

LA PARGUERA MARINE FISHERY RESERVE : A FEASIBILITY STUDY

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ABSTRACT

The feasibility study for establishment of a Marine Fishery Reserve (MFR) in La Parguera represents a joint effort by local fishermen, scientists, and regulatory agencies towards conservation and improvement of coral reef fishery resources. The fundamental management strategy proposed is the closing out to fishing of one of the island reefs in La Parguera, in an effort to increase size and abundance, and thereby, the spawning stock biomass of commercially important fish populations. Proposed objectives of the initial year of feasibility study were the following : 1) to consolidate local fishermen support for the project, 2) to select a site for establishment of the MFR, 3) to develop a scientific baseline for evaluation of the effectiveness of the MFR as a fisheries management option, and 4) to convey the MFR as a focus of multidisciplinary scientific research in Puerto Rico. Fishermen support was achieved by personal interviews at fishermen homes, workshops at the main fishing landing ports, and their participation in the site selection process. Alternative sites proposed by fishermen were Turrumote, Media Luna, and San Cristobal Reefs. These reefs were studied in terms of the physical habitat and reef associated ichthyofauna, with particular focus upon commercially important fish populations. A pilot study examining distributions of coral reef fish larvae was also launched as part of the feasibility study. At the end of the first year, preliminary results of scientific studies at the three reefs were presented to the fishermen community during an open workshop activity. Fishermen voted for Turrumote Reef as the proposed site for establishment of the MFR. Turrumote was then designated an experimental site, and the other two reefs as controls for a comparative analysis of reef ichthyofaunal differences before and after fishing closure practices are in effect. This represents the main strategy for evaluation of the MFR as a reef associated fisheries management option in Puerto Rico and elsewhere in the Caribbean.

INTRODUCTION

Marine fishery reserves (MFR) are discrete areas of insular or continental shelves closed to all kinds of fishing practices. MFR's have been

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established mainly as a management strategy for conservation and/or enhancement of reef associated fisheries, but also respond to recreational ecotourism priorities in some cases. Although long-term fisheries data is not available for most Caribbean coral reef fisheries, growth and recruitment overfishing for some species has been advocated (PDT, 1990; Appeldoorn et al, 1992; Sadovy and Figuerola, 1992; Sadovy, 1993).

Coral reef fisheries are highly susceptible to growth and recruitment overfishing due to their large size, slow growth and late reproduction (see review by PDT, 1990). The ever increasing and highly selective fishing effort upon the larger fish individuals causes a reduction of the spawning stock biomass, resulting in lower reproductive output (increasing possibilities of recruitment failure), and selective trends for smaller individual sizes (PDT, 1990). Therefore, one of the main objectives of Caribbean coral reef fisheries management is to protect and enhance the spawning stock biomass of commercially important species. Given the multiplicity of small artisanal fisheries landing ports, continuously reproducing nature of many coral reef fish populations, and lack of fisheries related and biological information about most of the fish species harvested, regulations based on size limits, catch quotas, seasonal closures and gear restrictions are very difficult, if not impossible or unfeasible, to design and/or to enforce. Closure of a discrete shelf area providing adequate habitat for coral reef fishes stands out as an alternative towards enhancement of the spawning stock biomass of exploited fish populations, and be enforcable.

Significant increments in size and abundance of commercially important fishes within reserves as compared with adjacent areas open to fishing have been reported for the Indo-Pacific (Bell, 1983; Russ, 1985; Ayling & Ayling, 1986; Jeff, 1988; Russ & Alcala, 1989), the Mediterranean (Garcia-Rubies and Zabala 1990), and for the Caribbean (Clark et al., 1989; Polunin & Roberts, in press), see Roberts and Polunin (1991) for a review. This suggests that fishing mortality is a key factor influencing size and abundance, and therefore, the spawning stock biomass of exploited reef fish populations. Unfortunately, many of these studies lack a-priori designs for testing hypotheses about the effects of fishing closure upon coral reef fish communities. Polunin & Roberts (in press) evaluated changes in fish community structure after closure in a Caribbean coral reef MFR. Lack of before-after comparisons in replicated control vs. experimental sites, and low numbers of surveyed individuals from 'target species' constrains the analytical scope of results obtained by Polunin & Roberts (in press). Nevertheless, increased fisheries value of commercially important stocks within closed areas is an evident trend in the Roberts and Polunin study.

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Whether or not increments in spawning stock biomass of commercially important species resident in MFRÖs can influence recruitment processes on a regional basis (e.g. within the MFR, and adjacent reefs) is still an open question. Most coral reef fishes reproduce from demersal or planktonic eggs which develop into a planktonic/pelagic larval stage. Duration of the planktonic stage (egg and larvae) varies considerably among species (Brothers et al., 1983; Victor, 1986), as well as the morphological and physiological adaptations of larvae for planktonic life (Smith et al., 1987). Dispersal mechanisms seem to operate at different temporal and spatial scales for different species due to an interplay of factors, such as the duration of planktonic stage, larval morphology and behavior, adult reproductive modes and spawning strategies, and water column hydrography (Richards, 1984; Williams et al., 1984; Shapiro et al., 1988; Williams & English, 1992; Cowen, in press). Offshore larval distributions of inshore reef fishes had been previously reported for the eastern tropical Pacific (Ahlstrom, 1971, 1972). At present, very limited information is available on spatial and temporal variability patterns of abundance and taxonomic distribution of Caribbean coral reef fish larvae. Such information is key to basic understanding of recruitment dynamics and early fish life histories and precludes formulation of management strategies for coral reef associated fisheries, such as the establishment of closed fishing areas.

This feasibility study for establishment of a Marine Fishery Reserve in La Parguera has been sparked by the motivation and initiative of local fishermen to protect their artisanal fishery resource from further degradation. The project is being developed from within the fishermen community, and when complimented it will represent a management request coming from the fishermen community to the regulatory agencies (e.g. bottom - up). A previous attempt to establish a marine sanctuary in La Parguera (NOAA/DNR, 1984) failed due to the lack of proper community background work and poorly delineated fisheries management objectives, but see Fiske (1992) for an alternative viewpoint.

OBJECTIVES

The principal objectives of the feasibility study during the first year were the following :

1. Consolidate local fishermen (and local community) support for a Marine Fishery Reserve (MFR) in La Parguera
2. Select a site for the establishment of the MFR in La Parguera

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3. Develop a scientific data baseline for evaluation of the MFR as a coral reef associated fisheries management option, and
4. Convey the concept of MFR as a focus of scientific research in Puerto Rico

METHODS

In order to achieve the principal objectives of the feasibility study, the following approach and methods were used :

A) Local fishermen and community support

Initially, the two presidents of fishermen associations in La Parguera, Don Tomás Padilla and Don Froilan Lopez, were approached with the idea of establishing a ‘closed fishing area’ as a management option that could protect and improve the artisanal fisheries resources of La Parguera. The concept of the MFR was conveyed, and alternative ideas considered and analysed in as much detail as possible. A letter of endorsement directed to the Secretary of Natural Resources was prepared in advance. After the initial interview, the presidents of both associations signed the letter of endorsement requesting a feasibility study for the establishment of a MFR in La Parguera.

Following the interviews with the fishermen leaders, a series of personal interviews were carried out with each known commercial fishermen of La Parguera. The interviews consisted of a general presentation of the project goals, approach to be followed, potential benefits and limitations, fishermen participation in the process of site selection and reglamentation, and an open discussion about the artisanal fisheries problem(s) from the fishermen perspectives and possible management alternatives. Interviews were scheduled after work hours, at the fishermen homes, so that their families were informed at the same time and discussion of the subject was stimulated at family level. Each interview lasted from one to two hours. A total of twenty-five interviews were performed. After many interesting discussions all fishermen gave their approval and support for the feasibility project, and signed the letter of endorsement which had been previously signed by the two presidents of fishermen associations in La Parguera. In addition, the mailing address of each fishermen was obtained during the interview, thereby creating the first directory of commercial fishermen of La Parguera. From then on, each communication regarding the project was sent by letter to each fisherman and their family. By doing this, we established both a personalized and group interaction between the scientist and the fishermen of La Parguera to discuss project issues.

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B) Site selection

The process of site selection for the MFR started at the time of initial personal interviews with the fishermen. Without exception, all fishermen asked about possible sites for the establishment of the MFR. At this point, the opportunity was used to provide an orientation of what features to look for in their choice of a 'Ögood' reserve site. Some of the good features mentioned included : reef integrity (the entire reef had to be closed), large size, high underwater topographic relief, position at the head of the prevailing current, low present utilization by local fishermen, offshore location, and presence of seagrasses in the vicinity. This initial orientation allowed each fishermen to develop a personal opinion of good alternatives for reserve sites. It was specified from the beginning that three site alternatives would be selected by the fishermen and studied during one year by the scientist in charge. At the end of the year, the results of the study would be presented and the fishermen would select one site.

After finishing the personal interview process, a letter was sent to each fishermen inviting them to take part in the decision process for selection of three site alternatives for the establishment of a MFR in La Parguera. At this meeting, held on Dec. 4, 1992, at the fishermen's dock in La Parguera, a full exposition of the project objectives and discussion on many aspects of the study was accomplished. The final session of the meeting focussed on the subject of site selection. A more comprehensive orientation of positive features that should be considered in the process of site selection was presented at this time. After all questions, ideas, and concerns were fully discussed, fishermen proceeded to vote on a previously prepared ballot sheet for three reefs of La Parguera as site alternatives for the establishment of a MFR at this locality. All ballots were filled and signed by each fisherman. A total of 17 fishermen voted. The three reef selected were : Turrumote, Media Luna, and San Cristobal. After the meeting, a letter was sent to each fisherman notifying the results of the voting exercise.

A general characterization of fish community structure, focusing on the taxonomic composition, abundance, and size distribution of commercially important species was performed at each of the three reef site alternatives (Hill and Garcia, this volume). The results of this characterization, along with aerial photographs, bathymetrical charts and a general oceanographical overview of each reef were presented to the fishermen at the end of the year during the reserve site selection meeting. A number of different considerations for selection

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of the reserve site were brought up by fishermen and analysed in as much detail as possible. The main considerations for selection of the reserve site were :

1. minimum size dimensions for closure at each reef site alternative.
2. possibility of establishing closing boundaries around a reef without reaching other reef platforms.
3. present fishing effort on each reef
4. proximity of the reserve reef site to the principal fishing grounds in La Parguera
5. fisheries potential of the reef, based on habitat characteristics and historical (anecdotal) accounts

At the end of this annual meeting, ballot sheets were provided to each fisherman with the three reef sites previously selected for evaluation as alternatives (e.g. Turrumote, Media Luna & San Cristobal). Again, 17 fishermen voted. Turrumote Reef was selected as the site which will be proposed to become the Marine Fishery Reserve of La Parguera with a total of 16 votes.

C) Scientific baseline data

Two main strategies were developed in order to provide a scientific baseline for evaluation of fishing closure at the MFR. The first approach was to study the community structure of adult and juvenile fishes at the three reef sites alternatives, Turrumote, Media Luna , and San Cristobal, see Figure 1. The idea was to provide a before closure assessment of commercially exploited stocks at the three reefs in order to retain two sites as controls for comparisons against the experimental (reserve) site after closure. This design would allow analysis of before and after differences of ichthyofaunal structure and other fishery related aspects at each reef, with replication on the controls (open to fishing reefs). Data on taxonomic composition and spatial (depth) distribution, abundance, and size-frequency distributions of commercially exploited species was obtained at the three reef sites using visual assessment techniques (Garc'a, 1994; Hill and Garc'a, this volume).

The second approach was to develop a framework of taxonomic structure and spatial/temporal variability patterns of abundance and size distributions of larval fishes within the insular shelf of La Parguera and adjacent oceanic waters (Ramirez and Garcia, this volume). Such basic ecological information is vital to understanding of coral reef fish recruitment dynamics, and consequently, to the evaluation of closed fishing areas as a fishery management option. The fundamental research objective was to examine the nursery role a

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coral reef dominated insular shelf (La Parguera) for commercially important coral reef fishes. This study was launched as a pilot initiative for development of a more comprehensive research in this field.

STUDY AREA

Turrumote Reef - Experimental Site

Turrumote is located about 3.5 km south off Punta Papayo, Lajas (17° 56.2' N; 67° 1.2'W), see Figure 1. Adjacent emergent reefs are Enmedio (known also as Corral), aprox. 0.8 km to the north, and Media Luna, about 2.0 km to the west. The reef runs in an east-west direction and has a longitudinal extension of about 1.8 kms. Its emergent extension is of about 0.5 km along the E-W axis. The total reef surface area is of approximately 1.3 km². Turrumote reef sits in an isolated platform with its base at about 20 m. The substrate at the base of the reef is sandy silt sediments with sparse growth of seagrass, *Halophila descipiens*. Several other submerged reef platforms lie very close to Turrumote, one of them is known as 'Pinnacles', to the southeast, which rise from a base at 20 m to aprox. 5 m from the surface. A small patch reef lies northeast, and an extensive hard ground, low relief platform (Turrumote ridge) is found to its southwest. The emergent section of Turrumote has a horseshoe shape forming a shallow reef lagoon at its center. The emergent area of the reef is partially vegetated with few trees of red mangrove. Turrumote is farther offshore than any other reef in La Parguera, and is also at the head of the prevailing westerly current.

Media Luna Reef - Control Site 1

Media Luna Reef is an emergent, elongated reef located about 3.5 kms south off the town of La Parguera (17° 56.4' N; 67° 2.8'W), see Figure 1. Adjacent reefs are Turrumote (ca.1.8 km to the east), and Laurel (0.7 km to the west). A deep channel (Pasa del Medio) separates Media Luna from Turrumote, but Laurel appears to share a common reef platform with Media Luna. Media Luna is oriented in an southeast - northwest position, with a longitudinal extension of 2.28 kms. Total surface area covered by the reef is in the order of 1.7 km². The base of the reef is at about 20 m depth and rises from a substrate covered by sandy silt sediments. Its emergent section is mostly unvegetated and of low elevation.

San Cristobal - Control Site 2

San Cristobal lies approximately 1.5 km south off Isla Cueva, in La Parguera (17° 56.4' N; 67° 4.5' W), see Figure 1. It has a relatively small

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emergent area colonized by a few trees of Red Mangrove (*Rhizophora mangle*). San Cristobal shares its reef platform with another emergent reef located to its southwest known as ‘Atravesao’. Both reefs are connected by a submerged, low relief, hard ground terrace that rises to about 10 m from the bottom. The base of the reef is at a depth of 18 m. The E - W longitudinal extension of San Cristobal is of approximately 0.8 km.

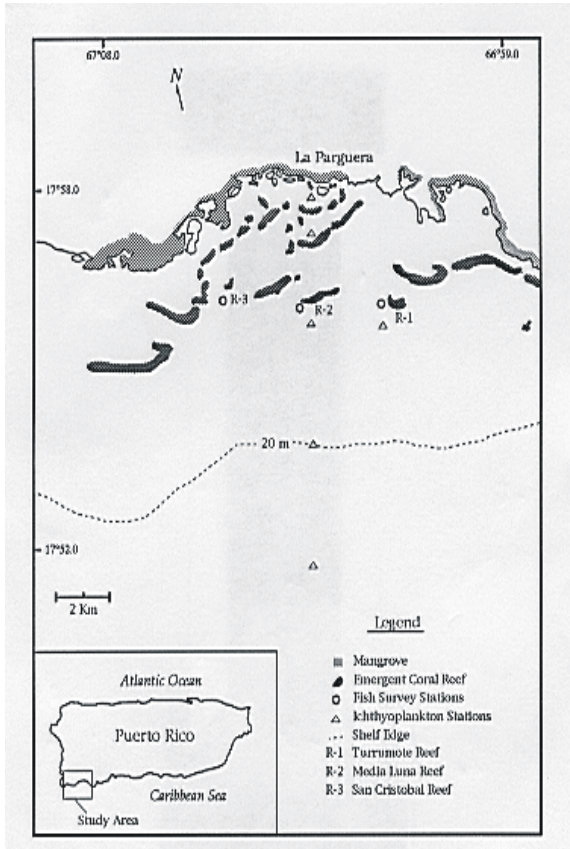


Figure 1. Map of La Parguera, Puerto Rico.

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PRELIMINARY RESULTS

A) Local Fishermen Support

A letter of endorsement with all the local fishermen signatures was hand delivered to the Secretary of Natural Resources during a meeting at DNR offices in San Juan. The UPR scientist in charge, Dr. Jorge R. García, a representative fishermen of La Parguera, Mr. Marcos Rosado, and representatives from the Sea Grant Program in P. R., Mr. Ruperto Chaparro, and Caribbean Fisheries Management Council, Mr. Miguel Rolón, and DNR representatives, Lcdo. Iván Sánchez, and DNR Secretary, Mr. Santos Rohena-Betancourt, were present in this meeting. The end result of this meeting was a multiagency commitment to sponsor this feasibility project with DNR as the leading agency and Sea Grant as the Coordinator agency.

A series of additional discussions with fishermen and other community members regarding the MFR issue were stimulated at local fish markets and grocery stores. These meetings were very informal but highly effective as many doubts about the project were discussed and clarified during the course of the first year. Some of the main concerns from the fishermen about this project were the following :

1. That after closure of one site, DNR would go ahead and close more sites in La Parguera without fishermen approval
2. Some fishermen would go in and fish inside the reserve
3. DNR would not provide surveillance and enforcement for the reserve
4. This project would lead to another 'marine sanctuary proposal'

B) Site Selection

Turumote, Media Luna and San Cristobal reefs were selected by local fishermen as site alternatives for establishment of the MFR in La Parguera. Turumote was finally selected as the site for the MFR (experimental site). Media Luna and San Cristobal remained as control study sites for evaluation of before-after changes in the community structure of fish populations at the experimental site.

C) Scientific Baseline Data

Adult and Juvenile Fish Stock Assessment at Reef Site Alternatives

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An initial basic characterization of commercially important fishes at the fore reef zones of three site alternatives under study for the establishment of a marine fishery reserve in La Parguera (e.g. Turrumote, Media Luna, San Cristobal) was performed. This included a total of 35 underwater surveys which covered the main physiographic zones of each reef (e.g. deep fore-reef 41-60', fore-reef slope 21-40', reef crest 0-20') using both transect and active search census (ASEC) techniques. A cumulative total of 56 commercially important fishes (target species) have been identified at the three reefs studied. Yellowtail and Schoolmaster Snappers (*Ocyurus chrysurus*, *Lutjanus apodus*), Bar Jack (*Carangoides ruber*), Yellow-tail Goatfish (*Mulloides martinicus*) and Parrotfishes, ranked among the 10 most abundant species at the three reefs. Size-frequency distributions evidenced a relatively high abundance of juvenile snappers, goatfishes, bar jacks, and parrotfishes, but also a very low abundance of large adults of these species. First class, commercially important species associated with coral reefs, such as groupers, hogfishes, trunkfishes, sharks, and other large fishes (and lobsters) were observed in very low abundance. San Cristobal Reef had the highest density of commercially important species with an average of 119 Individuals sighted (ASEC surveys) per 30 min. survey, Turumote ranked last with 58 Ind/30 min. survey. A more detailed description of fish stock assessment studies is found in Garcia (1994), and Hill and Garcia (this volume).

In conclusion, this feasibility study has positively accomplished its first year objectives, and in doing so has demonstrated that the 'bottom-up' approach to formulation of MFRs as a fishery management option can be more effective than office furnished regulatory packages. Fishermen now feel that this is 'their project', and that they are setting a model for other fishermen communities to follow for conservation and enhancement of a common fisheries resource. Basic research of applied relevance to evaluation of MFRs is being conducted as proposed, and actually represents the Ph. D. dissertation topic of two graduate students in the Department of Marine Sciences. Final preparation of a formal proposal requesting DNR the establishment and enforcement of fishing closure regulations in a MFR in La Parguera represents the ultimate goal objective of this feasibility study.

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