effort is highest during the months of May through July and lowest in October and November. Recreational fishing effort fluctuates more or less in tandem with commercial fishing, although the spring and late summer are the busiest months for tournament fishing. Marketing factors also affect levels of fishing activity, in that the demand for seafood is particularly robust during Lent but less robust during the period leading up to Christmas, when pork is in particularly high demand for the holidays.

Policy Implication: To the extent that fishing effort varies seasonally, regulatory officials may wish to consider the timing of seasonal closures to coincide with periods in which fishing activity is lower, if such closures can still meet their biological objectives.

2. Fishing and Occupational Multiplicity. Fishing provides the sole income for around 40% to 45% of commercial fishing families, yet nearly half (46.5%) of commercial fishers interviewed in the survey reported working outside of fishing, most primarily in the construction trades, including masonry, carpentry, welding, plumbing, painting, and manual labor. At the household level, this figure rises to 56.5%, which includes working spouses, children, and others. This suggests that fishing and other coastal occupations subsidize one another. Earlier studies of fishers have found that over 90% of commercial fishers work outside of fishing at some time during their lifetime.

Policy Implication: Fishery managers need to recognize that during any given year, it is unlikely that the full 1,500 to 2,000 officially licensed commercial fishers will be engaged in fishing full time. Instead, a

substantial proportion will leave fishing, partially or completely, as alternative opportunities arise, thus reducing the extent to which they exploit marine resources. Managers may be able to predict where this is likely to happen based on where new construction or other kinds of employment expansion is taking place, and consider that in those regions, fishing restrictions may have less of an impact than in areas where there are fewer employment alternatives to fishing. At the same time, it may be beneficial to fishers to educate coastal residents (particularly employers) regarding the importance of fishing as a cushion against unemployment, poverty, and other socially negative conditions.

3. Relations between Fishing and Seafood Marketing in Fishing Families. Puerto Rico's commercial fishery is family-based, similar to commercial fisheries in many other parts of the United States: specifically, women play important supportive roles in fishing and children usually learn fishing from their parents or from other family members. Family involvement in fisheries seems to increase with the elaboration of fish markets, and especially when *Villas Pesqueras* and private fish markets add seafood restaurants to their facilities. Women often manage or staff seafood restaurants, add value to or process seafood, and assist with fish marketing; children often work in these areas as well. Fishers' households tend to be between 3 and 4 people in size, with most fishers (60-70%) married. These figures do not vary significantly among commercial, recreational, or subsistence fishers.

Policy Implication: Adding value to marine resources in this way reduces the quantity of fish and shellfish fishers need to land to survive, thus reducing overall pressure on the resource. As such, managers should, where possible, promote and support the increasing involvement of families in fishing operations in this way.

4. The Changing Faces of Fishing Communities. Fishing communities in Puerto Rico can be place-based, network-based, or knowledge-based, with the first becoming less common and the other two increasing in importance. Place-based communities are those in which a majority of fishing families lives in a specific, relatively small, geographical location, such as a neighborhood or small town. Network-based communities are comprised of fishers who work together but live mostly apart, dispersed over several towns or neighborhoods in one or two municipalities. Knowledge-based communities tend to overlap with both place-based and network-based communities, consisting of groups of fishers who share knowledge about, for example, fishing territories, gear, fishing practices, political aspects of fishing, etc. Knowledge-based communities often serve as the basis for opposition to, or cooperation with, fishery management.

Policy Implication: As place-based communities become less common and network-based communities become more common, the significance of coastal gathering places as places where fishers exchange knowledge has increased. In addition, network-based communities have become repositories of *social capital*, or social relationships that enable members of meaningful groups (e.g. groups of fishers) to influence the economic well-being of the group and group members. Social capital can benefit individual group members or it can constrain group members' behavior. The more fishery managers learn about the ways network-based fishing communities marshal their social capital, the more they may be able to assist fishers in adding value to fishery products and to join them in their own efforts to pressure network members to learn about and abide by existing fishery regulations.

Fishery managers may use the information on the communities presented in this report to locate knowledgeable and well-respected fishers and locations where fishers are likely to exchange information. Place based communities are preferable to network based communities for communication purposes, but

when working in network-based communities, managers need to locate significant coastal locations where fishers gather.

5. The Diversity of Recreational Fishers. The recreational fishery of Puerto Rico draws participants from all walks of life, from professionals and government officials to factory workers, the temporarily employed, the unemployed, and the retired. The survey elicited 76 occupations spread over 98 working respondents, suggesting that recreational fishers do not cluster in any specific occupation.

6. Multiplier effects of Recreational Fishing. A majority of recreational fishers contribute to local economies by purchasing vessels, gear, bait, and other services locally. Of the 70% who own vessels, nearly 90% have purchased vessels constructed locally and have their vessels and motors maintained locally. Most fishing gear and bait are purchased locally as well, although electronic gear is purchased elsewhere (e.g. Miami) about half the time.

Policy Implication: Because of the diversity of the recreational fishing population, restrictions on recreational fishing are unlikely to affect any single economic sector in a negative way, except perhaps tourism and businesses related to fishing and other marine supplies, and vessel sales, storage, and maintenance. However, our ethnographic work suggests that recreational fishers make up a small proportion of recreational boaters.

The diversity of recreational fishing also suggests that recreational fishing has a broad base of popular support in Puerto Rico, and that restrictions on recreational fishing may be difficult without sufficient and well-communicated biological or social justifications.

7. Subsistence Fishing. The subsistence fishery in Puerto Rico—or people who fish primarily for food for their households—is made up mostly of people from working class backgrounds who target snapper-grouper species (40%) and pelagic species such as dolphin (7.4%) and king mackerel (5.9%), but almost no shellfish. Their gear varieties are similar to those of recreational fishers, but few use SCUBA gear.

Policy Implication: The working class backgrounds of subsistence fishers suggests that subsistence fishing may serve as a subsidy to employers, providing high quality protein to individuals who might not otherwise be able to afford it and thereby encouraging a healthier, more productive workforce. Managers may want to educate employers about these indirect benefits they receive from subsistence fishing, in their efforts to create alliances with employers in general attempts to control shore-based pollution for which those employers may be partially responsible.

8. Community Dependence on Fisheries. Dependence on fishing varies around the islands by several factors. For the commercial fishery, in addition to high average annual landings (> 100,000 lbs) and revenues (> $250,000), most fishing dependent communities are place based (as opposed to network based), where at least one third of its fishers fish full time, where ties between the commercial fishery and the tourist sector are complex, where both commercial and recreational fishing infrastructure are highly developed, and where the cultural significance of fishing is reaffirmed in festivals, statues, sculptures, murals, or other icons. Many fishing dependent communities also have close ties with the state, receiving government funding for vessels or infrastructure, and many are actively involved in conflicts over coastal development, new regulations, or other issues. Examples of communities that are highly dependent on fishing include: La Parguera, Lajas; Puerto Real, Cabo Rojo; La Playa, Ponce; Punta Santiago, Humacao; Pozuelo, Guayama; La Estella, Rincón; and the Downtown Harbor neighborhoods of Fajardo (Maternillo,

Mansion del Sapo, and Puerto Real). The north coast has the fewest communities that are highly dependent on fishing.

Policy Implication: Our work has shown that the number of pounds and value of landings, as well as other official sources of information, constitute a small part of several measures of dependence on fishing. Relying on official statistics to understand variations in dependence, therefore, may lead to unreliable conclusions. Understanding regional differences in dependence can aid managers in concentrating their efforts to educate fishers about the necessity of certain regulations.

VII.a.2. Issues Related to MPA Perfomance

1. Attitudes toward MPAs. In general, most fishers believe that most of the MPAs of Puerto Rico are achieving their biological goals of protecting fish stocks, spawning aggregations, etc., but have more mixed views about the sociological effects of MPAs.

Policy Implication: Managers need to monitor the sociological impacts of MPAs more closely, paying particular attention to fishers' responses to MPAs (including seasonal closures) immediately before and after they go into effect. They need to worry less about justifying MPAs on biological grounds, although soliciting opinions from fishers about the biological goals of MPAs is advisable.

2. Navigation and MPAs. MPAs present a problem for navigation, in that fishers need to sail around them when they have fish in their vessels. During stormy seas this increases the danger of seagoing travel and on a routine basis this increases trip expenses, particularly fuel costs.

Policy Implication: Fishers are able to contact DRNA, Coast Guard, or other officials to tell them of their intention to traverse a MPA with fish in their vessels during times of stormy seas or if facing other kinds of distress, but officials need to be sensitive to the possibility that denying requests can have serious, even fatal, consequences. Officials should judge, on a case-by-case basis, whether or not the crossing is justifiable.

3. Conch Closures. The seasonal closure for conch, which some fishers believe occurs at the wrong time of year in terms of conch breeding, has caused two problems: 1) it encourages "derby fishing" among divers, or fishing at high levels, making repeated hazardous dives, in the days immediately prior to the closure; 2) conch shells provide protection from predators from juvenile species.

Policy Implication: Basing their closures on local observations and analyses (rather than on studies done outside of Puerto Rican waters), managers need to prove to fishers that the closures are occurring during times of the year that conch are, indeed, breeding. Some fishers recommended interrupting the closed season with occasional openings. While this would address the conch-shells-as-protection issue, it would likely lead to increased derby fishing.

The prevalence of derby fishing among divers points to the more general problem of contracting the bends among divers. Educational materials regarding the hazards of diving should be developed and distributed to dive shops, fishing associations, and other locations, to increase awareness of the dangers of diving and surfacing too quickly.

4. Variations in MPA Performance. For Tourmaline, Bajo de Sico, La Mona/ Monito, Abrir la Sierra, and Desecheo, between 70% and 90% of those interviewed in the survey strongly agree that MPAs maintain

spawning aggregations, improve the quantity of fish inside the MPA, improve the quantity of fish adjacent to the MPA, protect species in vulnerable areas, and restore or maintain habitat quality.

Experienced fishers interviewed in the survey were less sanguine about Canal de Luis Peña in Culebra and Laguna Condado in San Juan, however. For Canal de Luis Peña, while over 70% believed that the MPA improved the quantity of fish inside and adjacent to the MPA and protected species in vulnerable areas, only 65.8% believed it maintained spawning aggregations and only 68% believed that it restored or maintained habitat quality. Around 70% of fishers familiar with Canal de Luis Peña cite contamination from the boating traffic and coastal construction projects as responsible for the declining health of marine resources.

The MPA viewed as least effective by those interviewed was the Laguna de Condado, in San Juan. Only between 50 and 60% of fishers believed that this MPA maintained spawning aggregations, improved fish quantities inside and adjacent to the MPA, protected species, or restored or maintained habitat quality. Over 60% of those familiar with Condado viewed contamination, primarily from boating and construction but also from industrial sources, as the principal cause of resource decline.

Policy Implication: The waters to the west of Puerto Rico may be overly protected, as all of the MPAs, according to fishers, have been accomplishing their biological objectives. Studies should first be conducted to examine whether or not fishers' perceptions about these MPAs are correct; if they are, some consideration should be made of opening currently closed waters to fishing.

Managers may wish to balance MPA placement with the current conditions of habitat. Areas that are already highly contaminated are unlikely to achieve the biological goals of closure.

VII.a.3. Issues Related to Coral Reefs

1. Coral Reef Health. Overall, fishers believe that the health of coral reefs has been declining over the past ten years and that it will continue to decline in the next five years.

Policy Implication: The high degree of consensus within the fishing populations of Puerto Rico about the health of coral reefs bodes well for developing monitoring systems that combine the expertise and experience of reef ecologists, fisheries biologists, and social scientists with the expertise and experience of fishers.

Protection of coral reefs will likely be seen as a high priority management effort among fishers, and thus easily justifiable by managers. However, their protection against fishing pressures must be combined with the effective monitoring of recreational boating and diving activity associated with reefs. That is, enforcement cannot concentrate on fishing alone.

2. Contamination, Recreational/ Tourist Traffic, and Coral Reefs. Survey respondents cited "contamination" as the principal cause of the declining health of coral reefs, with boating traffic, coastal construction, and industrial run-off as the three principal sources of contamination.

Regarding boating traffic in particular, many fishers viewed it as detrimental to coral reefs primarily because of anchoring behavior. Especially recreational boaters are liable to place their anchors directly on coral reefs. Fishers sensitive to this are less likely to damage reefs in this way.

Commercial divers report that they have witnessed recreational divers damaging coral reefs by standing on top of them instead of swimming over them. The increase in divers in Puerto Rico in recent years is important to coral reef health in that commercial divers are often the first to spot problems with coral reefs such as bleaching, damage from anchors, etc. Fishery managers and others interested in the health of coral reefs would benefit from engaging in more cooperative efforts with commercial divers to monitor coral reef health.

Policy Implication: Managers need to take active steps, when it is within their jurisdiction, to protect habitats from contamination by shore-based activities. One method managers could use to address contamination from coastal construction, for example, would be to prevent construction that is also destroying mangroves, since the protection of mangrove forests is usually within the jurisdiction of those agencies also responsible for protecting other marine resources.

3. Fishers' Protective Methods. Fishers in Gúanica claimed that they had defended coral reefs by discouraging, through direct confrontation, the use of *filetitos* (small gill nets), which snagged on coral reefs and caused damage.

In both the ethnographic work and the survey, fishers reported that they had witnessed people fishing for octopus, on coral reefs, with Clorox.

Policy Implication: These are two example of fishers monitoring activity around coral reefs (and, by extension, other marine resources) and taking steps to protect reefs on their own. Managers may want to assist fishers in these efforts, if they feel they are justifiable, or they may want to expand the role of fishers as marine resource observers and monitors.

4. Local Theories about Conch Shells. Divers in the east and south possess two conflicting theories regarding the impacts of discarding conch shells: 1) that conglomerations of empty conch shells attract conch; and 2) that conglomerations of conch shells repel conch by giving them the impression of a conch graveyard. Whichever view a fisher holds, it is likely to influence where they dispose of empty conch shells. Those who hold the first view are likely to leave them on or near coral reefs, while those who believe the second are likely to leave them on sandy bottoms where they will be covered, or in grass beds where they will be hidden. Other divers report that conch shells provide shelter for juvenile species on and near reefs.

Policy Implication: Research may be desirable to determine the behaviors of conch toward empty shells.

5. Trap Design and Placement. Traps are a major gear that can affect coral reefs, both as working traps, as they sit on top of coral reefs, or as ghost traps, that continue fishing (and rolling) over coral reefs after they have been lost. Commercial trap fishers in Fajardo and Yabucoa design and place traps in ways that are sensitive to coral reefs, and most commercial fishers are careful to place their traps alongside coral reefs, on sandy bottoms, rather than on top of them.

Policy implication: Information about less destructive fisher trap designs and placement techniques should be disseminated throughout trap-fishing communities.

VII.a.4. Issues of Importance to Fishing Communities

1. Seafood Quality and the Health of Fishing Communities. Among the most important goods fishers provide is high quality, fresh fish to locally-owned and -operated seafood restaurants. Commercial fishers commonly hold the view that they "defend themselves with *fresh* fish", contrasting their product to imported frozen, canned, dried, or other preserved products.

Although the high quality of their seafood enables commercial fishers to compete with lower-cost imports, most fishers view imports as a problem, particularly when imported fish is smaller than legal size limits on fish captured in Puerto Rican waters. The issue of imported fish, however, is more complicated than their competition with local seafood. At especially busy times of the year, imports enable small, family-owned coastal restaurants to provide seafood to customers in the absence of a sufficient supply of fresh local seafood.

Policy Implication: Assisting fishers in promoting their seafood as superior in quality to imported seafood is a way of adding value to the catch, and value-adding strategies, as noted earlier, allow fishers to make more money from fewer fish. Hence, managers may wish to assist in seafood promotions. If it is possible, managers may also wish to examine current import practices, to assess whether or not legally undersized fish are indeed being imported.

2. The Occupational Legitimacy and Licensing of Fishing. Some commercial fishing in Puerto Rico is done as part of the informal or underground economy. All communities that sit directly on the coast in Puerto Rico have members who fish, but in some cases, fishers are reluctant to report earnings from fishing, fearing they will jeopardize their ability to receive social services or increase their tax bills. In some rural and isolated communities, the links between fishing, contraband trade, smuggling, and other uses of coastal environments continue to the present, undermining the extent to which fishing has been able to develop as a legitimate (i.e. officially recognized) occupation.

At the same time, fishers perceive current licensing requirements as costly, burdensome, and biased against older, experienced fishers who do not happen to keep accurate records or do not keep records in an officially recognized way. Some highly experienced fishers have been humiliated when they receive licenses that designate them as beginners, which other fishers perceive as a serious blow to their dignity and to the dignity of the noble, moral, and at times dangerous craft of fishing. DRNA officials believe that this could be resolved simply by changing the name of the license.

Policy Implication: Change the name of the license. With regard to reporting landings, earnings, and other data, managers need to assure fishers of confidentiality.

3. Regional Variations in Fisheries. Dependence on, and engagement with, Puerto Rican fisheries varies geographically, from rural to urban settings, and in tandem with trends in tourism and other leisure, aesthetic, or recreational uses of coastal, littoral, and sea environments. The most viable fisheries are those that have managed to take advantage of a combination of state resources and tourism revenues. The most fishery dependent regions of Puerto Rico are the Southwest, Northeast, and Northwest; the least fishery dependent region is the North coast. However, there are families dependent on fishing in all the coastal municipalities.

Fishing in Puerto Rico is intimately tied to trends in coastal gentrification, in both positive and negative ways. Relations between commercial fishers and the tourist industry are ambivalent: on the one hand,

some fishing groups have utilized coastal tourism to increase revenue streams, establishing seafood restaurants that cater to tourists, providing water taxi services, selling bait to recreational fishers, and so forth; on the other, particularly near luxury resorts, fishers become involved in disputes with tourist developers over the destruction of mangroves and other critical habitats, slip space and coastal access, and crowding and contamination from recreational boating traffic.

Fishers' reactions to coastal development/ construction are similarly mixed, with over 20% of the fishers interviewed in the survey believing that coastal development destroys mangrove forests and causes contamination that leads to the deaths of coral reefs and declining fishery resources. Other fishers, however, view coastal development positively, as a source of increased demand for seafood and tourist services that fishers can provide; in addition, coastal construction provides work for many fishers and their family members when they are not fishing, and in this sense subsidizes fishing operations.

Policy Implication: Restrictions on fishing will have different impacts in different regions. This report is a first step in understanding regional variation, but the fishery is constantly changing. Establishing a regular monitoring system for changes in Puerto Rican fishing, perhaps modeled after current efforts at Long Term Ecological Research, should be developed.

4. The Moral Economy of Fishing. Full-time Puerto Rican commercial fishers view fishing as a "moral" enterprise, even in the context of attempts to professionalize the fishery through the modernization of equipment and improvements in record keeping. This implies that they view fishing as a productive use of natural resources that provides some food or subsistence security and is directed toward socially beneficial outcomes, such as raising families and providing consumers high quality, fresh seafood. As such, they regard wasting fish, as occurs when they have to discard undersized species, as morally reprehensible.
Policy Implication: Managers should revisit the regulation on catching undersized species by: 1) examining the biological evidence regarding the health of stocks and the sizes of fish; and 2) considering the issue of waste.

5. Fisher Knowledge. Commercial fishers in Puerto Rico possess a great deal of local knowledge about the fishery resources of the region that could constitute a valuable cultural resource for fisheries management. Currently, it forms a basis from which fishers criticize current regulations. Their knowledge includes information on reproductive, schooling, feeding, and other habits of fish and shellfish; factors that lead to resource decline; threats to water quality and nursery grounds; conditions of coral reefs, grass beds, and other substrates; conditions of estuaries; relations between lunar cycles and marine life behavior; seasonal changes in fish stocks; migration patterns of fish and shellfish; spawning aggregation sites; the health of stocks of different species of fish and shellfish; and so forth.

Policy Implication: Fishers and scientists could benefit from cooperative research projects, with fishers framing hypotheses and scientists developing ways to test them. North Carolina's Fisheries Resource Grant Program, currently handled through the UNC Sea Grant College Program, could serve as a model for this work.

As noted above, this also reinforces the idea that fishers are already observing and monitoring the resource on a daily basis.

6. DNRA officials' knowledge. Commercial fishers routinely report that DRNA officials have not been properly trained in fish identification, and that they often attempt to fine fishers because the officials

misidentify a legal species for a protected species. This undermines the legitimacy of the DRNA as an agency that is knowledge about the resource and, hence, as an agency charged with responsibility for protecting the resource.

Policy Implication: Training of DRNA officials in fish identification would be advisable. Such training would be most effective if combined with additional training about the biological, social, economic, and management goals of marine resource protection.

VII.b. Participatory Co-Management: Benefits and Drawbacks

In a recent article comparing the Maine lobster industry with the New England groundfishing industry, James Acheson (2006) found that the former had developed effective and enforceable conservation measures that protected lobster stocks while the latter had been unable to protect groundfish from continued declines. His comparison focused on the historical participation of lobstermen vs. groundfishers in the regulatory process, and he attributes the success of lobster conservation measures to the active participation of lobstermen in development of regulations concerning lobster fishing. He argues that lobstermen historically pressed marine resource managers to adopt restrictions on lobstering, promoting regulation "from the ground up." Groundfishing, on the other hand, was regulated from the top down, with far less active participation on the part of groundfishers, and has resulted in not only less effective conservation measures but also what Acheson terms a "roving bandit" strategy: that is, illegal fishing.

Acheson's work reaffirms that fishers who are not consulted in the policy-making process often consider the regulations developed "from above" illegitimate and ineffective from a marine conservation perspective. While the Maine lobstermen policed themselves, exerting peer pressure to conform to regulations, the groundfishers actively resisted regulations by engaging in illegal fishing. Increasingly, marine resource managers have been cognizant of the fact that incorporating fishers into the management process, or participatory co-management, is necessary to establish legitimacy and to encourage fishers to follow existing fishery regulations.

Drawing fishers into management circles, however, has not been easy, in that often their methods of communication differ as much as their understandings of marine resource dynamics. At the same time, participatory co-management has not always been as successful as the Maine case and, indeed, may have unanticipated negative consequences. It may be that Maine's unique coastal ecology, combined with the highly specialized nature of lobstering and the close-knit nature of coastal fishing communities, predisposed the lobster industry toward effective management and conservation measures. It may also be the case that participatory co-management in Maine entailed pushing less compliant lobstermen out of the industry, privileging one group of lobstermen over another.

This points to one of the principal problems with participatory co-management: at times, involving fishers in policy-making may inadvertently create leaders in fishing communities that undermine leadership that has emerged more informally over long time periods. The question of developing leadership becomes even more complex when we consider that many fishing communities are highly localized, concerned with a narrow range of issues, and that internal divisions and conflicts often exist within commercial fisheries. In Puerto Rico, for example, the long-term mistrust between trap fishers and SCUBA divers is one such example.

Nevertheless, without the active participation of fishers in regulatory development, it is unlikely that fishers will perceive fishery regulations as legitimate. Without legitimacy, fishers may choose to engage in the kind of civil disobedience Acheson found in the groundfishing industry, and fishery regulations will not achieve their biological or social objectives. Thus, this section begins with a discussion of participatory co-management in Puerto Rico, followed by a discussion of methods to improve communication between fishers and fishery managers.

VII.b.1. Prospects for Participatory Co-management in Puerto Rico

Commercial fishers have made attempts to enter fisheries management in a number of ways. These include the formal participation of fishers on the Caribbean Fishery Management Council, attempts by Yabucoa fishers to address the legal underpinnings of DRNA regulations through appeals to political representatives, and the emphasis, among some fishing leaders, on reporting landings and keeping more accurate records as a step toward more effective management of marine resources. Added to these are past and current organized fisher challenges to developments that threaten marine resources, such as mangrove destruction in Río Grande, Naval bombing operations in Vieques, and marina development in Fajardo—challenges that reveal fishers' concerns for marine resources and that, at times, push agencies dedicated to the protection of marine resources in new and important directions. Finally, fishers opposition to and violation of marine protective measures they believe to be misguided may also be considered a form of participation, though negative, in fisheries management, expressing civil disobedience and risking punishment to continued practicing fishing behaviors they apparently consider dear to their ways of life.

These behaviors suggest that fishers are willing to participate in fisheries management in Puerto Rico, however much their lack of attendance at CFMC meetings, public hearings, workshops, and other regulatory development settings may suggest otherwise. We learned from both our ethnographic work and from the workshops held in June 2006 that the corporate or classroom settings of public hearings and other policy venues are often intimidating to fishers, who are familiar with more fluid and open communication. We also learned that some fishers have grown cynical about participating in government, based on the lack of results they have experienced with past participation.

As a result of these problems, fishers' potential as participants has not been fully developed. In this sense they constitute an untapped resource and, in so far as their lives are intertwined with the sea's, an untapped *marine* resource. The reasons that fishers have not been drawn into management in as great a capacity as they could have are multiple and complex, but surely two reasons are credentialism and communication. Fishery managers, most of whom are educated and fully invested in fishery science, often consider fishers' knowledge bases as flawed, biased, and anecdotal, unsupported by reproducible experimental techniques and not backed by the credentials of science. Dismissing experiential knowledge from this perspective simultaneously raises the value of scientific knowledge and diminishes the value of experiential knowledge, widening the gap between them. Yet more and more social scientific examinations of experiential knowledge have found it to be based on repeated observation and even at times experimental procedures, suggesting that its development and accumulation is not so very different from how scientific knowledge is developed and accumulated (Chibnik 1987; Berkes 1999). At the same time, over the three decades since the Magnuson-Stevens Act, there has been increasing criticism of

fishery science and many of the assumptions of fishery management (e.g. the tragedy of the commons), questioning the extent to which scientific knowledge is truly unbiased and reproducible.[42]

These developments recommend bringing both experiential and scientific knowledge to questions of marine resource management, a process whose principal barrier seems to be one of communication. Problems with communication derive from the difficulty fishers have deciphering the technical language of science as well as the difficulty fishery managers have in overcoming the bad reputations of their colleagues who treat fishers in condescending or aggressive ways. We learned during the survey work for this project that many fishers do not understand percentages, for example, and thus would likely find many of the calculations of fishery science daunting. While this may reflect a lack of formal education, it does not reflect ignorance.

We also learned during our ethnographic work that the principal management agency, the DRNA, has lost much of its credibility with the fishing populations of Puerto Rico and that their past performance has created an environment of conflict rather than cooperation. We do not believe that relations have deteriorated to the point where they are irreparable; however, we do suggest that DRNA officials need to work on their public relations skills. Based on our success in this project at eliciting the thoughts and opinions of fishers, we recommend that the DRNA adopt an ethnographic approach to communicating with fishers, similar to the methods we have used in this work (open-ended interviewing, structured interviewing, mapping, etc.).

One of the primary goals of ethnographic research is to establish rapport with those from whom you rely on for information through repeated visits, the building of cooperative and trusting relationships, and sustained communication. Often this process is facilitated by joining together fishery and coastal managers with fishers as well as with others whom fishers perceive as more neutral than regulatory personnel, such as Sea Grant marine advisory service personnel, university scientists (particularly social scientists), members of NGOs, and so forth. In the executive summary of this report, we noted that the Caribbean Fishery Management Council (CFMC) has developed a protocol for the incorporation of the fishers into management processes, based on data from the Coral Reef Ecosystems Studies project, and data from this community profile.[43] The protocol addresses many of the communication and trust matters that are reviewed in this report, and provides a blueprint for action.

VII.b.2. Seating Participatory Co-management Efforts in Fishing Communities: the Importance of Network-based Communities

When drawing on ethnographic research methods, fishery managers need to consider issues of sampling and the accurate representation of fishers' opinions, a process that entails understanding the distribution of fishers across place-based, network-based, and knowledge-based fishing communities. In our table raking fishing communities by dependence in Chapter V above, we provide some leads regarding the differences between place-based and network-based communities. However, as network-based and

[42] In a recent study, Griffith and his colleagues found that biologists asked to classify species of the Kotzebue Sound, Alaska on them, did not sort them according to Linnaean classification methods, but instead imposed their own idiosyncratic understandings on the classification.

[43] The protocol is available at: http://www.caribbeanfmc.com/pdfs/Vald%E9s%20Trumble%20Methodology%20and%20protocol%20for%20fishers%20partic%85.pdf

knowledge-based communities become more prevalent in Puerto Rican fisheries, it is important for fishery managers to understand ways in which they might benefit from them.

In the chapter on communities we pointed out that social scientists have been conducting a great deal of research on non-place based communities in the context of migration studies, focusing explicitly on transnational social fields. Sociologists and anthropologists have had to engage social network analysis[44] to discuss transnational social fields, recognizing that social networks—networks of friends and kin—constitute the principal social mechanism by which migrants access jobs, housing, health care centers, assistance with legal documents, and the support systems that migrants often require to negotiate new social settings. In the context of this and other research on networks and communities, social scientists have developed and elaborated the notion of *social capital*: or the notion of social relationships enabling members of social networks to influence the economic well-being of its members, or, in the words of Portes and Sensenbrenner (1993: 1353), "those expectations for action within a collectivity that affect the economic goals and goal-seeking behavior of its members, even if these expectations are not oriented toward the economic sphere."

Building on insights about gift exchange, reciprocity, solidarity, cooperative productive relations, and other social practices that marshal social relationships for productive or other, usually beneficial purposes, the sociologist Robert Putman made the concept of social capital famous in his popular work called Bowling Alone (2000). In this work, he told of a white man who offered a black man his kidney for a necessary transplant because, as part of the team, they had developed a relationship that transcended either of them and that was beneficial to the entire team. In Putnam's example, the team was a kind of community—their network ties created a social organism that benefited each of its members and whose benefit, moreover, reverberated through a wider set of social relations—other communities—in which the team was embedded. The team's most notable effect was to create ties between members of different ethnic communities in ways that expanded the trust and communication between them.

While Putnam considers social capital primarily in terms of how it benefits members of networks, communities, and other groups, others have also pointed out that social capital can have a "dark side" or can work against the well-being of group members and at times even the group itself (Schulman and Anderson 1999). In fisheries, for example, fish merchants can utilize their social network connections with fishers to encourage them to target certain species to the neglect of others. This may result in the overexploitation of highly valued species to the expense of those that may be less valuable commercially but important culturally, such as species that fishers routinely give away to community members as gifts. Another dimension of social capital is that it can lay dormant for a time, becoming important during a time of crisis, as when fishers mobilized against the marine sanctuary in Parguera in the 1980s (Valdés Pizzini 1989). Coleman has expressed this in terms of its fungibility, suggesting that social capital is not always fungible, or interchangeable, but fungible only under certain conditions: in the Parguera case, social capital in the form of solidarity, though useful in opposing the sanctuary, may not have been

[44] Social scientists are not in complete agreement about what they mean by social network analysis. Some have engaged in highly formal, mathematical modeling of networks, isolating attributes of network structure and formalizing network positions. While this work has been useful in understanding the functions of specific network positions such as "centrality," "structural equivalence," and "betweenness," it has been less successful in capturing the fluid nature of social networks, or how networks change through time, particularly those networks that may be changing rapidly under conditions of stress. Ethnographic approaches to social networks, considering the roles of trust and credibility, represent networks more accurately by considering them in terms of how they are embedded in their broader social and cultural contexts, rather than as abstract entities by themselves.

similarly useful in cases where fishers are trying to mobilize opposition to a new marina complex or other development.

In terms of fishery policy, it is important to understand that social networks tend to generate social capital, which can both enable or constrain behavior, and that both the enabling properties of networks and the constraining properties can assist fishery managers. With the increase in network-based fishing communities in Puerto Rico, we can expect a concomitant increase in social capital, and fishery managers need to be able to recognize where and when social capital may develop and how it may enable or constrain fisher behavior. An example of social capital enabling group members comes from the fishing association at La Guancha, the network-based fishing community in Ponce, where fishers have developed a vertically integrated fishery, adding value to their products by incorporating them into the brisk tourist traffic that visits the association grounds and its neighboring park, boardwalk, and beach. They not only add value to fish through processing for retail sales, they also sell fish to tourists to feed schools of tarpon and further process fish by cooking and serving them in their restaurant. At the same time, areas of their association that are off-limits to the general public reaffirm their membership in a significant social group: that is, in a network-based community.

An example of social capital constraining group members comes from Rincón, where fishers have, through word-of-mouth, exerted peer pressure among themselves to abide by the closures at Tourmaline and Tres Palmas. In this case, while constraining behavior may be detrimental to the incomes of the individual and group members, at least in the short term, the constraints on behavior benefit the resource. In as much as the resource's health is a part of the social network's health, such constraints are, at least indirectly, beneficial to the group.

As network-based communities become increasingly prominent in Puerto Rican fisheries' social landscapes, they are likely to become more and more intertwined with one another either for specific purposes, such as opposition to or support for specific fishery regulations, or in terms of more general and sustained purposes, as in educational or apprenticeship programs designed to educate Puerto Rican youth about marine resources. An increase in the elaboration of fisher networks will also involve the growth of knowledge-based communities of fishers across the islands—or networks of fishers based on knowledge about specific components of the marine ecosystem. This process that cannot help but involve university scientists, fishery biologists, marine advisory services personnel, fishery managers, and others who profess to possess vast amounts of information about the health of marine resources. As such, this development can only benefit fisheries management in the Caribbean. Through the elaboration of fisher networks, the continuing overlap of network-based communities with knowledge-based communities—fortified by the few place-based communities that continue to persist—may provide opportunities for fishery managers to become valuable and trusted members of fishers' social networks. One sure avenue toward this would be for fishery managers to join fishers in their objections to sources of marine resource degradation that come from coastal development, mangrove destruction, contamination, and other sources that have nothing to do with overfishing, or to take steps to curb fish imports of undersized and prohibited species. While in some cases fishery managers' hands may be tied politically to *officially* join protests or otherwise support fishers in their efforts to prevent such developments, fishery managers can, as private citizens, certainly lend their support to such fisher causes while working within their agencies to "push the envelope," so to speak, regarding their legal mandate to protect marine resources.

Another, less politically volatile issue that fishery managers could take up is to assist fishers in adding value to their catch. In the regional profiles we describe several instances of how fishers have done this themselves, but surely the state could have a role in enabling improved prices for seafood through various

kinds of further processing (e.g. in restaurant dishes, in seafood pastries, etc.). We point out that this has an historical precedent in Puerto Rico in Norman Jarvis's attempts to smoke, cure, and otherwise increase the amount of fish that made it safely to consumers.

Whether or not fishery managers and fishers can move toward shared causes and increased communication and assistance, however, is bound to be a difficult road. It will require the development of trust and rapport that is equal to overcoming poor relations from past performance. Above all, it can only occur if fishery managers approach network membership with the same sense of shared respect and concern for the well being of the group that fishers currently demonstrate toward one another.

VII.c. Additional Policy Recommendations

In addition to the policy implications of our findings above, we also list here a number of policy recommendations and suggestions for future research, again repeating many of them from the Executive Summary of this report.

VII.c.1. Regulatory Development Oriented Toward the Continued Viability of Fishing Communities

State efforts to protect marine species and stocks are relatively recent in Puerto Rico. Regardless of the qualms and complaints of the fishermen, local authorities (the DRNA and the CFMC) do make an effort to conserve species and protect the environment. More needs to be done, and that is almost unanimous in the voice of the fishers interviewed and visited for this study. One of the missing aspects of policy is the conservation and protection of fishing communities, through economic opportunities, cultural protection of their patrimony and architectural and cultural integrity. Change, development and gentrification are altering the landscape of coastal communities, and also restructuring labor and economic interest in those communities that served as the stewards of marine and coastal resources. Policies on conservation of habitats and species do not take into consideration the future integrity and well being of those communities, and the individuals. This report is the first step into the process of delineating a comprehensive plan for the protection of fishing communities.

VII.d.1. Communication Between Management and Fishers

Several of our policy implications and recommendations point to the importance of improving communication between policy makers and fishers, as well as between enforcement personnel and fishers. We noted above that the use of ethnographic methods may benefit marine resource managers, a recommendation that derives from the fact that relations between managers and fishers suffer from a lack of trust. This influences the quality and quantity of communication in several ways, suggesting the following recommendations.

1. Reporting Landings Data. Due to the events associated with the development and implementation of fishing regulations by the DRNA, local fishers are boycotting the process of data gathering on fish landings. An essential component of the information used for the management of species and stocks, the situation threatens to harm the management process and increase the gap in communication and understanding between managers and fishers. Fishers are far removed from the process and few understand it. Government officials, researchers, and extension agents must make an effort to explain the social, biological, economic and management importance of providing landings data. They, however,

must also be incorporated into the process of designing methods and procedures for the acquisition of that data, and other relevant information for the process.

2. Need for New Models of Incorporating Fishers into the Management Proces. One of the key complaints of the fishermen visited and interviewed for this project was the government's failure to incorporate their opinions effectively into the policy process. This resulted in the perceived fiasco of the fishing regulations, and the constant fracas with the DRNA. There is an urgent need for a well thought process to incorporate the fishers' knowledge, data on species, perceptions and opinions into the fisheries management process. Such a process must go beyond the present *Junta Pesquera*, or Fisheries Board with representatives from different sectors.

3. Understanding Qualitative Appreciation of Marine Resources. Secondary source data, such as landings data and the fisher census, sometimes do not correspond to the views of fishers regarding their most important species, based on ethnographic interviews. For example, while both the landings data and the ethnographic interviews agree that lobster and yellowtail snapper are two of the most important species, most fishers also mentioned *sierra*, or king mackerel, as a highly prized, important species to them, as well as other, similar pelagic fish. However, the landings data indicate that king mackerel accounted for only around 3% of the total landings from 1999 to 2003 (the last five years for which we have landings data). On the other hand, some species that show up in the landings data as frequently landed fish, such as white grunt, are mentioned far more rarely than king mackerel as important species.

VII.c. Recommendations for Future Research

We reiterate here the suggestions for future research that we noted in the Executive Summary, which derive from the findings presented in the previous chapters and in the regional profiles in Volumes II and III. In repeating them here, we have taken this opportunity to discuss some of them in slightly more detail than in the earlier section.

1. Detailed multidisciplinary research is necessary in Puerto Rico, combining economics and sociological or anthropological approaches to an analysis of the specific linkages among fishing, tourism, and coastal development, focusing on transfers of human and social capital among economic sectors and their implications for fishing effort, investment in fishing, wage structures, returns to labor and capital, and other economic factors. Such analyses should also address the multiplier effects of the recreational fisheries of Puerto Rico and the ways in which the commercial catch enhances local restaurants, markets, and other coastal businesses. An additional goal of this work could be to develop a protocol for monitoring changes in fishing communities and practices over long time periods.

2. Multidisciplinary research comparing fishers' knowledge with scientific knowledge about the fisheries of Puerto Rico would determine where the two knowledge bases correspond to or conflict with one another, establish a basis for consensus and areas in need of additional research and education, and enhance current baseline studies in biology and anthropology that have collected data on fishers' knowledge and on the biology of Caribbean marine resources. This work might also enable managers to determine where fishers' knowledge bases could be relied on to inform management decisions. These studies could also serve as a basis for cooperative research, with fishers and scientists framing and testing hypotheses together.

3. Fishing as a productive process is well understood, and there are technical and ethnographic descriptions of fishing with gillnets, reel-lines and traps, among others. However, there has been very little research on the activities of the SCUBA divers, including their life histories and their lifestyles. Divers bring a new dimension to fishing, and they appear to be a group with socio-demographic characteristics different from the rest of the fishers. They are perceived as a threat to conservation, having a faulty conservation ethic, prone to trap theft, and belonging to the underclass of coastal communities. Shifts in gear, from traps to hand lines and to gillnets, is attributed to their success in fishing. SCUBA is at the present time the most important gear, responsible for most of the landings. This merits an effort to understand them in a social and economic context. An outreach component of this research could be to educate divers about the hazards of fishing.

4. The distribution of fish, its circulation as a commodity, its cultural significance, dietary and nutritional impact, and the local restaurant market remain ill understood aspects of fishing despite a handful of studies. This is the weakest link in management. The market usually remains untouched when regulations and prohibitions are in place, as long there is a paper-trail documenting catch and transactions of the species. As stated by Valdés Pizzini (1985) and others, fresh fish in coastal communities is a hook to entice customers to the local restaurants, where frozen and imported fish and shellfish are served as local. Puerto Rican fishermen have always complained on the frailty of the market as they felt victims to dumping by longliners, cheap fish imported by fish dealers during Lent (and other times of the year as well), and stringent regulations by the management agencies. Yet, it is in the circulation of fish, as presents, foodstuffs and commodities, that fishing acquires its true values in coastal communities. Fish for subsistence, as part of the local system of reciprocity, as a special item for the restaurant market, as food for local communities, and as a priceless delicacy for the tourist and visitors, the circulation of fish continues to add value to coastal communities, and sense to an activity in a difficult situation.

5. Research on the relationship between recreational boating/ diving and recreational fishing, including practices that some currently believe to be harmful to coral reefs and to seafood markets, would increase our ability to predict the scope, character, and impact of recreational fishing in Puerto Rico based on existing licensing records and other indicators or boating traffic.

6. Research on two fishing practices that are currently poorly understood: 1) fishing for aquarium fish, including its prevalence, regional variation, and its market; and 2) research on bait fish, including the relationships between recreational and commercial sectors that derive from the sale of bait fish. Aquarium fishing is particularly important in that it usually removes undersized and juvenile fish from the resource.

7. Outbreaks of *ciguatera,* a marine toxin that bio-accumulates in certain species of fish (e.g. barracuda) and is prevalent in some reef-feeding species, have unnecessarily negatively affected fish markets in Puerto Rico, with consumers rejecting fish after news coverage of a harmful algae bloom or other toxic marine event. Research into the perceptions of Puerto Rican consumers toward seafood, and their relationship to various sources of information, could be used to design more effective educational campaigns to inform consumers, perhaps through the public schools, which species of fish are susceptible to *ciguatera* poisoning and which are not. This work could be directed toward improving consumers' overall "seafood literacy," or their appreciation of the benefits and drawbacks of consuming various species of fish.

8. Research on current systems of folk management of resources, including where and how fishers have protected coral reefs, mangroves, and other important marine resources, would increase DRNA's abilities to utilize practices already in place to protect marine resources. Included in this study would be cases of where the political organization of fishers has resulted directly from efforts to protect resources.

9. An oral history project on the history of specific components of the marine ecosystem, as understood by elder fishers who have interacted with different components of the marine environment throughout their lives.

10. Research on the cultural significance of fishing to non-fishing Puerto Ricans would enable an understanding of the subtle ways that the loss of fishing may diminish the ambiance of coastal landscapes for more than fishers and their families. An important theoretical component of this work could be to investigate how the notion of *quality* assumes an importance in fishers' lives that challenges attempts to dismiss their collective economic contribution due to their small numbers. Their emphasis o quality is most evident in their insistence that they "defend themselves with fresh fish," yet an investigation into the notion of quality could engage long-running debates between qualitative and quantitative data collection and analysis in the sciences.

A way of life as interesting and complex as the multi-species, multi-gear fisheries of Puerto Rico is difficult, if not impossible, to understand with in a single research agenda or even a set of research issues, such as those above. As such, these suggestions constitute only a handful of the many that could be developed to address the problems facing fishers and marine resource managers in Puerto Rico. In the regional profiles that follow, we have been able to capture at least a part of the complexity of this way of life and the problems its protagonists face. These regional profiles need to be read, however, as a living document: one that is cognizant of the fact that Puerto Rican fisheries change through time, often in subtle yet important ways, and that continued monitoring of the fisheries will be necessary as managers continue to attempt to protect the marine resources of the Caribbean.