Pilot Study of the Recreational Queen Conch (*Strombus gigas*) and Spiny Lobster (*Panulirus argus*) Fishery in Puerto Rico

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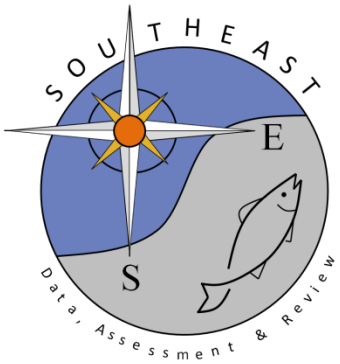

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For the

Gulf States Marine Fisheries Commission

By

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Contents

1 Executive Summary

This Project began in March 2014 and was completed in June 2016, with the field evaluation phase between September 2014 and September 2015. The objective of this pilot project in Puerto Rico was to test different approaches for collecting recreational queen conch and spiny lobster data that can be applied to incorporate these species in the Caribbean MRIP program. The main interest was to generate basic knowledge regarding the location, dimension, and operation of this sector of the fishery, and to examine possible association with other types of recreational activity. The results from this study will help other researchers and managers to improve (recreational) monitoring and management of shellfish species in Puerto Rico.

The research goals for this survey were to:

- Develop and implement a pilot roving-survey study to evaluate the effectiveness of different approaches for collecting information on recreational fishing for queen conch and spiny lobster in Puerto Rico.
- Characterize recreational fishing for these species in terms of the spatial and temporal distribution of the activity, the preferred modes of fishing, the methods and gears used, the target species, the association with other recreational activities for use by MRIP to determine how to best add invertebrates to the MRIP survey should MRIP decide to do so.
- Assess whether the roving survey could determine the amount of recreational catch and effort for these species and identify spatial and temporal patterns.
- Assess whether the roving survey could determine differences in catch composition and effort among different modes (shoreline and boats), and site types.
- Assess whether the roving survey could determine if there is a clear distinction between different sectors that harvest these species (recreational, commercial, subsistence)
- Assess whether the roving survey could determine if the regulations for queen conch are observed, specifically the size-limit and the closed season.

The methodology used for this study consisted in hiring local samplers and included semi-structured exploratory roving surveys to rank all the potential recreational sites for conch and lobster around the island, followed by a stratified survey of those sites with higher probability of displaying the activity. In Vieques and Culebra rapid assessments of the fishery were conducted. Informal interviews with locals and dive operators, formal interviews with fishermen intercepted, and field observations were the main sources of data. The interviews and surveys were designed to collect information about the fishing activity, in particular for conch and lobster, as well as additional information about the sites and other activities in the area. Whenever possible, the catch from participating fishers was identified and measured. Samples of conch shells from shell mounds were also measured. Numerous adaptations in the sampling design occurred throughout the project to maximize efficiency.

Daytime sampling by four interviewers spanned 12 months, with 118 sites visited around PR, 29 sites in Vieques, and 13 in Culebra, including beaches, ramps, docks, piers, fishing villages, marinas, and nautical clubs. Sites were stratified according to the presence/absence and intensity of the activity and revisited periodically. Locating and interviewing the target group was

challenging, so with only 47 interviews obtained, we could not identify clear patterns in the recreational fishery for these or other species. Recreational activity appeared elusive or minimal compared to the larger incidence of unlicensed commercial fishing. Furthermore, there appeared to be a continuum among subsistence, recreational, commercial, and unlicensed fishermen, suggesting that the fishery is mixed and largely opportunistic.

A large percentage of juvenile conchs were observed, particularly in Vieques and Culebra, suggesting that the legal size limit is not observed. Also, some poaching was documented during the closed season for queen conch, and surveillance and enforcement activities were rarely observed, particularly in remote areas and offshore islands.

More intensive sampling and alternative methods, such as social media surveys and community-based studies are recommended to better understand how and where this sector operates, and if it follows any patterns that can be monitored.

If MRIP adds invertebrates to the standard sampling protocol, we do not recommend including new sites specific for conch or lobster because the probability of encountering these species is low at all the sites we sampled and with the methods we used.

Finally, if the recreational monitoring program in Puerto Rico is to be restructured, it should account for the mixed nature of the fishery, the prevalence of opportunistic fishing, and the separation between high end recreational and low end subsistence fishing.

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2 Overview

2.1 Introduction

The marine recreational fishery statistics survey (MRFSS) has been conducted in Puerto Rico since the year 2000. Standard MRFSS protocol has traditionally specified that only finfish may be included in surveys. Nevertheless, in Puerto Rico queen conch (*Strombus gigas*) and spiny lobsters (*Panulirus argus*) are harvested both by commercial fishers and recreational fishers.

Queen conch and spiny lobster are regulated in Commonwealth waters under Fishing Regulation #7949 (DNER, 2010). In federal waters (outside of nine nautical miles) they are regulated under the Queen Conch FMP and the Spiny Lobster FMP and 50 CFR Part 622 Fisheries of the Caribbean, Gulf, and South Atlantic. In the case of queen conch, the fishery in federal waters around Puerto Rico has been closed since 2005.

The commercial value of these two species is the highest of any exploited species in Puerto Rico (Matos-Caraballo and Agar, 2010); however the recreational fishery has never been quantified nor formally described. Appeldoorn and Valdez-Pizzini (1996) initially described the lack of recreational information for queen conch. Garcia-Moliner et al. (2001) pointed out the importance of SCUBA divers as an element of recreational fishing effort on queen conch. The Southeast Data and Assessment Review (SEDAR) data workshop on queen conch in 2007 determined that landings of the mollusk remain uncertain but are "thought to be quite large" (SEDAR, 2007, p. 53)[1].

Other research (Macko, 2008) has demonstrated that recreational conch fishing is not usually undertaken on charter fishing trips, suggesting that such effort may be derived from persons that take dives from private vessels (and those who may take home a portion of commercially landed conch for personal consumption).

The 2007 reauthorization of the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) required establishing annual catch limits (ACL) for species under management (Public Law 109-479; CFMC 2010). The amendments to the FMPs established ACLs for the commercial and recreational sectors for most finfish FMUs. However, the lack of recreational data on the harvest of queen conch and spiny lobsters resulted in one comprehensive ACL for both sectors. Monitoring of ACLs is required and the accountability measures that are triggered by overages could result in reducing the length of the harvest season in subsequent years. Data on the recreational sector are needed so the two sectors can be managed separately and accountability measures applied accordingly. The spiny lobster ACL Amendment also established a recreational bag limit for spiny lobster. The CFMC Fishery Management Plans, Amendments, and ACLs for queen conch and spiny lobster, as well as proposed island-specific FMPs are available at the CFMC website.[2] [3]

The Marine Recreational Information Program (MRIP), which was established in 2008 and succeeded the MFRSS program[4], does not cover invertebrate species recreational fisheries data

[1] http://sedarweb.org/docs/sar/S14SAR3%20Queen%20Conch%20Report.pdf.
[2] http://www.caribbeanfmc.com/fmp_queen_conch.html#
[3] http://www.caribbeanfmc.com/fmp_spiny_lobster.html
[4] http://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP-Handbook/MRIP_handbook.pdf.

collection, resulting in a major data gap for important and highly valuable species. Invertebrates are important in other US jurisdictions, so requests for MRIP to cover them in other areas such as the US Caribbean are likely. The Puerto Rico Department of Natural and Environmental Resources (DNER) believes that it may be warranted to include queen conch and spiny lobster in the MRFSS/MRIP survey, in order to obtain a more complete picture of the overall harvest of these species. The results of this project would provide much needed information for Puerto Rico and a methodology for consideration by other regions.

While there remains a paucity of statistical data, informal observations in the recreational fishery suggest the likelihood of the following:

- Recreational effort may target queen conch and/or spiny lobster either as primary species or in an opportunistic manner when targeting finfish species.
- The magnitude and impacts of recreational effort remain an unknown for both queen conch and spiny lobster, creating a distortion in existing assessments.
- The high proportion of juveniles in conch shell mounts indicates the likelihood of significant recreational harvest; because of the relatively greater regulatory and enforcement constraints on commercial harvest (with respect to minimum size, daily harvest limits, and closed seasons), it is probable that the recreational sector represents a major driver of sublegal and juvenile harvest. While the extraction of nursery grounds occurs in Commonwealth waters, recruits to the future spawning population in the US Exclusive Economic Zone may be impacted.

Also, although catch and effort data for the Puerto Rico queen conch stock have been insufficient to conduct sophisticated stock assessments, signs of declining abundance and overfished/overfishing conditions were found by Valle (2002a, b, 2005) using standardized catch rate analyses and non-equilibrium production model (ASPIC) assessments. A subsequent SEDAR assessment in 2007 confirmed signs of overfishing, although a complete stock assessment analysis was not possible due to the inadequacy of the available data (including the unavailability of recreational fishery data) (SEDAR, 2007).[5]

Spiny lobster in the US Caribbean was last assessed in 2005 as part of SEDAR 8 (SEDAR, 2005)[6], but the results from that assessment determined that available data were insufficient to draw conclusions; again, the lack of information on recreational harvest totals represented a major data gap, although it was estimated (from the spiny lobster FMP) that recreational and subsistence harvest may account for as much as 30% of the commercial harvest. The assessment results also showed signs of population declines and overfishing in the relative abundance indices, the production model assessments, and the Bayesian approaches (data-free model).

New SEDAR data/assessment and review workshops for the CFMC data limited stocks (including yellowtail snapper, hogfish queen triggerfish, and Caribbean spiny lobster) took place between November 2015 and February 2016 (SEDAR 46, 2015)[7][8]. Commercial and recreational survey

[5] http://sedarweb.org/docs/sar/S14SAR3%20Queen%20Conch%20Report.pdf.
[6] http://sedarweb.org/docs/sar/S8SAR2_CaribLobFinal.pdf
[7] http://sedarweb.org/sedar-46-dataassessment-workshop
[8] http://sedarweb.org/docs/sar/S46_final_SAR.pdf

data, as well as probabilistic and length-based stock assessment methods were reviewed for data limited stocks. New stock assessments for queen conch or spiny lobster were not conducted.

Without data representing recreational harvest totals and trends in inter-annual landings, assessments for both queen conch and spiny lobster rely on assumptions based on past estimates (which are mainly local and anecdotal) and compliance with existing size and bag limits (ex., 12 conch allowed per recreational vessel per trip taken in Commonwealth waters, 10 lobster allowed by recreational vessel per trip) (NOAA/CFMC, 2015)[9]. As has been stated in both the conch and lobster SEDAR assessment reports (SEDAR 2007; SEDAR, 2005), recreational landings need to be estimated across the US Caribbean, including Puerto Rico, to provide accurate and timely management advice.

MRIP, if modified in the region to collect recreational conch and lobster trips and landings data, could surmount the existing data gaps, provide information essential to management process, and assist in the establishment of a regional baseline for recreational effort and harvest of the two highest valued species.

Finally, the recreational fishing license program [described in the Puerto Rico Fishing Regulations (DNER, 2004)[10] and the DNER Information Guide (DNER, 2011)[11]] has undergone a lengthy process to achieve consensus, but is due for implementation by the end of 2016. This program will require fishing licenses for recreational fishers, as well as permits for the recreational harvest of queen conch, lobster, land crab, billfish, and other species; and should contribute to a better understanding and management of this sector.

2.2 Project Description

This project was based on recommendations from a September 2012 MRIP workshop in the US Caribbean to gather and analyze information on recreational catch of conch and lobster. The Puerto Rico Department of Natural and Environmental Resources (DNER) and the Caribbean Fishery Management Council conceptualized the project, with technical support from the Southeast Regional Office. MRIP funded the project via a pass through to the Gulf States Marine Fisheries Commission, which provided administration, and MRAG Americas implemented the project. Implementation consisted in adapting the methodology, managing project personnel, conducting the analysis, and preparing all reports, presentations, letters, and communications. The Project Team chose to engage a fishery consultant (MRAG Americas) because DNER did not have the internal capacity to conduct the project, and personnel restrictions would not have allowed adding new personnel to do the work.

MRIP convened the September 2012 workshop to review progress and needs for improvements of MRFSS data collection for Puerto Rico in preparation for transitioning Puerto Rico's MRFSS program to the MRIP format. A separate but associated workshop developed recommendations for initiating MRIP in the US Virgin Islands. Statistical consultants[12] that worked with MRIP at the

[9] http://sero.nmfs.noaa.gov/sustainable_fisheries/caribbean/documents/pdfs/regs_booklet.pdf.
[10] http://www.caribbeanfmc.com/meetings/CFMC%20MEETINGS/127%20regular%20meeting-%20MARCH%2026-27,%202008/127%20presentaciones/PR%20Fishing%20Regs%20-%20good%20one.pdf
[11] http://www.caribbeanfmc.com/DNER%20Folletos/Guias%20para%20la%20%20Pesca%20Recreativa%20Folleto%202011.pdf
[12] From RTI International, Oregon State University, and Colorado State University

time attended the workshops to assist with survey design while ensuring compliance with the overall MRIP goals. This group of consultants also discussed with the workshop participants several pilot projects to provide the Territories and NMFS with information necessary to design a comprehensive MRIP survey in the US Caribbean. The consultants prepared a report in March 2013 (Munoz et al., 2013) based on the discussions and documentation provided at the workshops that made specific recommendations for MRIP in general and provides guidance on those pilot projects.

As no MRFSS surveys had occurred in the USVI, the workshop there focused on applying the general experience gained from limited recreational sampling to a new design that would meet MRIP requirements. Two pilot projects were undertaken in St. Croix: 1) a survey of shore-based non-commercial fishing (Goedeke et al., 2016), and 2) a creel survey (Cresson, in progress).

Because the MRFSS program has been underway since 2000 in Puerto Rico, a number of issues arose from that experience that suggested the need for improvements. As described in the Background Section, Puerto Rico DNER identified catches of queen conch and spiny lobster as important to the Commonwealth, but collection of pertinent data was not part of the MRFSS program in Puerto Rico and not planned for MRIP surveys. Participants at the Puerto Rico workshop identified conch and lobster recreational data as a high priority for MRIP. The consultants agreed with the participants on the value of a pilot project to obtain background information on the distribution of catch and effort data for queen conch and spiny lobster, including collection of biological data for both species. The report states (p.8, Munoz et al. 2013):

"Puerto Rico is currently not obtaining information of some species that are important to their assessment. In order to summarize effort for other species not currently collected in the MRIP questionnaire, options that include conch, whelk and spiny lobster as targeted species should be included in the MRIP questionnaire. Puerto Rico should consider a pilot study on how to best estimate catch (e.g., counts, sizes, counts at different sizes, etc.) for these species."

The current project was developed in response to the recommendation from the Puerto Rico MRIP workshop and is fully consistent with the recommendations of the statistical consultants. The project design called for additional interviewers, in addition to those currently employed by MRIP, whose focus will be to collect information throughout Puerto Rico to provide a preliminary characterization of the recreational catch of conch and lobster. The participants from the PR workshop also identified that the MRFSS sampling procedures did not work for remote locations, specifically Vieques, Culebra, and offshore cays. The consultants' report recommended several possibilities for sampling these locations, and the final survey designs incorporated aspects of the consultants´ recommendations.

Although queen conch and spiny lobster have minimum size limits and queen conch has a closed season (August 1 to October 31) in Commonwealth waters (there is a year-round prohibition in federal waters) and June 1 to October 31 in the EEZ[13] off eastern St. Croix (NOAA, 2015)[14], workshop participants suspect that not all recreational fishers are aware of or comply with these

[13] The queen conch closed season in the EEZ is from June 1-October 31. But the EEZ season does not affect PR because the only harvest allowed in the EEZ is the area east of eastern St. Croix. So, there is no federal fishery in PR; http://www.caribbeanfmc.com/Imagenes/vedas/vedas%20eez.pdf.

[14] Regulations Booklet http://sero.nmfs.noaa.gov/sustainable_fisheries/caribbean/documents/pdfs/regs_booklet.pdf

regulations. Juvenile (sublegal) conchs and lobsters occur on specific habitats, and therefore may be susceptible to recreational fishers who fish in these areas. The distribution of interviewer effort gathered data to determine if sublegal conch and lobster are disproportionately landed at those sites. Before the project began, evidence indicated that violations of size limits and closed seasons were occurring. Fishers, both commercial and recreational, often remove conch meat from the shells at the site of landing. Mounds of conch shells build up over time, and give both an indicator of prime landing sites and an opportunity to measure shells for size distribution to help inform the distribution of sublegal conch.

The project was initially planned to encompass the three-month conch closed period and three months of the open season. The project was later extended to include a full-year of field work, including the closed and open seasons for queen conch. While avoiding any perception of interviewers acting as enforcement agents, the project attempted to collect size distribution data to compare the legal and sublegal landings, both within and outside of the open harvest season.

Information from commercial landings suggests that other gastropod and lobster species different from queen conch and spiny lobster, are likely landed by recreational fishers. It would be very useful to know the relative quantities of these other species; as they tend to grow smaller than queen conch and spiny lobster, landings of these other species may give a perception of illegal take of undersized individuals. Therefore, some minimal level of biological data collection on all harvested species of conch and lobster was planned as an important aspect of the project.

Recreational fishers often harvest opportunistically, so may land a diversity of species. The interviewers had to identify and enumerate the catch of species of finfish and other incidental harvest.

3 Objectives

This pilot study seeks to provide answers to several questions regarding the recreational harvest of queen conch and spiny lobster in Puerto Rico:

- Is the recreational fishery for these species significant enough to warrant inclusion in the MRFSS survey?
- Are queen conch and spiny lobster target species of the recreational fishery, or retained/ discarded when harvesting finfishes?
- What is the proportion of undersized queen conch and spiny lobster to adults in the recreational harvest?
- Where are recreational fishers harvesting queen conch and spiny lobster?
- When are recreational fishers harvesting queen conch and spiny lobster?
- How much queen conch and spiny lobster is recreationally caught (total and by location)?
- Does the recreational fishery harvest species other the queen conch and spiny lobster?
- How many recreational fishers harvest queen conch/spiny lobster and how often (for example, number of trips, total catch, harvest location)?
- What methods do the recreational fishers employ to harvest queen conch/spiny lobster?

4 Methodology

This pilot study used port sampling surveys and interviews at recreational fishing sites around Puerto Rico for a one-year period that included the August-October closed period for queen conch. Considering the unknowns faced when designing a pilot study, the project was conceptualized as a dynamic one, with an adaptive set of tasks and activities that were modified as new circumstances arose. Such circumstances had to do with the constraints of managing a field team remotely, and with the reality of four or five people traveling around Puerto Rico to cover all the potential recreational sites and trying to intercept recreational fishers at days and times when the activity was likely to occur.

The project involved eight main tasks, which were adapted throughout the course of the study. The original activities proposed and planned, as well as the main adaptations implemented in the project design are described below. These departures from the original plan are later expanded in the results section, considering that adapting the methodology is one of the results expected from the implementation of a pilot project. Thus, the methodology and results became, to some extent, intertwined, but all modifications are described in the results. Note that the following activities follow the proposed work plan and are not listed in chronological or logical order. They are later structured into distinct phases of work.

1) Outreach activities to inform and involve recreational fishers before the project begins.
2) Identification and selection of potential recreational sites.
3) Development of an adaptive survey design (including detailed methodology, budget, equipment, materials, survey instruments).
4) Interviews at recreational landing sites.
5) Identification and stratification of recreational fishing sites (Conch-Lobster strata) based on interviews (1).
6) Sampling recreational catch directly from fishers (based on site stratification (2), following a survey design.
7) Analysis of recreational survey data.
8) Sampling conch species and sizes from shell mounds on the shore.
9) Intercept sampling
10) Dive shop survey
11) Vieques and Culebra surveys
12) Communication

4.1 Outreach activities

The original plan called for meetings to inform recreational fishermen and key stakeholders about the project before interviews were conducted. Other activities planned included mailing lists, distributing flyers with information about the project, phone calls, etc.

Due to budget constraints and lack of personnel, Outreach meetings prior to the inception of work were not feasible, as originally planned. Other outreach activities considered and/or implemented were (see results):

- Consulting with the outreach specialists of the NOAA Regional Southeast Office, the NOAA offices in Puerto Rico and the USVI, and DNER communications office in Mayaguez, Puerto Rico.
- Fliers, posters, e-Mails to inform marinas, yacht-clubs, dive-shops, bait shops.
- Radio interviews, press releases, articles in recreational journals, newspapers.

4.2 Interviews at recreational landing sites.

The MRAG investigators developed an interview form based on MRFSS and the suggestions from the MRIP workshop to understand where, when, and how the recreational fishery for conch and lobster occurs. MRAG attempted to hire samplers with previous fisher interviewing experience; this did not occur in all cases. All samplers received training for the specific requirements of the project.

Approximately 147 landing sites for recreational queen conch or spiny lobster harvesters had been identified (DNER, pers com.). Interviews conducted with recreational and commercial fishers, dive masters, port agents and MRFSS interviewers to obtain the best information possible about sites where queen conch and spiny lobster may be harvested by recreational fishers. The MRAG team used this information to clarify the sites and stratify the areas by expected (recreational) catch or effort levels.

This task was subdivided into three activities, described below:

1) Hiring a team of samplers/interviewers
2) Training of interviewers
3) Identification and selection of potential recreational sites
    a. Exploratory survey
    b. Stratified list/map of recreational sites

4.2.1 Hiring a team of samplers/interviewers.

MRAG relied on the DNER to provide a list of possible contractors to conduct the interviews and field work required for the project. DNER provided some names and CVs that were reviewed by MRAG. Initially, the selection criteria included: a degree in Biology, Fisheries, Environmental Studies or a related field; experience in the field; experience conducting interviews; owning a car and a driver´s license; and very importantly, the place of residence (because coverage of the whole island was needed).

It soon became evident that finding interviewers that met all these qualifications would be difficult, so MRAG expanded the search and used other recruiting techniques. MRAG established contacts with other colleagues and agencies who could distribute the job announcement among students or other qualified people. The agencies contacted were the DNER, the NOAA Southeast Fishery Science Center, the University of Miami, the Caribbean Fishery Management Council, the Center

for Independent Experts, different campuses of the University of Puerto Rico, other consulting firms in Puerto Rico, and the UPR Sea Grant Program, among others.

All the scientists contacted had extensive field experience in Puerto Rico, and provided other contacts and advice. Thus, the search for adequate people to conduct interviews was further expanded to other researchers, professors, students, and current (commercial) port agents at the DNER.

An additional job announcement was posted online on the Facebook page "Pesca, Playa y Ambiente"[15].

From these efforts, a few more names were received, but the complete list did not exceed 10 people. Of these, many did not meet the basic qualifications. Once a pre-selection was made, most potential interviewers resided in the South West part of Puerto Rico. Further recruiting efforts consisted in finding interviewers who cover the East Coast, where conch and lobster fishing is widespread.

Because the recruitment of suitable interviewers was essential to initiate field operations difficulties in finding qualified individuals in the right areas significantly delayed the start of the project By the summer of 2014, four suitable candidates were recruited, one as the field coordinator/ interviewer and three other interviewers to conduct surveys around the island. Two of them would cover the East Coast and two, the West Coast. Details are provided in the Results section.

4.2.2 Training of interviewers

Training for the selected team of interviewers was conducted in September, 2014 with the following objectives:

- Meet the MRAG Coordinator, the team interviewers and important contacts at the DNER
- Familiarize the interviewers with the project.
- Explain and implement the methodology in the field.
- Distribute equipment and materials.

Details of the training plan are provided in the Results section and in Appendix B.

4.2.3 Identification and selection of potential recreational sites.

MRAG relied on the DNER to provide a list of MRIP recreational landing sites, highlighting those with possible conch/ lobster activity. Those were identified on the MRIP map[16] which also provided specifications to access the location. This preliminary list included a total of 146 recreational landing sites, only 58 of which were potential conch and/or lobster sites.

Two additional strategies were implemented to verify if those sites were still used to harvest the species of interest, to investigate other potential locations and to stratify the areas by catch or effort levels: 1) an Exploratory Survey and a 2) Stratified List of recreational sites.

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[15] Pesca, Playa y Ambiente: https://www.facebook.com/groups/pesplaamb/

[16] MRIP Maps (Puerto Rico code is 072) https://www.st.nmfs.noaa.gov/siteregister/html/siteRegister.jsp

4.2.3.1 Exploratory Survey

Work consisted in informal interviews with commercial and recreational fishers at landing sites, dive masters, commercial port agents (DNER), MRIP staff, or in the absence of any of these, any persons intercepted at the sites. These surveys continued for the duration of the project, and in the absence of formal interviews, provided a significant amount of information about the sites that was also used to plan subsequent trips to those locations. The structure of the Exploratory Survey was the following:

I) Questions to determine if sites are recreational and likely conch/lobster sites:

1. Is this mainly a commercial or recreational fishing site? C/ R/ Both.

   If Recreational or Both, continue interview, else, go to next site.

2) Is this a site for recreational harvest of Conch and/or Lobster?

   (1) Unlikely

   (2) More or less likely (LOW USE)

   (3) Highly likely (HIGH USE)

II) Questions to rank the level of fishing pressure in High use/ Low use (modify if too detailed for exploratory survey).

3) If Highly likely (3) or more or less likely (2), are Conch/ Lobster target or opportunistic species?

4) How many vessels/ boats/ divers/ recreational fishers operate at this site?

5) Estimate of the total number of trips per week.

6) What proportion of the recreational trips harvest conch/ lobster?

7) Average catch of conch/ lobster per trip.

8) What is the regular schedule of (recreational conch/ lobster) trips at this site?

- Preferred seasons/ months
- Weekdays, weekends/ holidays
- Times of the day (morning, afternoon, evening)

4.2.3.2 Stratified list/ map of recreational sites

MRAG developed a map with a selection of 'Conch/ Lobster sites' by combining the exploratory surveys and collaboration with DNER staff and commercial port agents. The map designated expected HIGH USE/ LOW USE conch/ lobster sites that could be used as the basis to begin the interviews, based on main known, probable sites, including marinas, dive-shops, beaches, piers, bridges, etc., where there had been evidence of recreational use of conch and lobster, where tourists and subsistence fishers are likely to occur..

MRAG planned on developing a refined ranking of the fishing effort as the interviews and observations proceeded.

Once the key sites were selected and mapped, sampling effort in the High/ Low Use sites was stratified, with more sampling effort dedicated to the highly probable areas (i.e., 75%/ 25% effort).

In cases where there was not enough confidence in the High/ Low stratification, sites were weighted evenly and equal sampling effort was applied.

4.3 Project Design

The project was conceptualized to have an adaptive design that could allow for flexibility in the structure and implementation of the different project components. This dynamic nature is also reflected in the way this report is organized. In this section we present the initial configuration, but in later sections we present the most important changes that accrued as the project developed. The survey design included developing and adapting field methodologies and the associated budget, as well as developing survey instruments and the necessary equipment and materials for the field implementation phase.

4.3.1 Identification and stratification of recreational fishing sites (Conch-Lobster strata) based on interviews.

The plan divided the sites into strata (e.g., north, west, south, and east coasts and offshore islands and cays), with interviewers assigned to cover each stratum. The plan called for sites to be sampled randomly, with testing of a sampling design for interviewing active fishers in each stratum.

This activity followed the preliminary stratification of sites described above, under the assumption that sufficient evidence existed (from informal interviews and preliminary maps) to stratify in High/ Low use sites.

A rapid, qualitative analysis of the initial interviews was performed to divide the recreational landing sites into strata, and to assign interviewers to cover each stratum. Initially, the sites were sampled randomly, interviewing active fishers in each stratum according to the following sampling design:

1) Divide the area (Puerto Rico) in 4 regions: NW, NE, SE, SW. Offshore islands and cays were not included in this methodology due to logistic difficulties associated to sampling. However, two intensive scoping trips were planned to Vieques and Culebra.
2) Divide each region in High Use/ Low Use sites, depending on fishing pressure ranking category.
    a) Ranking of fishing pressure was based on:
        - Answers to questions 3 to 7 of the Exploratory Survey.
        - Historic fishing pressure as reported in previous research and by resource managers (DRNA, MRIP staff).
        - DNER's experience and preliminary selection of sites.
    b) Due to the seasonal closure for queen conch, we considered that fishing effort would probably shift to other areas or that effort for lobster might increase in the most active conch areas. The sampling design would be adjusted if such shifts occurred.
        - Conch closed season: August, September, October
        - Conch open season: November to July
    c) Distribute sampling effort between High/ Low use sites (Example: 75/ 25% coverage).

3) Other strata and weights that we anticipated (as the results of the preliminary survey OR DNER's preliminary selection of sites) were:

   a) Primary sampling unit: Combination of High use/ Low use sites and days of the week.
      - Weekday (50% coverage)
      - Weekend/ holiday (50% coverage)

   b) Secondary sampling unit:
      - Morning (50% coverage)
      - Afternoon (50% coverage)
      - Evening (0% coverage)- Due to risks associated with sampling at night, the evening stratum was not included, which may have created a bias in the observations.

4.3.2 Sampling recreational catch following a survey design.

The plan called for a development a survey instrument to address all the questions listed in the objectives. To reduce the rate of interview refusals, the interview was designed to take no more than 15 minutes. The survey instrument included filter questions to exclude licensed commercial fishers and appropriately identify, to the degree practicable, the remaining fishers as recreational (personal use) or commercial without valid licenses (sales outside of the authorized commercial system).

This task was divided into two main activities: 1) Survey logistics, and 2) Design of the survey instrument.

4.3.3 Survey logistics

Based on the preliminary strata outlined above, sites were clustered according to the region and fishing activity. Initially, the sampling period was planned for a total of six months; it was later extended to a whole year, with four interviewers working 8 hour shifts, 5 days a week. The following considerations were taken into account for this preliminary (theoretical) plan:

- In each 8 hour day, 4 nearby sites could be sampled, considering 1.5 hours of interviews/ sampling and 0.5 hours for travel.
- Sampling was conducted by Fishing Mode: party/charter boat, private or rental boat fishers. Shore-based (man-made structures, beaches and banks).
- Interviewers generally resided in the region that will be assigned to them to minimize the burden and the expense of travel, but occasional longer distance travel occurred..
- Sampling difficulties (distance, expensive, difficult to reach) on the offshore islands/ resulted in three options for sampling:
  - Do interviews at selected sites on the islands over a short period of time. This option was selected and one-week trips with intensive sampling were planned for Vieques and Culebra.
  - Intercept people when they get off from the ferry: proportion of people that fished/ proportion of people who catch conch/lobster.
  - Do not conduct interviews in offshore islands.

This original plan was modified throughout the course of the study to make sampling effort more efficient and more feasible in terms of logistics, budget, availability of samplers, conditions on the ground, and most importantly, to increase the probability of intercepting recreational fishers at the selected locations. The methodology was thus adapted frequently, allowing for all necessary improvement. This structure and premises were used as the basis for later project configurations.

MRAG provided oversight for all the field operations, planned all the activities of the interviewers, in close collaboration with the field coordinator; provided quality control for data collected; performed all the analyses; and elaborated draft reports and this final report.

4.3.4 Design of the survey instruments

4.3.4.1 Survey instrument for fishermen

A survey instrument was developed after consultation with MRIP staff, MRIP data-base managers, DNER staff, CFMC staff, and other scientists who have conducted similar work in the US Caribbean. Various survey forms were reviewed, including the existing MRFSS intercept survey forms, an experimental shore-based recreational activity form used in St Croix (Goedeke et al. 2016) and the one developed by R. Appeldoorn and M. Valdez-Pizzini (1996) for a survey of recreational fishing in Puerto Rico, with emphasis on queen conch.

It was not possible to obtain a MRIP database to modify for this project because it is managed by a private company. For this reason and because the scoping information to be collected with this project would not contain the level of detail specified in MRIP surveys, we decided to use a more simple and adaptable form. Thus, the recreational form for conch by Appeldoorn and Pizzini (1996) was selected and used as a basis, with the consent of original author (R. Appeldoorn, pers. comm.). A few modifications were added. The survey form focused on addressing the questions that this project seeks to answer regarding the recreational harvest of queen conch and spiny lobster in Puerto Rico, as described in the Objectives. The final forms are described in the results section and are included in Appendix C[17].

To reduce the rate of interview refusals, we intended for the interview to take no more than 15 minutes. Also, the form included filter questions to exclude licensed commercial fishers and appropriately identify, to the degree practicable, the remaining fishers as recreational (personal use) or commercial without valid licenses, or illegal fishermen.

4.3.4.2 Survey instrument for dive shops

Interviews with dive operators wre planned toward the end of the study (August, 2015) to obtain additional information about the recreational fishery for conch and lobster. An additional questionnaire was developed to investigate whether this sector (sport divers) is involved in the activity. It included information on where they dive, if those are places are conch and/or lobster habitats, if they allow fishing, if the divers catch these species occasionally, how often, and the quantities they catch. Also, we inquired whether their activity normally allows or includes fishing as part of the diving package, if divers observe other recreational fishers taking these species at their dive sites, the frequency and intensity of those observations, and the methods that they see being

[17] Spanish and English versions included, although all interviews were conducted in Spanish.

used to harvest fish or shellfish. The interview form for dive operators is described in the results section and is included in Appendix D.

4.3.4.3 Exploratory Survey/ Site identification form

To improve the site identification and description, to keep track of sites visited, and to help stratify sites, a new form was developed “Exploratory Survey form”.

To improve the site identification and description, to keep track of sites visited, and to help stratify sites, we modified the Exploratory Survey form into the Site Identification and Survey Form, which includes the following information for every trip: the date, day of the week, time of the visit site coordinates, access information, site classification, municipality, main activities observed or reported, and the number of boats, trailers, jet skis, kayaks observed, as well as whether diving and/or snorkeling were observed or reported. If fishing was one of the activities, the characteristics of the fishing activity included: gears and species observed or reported at the site, the fishing modality (commercial or recreational), the species of interest; seasonality, days and times of the fishing activity; presence of shell mounds; evidence of illegal fishing; number of interviews; observations and comments about the site; and contacts.

4.3.4.4 Social media inquiries

This method was used as an additional resource to provide information needed for the project. Although social media were recognized as powerful tools for networking and communicating with the target groups, it was only applied sporadically and informally. A structured social media survey would have required time and human resources that were not originally planned originally for this project.

Relevant Facebook pages were visited and inquiries regarding the recreational activities for queen conch and lobster in Puerto Rico were made.

4.4 Analysis of recreational survey data.

The plan stated that MRAG would analyze the survey data, with technical feedback from NMFS. One of the main outcomes expected from this analysis was the verification or rejection on the recreational use of the sites for queen conch and spiny lobster harvest; the spatial distribution of catch and effort; and the differences among sites and times of the day.

Recreational survey data were divided in five main categories:

1) Exploratory survey data (and Site identification data)
2) Formal interview data
3) Queen conch morphometric data
4) Dive shop survey
5) Vieques and Culebra surveys

Data analysis was planned to begin by the end of the field evaluation period and after all the data had been integrated.

4.5 Sampling conch species and sizes from conch shell mounds on the shore.

The sampling plan called for noting the presence of conch shell mounds by the shore, taking coordinates and photographs, and a subsampling of the shells with identification to species and measurements.

This activity was implemented as planned, with shell measurements obtained at every location where conch shells or mounds were found. Conchs shell length and shell-lip measurements were taken of a subsample of individuals (Appendix C, Form 3).Very few lobsters were measured.

4.6 Intercept sampling

The plan required interception of recreational fishers of conch and lobster species when encountered. The coordinates of the site would be recorded, fishers would be interviewed and their catch identified to species, photographed and measured. Any by-catch would be identified, weighed and measured as appropriate.

This activity was implemented as planned. Each interviewer was provided with the following documents and materials needed for the intercept sampling: interview forms, water-proof digital cameras, digital scales, large and small calipers to measure lobsters and conchs, bag to weight individuals, interviewers obtained coordinates from smart phone apps.

The majority of the fishers intercepted did not allow photographs or measurements to be taken of their catch, so interviewers had to provide common names of the finfish species observed, and obtained few measurements of conchs and lobsters.

4.7 Internal and external communication plans

4.7.1 Internal discussions

Since the project relied on interviewers to collect information from recreational fishers, a rigorous communications schedule was set up between the Interviewers and Interviewer Supervisor (or Field Coordinator) and between the Interviewer Supervisor, MRAG Americas and the DNER Project Leader.

During the final design plan for the project, MRAG communicated with the project team to present draft designs, and to present a final design prior to the start of the sampling. Once sampling started, weekly or daily communications occurred between MRAG and the Field Coordinator, by email and by telephone, to review previous sampling and agree on the priorities for the upcoming week. The Field Coordinator set up a weekly schedule for each Interviewer and distributed it at the beginning of the week.

Every two weeks or as often as needed, Skype and phone communications were set up between MRAG and the team of interviewers, to review the results and restructure the methodology when required.

The Interviewer Supervisor maintained regular contact with the Interviewers to assure compliance with the survey design and to help resolve issues. The Supervisor conferred with MRAG whenever questions arose. MRAG set up regular Skype communication with the Team of Interviewers to review the results and restructure the methodology whenever required. The Team of Interviewers was encouraged to provide suggestions for changes that would improve the methodology, considering that they performed all the field work and had a better grasp of the difficulties confronted every day in different areas of Puerto Rico.

4.7.2 External discussions

Whenever MRAG identified issues that needed resolution at a higher level, MRAG consulted with the Project Team and the Operations Team. Such issues included modifications in the design, the budget, or the timing of project tasks and activities.

MRAG prepared monthly reports that were reviewed, edited, and submitted by the Team Leader to the MRIP Operations Team. These reports described the progress achieved during the month in each of the project tasks, including the problems encountered and the solutions that were implemented. Monthly reports and subsequent data analysis led to this Final Report.

4.8 Dive shop survey

A short survey with dive operators was planned toward the end of the study (August, 2015) to obtain additional information about the recreational fishery for conch and lobster. The “Survey instrument for dive operators” developed for this activity is described in section 3.3.

Essentially, dive shops around Puerto Rico were identified from previous studies (D. Beltrán, pers. comm.), and a list of dive operators was developed (see Section 4.8). Project interviewers contacted the dive shops in their region by phone, and in-person meetings were scheduled to interview the owner or a dive-master or tour guide operator at each shop. The results from this survey are only qualitative.

4.9 Vieques and Culebra surveys

Toward the end of the field evaluation phase (in June and July, 2015), the plan was extended to carry out rapid assessments of the recreational fishery for conch and lobster in the remote islands of Vieques and Culebra. The sampling design for surveys around these islands was adapted to have as much coverage as possible during a short period (one week and 11 days, respectively).

The plan called for scoping interviews during the first couple of days to find out the potential sites of recreational conch and lobster activity. Interviews were conducted with all fishers encountered, with park rangers, enforcement agents, DRNA ad US Fish and Wildlife staff, and NGOs present in the islands. After that, the team visited all the possible fishing sites, roving the majority of the beaches around Culebra and Vieques, and visiting some marinas and private docks. Also, large samples of conch shells were measured at every “conch cemetery” identified.

5 Results and Discussion

Continuous consultations with the DNER and NOAA Fisheries occurred between 2013 and 2014 to decide the timing to initiate the project and the best project configuration to attain the objectives. The project was on hold until January 2014 because it was considered important to cover the closed and open seasons for queen conch and to have sufficient sampling effort distributed over time and space. This entailed having the human and technical resources available for the entire sampling period. During the month of February 2014 MRAG initiated the planning phase and reviewed the documentation necessary to develop the methodology.

Again, it is important to emphasize that due to the dynamic and adaptive nature of this project, the Design Phase is intertwined with the Field Evaluation Phase, as some of the results were continuously applied to refine the methodology. There are thus some overlaps in the phases of work.

The project was structured into five distinct phases or tasks. These phases include all the main activities described in the methodology, but grouped in a logical or sequential way, and with the adaptations required to meet the project goals.

1) Planning phase
    a) Outreach activities to inform and involve recreational fishers before the project begins.
    b) Hiring and training a team of samplers/interviewers.
2) Final project design phase.
    a) Identification and selection of potential recreational sites.
    b) Other criteria for stratifications
3) Field evaluation phase
    a) Distribution of sampling effort
    b) Other logistics
4) Data analysis phase.
    a) Exploratory survey data
        i) Site data
        ii) Exploratory survey data
        iii) Daily trip data
    b) Formal interview data
    c) Queen conch morphometric data
    d) Dive shop survey
    e) Vieques and Culebra surveys
5) Final report phase

5.1 Planning phase

5.1.1 Outreach activities

The first set of outreach activities consisted of consulting with the outreach specialists from the NOAA Regional Southeast Office and from the NOAA offices in Puerto Rico and the USVI. The main recommendation was to work directly with the DNER communications office in Puerto Rico.

Budget constraints, lack of information to identify recreational fishermen, and lack of personnel to organize and facilitate meetings around Puerto Rico, restricted the strategies to reach out to fishermen.

We relied on posting a short article in the nautical journal "La Regata"[18] to advertise the project and to encourage recreational fishermen to participate. Once samplers were hired and began field work, they distributed flyers at each new location that they visited and also presented a formal letter from MRAG and an official identification card, to have more credibility and inform fishers of the objectives of the project.

The article in La Regata was posted twice, a year before (October, 2013) and a few months before (April, 2014) field work began (by mid-September 2014). A copy of the outreach documents (project introduction letter, examples of official ID badges, and the article published in "La Regata" are provided in Appendix A).

5.1.2 Hiring a team of samplers/interviewers

Recruiting interviewers was a cumbersome process that took at least 6 months. Several hurdles were encountered during the recruitment process:

- There were few people who met the requirements;
- A short-term contract did not seem appealing, since the project was originally planned for 6 months of part-time field work
- The interview team had to be distributed around the island to maximize efficiency and costs;
- Tthe schedule of activities did not suit people´s interests (work was to be concentrated on weekends and holidays to intercept most recreational fishers); and
- Some of the candidates did not maintain interest in the project.

In August, 2014, interviewers were selected and recruited to begin sampling in September. Unfortunately, changes still happened the week of the training: one person declined the position due to last-minute health issues and the person selected to work in the east coast did not communicate or show up for the training. Alternative candidates were contacted. Also, over the course of the project, there was some turnover. One person left in January, 2015, and another one in June, 2015. An additional person was recruited in June, 2015 to cover the east coast. Each time there were changes in staff, the days of the week, times and locations, as well as the roles of the remaining interviewers and the field coordinator were reviewed and adjusted.

Over the study period, the team included the following members; only the first two people stayed the course. The place of residence and assigned sampling regions included in the list:

1) Interviewer 1- Field coordinator- SAN GERMAN- South/Southwest Puerto Rico.
2) Interviewer 2- VEGA ALTA- Northeast/ East PR
3) Interviewer 3 –BARCELONETA- Northwest/ West PR.
4) Interviewer 4- SAN JUAN- Eastern PR
5) Interviewer 5- FAJARDO- Eastern PR

[18] La Regata, El Periódico Náutico de Puerto Rico. http://www.laregatapr.com/index.html

The first interviewer was the field coordinator for the project. Her responsibility was to coordinate all the field work and logistics. This included the review each week´s results, planning the schedule for each sampler each week based on prior results, and to supervise that the data were entered on the data base. On a daily basis, the Field Coordinator communicated with the other interviewers to discuss weekly plans, weekly results, issues, and immediate solutions. She also consulted the MRAG coordinator directly and perodically with the DNER to find alternatives and solutions to the issues that arose. She also established contact with agencies and persons in Puerto Rico that provided technical or logistical support for the project (such as port agents, lodging facilities, NGOs in Vieques and Culebra), provide MRAG with the data necessary to produce monthly reports, developed all the maps for the project, and provided feedback for the final report. When time allowed, the Field Coordinator also did surveys as the other team members.

The tasks for the rest of the team were to rove the island according to a weekly schedule (date, time, and location to visit) provided by the Field Coordinator, document all observations at each site visited (using the Site Information Form), conduct formal and informal interviews, write field notes and daily reports, log the coordinates and take photographs of each site visited, take measurements of the catch, and enter the data collected into a shared database.

The MRAG coordinator had regular communication, usually bi-weekly with the field team to evaluate methods, results and to discuss solutions to improve the methodology, increase efficiency, or confront issues. The MRAG coordinator also reviewed the weekly schedules, weekly reports, evaluated proposals from the team for any changes in schedules or methodology, communicated with the DNER and the Project Team for higher level decisions, conducted the analysis, and developed all the reports and presentations for the project, with inputs from the Field Coordinator.

5.1.3 Training of interviewers

A detailed training plan is provided in Appendix B. A three day training for interviewers was carried out between September 11 and 13, 2014, at the Fisheries Laboratory of the DNER in Mayaguez, Puerto Rico. The training was led by MRAG, with the participation of Daniel Matos (DNER) and his team of commercial field samplers.

The training included an introduction to the project, a review of the methodology, objectives, and administrative information; visits to fish houses to become familiar with the species of interest and to take measurements of a few specimens; review of the survey- interview forms; practicing interviews; review of maps and recreational locations to visit, and a roving trip around the area of Mayaguez-Joyuda-Cabo Rojo to identify recreational locations and understand the operations that occur at different sites. Interviewers began doing surveys and interviews on their own the week after the training.

5.2 Project design phase

The methods were revised throughout the planning phase, as specified in the Methodology section. Once field work began (September 15, 2015) interviewers were encouraged to provide regular feedback to refine the methodology, according to the reality of the conditions in the field

and the logistics required. As discussed earlier, the methodology was adapted continuously as the conditions in the field changed or the needs of the project evolved.

None of the alternative design configurations proved consistently useful to intercept and interview recreational fishers, which was the main goal of the study. Only 47 interviews were successfully achieved over the course of the study, half of which were from recreational fishers; remaining interviews came from commercial and unlicensed fishers. Therefore, the data obtained from interviews was not sufficient to answer many of the questions posed by this project. However, the information collected with the Exploratory Survey/ Site Identification method provided data that may help to understand patterns in the conch and lobster fishery as a whole, including commercial, recreational, and illegal fishing activities. Although unexpected, this additional information produced the main results obtained from this study.

The core design and adaptations are summarized below. Details of all the changes implemented were provided in the monthly reports submitted to MRIP Operations Team between September 2014 and September 2015 and are not reproduced here.

5.2.1 Identification and stratification of Conch-Lobster recreational fishing sites

5.2.1.1 Intensity: high/ low use strata

A preliminary list/map with semi-stratified queen-conch lobster sites was produced as a result of the interviews, inquiries and research conducted during the planning phase. The Team decided to combine roving and fixed sampling techniques to select sites, adapting to the conditions of the field operations and the frequency and the intensity of recreational fishing activity observed over the study period.

All potential sites for recreational fishing for queen conch and/or spiny lobster were visited during the first four months of the study, with gradual selection of those with greater potential to display the activity. This selection was based on field observations, anecdotal information retrieved from informal interviews, from actual interviews, from consultation with port agents and experts, or from a combination of these. Any information gathered about the site activities was used to characterize and stratify the sites. The complete list of the 202 sites identified by municipality is provided in Appendix E and the list of the selected, “Likely” sites, where sampling effort focused during the Interview Phase of the field evaluation period is provided in Appendix F.

It is important to note that all these preliminary site evaluations were qualitative and relied either on expert knowledge (ex., port agents, MRIP staff), or on anecdotal information obtained from random people. Thus, it was not possible to produce a definitive map with highly likely or highly unlikely sites for recreational fishing of queen conch and/or lobster.

Fishers were intercepted very rarely, so the planned, formal survey stratification from actual data (from fishers interviewed) could not be implemented. However, the information collected with the Exploratory Survey/ Site Identification Form was used to decide if each site was a HIGH/LOW use site. Many sites were only visited once only to confirm that the activity did not occur at that location. Others were visited 2 or 3 times when there was indication that the activity might occur. Those visited more than 3 times showed potential for more activity. Further stratification was not possible due to limited data. Also, a random design was not considered practical as the sampling effort had to be selective and had to focus on sites with greater probability of interceptions.

The number of sites continued to be reduced based on the criteria discussed before (basically, informal interview data on site use), and also if the locations were too remote, difficult to access, unsafe, or if absolutely no fishing for the species of interest was likely to occur. After a few months of sampling, Marinas were discarded entirely, as were many other sites. By the middle of the field evaluation period (April-May 2015), only the selected sites were visited repeatedly, with approximately 20% sampling effort dedicated to those with medium probability of displaying the activity, and 80% to those with higher probability, or "Most likely" sites. Even with these changes, the activity was rarely observed and few interviews were successfully applied.

5.2.1.2 Other criteria for stratification

Other criteria for stratification considered in the plan besides the intensity of the activity were the geographical distribution (location and ease of access), safety, seasonal, weekly, daily patterns in the activity and other recreational activities, etc. that could help to allocate sampling effort in the most effective way. The criteria and parameters described in the Methodology (see Section 3.3) was followed to the extent possible, however, they could not be fully implemented, again, because very few fishers were intercepted during the study and because other random people encountered were generally not too willing to cooperate or did not know enough about the sites to contribute useful information.

Thus, to further stratify the sites by geographical; temporal, and other patterns, the method was further adapted to a variety of situations encountered in the field. Again, these additional strata relied heavily on qualitative observations, informal interviews and anecdotal information, which proved to be very useful to characterize the sites and to plan and schedule future visits. These criteria aimed at achieving greater probability of success and included not only the likelihood of the activity, but also the best seasons, months, days of the week, and times to sample at each location.

All the information collected with the Exploratory Survey/ Site Identification Form was consolidated in two databases (as "Site Data" and "Daily Trip Data"), where data from all trips to a location resulted in summary data per site. It is important to note that this approach did not have methodological or statistical rigor, but was flexible and open to alternatives that could provide useful information for the project. The data collected in this manner included similar information to the formal interview forms, including a description of the site, the date and time visited, the activities observed, and details of the fishing activity when present. Ultimately, this information provided summary results that can help to guide future surveys.

5.3 Field evaluation phase

The preliminary phases of work took longer than expected, in particular, recruiting a suitable team of interviewers that had the qualifications and skills required (described in the Methodology section) was complicated. A team was finally recruited in August, 2014, so the field evaluation phase began shortly after.

Also, during the planning phase there was an intense consultation process with the Project Team regarding the timing of the project. The idea was to schedule activities in a way that would provide the best coverage of the recreational conch and lobster fishing activity and that would maximize

interceptions at landing sites. It was decided that the field evaluation period should include sampling before, during, and after the conch closure, to investigate possible shifts in the fishing patterns and to assess compliance with the closure. For this reason, the project period and funds were extended to cover an entire year of field surveys, beginning on the second half (1.5 months) of the closed season for conch (September-October 2014), ending after the first half of the closed season (August, 2015), and covering the whole open season (November to July 2015) when more recreational activity for both species was expected.

The field evaluation phase began on September 11, 2014, with the 3-day training for interviewers before. The exploratory phase lasted through January, 2015, and consisted in roving the entire island and visiting all the potential or known recreational fishing sites for conch and lobster. Field surveys continued through September, 2015.

The distribution of sampling effort over the year of the field evaluation phase followed the configuration described below.

5.3.1 Distribution of sampling effort

5.3.1.1 Regional

During the first three months of sampling, the team was divided in two groups; the first group: worked throughout the Northwest, West and Southwest regions; and the second team was responsible for work in the Northeast, East and Southeast regions of Puerto Rico. It was decided that interviewers traveled in pairs, first for safety reasons, and also because initially it was considered very important that fishermen knew them as a team, with one person conducting the interviews while the other one identified, measured, weighed the catch, and collected other information about the site. Since each person resided in different towns, they usually met at the site scheduled or at an agreed location.

With later turnover in the team, there were only 2 or 3 interviewers available at times, so traveling in pairs was no longer possible. Thus, during the following 9 months of the study each person traveled separately to different locations. This provided more coverage and the possibility of intercepting more fishers, and was also a more efficient allocation of resources.

5.3.1.2 Temporal

1) Days of the week

There are no marked seasons in Puerto Rico, except for the rainy and the dry seasons. No seasonal patterns could be detected with the limited information obtained. However, other factors were known to affect the likelihood of fishing, such as weather conditions and oceanic conditions that are largely unpredictable too.

Under initial the hypothesis that recreational fishing would be more likely to occur on weekends and holidays, field visits during the first 2-3 months of the project were initially planned on weekends and holidays and one alternated day during the week. This design helped understand the weekly trends in the activity. By the second month of sampling (October 2015) it became evident that Sundays were generally dedicated to other recreational activities (swimming, cruising,

jet ski, surfing, sun bathing, etc.), so trips on Sundays were suspended or done only once a month at selected locations.

Also, because funds were limited, it was decided to conduct field work three days a week, with 10-hour days. This plan considered 1-hour travel to sampling locations, 4 hours in two different sites, and a 1 hour return.

Other trials included different weekdays, but always keeping Fridays and Saturdays. By the middle of the project, it became clear that Sundays, Mondays and Tuesdays were not preferred days to fish recreationally, so sampling on those days was reduced. During the second half of the project, sampling effort concentrated on Wednesday, and the weekend (Thursday, Friday, and Saturday). All holidays were included in the sampling schedule. This resulted in approximately 25% coverage on weekdays and 75% coverage on weekends and holidays.

2) Times of the day

During the first half of the sampling period, sampling trips began at around 8 am and ended by 6-7pm. The idea was to have 10-hour days, spending at least 6 to 8 hours making observations and interviews at 2 nearby sites, with an average of 1 hour one-way travel to the site. Samplers were encouraged to work on their daily reports and data entry upon their return, or while they waited to intercept fishers. Samplers were discouraged from staying at sampling sites after dark, so no generally observations were made after 7pm at night.

Generally, the trips were designed to inspect 2 sites per day, spending 2.5-3.5 hours per site, since there was greater possibility to intercept fishermen if observers waited for long periods of time. Unfortunately this method proved to be inefficient, since several opportunities to intercept boats were missed while roving between sites.

Thus, a transition was made in April 2015 from working 3 ten-hour days to working four days a week for 7-8 hours a day in order to have a greater window of opportunity to intercept fishers. Two different schedules were implemented too, very early in the morning or around sunset to try to intercept fishers before they left or to intercept them upon their return after a fishing trip.

This change also entailed sampling a single location each day, to increase the possibility of intercepting fishers and to reduce the chance of missing them while moving to another location. A final change included visiting the same location twice on the same week, to try again to observe weekly patterns or detect differences between the days of the week or the weekend.

Also, many interviews and conversations with port agents held in April suggested that significant activity occurs after sunset. We did not do surveys after dark, but a few observations at dusk when samplers were returning home reinforced the idea that the activity increases at night.

5.3.2 Other logistics

Strategic planning was needed for the success of the project, so day to day operations had to be designed in an increasingly structured way. By December 2015, a schedule of visits was planned one week in advance, taking into account the site stratification criteria and other patterns observed. A schedule was designed for each interviewer, with a list of nearby locations to visit (maximum 3 per day) and alternative locations, by day of the week and by times of the day. If available, a route to facilitate travel to the sampling sites was provided.

Before all field trips, interviewers were encouraged to find contacts (fishermen, divers, marina managers) at the desired sites and to call them in advance to ensure entrance to the sites. This was done during the first few months until every site was visited.

5.3.3 Field evaluation phase: preliminary observations

The following sections document the qualitative information obtained throughout the different phases of field work. The conclusions drawn from this information guided all the modifications and adaptations over the course of the study. These observations are not quantitative, but support the semi-quantitative analysis and data summaries provided in the Data Analysis section (Section 5).

5.3.3.1 Seasonal observations

The field evaluation phase began on September 11, 2014 and ended on September 30, 2015. Surveys were conducted during part of the queen conch season in 2014 (September 15 –October 31) and in 2015 (July-August). During this period general findings were documented and preliminary summaries of the data were interpreted. These were later substantiated when the database was consolidated and fully analyzed (in the Data Analysis Phase).

The Queen Conch fishery re-opened in November 2014 after the 3-month closure that lasted from August through October. As expected, the team observed more fishers harvesting queen conch, some recreational, most commercial, or commercial without a license (illegal fishers). Recreational fishing for spiny lobster occurred simultaneously, but field observations suggested that that the activity was not intense.

For the December holidays, the team continued sampling under the hypothesis that during the holiday weekends more activity would be encountered. Our observations did not support this hypothesis, as low activity was found at the places visited, and some sites (marinas) were closed on Christmas Eve or New Year´s. Most of the recreational activities observed during the holidays did not include fishing. However, commercial fishing for both conch and lobster was observed on the East Coast.

5.3.3.2 Exploratory phase observations

The goal of exploratory surveys was to rove the entire island and visit all the potential or known recreational fishing sites for conch and lobster. By January 2015, 112 of 118 potential sites, 66 in the East Coast and 26 in the West coast had been surveyed, and only four (remote or potentially dangerous) sites remained. Also, by that time, 48 sites had been eliminated from the list based on the security, lack of activity, no potential for fishing, etc.

Throughout the project, interviewers continued to document observations around the island and to conduct formal and informal interviews whenever possible. Few full interviews were completed because recreational fishing activity in general, and for conch/ lobster in particular, was scarce at the sites visited during the times visited. At some locations, it was likely that more activity might be observed at different days and times, so many places were re-visited.

Given the value that the Exploratory / Site Identification Survey acquired for the project, informal interviews with locals at the selected sites (after stratification) continued for the duration of the

project. These random interviews provided general information about the activity at the site, times of operation, referrals to other fishermen, and clues to other potential sites. This information helped to classify the sites into active/ not active recreational fishing site, active for what species, what gears, when the activity occurs, and the preferred times. This information was used to keep or discard sites from the list for the next phase (Interview phase), that began in February 2015, focusing on the sites with greater potential and that required more attention.

The main information gathered from exploratory surveys suggested that:

- There were 118 potential sites, 66 in the East Coast and 26 in the West Coast.[19]
- Of the 118 sites, 66 (56%) had a greater potential to display the activity. These continued to be visited and if after 2-3 visits no activity was observed, they too were removed from the list.
- 48 low use sites were eliminated and were not surveyed again. Many of the sites eliminated are used for other recreational activities (swimming, jet ski, kayak), but fishing was not observed.
- Potentially dangerous sites were eliminated. A number of sites were deserted and no activity of any kind was observed during the days/ hours visited. It was not recommended to visit these places alone.
- Additional sites were added to the original list from consultation with port agents, informal interviews with locals, and the teams´ observations. The complete list included 201 sites, approximately 160 in the main island, and 41 in Vieques and Culebra.
- The final site selection during the Exploratory Phase concluded in January 2015, and included 52 sites distributed in 27 towns around Puerto Rico. The list of selected sites is provided in Appendix F and in Figure 1 below. Final summary data of the sites visited is presented in the data analysis section.
- On the sites selected, some fishing activity was observed, including fishers targeting lobster commercially and recreationally.
- Different recreational fishing modes were observed: from shore (piers, docks, beaches) and from boats, kayaks, jet skis that depart from beaches, marinas, ramps.
- Recreational fishing activity appeared more intense on weekdays during morning hours.

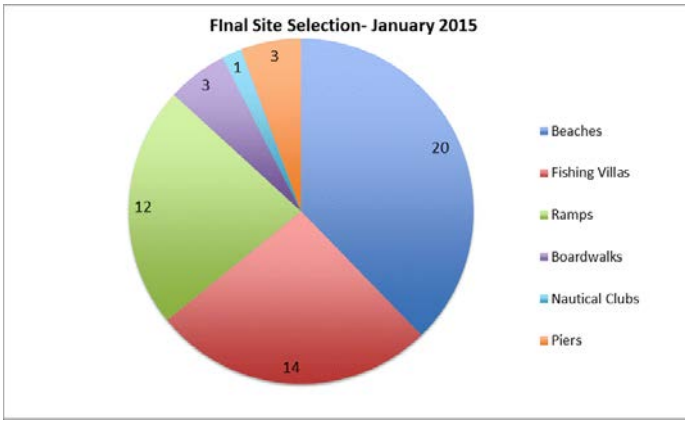


Figure 1. Final site selection (see Appendix E with details of the name, municipality, and location of the sites selected).

[19] Lists with details of potential and selected sites are available upon request.

5.3.4 Interview phase observations

5.3.4.1 Site stratification

The second phase of the survey ("Interview phase") began in February 2015, and focused on trying to maximize the number of interviews. For this, sites with observed or reported activity were visited more frequently, and sites with limited or no known potential activity were discarded or were surveyed only sporadically.

The observations by that time were still not sufficient for a fine classification or stratification of sites; therefore there were only 3 categories: "likely active", "possibly active", and "not active", instead of "high", "low", or "no activity" as was previously planned. This situation continued for the duration of the field evaluation phase, so the stratification according to intensity of the activity ended up being very coarse, despite the plans for a finer resolution.

By the last two months of the study (August-September 2015), sampling effort focused on the "highly likely sites", with more frequent visits to the same locations. While this approach was not random, it would possibly increase the probability of intercepting the target group. This effort did not produce the desired results either.

5.3.4.2 Interviews

The number of formal interviews was very limited, so no clear trends were observed. Intensifying surveys in the more likely recreational conch/ lobster sites did not increase the likelihood of interceptions or interviews. Fishing for both species did occur at some of the sites surveyed, but the team suspected that the majority of the fishers intercepted were fishing illegally and selling their catch. The team was not in a position to request their licenses, so only when it was very clear that they were legal, licensed commercial fishers, the team did not proceed to a full interview. However, interviews were applied whenever there was doubt about the fisher's license or intention. It was very rare that fishers declared themselves as recreational or, obviously, as illegal. They generally stated that they were commercial fishers, occasionally with licenses that had "just expired".

Considering that there was very limited data to analyze, our general impression was that the recreational activity around the island is very elusive, or does not follow any patterns that we were able to track with our methodology, or with our limited capabilities to rove the whole island and be present at the right time at the right place.

It did not appear that recreational fishers visit the same places on the same days of the week or at the same times of the day. Also, if and when they do, samplers might not have been there. The team attempted to visit sites on days and times when someone had reported activity.

Unfortunately, many sites, particularly in the East coast were deserted and very few fishermen were found. We also suspect that recreational fishermen may prefer to fish late afternoons and evenings, after work, and these were times when we did not conduct surveys for security reasons.

5.3.4.3 Main adaptations in the methodology

Adaptations to the sampling protocol were made every month, after reviewing the previous month´s activities and results. We continued to search for more activity, to maximize the interviews,

and to minimize the costs, with very limited success. We, for instance, took Marinas out of the list of sites, stopped sampling on Sundays (it was extremely rare to observe activity), spent all day at the most likely sites (instead of 3-4 hours), went in pairs, went alone, but always sticking to the general plan. Initially, the field coordinator planned 1 or 2 nearby sites per day for 10-hour days, 3 times a week. Later, longer hours were spent at a same location to avoid missing the activity while commuting to another site and attempts were made to intercept fishers early in the morning before they left on a fishing trip or at sunset, at their return. Alternative sites were always listed in case any contingency occurred, in case the site was closed, or if the weather was not favorable for fishing on any particular day and time.

Another major change was that the project was extended from a 6-month sampling period to an entire year. The idea was to identify if any seasonal patterns could be detected over complete annual cycle and if there were clear changes in the activity over the entire closure of the queen conch fishery (July to September). The first half of the seasonal closure was covered in September 15 to October 31, 2014, and the second half of the closure between August and September 15, 2015.

Toward the end of the field evaluation period the team traveled to the islands of Culebra and Vieques to carry out a rapid assessment of the activity in those islands. Intensive sampling effort was applied to survey the islands in June and July, 2015, respectively. Most of the likely landing sites were surveyed and substantial information was collected. Also, shell conch mounds were found at the majority of the sites visited, allowing for the collection of morphometric data, to assess if juveniles were commonly harvested. The main results from this effort were that indeed, juvenile conchs represent a large percentage of the catch.

In August, 2015, yet another approach was implemented as a final attempt to obtain information about the recreational fishery. Interviews were carried out at dive shops around the island to find out if conch and lobster were collected during diving or snorkeling trips. The main results were that in general dive shops do not normally include recreational fishing as part of their tour, and those that allow fishing focus on spearfishing (fishes) rather than shellfish. Also, it is apparently very rare for tourists to take conchs or lobsters, with conch being a slightly more desirable target because some people like to keep the shells as souvenirs.

Although none of those modifications produced tangible results (ex., more interceptions and interviews), they overall helped us to have a better understanding of possible patterns in the activities that take place in each of sites. Shifting days and times of surveys most certainly helped to program visits at times when activities were more likely to occur.

5.3.4.4 Target group and fishing modes

Very importantly, the definition of “Recreational Fisher” was ambiguous in practical terms and some samplers were confused, which was reflected in the data. By March 2015, it became imperative to revisit the definition and to decide who we wanted to include in the survey, or actually, who we were able to interview.

It is also worth noting that most of the activity that we observed occurred at the fishing villas, “Villas Pesqueras”, Mondays through Fridays from the early morning through 2-3pm. Scarce activity was seen there on weekends or holidays. This suggested that fishing was their livelihood, their day job,

thus a commercial activity. Also, most fishers were reluctant to define themselves in any category, but it became rather clear that many sold their product with or without a fishing license. These uncertainties about the target group made us rethink of solutions to find the "real" recreational fishers. Also, unintentionally, the project ended up encountering more IUU fishing activity.

With the above observations and constraints in mind, the project interviewers continued do surveys around the island and to use every opportunity to carry out interviews. During the second half of the field evaluation, sampling effort increasingly focused from "likely active" to the "highly likely" sites. By the last two months of the study (August-September 2015), "highly likely sites" sites were repeatedly surveyed to further increase the probability of observations. This effort did not produce the desired results either.

We can conclude that project explored every possible avenue to achieve its objectives, within the planned methodology and budget. Even so, few full interviews were completed because the activity was scarce at the sites visited during the times visited and we had limited capabilities for greater coverage. At some locations, it is possible that more activity might occur at different days and times; at other places it might not occur at all. This project was not able to find answers to these questions.

5.4 Data analysis phase

The Field Evaluation phase of the project ended in September 2015. The Data Analysis phase began in October 2015 and continued through March-April 2016. The Data Analysis phase included six main tasks:

1) Complete data entry
2) Organize/ clean/ filter the data
3) Consolidate data sets from all interviewers
4) Summarize the data
5) Analysis
6) Interpretation

As with every other phase of the project, this phase was plagued with hurdles. It took several months to retrieve all the information from each of the samplers, especially from those that had left the project earlier on and had not uploaded all their information unto a shared Google Drive folder. All the data were finally received by April, 2016, but not in the shape needed for analysis. Unfortunately some team members did not use the pre-defined formats that were specified in the databases, or even digitized some of their data. Thus, significant effort went into recovering and salvaging as much information as possible. This included obtaining, reviewing, organizing, entering, cleaning, filtering for errors and standardizing the data. Once all the data sets from each interviewer were complete, clean, and in a uniform format, they were consolidated into 6 main data sets and a photographic collection, each containing different aspects of the recreational conch and lobster survey:

1) Exploratory survey data

a) *Site identification data* (from site lists, interviews and exploratory surveys): site name, municipality, location in coordinates, access, importance for the activity.

b) *Site characterization*: site recreational activities and details of fishing, if present

c) *Daily trip data*: all the information collected on each sampling trip.

2) *Formal interview data*: based on the questionnaire for fishers intercepted.

3) *Morphometric data* of conchs and lobsters sampled from the catch or conchs found in shell mounds

4) *Dive shop interview data*: based on the dive shop questionnaire.

5) *Photographic collection*: includes photographs of every site visited since field work began in September 2014.[20]

The data summary, analysis and interpretation were carried out once these databases were consolidated. These last activities were performed during the months of April, May and June 2016. Details of the analyses undertaken with each dataset are presented in the sections below.

5.4.1 Exploratory survey data

Daily trip data included information about the visit, the site and the activities observed or reported. The initial purpose of collecting this information was to explore the sites that had been proposed as potential conch and lobster fishing sites, and then stratify the sampling protocol according to their importance for the activity.

The following data were collected on every trip: the date, day of the week, time of the visit site coordinates, access information, site classification, municipality, main activities observed or reported, and the number of boats, trailers, jet skis, kayaks observed, as well as whether diving and/or snorkeling were observed or reported. If fishing was one of the activities, the characteristics of the fishing activity included: gears and species observed or reported at the site, the fishing modality (commercial or recreational), the species of interest at the site; seasonality, days and times of the fishing activity; and observations and comments about the characteristics of the site and the activities at the site. Among these, we included observations of whether conch shell mounds were observed, if there were signs or reports of illegal fishing activity, and whether interviews were carried out during that trip. In the absence of interviews, this daily trip information helped to examine if any patterns or trends existed in the recreational queen conch and lobster fishery.

During the initial visits to each site, the importance of the sites for THE ACTIVITY (= recreational fishing for conch and lobster) was determined, as well as the days and times that were observed or reported for peak fishing activity. This information helped to stratify the sites as Highly Likely, Likely, Likely or Unlikely for THE ACTIVITY. Sites of low importance (Unlikely) were discarded from the sampling protocol, and sites of medium and high importance continued to be visited. Other sites of medium importance were gradually discarded too, and for the last 7 months surveys focused on the sites more likely to be of high importance for the activity.

It is very important to note that at the beginning of the study all of this additional site information (described above) was not considered a priority. However, as the sampling progressed and it became evident that finding and intercepting recreational fishers to interview was difficult,

[20] Photographs from all the sites surveyed are available upon request.

documenting daily trip data became a higher priority. Site-specific data was sometimes difficult to obtain too, particularly when sites were remote, when activities were mostly recreational or not fishing-oriented, when there were no people in the vicinity or when they were unwilling to participate. A large part of the data depended on random people's perceptions that were not part of a structured, formal interview. In general, our team approached any person encountered while waiting to intercept actual fishers, so they obtained comments from anybody willing to provide it.

It is also uncertain in the data base whether some information was based on actual observations or on (reported) information from informal interviews and comments. This is because some samplers did not make a distinction between observed characteristics of the site and reported ones, such as the activities occurring, the gears used if fishing, or the species of interest. Thus, some the information in our database may be anecdotal and not factual, and should be interpreted taking this into consideration.

Also, some samplers did not make a clear distinction of the different recreational activities encountered (swimming, jet ski, kayak, paddleboard, yachting, cruising, etc.) and instead grouped all activities as recreational. The same applied to the sector of the fishers (commercial vs recreational or both), the gears used, the species targeted and fished at the site, etc. Thus, the level of detail varied by sampler, so we had to use the more general descriptions that resulted in the loss of interesting details in the summary data. An additional problem was that some samplers did not collect site information on every trip to the same site, but instead repeated the data from previous trips, resulting in redundancy and data that were not credible. This and other evidence suggested that some information might have been forged.

All these circumstances are reflected in the quality and amount of daily-trip data obtained. Keeping all these flaws and gaps in the data in mind, we consolidated and summarized the data to get the most information from it. This helped to examine the characteristics of the sites and to try to find spatial patterns in the activities, particularly fishing.

In order to salvage as much useful information as possible, we consolidated daily trip data into site-specific data. Some judgment was necessary to determine what data from each trip to a same site was representative, and which one was meaningless, so decisions had to be made about information that appeared as outliers or errors and did not describe the site appropriately. In general, any information, however inconsistent, was included in the site data (for example, no fishing reported and then lines as the main gears observed). Data that were totally implausible were not used to summarize or analyze the information.

Because only rapid assessments were made in Culebra and Vieques, information could not be corroborated on multiple trips or gathered at all at these islands, and thus we were unable to summarize information or analyze most characteristics. For the main island (Puerto Rico), only the records (trips) that contained information were used for summaries, so summaries of sites do not always include all the characteristics, resulting in fewer sites than the total surveyed.

Finally, and most importantly, the data obtained from informal interviews and random comments from locals were not considered robust as to carry out formal statistical analyses. Thus, even if we salvaged as much data as possible from inconsistent and flawed databases, we acknowledge that the quality and amount of information obtained in this way is not sufficient for proper analyses. It was used to produce summaries that can provide some general insight into the activity.

This daily trip database was used to create three data sets:

1) **Site identification data:** created with information from original MRIP site lists, interviews and exploratory surveys (daily trip database). Includes: site name, municipality, location in coordinates (latitude and longitude), access, and importance for the activity (high, medium, low, used for site stratification). This data set was used to develop GIS maps, as described in the **Site Identification Analysis** (Section 5.4.1.1).

2) **Site data set**: created by grouping all the trips to a same site, drawing the main characteristics for each site, and discarding temporal information (day, time of each trip). The main characteristics, activities, and details of the activities were consolidated into a single record per site. This data set was used to examine the SPATIAL distribution of sampling effort and to describe the characteristics of the sites, as described in the **Site Characterization Analysis** (Section 5.4.1.2).

3) **Daily-trip data set**: created by sorting the trips by date, and keeping only the day, name and location of the site. All the characteristics of the site and of the activities observed were removed. This data set was used to examine the TEMPORAL distribution of sampling effort, as described in the **Daily Trip Analysis** (Section 5.4.1.3).

5.4.1.1 Site Identification analysis

Site identification data were mapped using ArcGIS Desktop, release 10.3.1. The goal of these maps was to locate the areas where (recreational) conch and lobster fishing occurs and to identify patterns in the site attributes associated with the activity.

All the maps developed with site data are provided in Section 8. They illustrate the spatial distribution of the sites surveyed during the study, as well as the distribution of the different attributes and activities observed during the surveys or obtained from informal interviews with locals at the sites.

The level of resolution in the data did not allow to clearly link attributes with the (conch and lobster) recreational fishery because the sector or intention of the fishers (commercial, recreational, subsistence, or unknown, possibly illegal) was not clearly defined, but rather there appeared to a continuum in these categories. Also, samplers placed fishers in a combined-sector category (commercial AND recreational or both) when the sector was unclear, which did not provide any useful information. Even so, all the information was sorted in the best possible way to attempt to elucidate spatial trends. The maps were used as an additional tool to interpret the results, and helped to visualize the spatial trends observed in the data. Maps are discussed as part of the results in the sections below.

A total of 21 maps were produced, illustrating the following:

1. Sampling sites
2. Activities: fishing, recreation, both.
3. Fishing modes: recreational, commercial, both.
4. Sampling intensity: number of surveys (visits) per site during the study.
5. Sub-aquatic activities: diving, snorkeling, both

6. Fishing sites:
   6.1. Lobster, Queen Conch, Fish
   6.2. Lobster
   6.3. Conch
   6.4. Finfish
   6.5. Other species
7. Fishing gears:
   7.1. Main fishing gears
   7.2. Lines
   7.3. Underwater gears (dive, snorkel, gaff, snear, by hand)
   7.4. Other fish gears (spear, net)
   7.5. Traps
8. Fishing Sites by municipality
   8.1. Lobster
   8.2. Conch
   8.3. Fish
9. Number of interviews by species (conch and/or lobster) and species associations.
10. Potential sites with IUU fishing activity
11. Number of potential IUU sites by municipality

5.4.1.2 Site characterization analysis

Site data were summarized to obtain spatial information about the distribution of sampling effort over the study period (September 2014 to August, 2015), including the number of sites and sampling trips by site, by municipality, and region; and the distribution of sampling effort by site category. Also, summaries of the spatial distribution of fishing activities and other recreational activities were possible with this information. The results from each spatial analysis are described below.

5.4.1.2.1 Sampling intensity by region and municipality

A total of 482 sampling trips were conducted in the main island (Puerto Rico) between September 18 and August 30, 2015. Only one trip was done to Culebra and Vieques, in May 2015 and June 2015, respectively so the sites in those islands were only visited once and are not counted here as part of the East coast. Sampling trip in this section refers to a day sampling by one, two or more samplers (as in Culebra and Vieques). Note that usually two or more sites were visited on a sampling trip on the same day, until the end of the study when sampling only one site per day was tested.

Only two coastal municipalities in the main island did not have any sites, Quebradillas and Juana Diaz. Quebradillas is located in the NW of the island, between Isabela (to the west), and Camuy (to the east). Juana Diaz is located in the central south part of the island, between Ponce (W) and Santa Isabel (E). These municipalities are not discussed further or shown in most maps.

More sampling effort was applied in the East Coast (35% of the trips) and less in the South (25%) and North (17%) coasts because fishing in general and for lobster and conch (in particular) is more

intensive in the East (see distribution of fishing activity, Maps 6.1-6.4), so trips concentrated in those regions with higher probability of fishing.

Table 1. Distribution of sampling effort by region in: a) the main island (Puerto Rico) and b) in Culebra and Vieques

Region	N Trips	N Sites	% Trips
N	83	22	17%
E	170	54	35%
S	121	45	25%
W	108	35	22%
Total	482	156	100%

	N Sites
CULEBRA	12
CULEBRITA	1
VIEQUES	28
Total	41

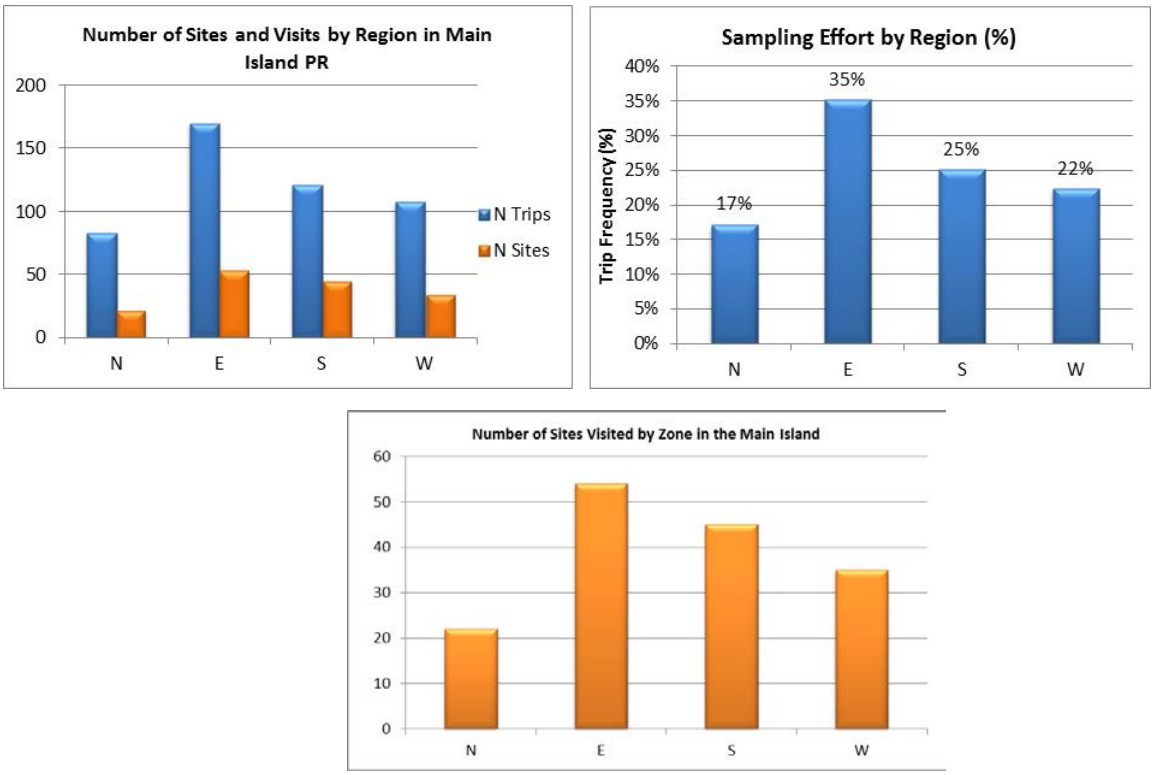


Figure 2.Distribution of sampling effort in a) number of sites and visits (trips) by region, b) trip frequency (percent) by region; c) detail of number of sites in the main island.

The number of trips by municipality is illustrated in Map 4, with greater number of trips in municipalities located in the Northeast coast. The sites surveyed during this study were distributed in 42 coastal municipalities around Puerto Rico, and in the islands of Vieques and Culebra. The number of sites visited in each municipality is provided below.

Table 2. Number of sites surveyed by municipality.

N	MUNICIPALITY	N SITES SURVEYED
1	AGUADA	1
2	AGUADILLA	1
3	AÑASCO	2
4	ARECIBO	3
5	ARROYO	2
6	BARCELONETA	1
7	BOQUERON	4
8	CABO ROJO	18
9	CAMUY	2
10	CAROLINA	2
11	CATAÑO	1
12	CEIBA	3
13	CULEBRA	12
14	CULEBRITA	1
15	DORADO	2
16	FAJARDO	17
17	GUANICA	14
18	GUAYAMA	4
19	GUAYANILLA	2
20	HATILLO	3
21	HUMACAO	3
22	ISABELA	4
23	LAJAS	7
24	LOIZA	4
25	LUQUILLO	4
26	MANATÍ	2
27	MAUNABO	3
28	MAYAGUEZ	4
29	NAGUABO	2
30	PATILLAS	3
31	PEÑUELAS	1
32	PONCE	5
33	RINCON	5
34	RIO GRANDE	2
35	SALINAS	7
36	SAN JUAN	5
37	SANTA ISABEL	3
38	TOA BAJA	2
39	VEGA ALTA	1
40	VEGA BAJA	2
41	VIEQUES	28
42	YABUCOA	5

5.4.1.2.2 Site categories

The number of sites by category was not mapped because there was a large overlap among beaches, docks, ramps, fishing villas, etc., which were often found at the same location. For example, recreational beaches often have docks, ramps and restaurants, and some interviewers did not differentiate the precise coordinates among these; therefore they could not be mapped separately.

From the field observations, we applied the following definitions:

- "Balnearios" (in Spanish) are recreational beaches that often have docks, ramps, restaurants, and other facilities.
- The "Muelle/Malecon" category (in Spanish) was translated as Docks and Piers, and also includes seafront boardwalks.
- Fishing Village includes fish houses, fishing cooperatives, and fish markets by the water that usually have ramps & docks.
- Ramps can be private or public.
- Nautical Clubs and Marinas also have ramps and docks, usually private.

The summary statistics in the number of sites visited by category are illustrated in the tables and figures that follow.

Table 3. a) Number of sites visited by island and category. b) Proportion (in percent) of site categories by island.

Site Category	Main Island	Culebra	Vieques	All Islands
Beach	57	12	28	97
Beach/Ramp/Dock	12			12
Dock/Pier	14	0	1	15
Fishing Village	25	1	1	27
Marina	13			13
Nautical Club	12			12
No sea access	1	2		3
Ramp	20	0	2	22
Total Sites	**154**	**15**	**32**	**201**

Site Category	Main Island
Beach	37%
Beach/Ramp/Dock	8%
Dock/Pier	9%
Fishing Village	16%
Marina	8%
Nautical Club	8%
No sea access	1%
Ramp	13%

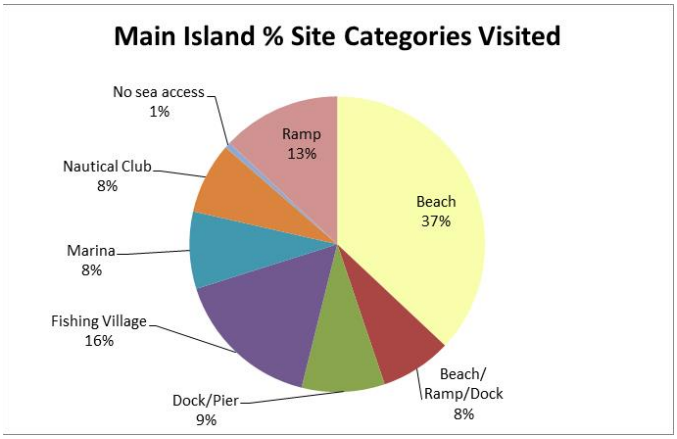


Figure 3. Proportion of sites by category in the main island (Puerto Rico).

The great majority of the sampling sites were beaches (37%), although this category sometimes included recreational beaches that include ramps, etc., as described above, so this proportion might be inflated. The second most visited category were fishing villages (16%), but most of the fishing activity at those sites was commercial, as described elsewhere. The proportion of ramps was next (13%); and docks/piers, nautical clubs, and marinas with the same proportion (8-9%). Only one landing site in La Parguera did not have sea access.

5.4.1.2.3 Site category and region

An additional representation of the sites visited by site category and region is illustrated below.

Table 4. Distribution of sites by category and region.

		MAIN ISLAND				
Zone	**E**	**N**	**S**	**W**	**Culebra**	**Vieques**
Beach	28	13	14	10	11	26
Dock/Pier	7	1	4	1		
Fishing Village	10	4	7	7		
Marina	7	0	5	1		
Nautical Club	1	3	5	3		
No sea access	0	0	0	1	1	
Ramp	1	1	10	12		1
Total	54	22	45	35	12	27

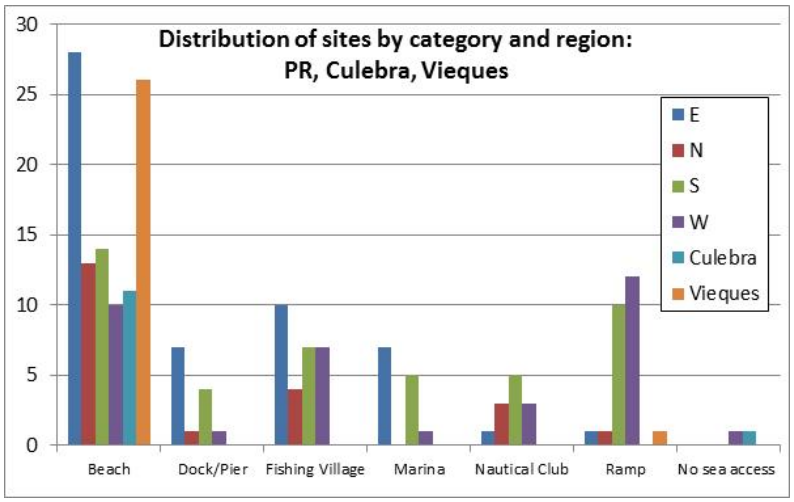


Figure 4. Distribution of visited sites by category and region.

Beaches in the East coast and Vieques represented 14% and 13% of the total sites visited, with an average representation of 8.7%; all other categories in each region were represented by less than 6% of the total sites. There were fishing villages in every region, represented by an average of 3% of the total sites. This information shows that sites visited were not random, but stratified by site category too, clearly focusing more on beach sites. Also, in Vieques and Culebra beaches were 95% of the sites; only one ramp and one inland site were visited.

5.4.1.2.4 Distribution of recreational activities and fishing

The main activities by site are illustrated in Map 2, which does not show clear spatial patterns, except that fishing and recreation occur all around the island, with a combination of activities perhaps concentrated in the northeast and southwest portions of the main island. The distinction was clearer in Culebra and Vieques. Most fishing sites in Vieques appear in the southeast and in the north-central part, but the easternmost area was not sampled.

Other displays of the number and proportion of activities observed or reported (ie., otherwise documented) are shown below. During the surveys, there was a finer resolution of the recreational activities, including: cruising, swimming, kayaking, jet skiing, skiing, surfing, scuba diving, and snorkeling. The number of kayaks, recreational boats, divers, surfers was also documented on occasion. However, not all samplers used the same resolution, so to consolidate the information we had to use the coarser categories. It is important to note that diving and snorkeling were documented both as recreational activities and as fishing methods. In the next section, those activities are examined further because of their association with conch and lobster fishing. Importantly, some sites had multiple activities.

Table 5.Grouped activities documented at sites visited in Puerto Rico (main island).

Grouped Activities	Number	%
Fishing, Recreation, Dive/Snorkel	92	59%
Fishing	15	10%
Fishing, Dive/Snorkel	21	13%
Recreation	28	18%
Total	**156**	**100%**

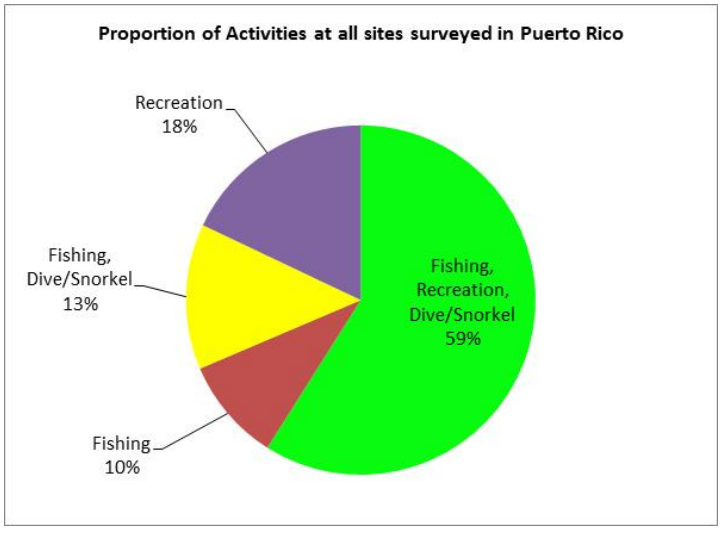


Figure 5. Proportion of activities encountered at the sites surveyed in Puerto Rico (main island).

Different kinds of recreational activities were observed in 59% of the sites surveyed , followed by only recreation (18%), Fishing and Diving/Snorkeling (13%) and only Fishing (10%).Dive/ snorkel was perceived both as a recreational activity, and as an activity with the potential to generate queen conch and lobster catch. Note that fishing is not necessarily recreational, since this distinction was not always clear at every site. This is analyzed further in the next section. Also, when samplers did not discriminate among recreational activities, the quality and resolution of the information was reduced, and clearer distinctions could not be assessed for all the sites surveyed.

5.4.1.2.5 Regional distribution of recreational and fishing activities

The proportion of the activities observed or reported by site were also examined by zone, to identify it regional patterns existed around the main island. The following information illustrates these trends.

Table 6. Number of observed/reported activities by region.

	North	East	South	West
Fishing	3	8	3	1
Fishing, Dive/Snorkel	1	5	10	5
Fishing, Recreation	7	9	13	12
Fishing, Recreation, Dive/Snorkel	7	19	10	15
Recreation, Dive/Snorkel	4	13	9	2
	22	54	45	35

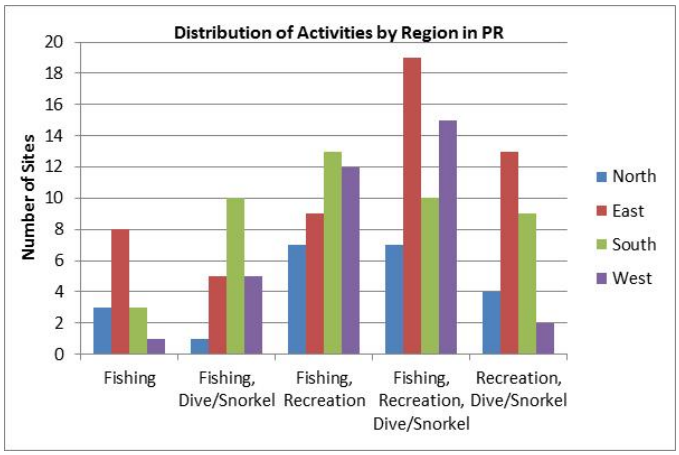


Figure 6. Distribution of recreational and fishing activities by region in Puerto Rico.

This figure illustrates both, the geographic distribution of sites, and the distribution of activities by region. This allowed examination of patterns in the activities by region, since this was not possible from the map alone. The combined categories suggest that most sites either display multiple activities, or that the data has poor resolution. Combined activities are observed mostly in the eastern and western parts of the island. Fishing alone and recreational activities with diving and snorkel included, occur mostly in the East. Overall, if fishing is examined, some form of **fishing occurs in 82% of the sites surveyed** in this study, alone or in combination with other activities. Only 28 sites (18%) did not show fishing activity and were exclusively used for other recreational activities.

5.4.1.2.6 Regional distribution of diving and/or snorkeling activity

This section examines sites where snorkeling and/ or diving for recreational or fishing purposes occurred. These activities were considered important because they are also the main methods to harvest conch and lobster. In particular, if these species are harvested recreationally, identifying this activity would help to find a subset of sites where divers and snorkelers actually fish. This is illustrated in Map 5 (Sub-Aquatic activities) and in the figures below.

Table 7. Sites with diving/ snorkeling activity.

	N Sites	%
Activ not present	81	52%
Diving	43	28%
Snorkel	9	6%
Diving/ Snorkel	23	15%
Total	**156**	**100%**

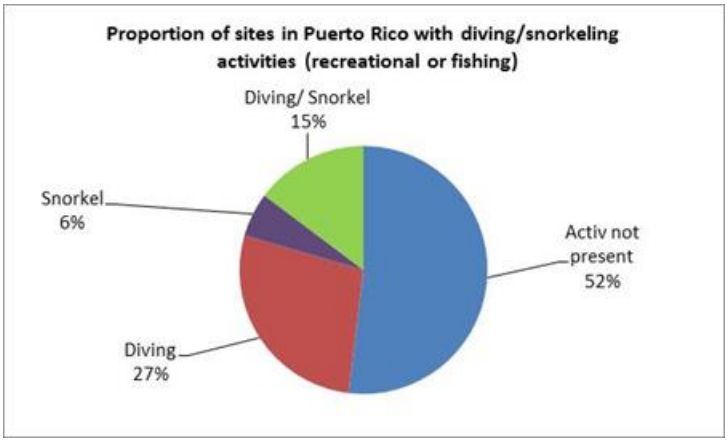


Figure 7. Sites with diving/ snorkeling activity.

The activity was not present in roughly 52% of the sites, but was observed or reported in the remaining 48% sites, suggesting that it is a widespread activity, as is also illustrated in Map 5 (Sub-aquatic activities).

Table 8. Regional distribution of sites with diving and/or snorkeling activity.

Dive/Snorkel Activ	East	North	South	West
Activ not present	27	14	25	15
Diving	13	5	12	13
Snorkel	4	0	1	4
Diving/ Snorkel	10	3	7	3

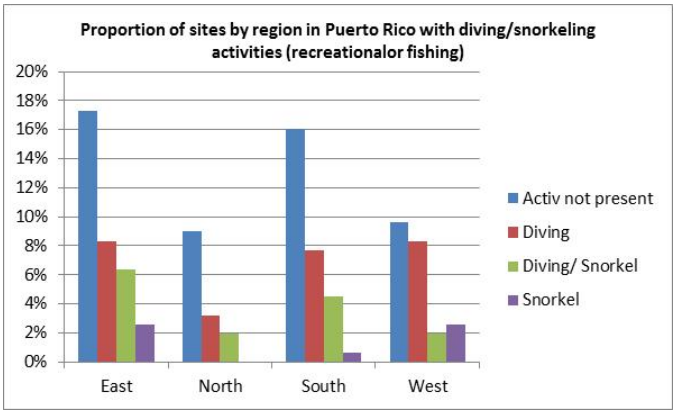


Figure 8. Proportion of sites by region with diving/ snorkeling activity.

The map also suggested that both activities combined occurred mostly in the eastern and southern regions, whereas diving alone seemed more prevalent in the western and southwestern portions of Puerto Rico. Snorkeling alone was only observed in the North/Northeast and in the Southwest coast. The figure above suggests that the same patterns occur in every region, with diving alone equally present (8%) in the East, South and West, and combined diving and snorkeling, representing less than 6% in every region. On average, in the areas where only snorkeling is observed, the proportion is minimal (less than 3% of all the activities). Diving and/or snorkeling were not present, on average, in 9% to 17% of the sites in all regions.

5.4.1.2.7 Fishing Sector

As with the previous analyses, this information was obtained both from actual observations and from informal comments by random locals. This, and the fact that some samplers grouped all non-commercial into the recreational category, or labeled the sector(s) operating in the site as “Both”, severely reduced the quality of some data. We do not consider that the summary for this information is reliable or informative, so we will not examine it further. Summary data are illustrated in Map 3 and below.

Table 9. Commercial and recreational fishing sites.

Sector	N Sites
Both	66
Recreational	48
Commercial	14
All	128

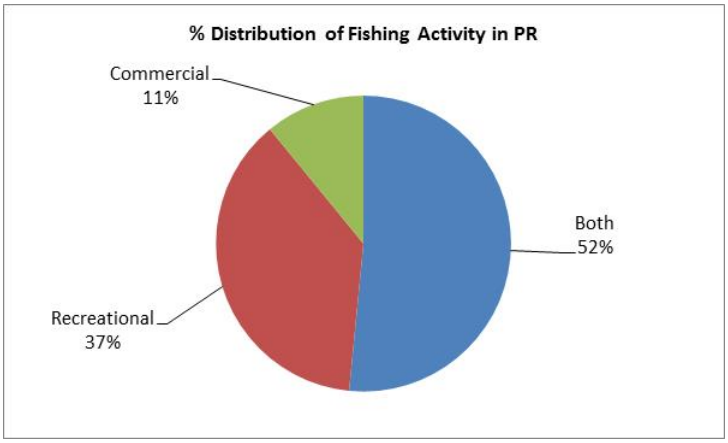


Figure 9. Proportion of Commercial and Recreational fishing sites detected.

5.4.1.2.8 Fishing Gears

Another effort to identify potential fishing locations for Conch/Lobster was based on the gears used or reported. Multiple gear use was frequently observed. To summarize and map multiple combinations of gears encountered, we identified four main combinations of gears: underwater gear (UG= Dive, snorkel, gaff, snare, by hand), lines, other fish gear (spear, net, trap combinations), and traps (lobster or fish) alone.

On map each site was mapped multiple times (Maps 7.1 to 7.5), depending on all the gear combinations that were observed or reported. The mapping data thus includes the occurrence of multiple gears per site. Occurrence is defined here as the number of times a gear was observed (in any combination), so each site can display multiple gears.

Table 10. Occurrence of gears in sites sampled (N=255).

Gears	N Occurrence
UG	66
Lines	104
Other FG	70
Traps	15
	255

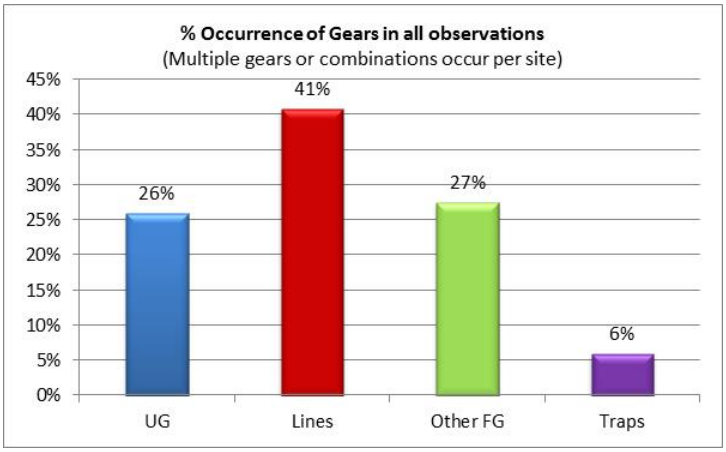


Figure 10. Proportion (%) of gear occurrence in all sites with fishing and gears reported (N=255).

Results suggest that the gears most used in Puerto Rico are fishing lines, with other fish gears and underwater gears used in similar, but lower proportions (27 and 26%). Traps are the least common gear (6%). Limited use of underwater gears was observed in the North.

More detailed analyses by region suggested that the gears of interest for this study, Underwater Gears (UG) are used similarly in the East (7.5%), South (8.2%), and West (7.1%), with limited use in the North (3.1%). This suggests that limited fishing for conch and lobster may occur in that area. Proportions of other fish gears were similar to UG in every region, and lines were the most prevalent gear, ranging from 13% in the East, West (12%), South (11%), and North (5.1%). Note that sport fishing was not surveyed, and deep water lines were only reported once, to capture deep water snappers.

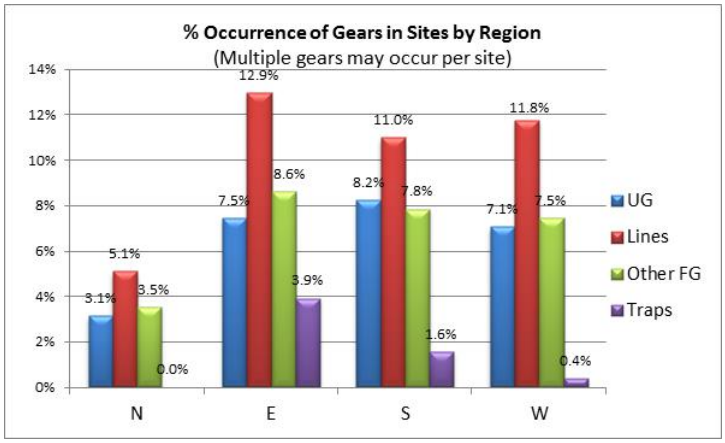


Figure 11. Proportion of gear occurrence by region.

5.4.1.2.9 IUU by Region

Roughly, in 47% of all sites sampled, some form of IUU fishing activity was observed or reported. IUU fishing in this study was defined as the capture of conchs and lobsters, in any amount, without a fishing license for commercial purposes; the capture of individuals below the legal size; and the capture of conchs during the closed season. As noted before, it was difficult to distinguish non-commercial fishers (recreational, subsistence, illegal) from commercial ones and licensed commercial from unlicensed fishers too. However, any information that suggested that IUU fishing took place at a site was documented.

Sites where mounds or scattered undersized conch shells were found or reported (C. Lilyestrom) are included in the list, as well as sites where evidence of conch fishing during the closed season were observed.

Table 11. Number of sites with potential IUU fishing activity (observed or reported).

	Legal/Unknown	Illegal
North	14	8
East	25	27
South	22	23
West	20	15
Total	81	73
%	**53%**	**47%**

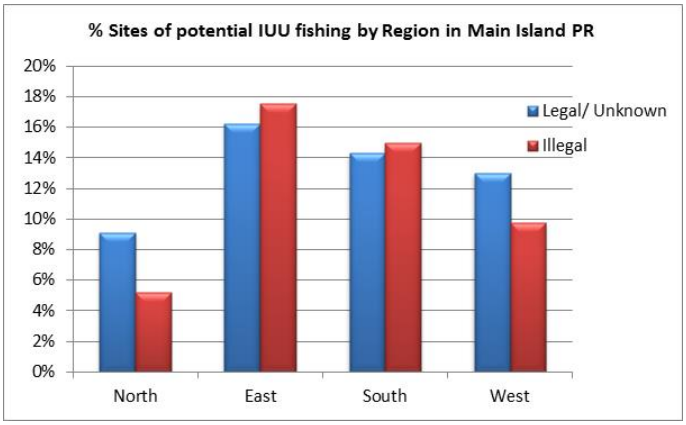


Table 12. Proportion of sites with potential IUU fishing by region.

More sites with potential IUU fishing were detected in the East (18%) and Southern parts of the island (15%). This summary does not include the sites in Vieques and Culebra, where a large incidence of IUU fishing was reported. However, considering that the methodology in these islands was different and included only one visit, this information could not be corroborated over multiple visits (see Culebra and Vieques reports). Potential IUU sites are also shown in Map 10.

The examination of sites by coastal municipality showed that 33 out of 40, or 83% municipalities reported some form of IUU. IUU data was sparse and could not be corroborated, but provided (sensitive) information that would otherwise be difficult to obtain. Map 11 shows the sum of potential IUU fishing sites per municipality

5.4.1.3 Site characterization: catch composition

5.4.1.3.1 Species Occurrence

Another approach to identify potential fishing locations for Conch/Lobster was based on the species harvested or reported as target species by locals in the sites surveyed. We considered only four species categories (conch, lobster, finfish, and other species), and at least 12 combinations of species were observed. Only queen conch (*Strombus gigas*) were observed in the conch group, and spiny lobster (*Panulirus argus*) in the lobster group. The main fish reported in the fish category are listed in Table 12 below. The "Other species" categories, include Octopus (species not described) and "*Bulgao",* or Top Indian Shell *(Cittarium pica).*

Of the 156 sites surveyed, there were 119 where the species targeted or fished were reported. All species present at a site were counted separately to determine the occurrence and to produce GIS maps for each species group (Maps 6.1 to 6.6).

The summaries below and maps 6.1 to 6.5 illustrate species group occurrence and their spatial distribution. Species occurrence is defined as the number of times a species group was observed, knowing that multiple species can occur in one site. These data thus describes the occurrence of multiple species at the sites surveyed. The total observations of species in combinations and alone were 240.

Fish represented 42% of all observations, lobster, 32%, conch 23%, and other mollusks (octopus and top shells), 3%. The region with the greatest lobster and conch occurrence was the South, with 10% and 8% presence, respectively.

If presence/ absence of the species groups in the sites surveyed (121 of 156 sites that reported catch) are examined (instead of the number of observations of multiple species by site, N=240), these statistics are greater. Lobster fishing was observed or reported in 73 sites (60% of all fishing sites); conch in 54 sites (45%), fish in 102 (84%), and other species in 8 (7%) of all fishing sites.

Table 13. Species group composition in 119 sites, with multiple species per site (Total observations, N=240).

Species	Occurrence
Lobster	76
Conch	55
Fish	101
Other spp	8
Total	240

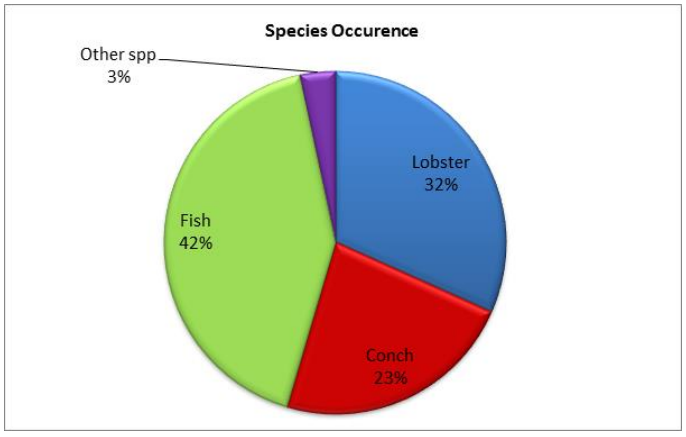


Figure 12. Species group occurrence (% presence alone or in combination with other species in 119 sites with reported fishing activity (N=240).

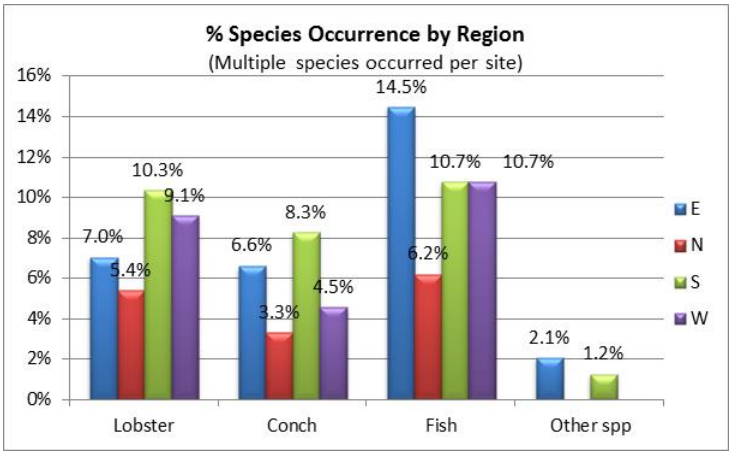


Figure 13. Species occurrence by region.

5.4.1.3.2 Species Occurrence by Site Category

The occurrence of each species group was estimated to assess the relative importance of site types to the harvest of each species.

Table 14. Species composition by site category

Site Category	Lobster	Conch	Fish	Other Spp	N Sites
Nautical Club	3	3	7	0	12
Marina	2	2	8	0	13
Dock/Pier	10	6	10	1	13
Beach	25	18	35	4	65
Ramp	15	8	18	1	24
Fishing Village	22	18	24	2	28
	77	55	102	8	**155**

A closer examination of this table by species group suggests that lobster and conch display the patterns illustrated in the figures that follow. The sites with most lobster fishing were beaches (32%) and fishing villages (29%), and least in nautical clubs and marinas, perhaps because these sites target pelagic fishes and not coral reef species. Lobster was caught or targeted in 19% of the ramps surveyed. The trends for queen conch were similar, with beaches (33%) and ramps (14%) being the site types where most conch fishing was observed or reported. Fishing villages are not discussed further because they usually represent the commercial fishing sector.

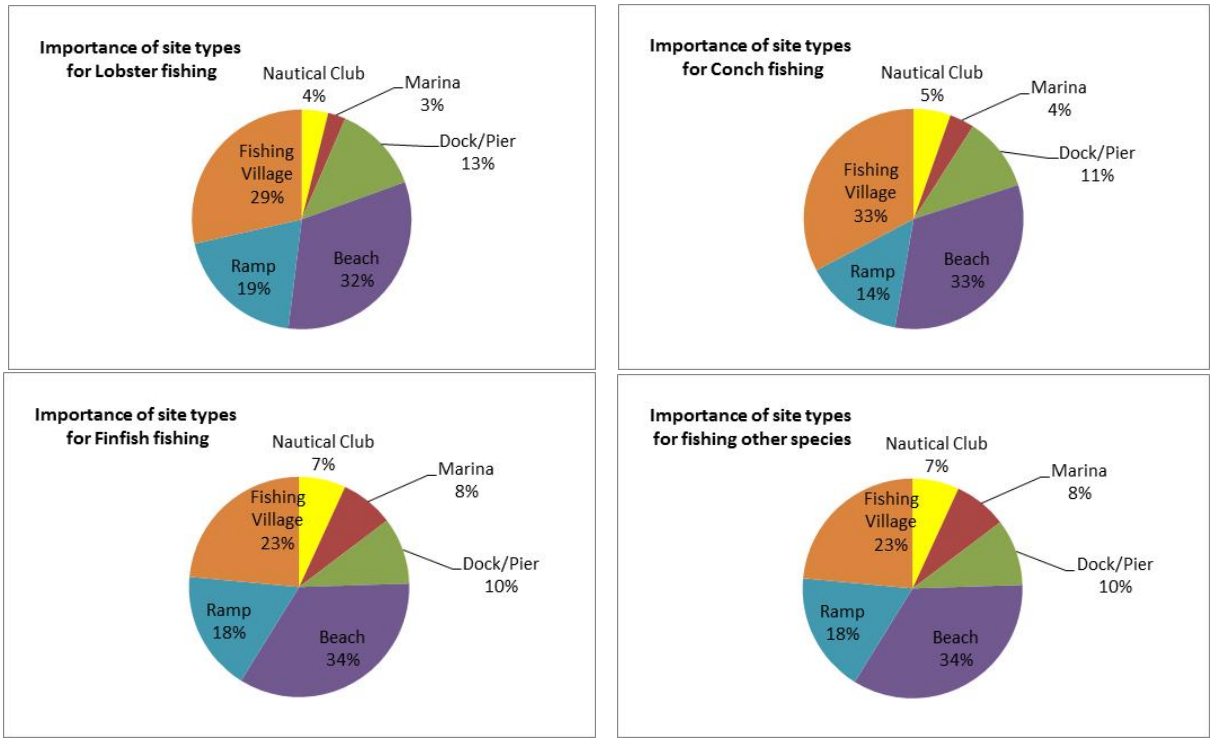


Figure 14. Species occurrence by site category.

5.4.1.3.3 Site Activities and Species Fished

As in previous analyses, many combinations of activities and species were observed at the sites surveyed. To examine the relevance of main site activities in the species targeted, again, data were grouped in broad activity and species categories. For example, combinations such as Fishing, Recreation, Diving, Snorkel, were grouped into Fishing and Recreation. The number of sites where each species was reported was counted. Given that multiple species are captured at most sites, the total number of observations was greater than the number of sites surveyed.

Table 15. Main site activities and species fished

Activities 2	Tot N Sites	Lobster	Conch	Fish	Other Spp
Fishing	35	24	20	29	2
Fishing, Recreation	90	52	34	69	5
Recreation	31	1	1	4	1
	156			Total obs	242

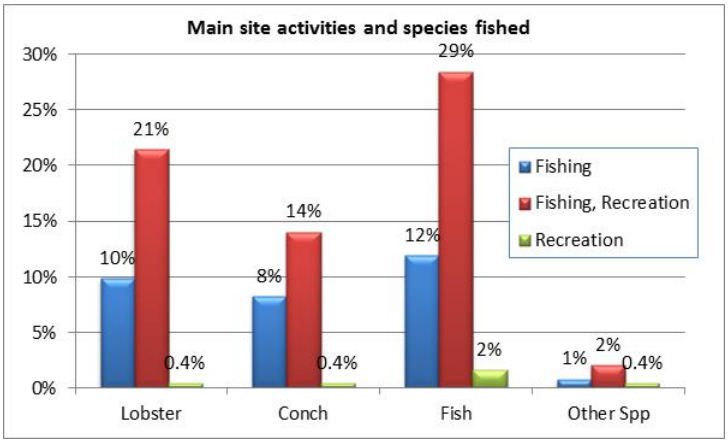


Figure 15. Association of main site activities and species fished.

Results showed that 21% of all lobster fishing sites and 14% of all conch fishing sites occurred where both recreational activities and fishing activities were reported. In contrast 10% of lobster sites and 8% of conch sites occurred where only fishing was reported. This suggests that sites where other recreational activities occur are more likely to have conch and lobster fishing. Negligible fishing for these species occurs in sites where only recreation was reported, suggesting that recreation activities (swimming, kayaking, surfing, paddle-boarding, snorkeling and diving for recreation, etc.) are not associated with fishing. There were however, a number of observations (not documented in data records) of kayaks fishing.

5.4.1.3.4 Diving/ snorkeling Activities and Species Catch

A relationship between diving and snorkeling activities (as recreational activities and as fishing methods) with the species caught was also examined because these are the main methods to fish conch and lobster.

Table 16. N= Number of dive/snorkel sites with fishing activity for each species group.

Diving/ Snorkeling (Rec or Fishing)	Tot N Sites	N(Lobster)	N(Conch)	N(Fish)	N(Other Sp
Other Fishing/Rec activities	81	22	16	43	2
Diving	43	37	27	35	4
Diving/ Snorkel	23	15	12	17	1
Snorkel	9	3	0	7	1
Tot observations by Species	156	77	55	102	8
				Total obs	242

Interpretation of this information suggests, for example, that 15% of all the sites surveyed (22 of 242 observations) were sites where diving occurs and lobsters are captured. These trends are observed more clearly if only the lobster or conch observations by species are considered to evaluate the relationship with diving and snorkeling, instead of estimating the proportion from all the sites surveyed.

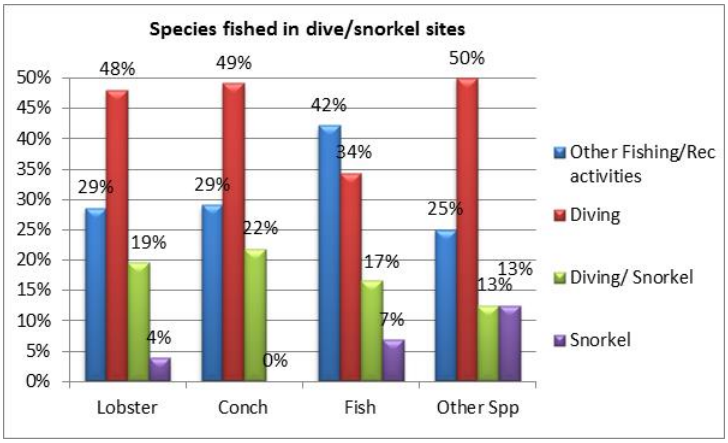


Figure 16. Main species fished in dive/ snorkel sites.

Results suggest that half of the lobster and conch sites are dive sites, while 30% of conch and lobster fishing occurs at sites with other fishing and/or recreational activities, but where diving or snorkeling were not observed or reported (possible inconsistency in the data). 19% of diving/snorkel sites are lobster sites, and 22% are conch sites. These proportions suggest that approximately 50% of the sites where diving occurs, are conch and lobster sites, so the presence of this activity increases the likelihood of finding these spp. Negligible fishing for these species occurs in sites where only snorkeling was reported.

Fish are reported in greater proportions (42%) in sites where other fishing or recreational activities occur, but are also associated with diving sites (34%); dive/snorkel sites (17%), and snorkel sites (7%). The main gear used to catch fish while diving or snorkeling are spears, with widespread use (see Map 7.4).

5.4.1.3.5 Gears and Species

Fishing gears were observed or reported in 121 sites of the total 156 sites surveyed. As before, occurrence is defined here as the number of times a species was observed, multiple spp. can be fished in one site, with one or a combination of gears.

Table 17. Gears and species reported.

Fishing Gears	N Rows	Lobster	Conch	Fish	Other Spp
NO FISHING GEAR	35	4	1	0	0
Line	37	8	4	36	2
UG	11	8	5	5	1
Line, Spear, Net, Trap	18	11	10	17	0
UG, Line, Spear, Net, Trap	41	33	24	33	1
All	14	13	11	11	4
Total by Species		77	55	102	8
				Total Obs	242

Only 2% of conch and lobster fishing was observed in sites where no gears were reported. Gear combinations including underwater gear and lines represented the majority of the observations, reporting lobster and conch catch. These broad gear categories are not very informative but

suggest that sites where underwater gears are used are the most likely to catch conch and lobster. Similarly, gear combinations using Lines are the most likely to catch fish. A more detailed examination of this information consisted in grouping gear use by species, using the total observations by species as the reference (ex., gears used in lobster fishing, N= 77) to estimate the proportion of gear by species instead of the proportion from the total.

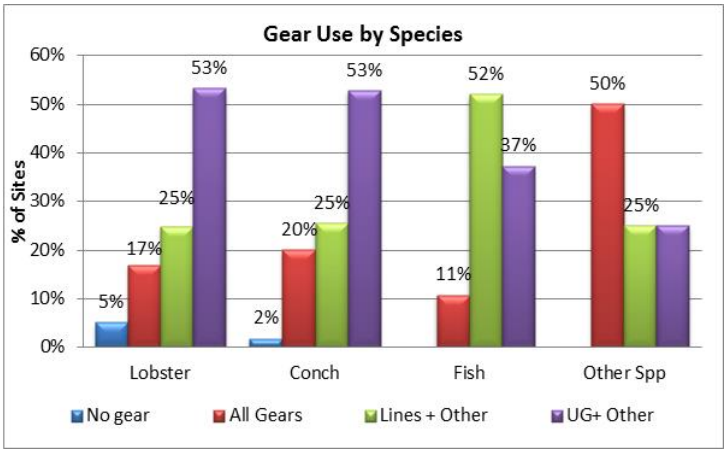


Figure 17. Gear use by species.

In sites where each species is present, 53% showed that lobster and conch were fished where gear combinations included underwater gears. Also, Fish are captured in 52% of the sites where gear combinations included Lines. This again suggests that sites where underwater gears are used are more likely to be conch and lobster sites. Sites where Lines and other gear combinations are used also showed a 25% of probability of catching lobster and conch. This may be due to errors or some non-informative data, in cases where samplers reported all the gears or all the species in every site.

The high probability (37%) of catching fish with UG and other gears is because spears, nets and traps are also important gears to catch fish. Lower probabilities of catching each species in sites where all gear combinations occur might imply that those sites are more opportunistic, less specialized in the use of UG or fish gears, and/or that there isn't a higher abundance of any species in particular.

5.4.1.4 Daily trip analysis: Temporal distribution of sampling effort

Daily trip information was analyzed over the study period. The number of trips and sites were summarized by month, week, and municipality. Note that on any one day trip, one to four sites were visited. The number and frequency of surveys by site, municipality and region by month was calculated, as well as the trips by site classification and coast over the duration of the study.

Due to a number of gaps and flaws in the daily-trip data (as described above) it was not possible to examine patterns related to the recreational queen conch and lobster fishery. That is, some daily trips did not specify the presence/ absence of fishing activity for these species or the characteristics of the fishing activity, if any. Also, observations of fishing for conch and lobster were scattered and rare, and truly recreational fishing was even rarer. Often, when fishing for these species was observed once, the observation was recorded in subsequent visits, again not distinguishing actual observations from previous ones. This is another reason why the data was consolidated BY SITE, rather than by sampling trip. Due to these inconsistencies, temporal patterns in the Activity could not be determined with any degree of certainty from trip-specific data.

Despite of the many gaps in the data, we summarized the trips where fishing for these species was observed or reported, but relationships between factors that could determine the presence or absence of conch and lobster fishing at a particular site on a particular trip, at a particular time could not be established. These patterns could be temporal (i.e., the time of the year, the day of the week, the time of the day), spatial/geographical (location of the site: North, East, South, West coordinates, municipality), the site classification (beach, marina, port, ramp, dock, fishing village, etc.), the activities occurring at the site, the gears used, and obviously, variables that were not measured such as the species' distribution and abundance.

Although temporal patterns for the presence for conch and lobster fishing could not be analyzed, we attempted to discern other patterns related to site-specific information (geographical, activity, site classification, gears).

Unfortunately, fishing patterns related to the seasonal closure for conch could not be discerned either, since our limited observations of fishing activity did not allow us to observe if fishing for other species increased or not during the closure. However, we did observe that some fishers continued to harvest conch during this period.

5.4.1.4.1 Trips and Surveys by month

The number of trips and surveys (sites) by month over the field evaluation period, including multiple trips to the same site were calculated. The methodology was different for the main island (Puerto Rico) and Vieques and Culebra; where only one short trip was carried out per island. The sampling period in each island was:

- Puerto Rico: Sept 18, 2014 to Aug 30, 2015
- Culebra: May 28 to June 2, 2015
- Vieques: June 25 to July 4, 2015

Note that number of surveys refers to the number of sites visited, so survey and site are used indistinctively in these analyses. However, it is important to note that one to four sites were usually visited by each sampler on one day trip.

A total of 183 trips and 506 surveys were carried out during the study, with 170 trips and 463 surveys on the main island over the 12-month period. One to 9 sites were surveyed per day by one to four samplers, depending on the month and their availability. On the main island, the average number of trips per month was 14.16 and 2.73 sites per day (SD=1.69). In Culebra, 14 sites were surveyed in 7 days (at a rate of 2 per day) and in Vieques, 29 sites were surveyed in 10 days (3 per day).

In the main island (PR), 55% of the trips surveyed 1 or 2 sites per day, 34% surveyed 3 to 4 sites, and only 11% of the trips visited 5 or more sites in one day.

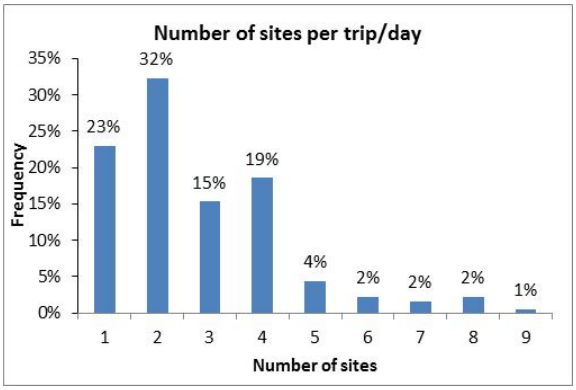


Figure 18. Number of sites (surveys) per day of sampling (trip).

Table 18. Number of trips and surveys (sites) by month over the sampling period. Most trips surveyed multiple sites on one day, and some sites were visited multiple times in any particular month.

Year	Month	N Trips	N Sites
2014	9	8	34
	10	17	69
	11	15	48
	12	12	35
2015	1	17	48
	2	13	23
	3	13	47
	4	20	55
	5	22	50
	6	3	5
	7	13	25
	8	17	24
		170	463
		10	29
		6	14

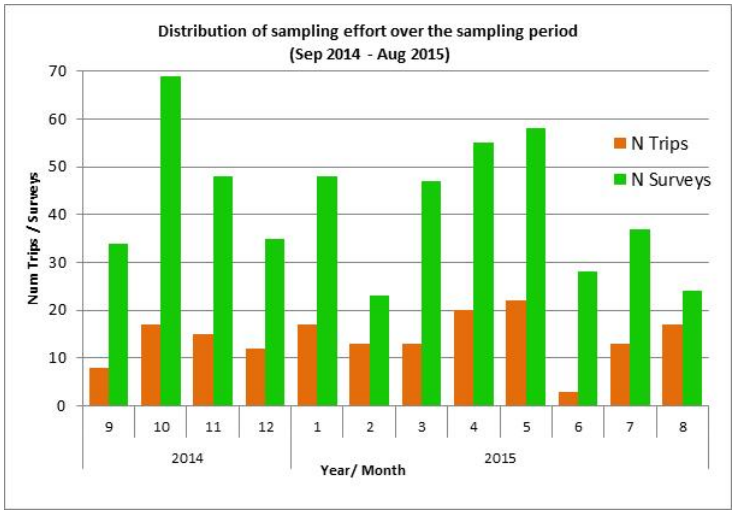


Figure 19. Distribution of sampling effort (in number of trips and surveys over the sampling period (Sept 2014-Aug 2015)

On average, on the main island 42 surveys were conducted by month, and 3.5 sites surveyed per day. It is important to recall that sampling effort was affected by samplers' availability. In June and the beginning of July, 2015, most of the surveys were in Culebra and Vieques; these are not considered in the average. The average number of municipalities visited by month was 18 (not illustrated).

5.4.1.4.2 Sampling effort distribution by day of the week

The sampling distribution by day of the week showed that the study indeed focused most sampling effort on weekends (Friday through Sunday).

Table 19. Sampling effort distribution (in number of surveys) by day of the week (all islands).

Day of the Week	N Surveys	% by Day All Islands
Mon	17	3%
Tues	16	3%
Wed	18	4%
Thurs	68	13%
Fri	126	25%
Sat	161	32%
Sun	100	20%
Tot Surveys	506	

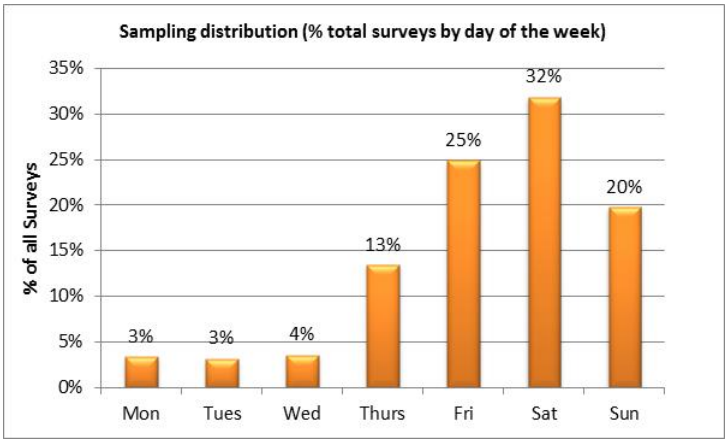


Figure 20. Sampling effort distribution by day of the week.

This distribution was analyzed by month to find how this pattern changed over the duration of the study. Note that shifts in sampling days were made intentionally (not randomly) to stratify sampling effort. This is described in the methodology. The minimum, maximum, and average number of surveys carried out by day of the week are illustrated below, as well as the sampling effort by day and month over the duration of the study.

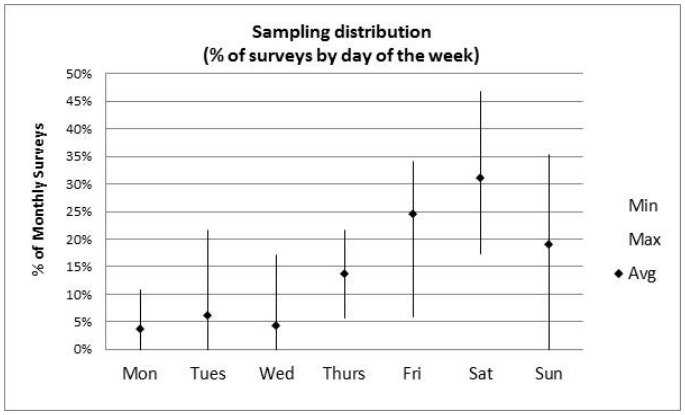


Figure 21. Average number of surveys by day of the week over the study period.

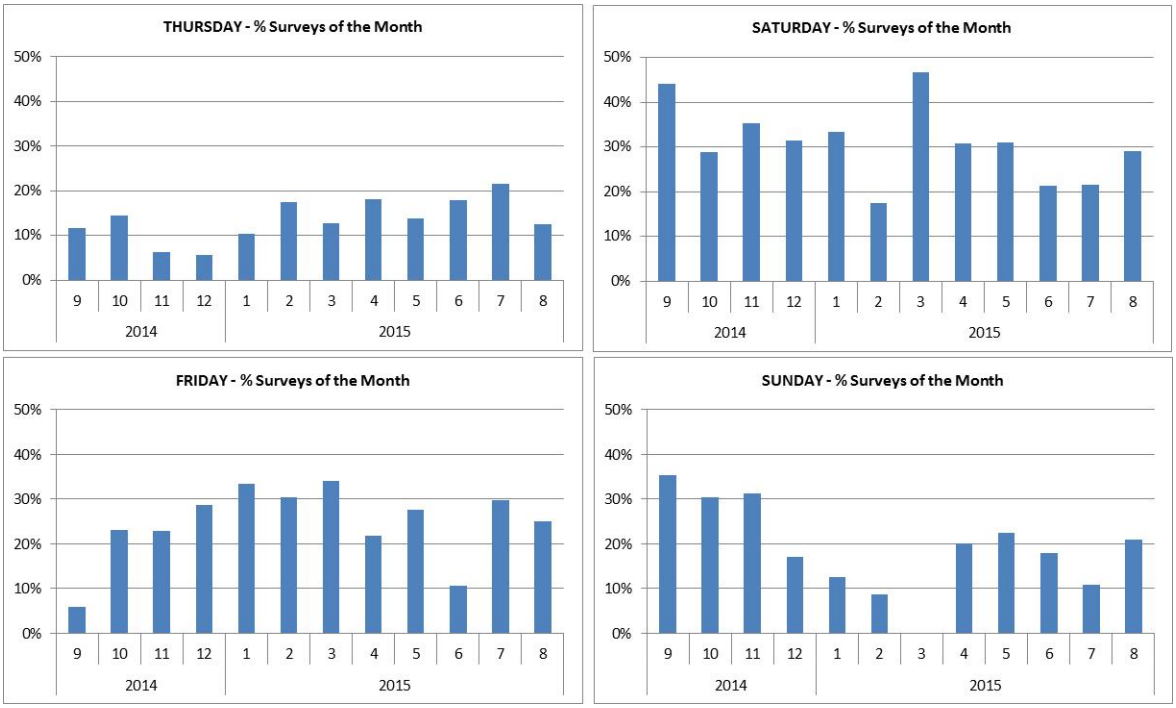


Figure 22. Distribution of sampling effort on weekends (in % surveys of the month).

5.4.1.4.3 Sites surveyed by month

The number of sites surveyed each month for the duration of the study is illustrated below. The declining trend is the result of stratification, as fewer sites were selected during the second half of the study. By January, 2015, all the sites had been surveyed (close to 200), so after that, "more likely" sites were revisited. Note that the number of sites surveyed each month is different from the number of surveys (and trips) carried out by month because each site was visited multiple times each month (Section 5.4.1.4.1).

This summary only shows sites on the main island, but between the end of May and the beginning of July, 2015, 13 sites were surveyed in Culebra and 28 in Vieques, and are not included here because the method was different, with intensive effort applied in those islands.

On average, 30 different sites were surveyed each month between September 2015 and August 2015.

Table 20. Number of sites surveyed by month

Year	Month	N Sites
2014	9	24
	10	57
	11	42
	12	32
2015	1	44
	2	21
	3	35
	4	35
	5	31
	6	5
	7	21
	8	16
		363

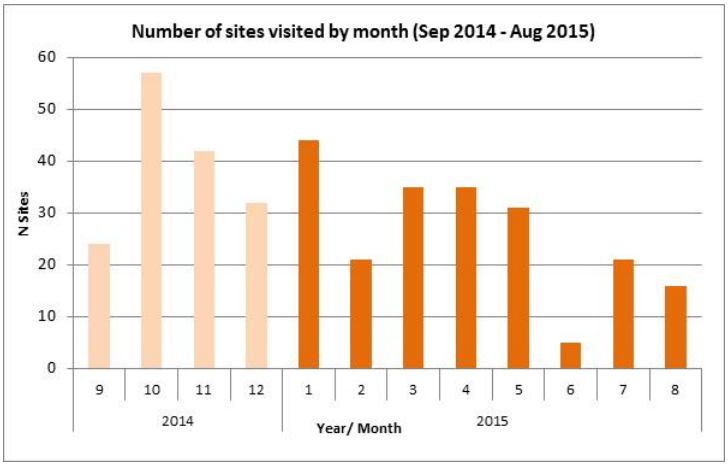


Figure 23. Number of sites surveyed by month

5.4.1.4.4 Temporal distribution of sampling effort by site category

The number of surveys conducted by site category is summarized below. Note that 2 to 4 sites were surveyed each day per sampler during the exploratory phase of the project; and later sampling effort was reduced to 2 or 1 sites per day, to increase the possibility of intercepting fishers. Thus, the number of trips in this section refers to trips (visits) to each site type on one day of sampling, resulting in multiple sites visited by day of sampling. The proportions by site by month were unnecessary and were not calculated.

Table 21. Number of surveys (visits) by site category between September 2014 and August 2015.

Site category	N Visits/Site	Avg/Month	Min	Max
Beach	246	67.7	7	246
Fishing Village	95	24.1	1	95
Ramp	77	19.8	1	77
Dock/Pier	47	12.5	0	47
Nautical Club	21	5.1	0	21
Marina	17	4.6	0	17
Inland	3	0.9	0	3
Total	506			

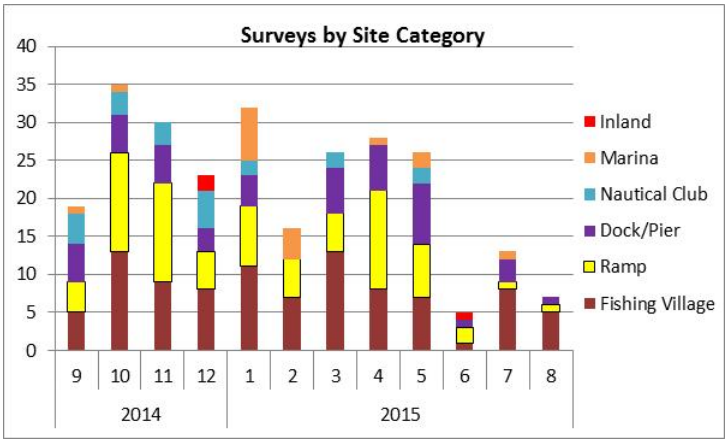


Figure 24. Number of surveys by site category over the study period.

5.4.2 Formal interview data

A total of 47 full interviews were conducted between September 2014 and July 2015, with an average of 4.27 interviews by month. The number of interviews by site is depicted in Map 9, which also includes the main species reported in the interview (conch, lobster and other species).

Due to the low number of interviews obtained over the sampling period, temporal or spatial patterns in the interview rates or a correlation with sampling effort (the number of surveys) were not examined.

Considering the low number of interviews obtained, no attempts were made to find spatial or temporal patterns in the interview rates. However, we speculate that the lack of activity observed (and low number of fishermen intercepted) can be explained by:

- Low sampling effort- few interviewers to cover the whole island.
- The random nature of the sampling trips (stratification made little difference in the intercept rate).
- The areas were visited at days/ times when the activity may not occur: sampling days/ hours did not coincide with hours of departure/ arrival of fishers.

- Recreational fishers may have more activity on evenings and nights, and the team did not sample after dark.
- Some of the fishers encountered declined to be interviewed or to have their catch measured or examined.
- Or simply, with this sampling design methodology, it was not possible to find clear spatial or temporal patterns in the recreational activity.

The summaries that follow are organized according to the structure (and questions) of the interview form (Appendix C). Many of the fishers interviewed refused to have their catch identified, photographed, measured, or examined. Thus, the species reported here are based on the amount/weight and species that each fisher reported.

Table 22. Number of interviews by month

Year	Month	N Interviews
2014	9	2
	10	5
	11	7
	12	0
2015	1	8
	2	2
	3	3
	4	4
	5	4
	6	7
	7	5
Total		47

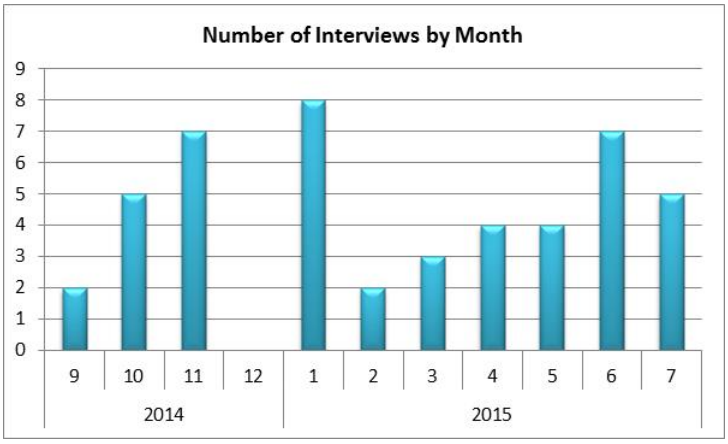


Figure 25. Number of interviews by month.

5.4.2.1 Interviews by municipality

Of the 47 interviews, 51% (N=24) were conducted in the East coast of Puerto Rico, 30% (N=14) in the South, and 19% in the West (N=9). Interviews were conducted in 35 different sites, with more than one interview at some locations. The sites of interviews are provided in Map 9 and Appendix G also includes the areas where the interviewees fished that day and other areas where they normally fish for conch and lobster.

Table 23. Interviews by municipality

Zone	Municip.	N Interviews
E	Ceiba	1
	Culebra	4
	Fajardo	2
	Humacao	1
	Loiza	1
	Luquillo	1
	Maunabo	2
	Patillas	1
	Rio Grande	1
	Vieques	10
S	Arroyo	3
	Guánica	7
	Guayanilla	1
	Lajas	1
	Peñuelas	1
	Ponce	1
W	Cabo Rojo	9
Total		47

5.4.2.2 Characteristics of the fishing trip

5.4.2.2.1 Commercial license and intention of the fishing trip

The first set of questions intended to differentiate commercial from non-commercial fishers, as the first criterion to conduct the full interview or not. 70% (N=33) of the 47 people interviewed DID NOT have a commercial license, but at the same time 76% (35) of all interviewees had the intention to sell their catch, with or without commercial license. As noted elsewhere in this report, the distinction among sectors was not always clear. Considering the small number of fishers intercepted, the team took the opportunity to interview all fishers whose sector or intention were not well defined, as will be explained below.

Among the fishers without a license, 43% (N=20) had the intention to sell their catch and 26% (N=12) had other intentions, including consumption, bartering, or giving it away.

Of those with a license (N=14), 2 people did not have a valid license, so only 26% (N=12) of all people had a valid license. 34% (N=16) of those without a license answered that their license had expired and 36% had no comment (perhaps never had a commercial license).

Table 24. Commercial fishing licenses

1. Commercial License	2 Valid?	N	%
No	No answer	17	36%
No	No	16	34%
Yes	No	2	4%
Yes	Yes	12	26%
	Total N	47	100%

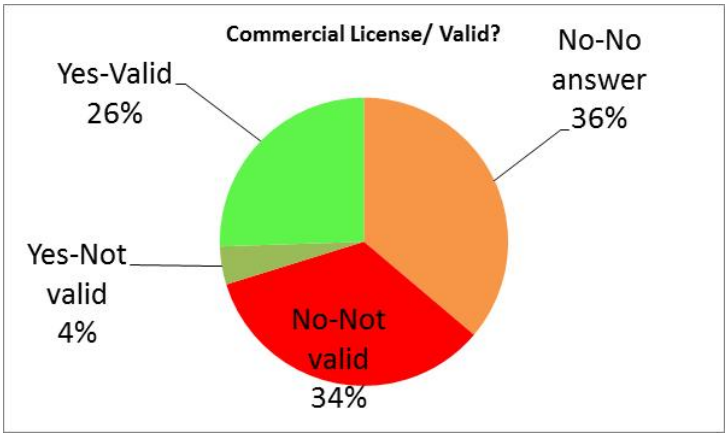


Figure 26. Proportion of a) Commercial licenses, valid, unknown or no license

The intention of the trips showed that at least 73% of the fishers with or without a license had the intention to sell their catch, and 26% did not.

Table 25. Intention of the catch

Commercial Licence	**Intention**	N	%
No	No answer	1	2%
No	No-Other	12	26%
No	No-Sell	20	43%
Yes	Yes-Sell	14	30%
		47	

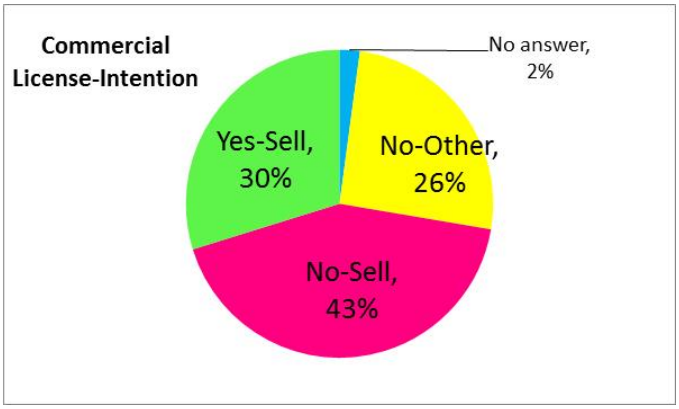


Figure 27. Intention of catch for commercial and non-commercial fishers. License=Yes/No and Intention of catch (sell, not sell, or no answer).

A closer look at the intention of the catch showed that 65% (N=30) of the interviewees had the intention to sell, 17% (N=8) to sell, consume, barter and/or give away, 9% (N=4) to only consume and the remaining 9% to consume, barter, and/or give away.

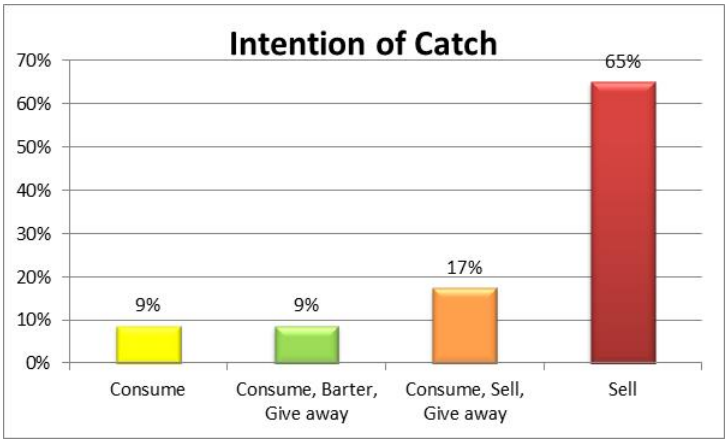


Figure 28. Intention of catch (detail): consume, sell, and combinations of Other intentions (consume, barter, give away, and sell).

The second important question to scope if the fisherman intercepted was a candidate for the interview was if he fished or normally fishes conch and lobster. 91.5% of the 47 fishers interviewed answered that on this trip they fished or regularly fish these species.

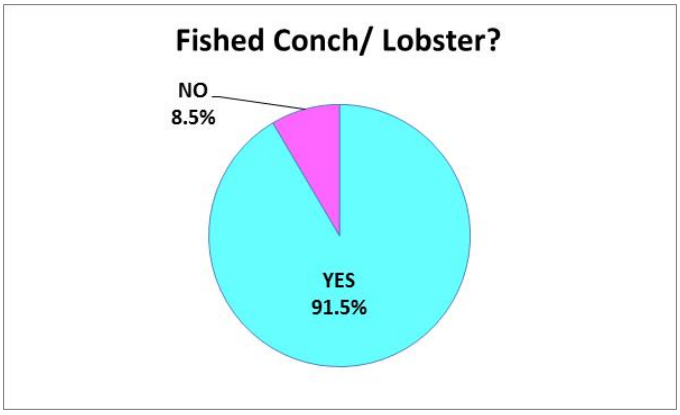


Figure 29. Proportion of fishers who fished or regularly fish conch and/or lobster.

5.4.2.2.2 Trip Activities and Fishing mode

a) Main activity: as the main activity on the trip, 45 fishers (95%) reported fishing; only one reported cruising and another one, snorkeling.

b) Fishing Mode

Of the 47 interviews, 81% of the fishers fished from a boat, and 19% fished from the shore. Of these, the majority fished from the beach or shore13% from the beach or shore fishers that fish from the shore, 6.4% from a boardwalk, and 4.3% from a pier or dock.

In the shore mode group (N=11), 64% of fishers indicated that they fished as part of a group, and 36% were independent. In the boat mode (N=39), 64% of the fishers indicated that they are both, captains and owners of the boat. 28% were visitors, and 8% were captains.

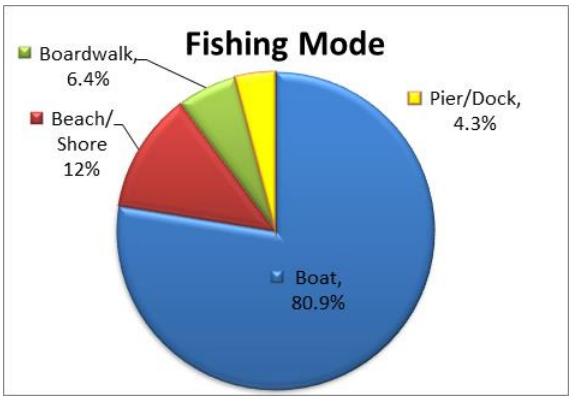


Figure 30.Fishing mode: shoreline mode (beach/chore, boardwalk, pier-dock) or boat mode.

5.4.2.2.3 Boat information

a) Crew- Of the 40 fishers in the boat mode, 60% reported a crew of 2 people, 21% a crew of three, and 13% a crew of one person. Only 6% reported a crew of 4 people.

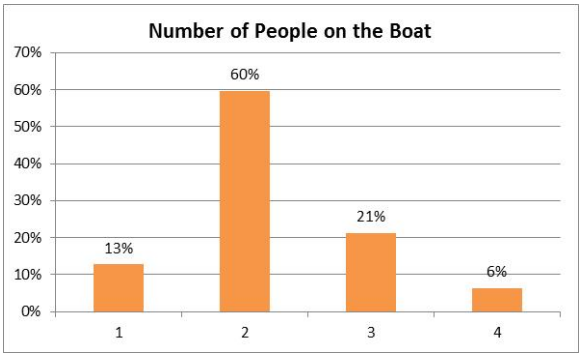


Figure 31. Number of people on the boat.

b) Boat size ranged from 12 to 26 feet (N=47), with a mean size of 18.4 feet (s=3.6ft). 54% (N=39) were classified as boats, 44% (N=17) as dinghies ("Yolas'), and 2.5% (N=1) as kayaks. Although not part of these interviews, there were several sightings of fishing activity from kayaks.

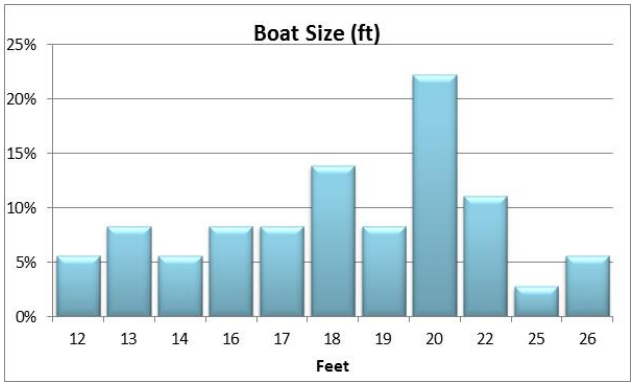


Figure 32. Boat size (ft) probability distribution (N=47). Average,18.4 ft (SD= 3.6).

c) Boat Horse Power ranged from 15 to 180 HP, with a mean of 70HP. Some boats had two 85 or 90 HP outboard engines, we added the total engine power. 24% of the 33 fishers reported 40HP engines, 18%, 85HP engines, 15% 25 HP, 9% 75 HP, 9% 90HP, and the rest were under 6%.

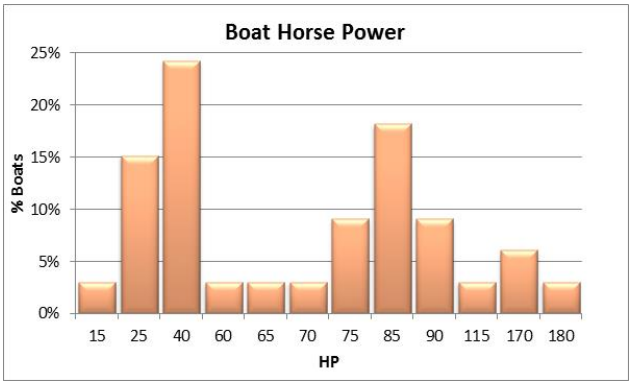


Figure 33. Boat horse power (HP) probability distribution (N=33).Average, 69.5HP (SD=42.3)

5.4.2.2.4 Fisher's Information

43% of the fishers interviewed (N=47) indicated that their occupation was fishing, while 13% reported fishing and other occupations, including construction, boat building, working at a business (own or marina), teaching, and welding. The 38% (N=18) that reported other occupations as their main economic activity, cited working in construction, security, welding, carpentry, being students, or retired.

All the fishers interviewed were male, and only 7 provided their age, ranging between 20 and 50 years of age, with a mean of 31 years old (SD= 9).

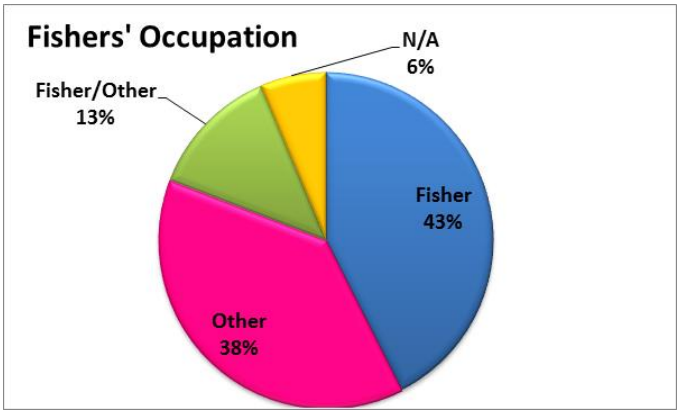


Figure 34. Fishers' main occupation.

5.4.2.2.5 Fisher's preferred days and times to fish

d) Preferred season of the year- 97% of the fishermen answered that they don't have a preference and fish all year; only one person preferred the summer.

e) Preferred days of the week to fish- 57% of 46 fishermen answered that they preferred to fish all week, 33% on week days (Monday to Thursday), and 11% on weekends and holidays. This is another indication that the majority of the people interviewed fish commercially and not for recreation.

f) Frequency of trips- 35% of the fishers indicated that they fish every day, 19% fish twice a week, 14% fish 3 or 6 times a week, and 7% fish 4 or 5 times a week. Only 2% fish one day or half a day per week. The average number of times that fishers go fishing per week is 4.7 (SD= 2.17) days per week.

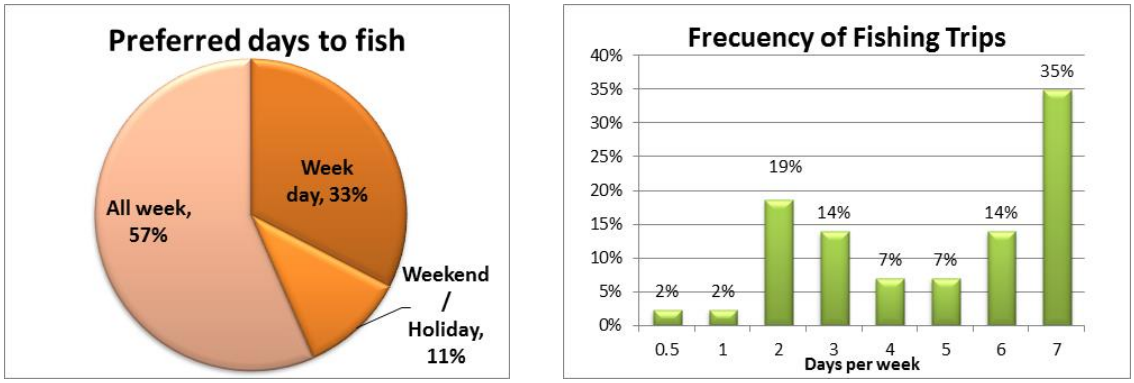


Figure 35.a) Preferred days to fish (N=46); and b) Preferred frequency of fishing trips (N=43).

g) Preferred times of the day- 74% of all fishers (N=47) prefer to fish in the morning, 21% in the early morning, and only 2% in the afternoon or evening.

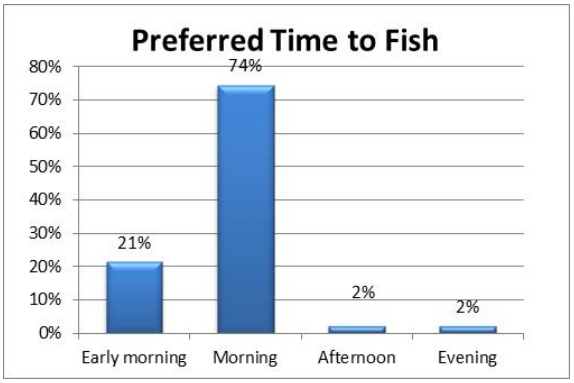


Figure 36. Preferred time of the day to fish.

5.4.2.2.6 Fishing methods and gears

The main fishing method reported from interviews (N=47) to harvest conch and lobster was scuba (59%), followed by free diving (33%) and by hand (11%).

The main fishing gears reported by 29 of 41 fishers (71%) were hooks/gaffs, snares, fish spears, and fishing by hand. Other gears were used in smaller proportions, hook and line, 15%; traps, 10%, and nets, 5%. All the traps reported were fish traps.

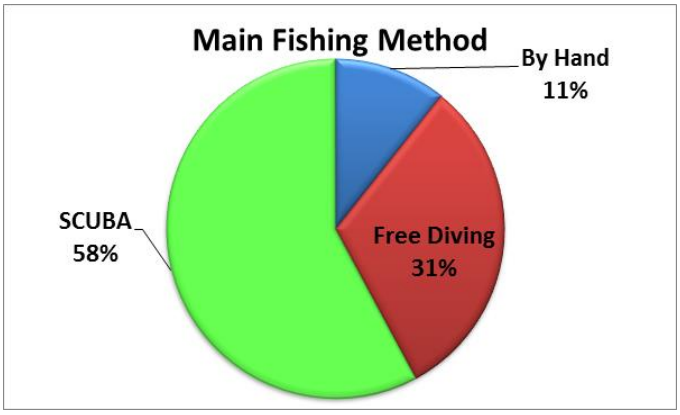


Figure 37. Main fishing methods (N=47).

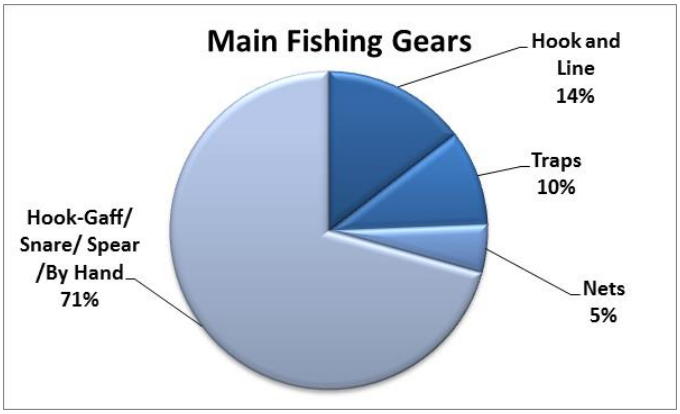


Figure 38. Main fishing gears (N=41).

5.4.2.2.7 Duration of the fishing trip

From 46 fishers that provided this information, the time spent fishing ranged from 45 minutes to 7 hours, with an average of 3.5 hrs fishing (SD= 1.5).

Total trip duration ranged from 1.5 hours to 9 hours. It is important to note that 9 fishers (19%) did not make a distinction between trip duration and time fishing. These were excluded from the average time cruising of 2.4 hours, which ranged between 0.5 hrs and 7 hrs.

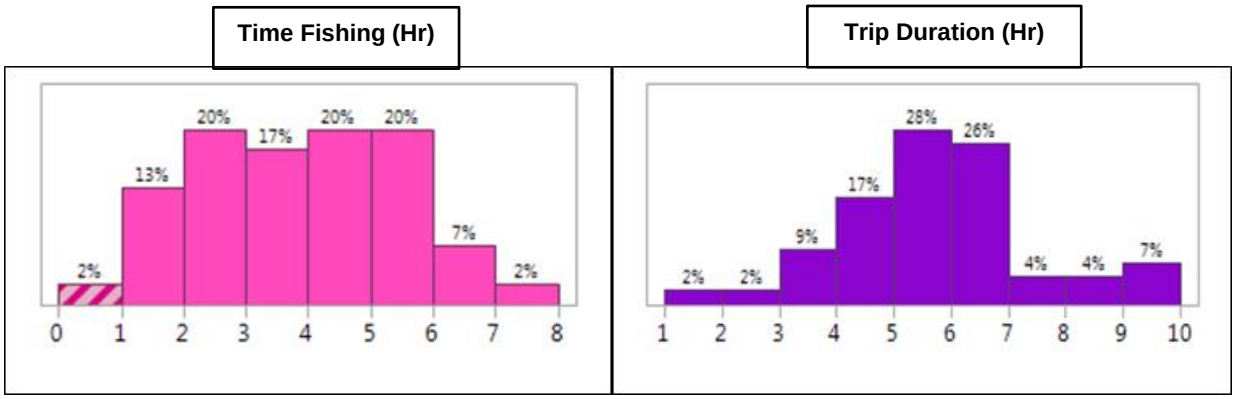


Figure 39. Time spent fishing and trip duration (in hours) (N=46).

5.4.2.2.8 Target Species and Catch

When asked for their preferred catch, 64% (N=30) of fishermen did not have a preference for conch, lobster or fish and would fish anything they can find. Of those who had a preference, 14% (N=14) preferred lobster, and only 6% preferred conch (N=3).

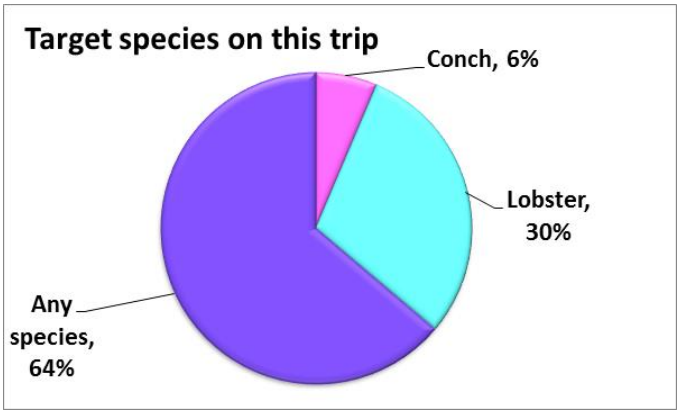


Figure 40. Target species, conch, lobster, or any species (conch, lobster, and/or fish) (N=47).

If fish are the target species, 60% of fishers replied that they also catch conch and/or lobster on more than 50% of the trips; and 40% replied that this only occurs in less than 50% of the trips.

The actual catch composition of the trip was assessed too. 11% of fishers caught only conch, 4% only finfish, and 17% only lobster. 9% did not catch anything or report any catch, while the majority (60%, N= 28) caught different combinations of species, with lobster and fish being the most prevalent species (23%, 11 trips).

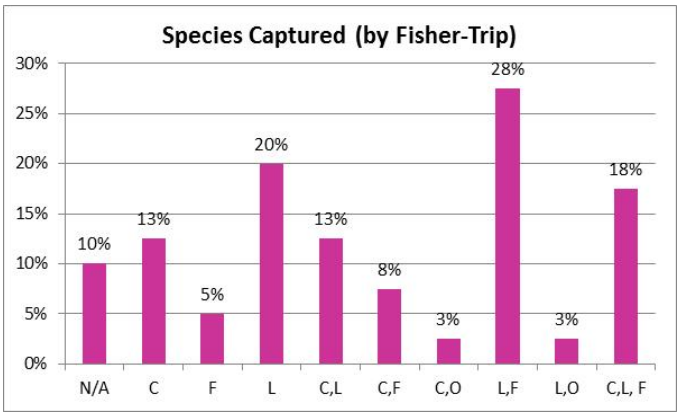


Figure 41. Composition of species captured on the trip (N=40). C=Conch, L= Lobster, O= Octopus, N/A= information not provided.

A complete list of the fish species reported by the fishers interviewed is provided below.

Table 26. Main fish species targeted or reported in the sites surveyed. [21]

	Spanish	English	Scientific
1	Arrayado	Lane snapper	*Lutjanus synagris*
2	Bajonado	Jolthead porgy	*Calamus bajonado*
3	Cabrillas	Red hind	*Epinephelus guttatus*
4	Capitanes	Hog fish, hog snapper	*Lachnolaimus maximus*
5	Chapin	Trunkfish	*Lactophrys trigonus*
6	Cojinudas	Bar jack	*Caranx ruber*
	Cojinudas	Blue runner	*Caranx crysos*
7	Colirrubia	Yellowtail snapper	*Ocyurus chrysurus*
8	Corcobado	African pompano	*Alectis brevirostris*
9	Cotorroros, Loros	Parrotfish	Scaridae
10	Meros	Sea basses	Serranidae
11	Palometa	Permit	*Trachinotus goodel*
12	Pargos	Snappers	Lutjanidae
13	Pejepuerco, Puerco	Queen triggerfish	*Balistes betula*
14	Salmonete	Goatfishes	Mullidae
15	Sama	Mutton snapper	*Lujanus analus*
16	Sierras	Mackerels (King)	*Scomberomerus caballa*
17	Tiburon limón	Lemon shark	*Negaprion brevirostris*

5.4.2.2.9 Catch

Some fishers reported their catch in pounds; others in kilograms, or numbers. The summaries below used the data converted to weight in pounds; therefore some assumptions were made, based on personal observations, the team's observations, communications with other scientists experienced in Puerto Rico data collection, and some limited literature research. The main assumption was that the species harvested by these fishers barely met the minimum size regulation.

- Queen Conch- 3 conchs per pound, or mean (clean meat) weight per conch of 0.33 lb. Conchs are generally landed as clean meat.
- Spiny Lobster- Mean weight per lobster of 1.25 lb.
- Finfish- Mean weight of 1lb per fish.

The estimated catch statistics under these assumptions are illustrated below. These general trends in catch suggest that the volumes landed are too large to be for recreational or subsistence purposes only. We did not segregate the catch from fishers with or without a license because both sets of information (the license and the catch) are based on assumptions and not on solid evidence. Also, as explained before, catch was generally multi-specific, with variable proportions of each species.

[21] English and scientific names from Erdman (1983). URL: http://www.caribbeanfmc.com/reports-sci-docs/FISH%20COMMON%20NAMES.pdf

a) Queen Conch: 57 % of the fishers reported catches between 50-100 lb, and 24% between 100-150 lb. Catches greater than 200 lb only represented 20% of the observations. Note that sample sizes are small.
b) Spiny Lobster: 63% of fishers reported catches between 10-20lb, 25% between 20 and 40 lb, and a very small proportion (12%) reported catches greater than 40lb.
c) Finfishes: 74% of fishers reported catches between 10 and lb pounds. Note that the assumption to convert numbers to pounds assumes that fish of all species weight on average 1lb, and this may be a gross overestimation for smaller species, or the opposite.

Table 27. Estimated catch statistics (in pounds). Raw data were converted to pounds, assuming mean weight of 0.3, 1.5, and 1lb for conch, lobster, and fish, respectively.

CONCH	CONCH	LOBSTER	FISH
Mean	78.7	15.2	15.2
Std Dev	88.1	17.2	20.8
Std Err Mean	19.2	3.0	4.3
upper 95% Mean	118.8	21.3	24.2
lower 95% Mean	38.6	9.0	6.2
N	21	32	23

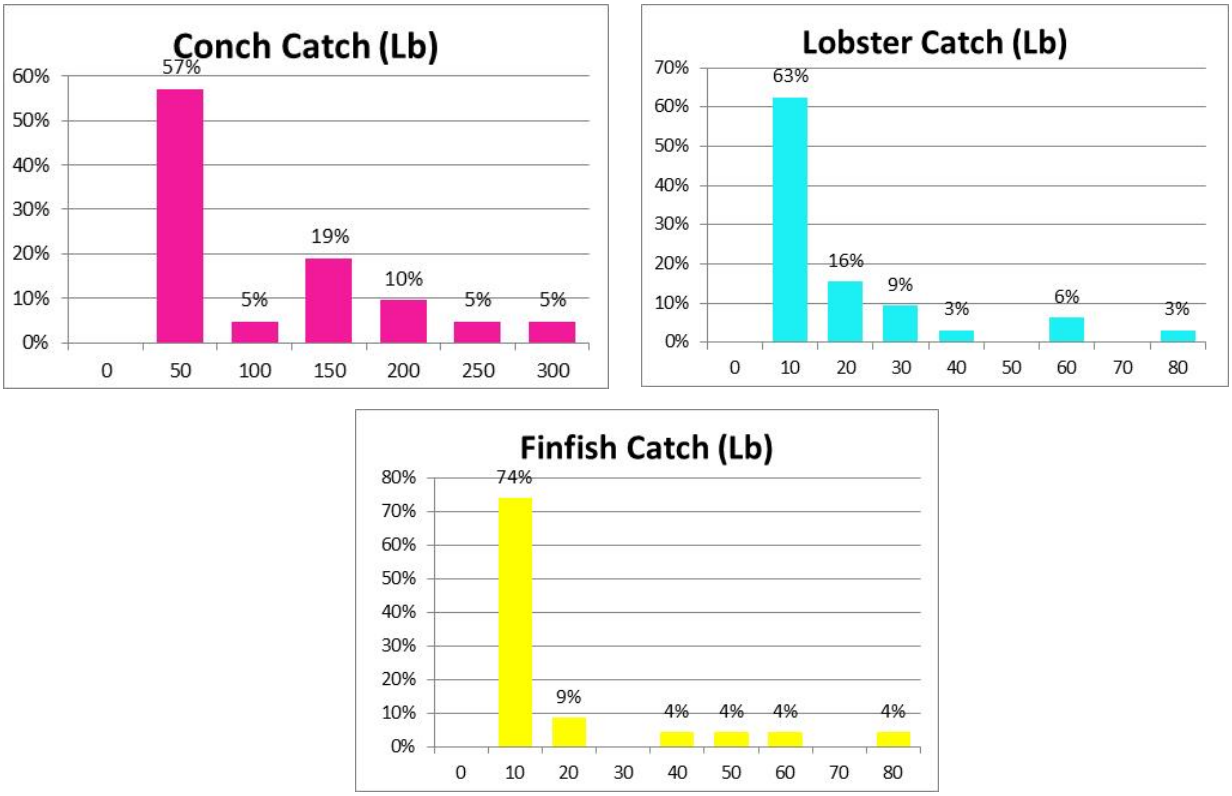


Figure 42. Estimated catch frequency distribution (% in lbs) for a) queen conch, b) lobster, and c) finfish.

5.4.3 Size distribution of the catch

The majority of the fishermen interviewed did not allow the samplers to measure their catch; therefore statistically significant size distributions are not available. Only 10 spiny lobsters were measured, with an average carapace length of 99.4mm (SD= 21.2), and 70% were females. Only two lobsters were measured for total length, and weight, averaging 276 mm (SD=59.4), and 912 (SD=390) grams, respectively.

Similarly, only 5 queen conchs were measured, with an average length of 97mm (SD=1.2) and lip thickness of 0.8 mm (SD= 0.27), all of which were immature individuals. Larger samples of conch shells were taken in Culebra and Vieques. Those analyses are provided in Section 5.4.5.3 Queen Conch Morphometric Data)

5.4.4 Dive shop survey report

During the months of August and September 2015, the team visited dive shops around the island to find additional information that could be useful to the project from a specific sector. We considered that dive shops could potentially encourage tourists to fish recreationally or take divers to places where they observe the activity happening. We set up appointments with dive shop owners or dive masters before traveling to the locations.

We designed another questionnaire (see Appendix E) to interview this sector and obtained information on where they dive, if those places are conch and/or lobster habitats, if they allow fishing, if the divers catch these species occasionally, how often, and the quantities they catch. Also, we inquired whether their activity normally allows or includes fishing as part of the diving package, if they observe other recreational fishers taking these species at their dive sites, the frequency and intensity of those observations, and the methods that they see being used to harvest fish or shellfish.

Thirteen dive shops were surveyed in August, and fifteen in September, with a total of 28 dive shops.

1. Neptune Divers (Vega Baja)
2. Ocean Sports (Isla Verde)
3. Scuba Dogs (Guaynabo)
4. BDS Cycling (Guaynabo)
5. Casa del Mar (Fajardo)
6. Davi shop
7. Black Beard (Ceiba)
8. Diver Center (Fajardo)
9. Zumba Fun Rental
10. Majoa Dives (Fajardo)
11. Pure Aventure (Las Croabas, Fajardo)
12. Puerto Rico Diver Supply & Aquarium (Fajardo)
13. Sea Ventures (Fajardo)Ocean Sports (Isla Verde)
14. Scuba Dogs (Guaynabo)
15. BDS Cycling (Guaynabo)

16. Scuba Motion (Vega Baja)
17. Kalichee Surf Shop (Dorado)
18. Akuazone (Río Piedras)
19. La Casa del Buzo (Río Piedras)
20. Paradise Scuba & Snorkeling Center (La Parguera)
21. Papayo Divers (Papayo)
22. West Divers (La Parguera)
23. The Dive Shop (Mayaguez)
24. Taino Divers (Rincon)
25. Copa Marina Beach Resort Dive Center (Guanica)
26. Aquatica Dive and Surf (Aguadilla)
27. Island Scuba (Guanica)

The information obtained from dive shop interviews was qualitative. The main results from interviews held at dive shops/ dive schools can be summarized as follows:

- Many shops specialize in diving in marine protected areas around the island; others go to assorted dive sites.
- Dive shop operators sometimes observe illegal fishing at the diving sites, but not in marine protected areas where fishing is prohibited.
- The sites around the island most visited by dive and snorkeling tours are:
  1. Cerro Gordo
  2. El Escambrón
  3. Los Tubos y Mar Chiquita
  4. Balneario de Vega Baja
  5. Crash Boat en Aguadilla;
  6. Todos los Cayos de La Parguera (Cayo Enrrique, El Mario, Turrumote, Media Luna)
  7. La Pared entre Cabo Rojo y Guanica
  8. La Pared de Cabo Rojo a Ponce
  9. Las Pozas
  10. Andreas Reef
  11. La Cueva de Franklin
  12. Nene Reef.
- Outside of their preferred dive and snorkeling sites, the places where dive shop operators have observed recreational or illegal fishing of Conch and Lobster are:
  1. Balneario de Vega Baja
  2. Flamenco
  3. Pinones
  4. Area in front of the capitol named “Las ahogas”
  5. Fajado, Vieques y Culebra
  6. Beril de La Parguera y Guanica
  7. Ventanas (Guanica)

- Some shops are not aware of the areas where fishing for the species of interest occurs. Others know there is fishing because customers buy fishing gears, but they do not specify where exactly they will go fishing.
- Most of the dive shops do not allow fishing of any kind (lobster, conch, finfish) during their dive or snorkel trips. However, only two of the shops do not sell fishing gear. All other shops sell gaffs and hooks to catch lobster, spear guns, fishing poles, rods, lines. They also fill out tanks for commercial fishermen.
- As noted above, in general dive shops do not normally include recreational fishing as part of their tour, and those that allow fishing focus on spearfishing (fishes) rather than shellfish. It is very rare for tourists to take conchs or lobsters, with conch being a more desirable target because tourists want to keep the shells as a souvenirs.
- Based on the dive shop experience over the years, the majority of interviewees observed that there has been a great decline in the number of conch and lobster, and that these species are rarely seen anymore due to overfishing. They have observed that fishers try to catch more lobsters than conchs because they are more profitable. One interviewee was unable to answer any questions because he does not pay attention to those species. They listed as possible causes of decline of the lobster and conch populations:
    - Deterioration of marine ecosystems (eg., Forest Reef in La Parguera)
    - Excessive coastal development
    - Sewage into the ocean (Guanica and La Parguera)
    - Lion fish is a big problem, they are observed very frequently.

5.4.5 Vieques and Culebra surveys

5.4.5.1 Culebra Survey Report

A one week survey was conducted in Culebra from **(**May 27 to June 3rd, 2015). The sampling design for this short-term, intensive survey was adapted to have as much coverage as possible during a short period of time. Scoping interviews were carried out in the first two days to find out the potential sites of recreational conch and lobster activity. The team visited all the possible fishing sites, roving the majority of the beaches around Culebra and visiting some marinas and private docks. Also, large samples of conch shells were measured at every “conch cemetery” identified. Interviews were conducted with all fishers encountered, with park rangers, enforcement agents, and DRNA and US Fish and Wildlife staff.

Three team members participated in the sampling trip to Culebra. They worked intensively for 7 days, from 7-8 am to 8 pm or longer when needed. During the first two days the team interviewed fishermen, park rangers, enforcement agents, staff from the DRNA and US Fish and Wildlife, a person from Coralations, and other assorted people who had any knowledge of the recreational fishing activity in Culebra. The team obtained good leads to other people and to the most active sites for conch and lobster.

A total of 13 sites were visited in Isla Culebra and Culebrita and 4 interviews with conch and lobster fishermen were undertaken. The names of the sites were:

1. Punta Soldado
2. Playa Zoni
3. Playa Melones
4. Playa Dátiles
5. Playa Cable
6. Playa Larga
7. Playa Tamarindo
8. Bahía Mosquito
9. Playa Manzanilla
10. Playa Tortuga (Culebrita)
11. Playa Brava
12. Playa Flamenco
13. Anfiteatro en la Isla de Culebra
14. Cayo Las Pelas and Peladita (Not visited, referred to as a potential sites)

Conch mounds were found practically everywhere, at twelve of the beaches surveyed and at one site inland. A significant part of the trip was spent sampling and measuring shells at these "conch graveyards". Samples of conch shells were taken and measured for shell and lip thickness at each of the aggregations found per site. A total of 1456 shells were measured at 12 beaches: Punta Soldado, Playa Zoni, Playa Melones, Playa Dátiles, Playa Cable, Playa Larga, Playa Tamarindo, Bahía Mosquito, Playa Manzanilla, Playa Tortuga (Culebrita), Playa Brava, Playa Flamenco and the amphitheater in town. Estimates of the total number of conchs per site were made, with approximately 2,996 shells observed. These conch observations from Culebra are summarized in the Morphometric data section.

The main observations from the surveys and interviews conducted in Culebra were:

- In general, there appeared to be a lack of patrolling and enforcement of regulations for natural resources. As in other areas of Puerto Rico, very few agents were observed patrolling the ocean.
- It was rare to intercept the fishers as they arrive from a fishing trip. The team was unable to find defined places (ramps, docks) where many of them land their catch. Interviews revealed that many fishermen fish out of docks near their houses or from their own private ramps in their backyard. It is necessary to have an authorization to access private ramps and wait for fishers to arrive. It is for this main reason that only 4 interviews were conducted with recreational or illegal fishermen in Culebra.
- In Culebra we observed very few commercial fishermen with a valid license (only 3 with certainty, according to field data). The rest of the fishermen observed act as commercial conch and lobster fishers, considering that they fish large quantities and their ultimate goal is to sell their catch. Thus, a large part of the activity is carried out illegally, not following the DNER or federal regulations.
- Each conch "graveyard" had different number of shell aggregations or mounds. In general, it was observed that the shells had been discarded from recent fishing trips; the shells were generally fresh, colored, not worn by erosion, and still decomposing. Samples were taken at all sites and from all the different mounds encountered, with a total of 1,456 individuals measured for length and lip thickness.

- The average length of the shells from all the sites sampled was 14.04 cm, well below the minimum legal length of 22.9 cm. Lip thickness averaged 1.13 mm, also below the minimum lip thickness of 9mm. We observed 100% juveniles, all below legal size.
- There appears to be significant evidence that juvenile conchs are being captured around the island of Culebra. A follow-up study is recommended to assess this situation, because there is a risk that growth overfishing may be occurring, which may soon lead the stock to recruitment failure if conchs are not being allowed to grow to reproductive sizes and spawn in the area.

5.4.5.2 Vieques Survey Report

A trip to Vieques was carried out from June 24 to July 5th, 2015. The purpose was to get a snapshot of the recreational activity for conch and lobster in this island, through intensive surveys and interviews over 10 days of continuous work.

The sampling protocol was adapted to have as much coverage as possible during the 11-day trip. Scoping interviews were carried out in the first two days to find out the potential sites of recreational conch and lobster activity. The team visited all the possible fishing sites, roving the majority of the beaches around Vieques and visiting some dive shops, marinas, docks, piers, and cays. Also, large samples of conch shells were measured at every “conch cemetery” identified. Interviews were conducted with all fishers encountered, with enforcement agents, and DRNA and US Fish and Wildlife staff. Fishers in general were reluctant to participate in the study, so full interviews were not completed in Vieques.

A summary of the activities and results from the trip to Vieques follows.

Three team members participated in the sampling trip to Vieques. Two of the team members stayed for the duration of the trip, and the other worked for four days. Two qualified volunteers participated, one for five days and the other two days only, to provide advice on the people and places to visit and to introduce the team to some of the main known contacts. The team of samplers/ interviewers worked intensively for a total of 10 days, arriving one day before and leaving one day after the work concluded. They roved the island in its entirety, focusing on those places that had been recommended by a port agent from the DNER and people from Fish and Wildlife or other contacts made during the first two days. In general sampling started at around 8am and ended by 8pm or later when needed. During the first two days the team interviewed fishermen, park rangers, enforcement agents, staff from the DRNA and the US Fish and Wildlife, and other assorted people who had any knowledge of the recreational fishing activity in Vieques. The team obtained good leads to other people and to the most active sites for conch and lobster.

Nearly thirty different sites were visited, the majority of which were beaches where recreational fishing had been reported. Other sites visited included dive shops, ramps, fish houses, piers, cays, and other ports with fishing and recreational activities. The team also snorkeled around some beaches where underwater conch “cemeteries” had been reported. Conch mounds were also found at several other beaches. A significant amount of time was dedicated to taking samples of conch shells at “conch graveyards”. Samples of conch shells were taken and measured for shell and lip thickness at each of the aggregations found per site.

The list of the sites surveyed in Vieques Island is:

1. Pescadería Angelyz
2. Sun Bay Beach
3. Playas de Media Luna
4. Muelle de La Esperanza
5. Playa Negra
6. Playa Caracas
7. Cerro de Playuela
8. Rampa de Tres Palmitas
9. Playa Escondida
10. Playa La Chiva
11. Cayo La Chiva
12. Playa la plata
13. Playa en Ensenada Honda
14. Dive shop: Black Beard
15. Abe's Dive Shop
16. Isla Nena Scuba
17. Rompeolas Mosquito Pier
18. Puerto Frerro
19. Playa Berdiales,
20. Playa Media Luna
21. Playa Navio
22. Playa Grande
23. Playa Gallito
24. Sea Glass Beach
25. Punta Martineau
26. Punta Claque
27. Playa Pata Prieta
28. Playa, east of Punta Arenas
29. Punta Arenas

The main observations from the surveys and interviews conducted in Vieques were:

- As in other areas, there appeared to be a lack of patrolling and enforcement of regulations for natural resources. In particular there are very few agents and no patrols were observed at sea.
- There appears to be a lack of understanding of the conch regulations, especially size limits when conchs are landed without the shell. Enforcement agents can´t enforce this regulation, and the large majority of the conch landed are well below the legal size.
- Free divers were observed fishing recreationally for fish, conch, and lobster.
- Strong evidence was found that juvenile conchs are being captured around Vieques. We recommend a study that focuses only on this problem that appears to be persistent both in Vieques and Culebra.
- A total of 603 shells were measured at 4 sites in Vieques: Muelle la Esperanza, Playa El Machete, Sea Glass, and Playa Chiva. The average length was 17.47 cm and average lip thickness, 1.55mm. 100% of the samples were below minimum length (22.9 cm) and below

minimum lip thickness (9mm). This suggests that 100% of the conch harvested in Vieques may be juvenile individuals.

- A follow-up study is recommended to assess this situation, because there is a risk that growth overfishing may be occurring, which may soon lead the stock to recruitment failure if conchs are not being allowed to grow to reproductive sizes and spawn in the area.
- Recreational conch and lobster fishermen, as such, were not located or interviewed. We suspect that a large number of the fishers interviewed were illegal or had expired licenses, but we were unable to confirm.
- Fishermen sell their product to any buyer, not specifically to fish houses, so it is difficult to control the volume and quality of the catch for every species.
- We obtained reports that the most serious problem in Vieques is vandalism among fishermen, so there is a general lack of trust in this sector.
- It was difficult to obtain interviews from fishermen, and some of the reports we obtained may not be too accurate, given the lack of trust for "Biologists" or anyone who requests information about the fishing activity in Vieques.
- In Vieques as in Culebra, there appear to be very few commercial fishermen with a valid license. The rest of the fishermen observed act as commercial conch and lobster fishers, considering that they fish large quantities and their ultimate goal is to sell their catch. Thus, a large part of the activity is carried out illegally, not following the DNER of federal regulations.

5.4.5.3 Queen conch morphometric data analyses

A total of 2,059 queen conch shells were measured in Culebra and Vieques; 1,456 in Culebra and 603 in Vieques. Statistics for shell length and shell lip thickness from these samples are provided below.

Table 28. Shell length statistics (in mm) by island.

SHELL LENGTH (mm)			
Statistics	**Culebra**	**Vieques**	**All**
Mean	139.96	174.74	150.15
Std Dev	26.44	27.61	31.11
Std Err Mean	0.69	1.12	0.69
upper 95% Mean	141.32	176.95	151.49
lower 95% Mean	138.60	172.54	148.80
N	1456	603	2059

Table 29. Shell lip thickness statistics (in mm) by island.

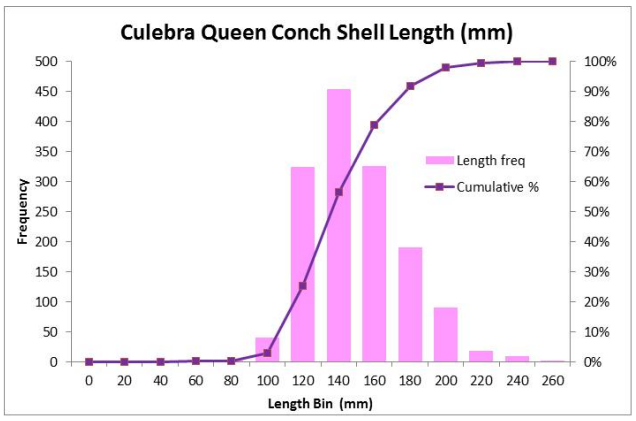
SHELL LIP THICKNESS (mm)			
Statistics	**Culebra**	**Vieques**	**All**
Mean	1.12	1.55	1.25
Std Dev	0.69	1.28	0.93
Std Err Mean	0.02	0.05	0.02
upper 95% Mean	1.15	1.66	1.29
lower 95% Mean	1.08	1.45	1.21
N	1456	603	2059

5.4.5.3.1 Culebra

In Culebra, the minimum length observed was 40mm, and the maximum, 243 mm. The average length was 140 mm. 99.3% of the 1456 individuals observed were below the minimum size limit of 229 mm.

The minimum and maximum shell lip-thickness observed was 0.1 and 9 mm, respectively. The average lip was 1.12 mm. 100% of the individuals measured were below the minimum lip limit.

Size frequency distributions and size limits are illustrated below.



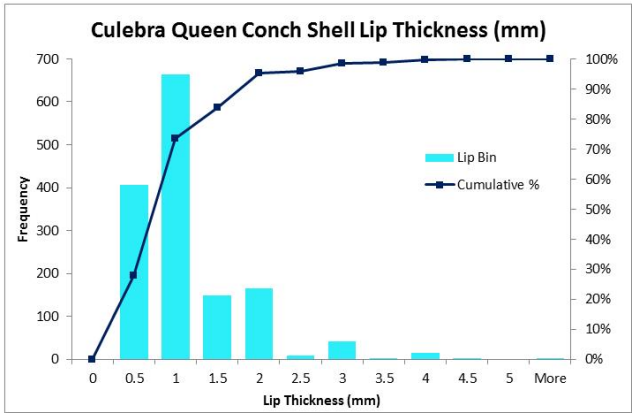


Figure 43. Culebra Island queen conch size frequency distributions and cumulative per cent curves (N=1456 individuals). Shell length and lip thickness are in millimeters.

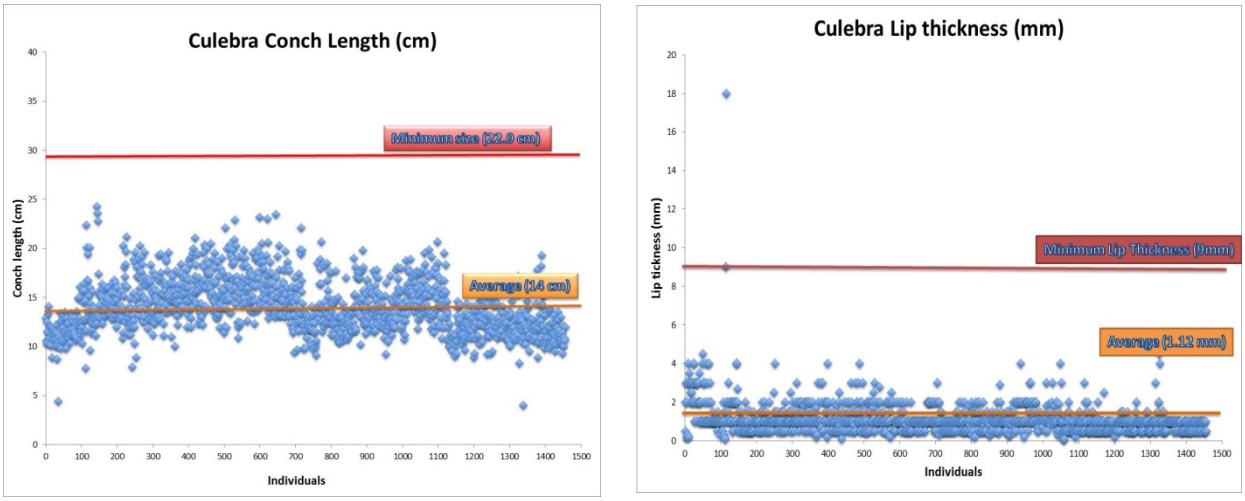


Figure 44. Conch shell size measurements (Length in cm, Lip in mm) for individuals sampled in Culebra, showing the average length and average lip compared to the legal size.

5.4.5.3.2 Vieques

In Vieques, the maximum shell length observed was 268 mm, and the minimum, 55 mm. The average length was 174.7 mm. Of the sample measured (N=603 individuals), 15 individuals (2.5%) were greater than 240 mm; thus 97.5% were below the minimum size limit of 229 mm.

The minimum and maximum shell lip-thickness observed was 0.1 and 18 mm, respectively. The average lip was 1.55 mm. 100% of the individuals measured were below the minimum lip limit of 9 mm.

Size frequency distributions and size limits are illustrated below.

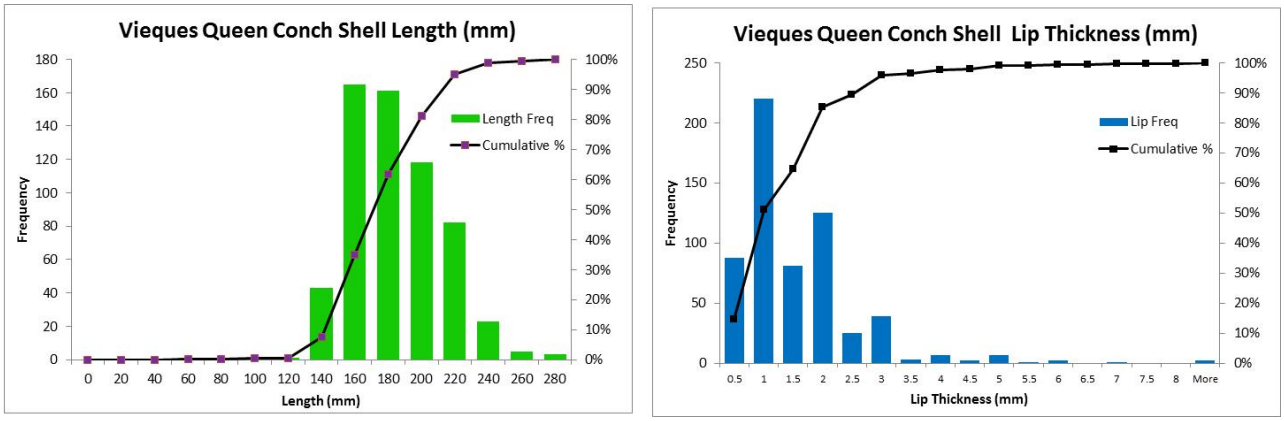


Figure 45. Vieques Island queen conch size frequency distributions and cumulative per cent curves (N=603 individuals). Shell length and lip thickness are in millimeters.

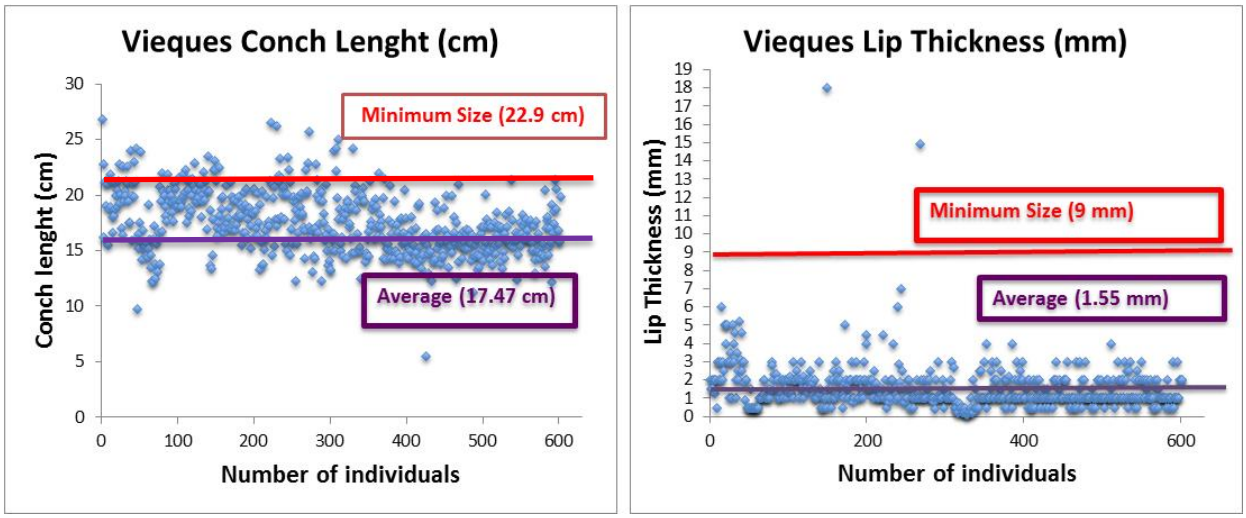


Figure 46. Conch shell size measurements (Length in cm, Lip in mm) for individuals sampled in Vieques, showing the average length and average lip compared to the legal size.

5.4.5.3.3 Culebra and Vieques data combined

Size frequency data for both islands combined are illustrated below.

T-Tests were performed to find if there are differences in shell size between Culebra and Vieques, using the statistical software JMP 12.0 (trial version). Analysis of Shell Length produced a two-tailed P value < 0.0001, showing statistically significant difference in shell length between both islands.

Analysis of Lip Thickness resulted in a two-tailed P value < 0.0001, also showing statistically significant difference in lip thickness between both islands.

Details of T-Tests are provided below.

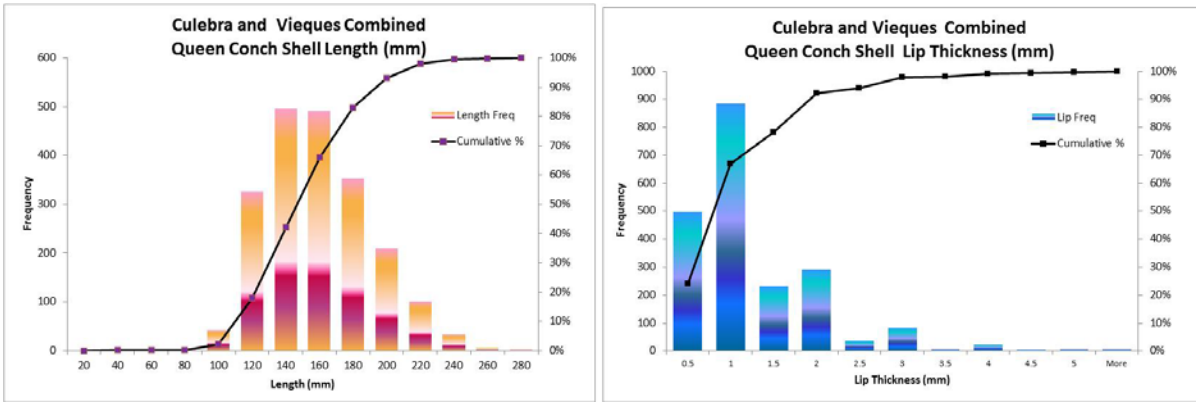
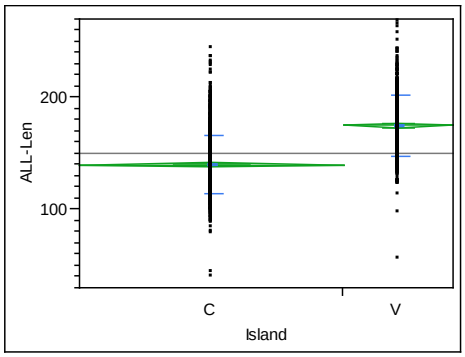


Figure 47. Culebra and Vieques Islands queen conch size frequency distributions and cumulative percent curves (N=2059 individuals). Shell length and lip thickness are in millimeters.

a) T-Test of Shell Length by Island



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Culebra	1456	139.959	26.4375	0.6928	138.60	141.32
Vieques	603	174.745	27.6096	1.1243	172.54	176.95

t Test

Vieques-Culebra
Assuming equal variances

Difference	34.7851	t Ratio	26.81638
Std Err Dif	1.2972	DF	2057
Upper CL Dif	37.3290	Prob > |t|	<.0001
Lower CL Dif	32.2412	Prob > t	<.0001
Confidence	0.95	Prob < t	1.0000

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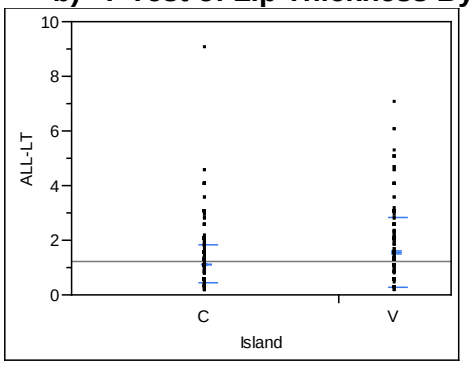
b) T-Test of Lip Thickness By Island



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Culebra	1456	1.11780	0.69417	0.01819	1.0821	1.1535
Vieques	603	1.55406	1.27678	0.05199	1.4520	1.6562

t Test

Vieques-Culebra
Assuming unequal variances

Difference	0.436268	t Ratio	7.91988
Std Err Dif	0.055085	DF	753.7421
Upper CL Dif	0.544406	Prob > |t|	<.0001
Lower CL Dif	0.328129	Prob > t	<.0001
Confidence	0.95	Prob < t	1.0000

6 Conclusions and Recommendations

Consistent with other projects in the region, we had difficulties in finding and retaining interviewers (the MRIP Consultants report and other references also mention this problem). Also, finding interviewers with the qualifications and experience required for the project was complicated. Hiring, training, and supervision is best done by a local strong manager, and remote hiring and supervision is fraught with difficulties.

This situation significantly delayed the start of the project, and produced imbalances in the sampling design and in the quantity and quality of the data produced.

It is worthwhile to re-examine our sampling design, which included variations in the number of samplers, the number of samplers per trip, the selection of the site types (marinas, beaches, fishing villas, docks, ramps), the number of trips/sites per week, the number of sites per day; hours per site; days of the week, hours of the day; randomized sites *vs.* stratified, and others.

The final survey design may need to be revisited if similar projects are to be implemented. Fine-tuning some variables may still be required. In particular, we would recommend a finer stratification because many potential sites were not active for fishing in general, or for recreational fishing, or for fishing queen conch and spiny lobster. Surveys should be attempted in the evening hours, to find out if there is more recreational activity at that time of the day.

Even though the sampling design evolved to maximize the probability of encounters and interviews, we had limited success in locating recreational fishers or finding any clear patterns in the activity. This resulted in a very low encounter rate, with only 47 full interviews completed over a whole year of sampling (or an average of 4 interviews per month). Also, many of the fishers interviewed were not clearly recreational fishers or fished exclusively conch and/or lobster. We conclude that locating the target group of recreational conch and lobster fishers was difficult due to the following reasons:

- Non-commercial fishers were elusive, and the recreational fishing for these species did not demonstrate a pattern in space or time such that we could identify peak times or locations of harvest.
- Low sampling effort capacity: we only had a limited number of samplers at limited days and times to cover the entire island.
- Because of safety issues we did not interview at night, and this would have missed any nighttime patterns.
- Fishers were often reluctant to talk to the interviewers so we could not interview all the fishers that we encountered. This reluctance may have resulted from the lack of compliance with regulations.
- The fishery is opportunistic and therefore multi-specific.

Very importantly, we were able to identify that non-commercial fishing consisted of recreational, subsistence, and illegal (unlicensed commercial) fishing. Apparently, there is a continuum among these sectors, and they cannot be easily differentiated. Other studies in Puerto Rico have demonstrated that fishers with or without invalid licenses harvest small or large amounts of fish and

shellfish, often selling the most valuable species and using others for consumption or trade for other commodities (M. Shivlani, pers. comm.).

From this information, it became clearer that the fisheries in Puerto Rico are mixed and perhaps opportunistic, with subsistence, recreation, and commercial activities occurring at the same time. Non-commercial, non-recreational fishing is widespread and seems ingrained it the local culture. This will likely make behavior resistant to changes through enforcement actions.

We identified and sampled many “Concheros” (discarded shell mounds). The vast majority of shells measured were juveniles. However, the origin of these shells and mounds is unknown, since we were not able to intercept fishermen landing and discarding shells on the beach. Also unknown is whether the majority of these mounds come from commercial or non-commercial fishers, but again, we suspect that the mixed fishery harvests, sells, and consumes juveniles.

Other important IUU fishing activities were commercial fishing without a license and fishing queen conch during the closed season. We also considered reports of undersized conch shells from the project team (C. Lilyestrom, pers. comm.) and noted the locations. Finally, the team of samplers never witnessed any form of reporting or monitoring by the fisheries department, so it appeared that most “non-commercial’ catches go largely unreported. With these observations, we were able to determine if some form of IUU fishing was occurring in many of the areas surveyed, and we mapped those sites as “potential IUU activity”. Even though such “IUU data” was sparse and could not be corroborated, it may provide useful information that would otherwise be difficult to obtain.

Linked to possible IUU fishing, we observed that surveillance and enforcement activities by the fishing authorities were minimal or non-existent in most areas, and particularly in Vieques and Culebra. IUU practices will be difficult to deter without enhanced monitoring and control.

Based on our results and field observations, we would recommend more intensive sampling, with more spatial and temporal coverage, and refining the methodology presented here toward a more structured and stratified sampling design. Also, we suggest that alternative survey methods are applied, such as community-based surveys with a more social focus, perhaps with interviewers embedded in the main fishing communities for a period of time.

Another alternative which may prove successful to locate and interview the target group is to carry out a social media survey. Social media are recognized as powerful tools for networking and communicating with target groups. We consider that a well-structured survey of this kind would attain great coverage in a short period of time, at a very reasonable cost.

Our main conclusion is that If MRIP adds invertebrates to the standard sampling protocol, we suggest not including new sites specific for conch or lobster because the probability of encountering these species is low at all the sites we sampled and with the methods we used.

Monitoring the distribution of conch and lobster catch in MRIP data over time may uncover patterns that could lead to opportunities for stratification to improve estimates of conch and lobster catch or suggestions for opportunities to expand the sampling range.

Finally, we believe that if the recreational monitoring program in Puerto Rico is to be restructured, it should account for the mixed nature of the fishery, the prevalence of opportunistic fishing, and the separation between high end recreational (ex., sports fishing for billfishes, bonefish) and low end subsistence fishing (ex., reef fishes and invertebrates).

7 References

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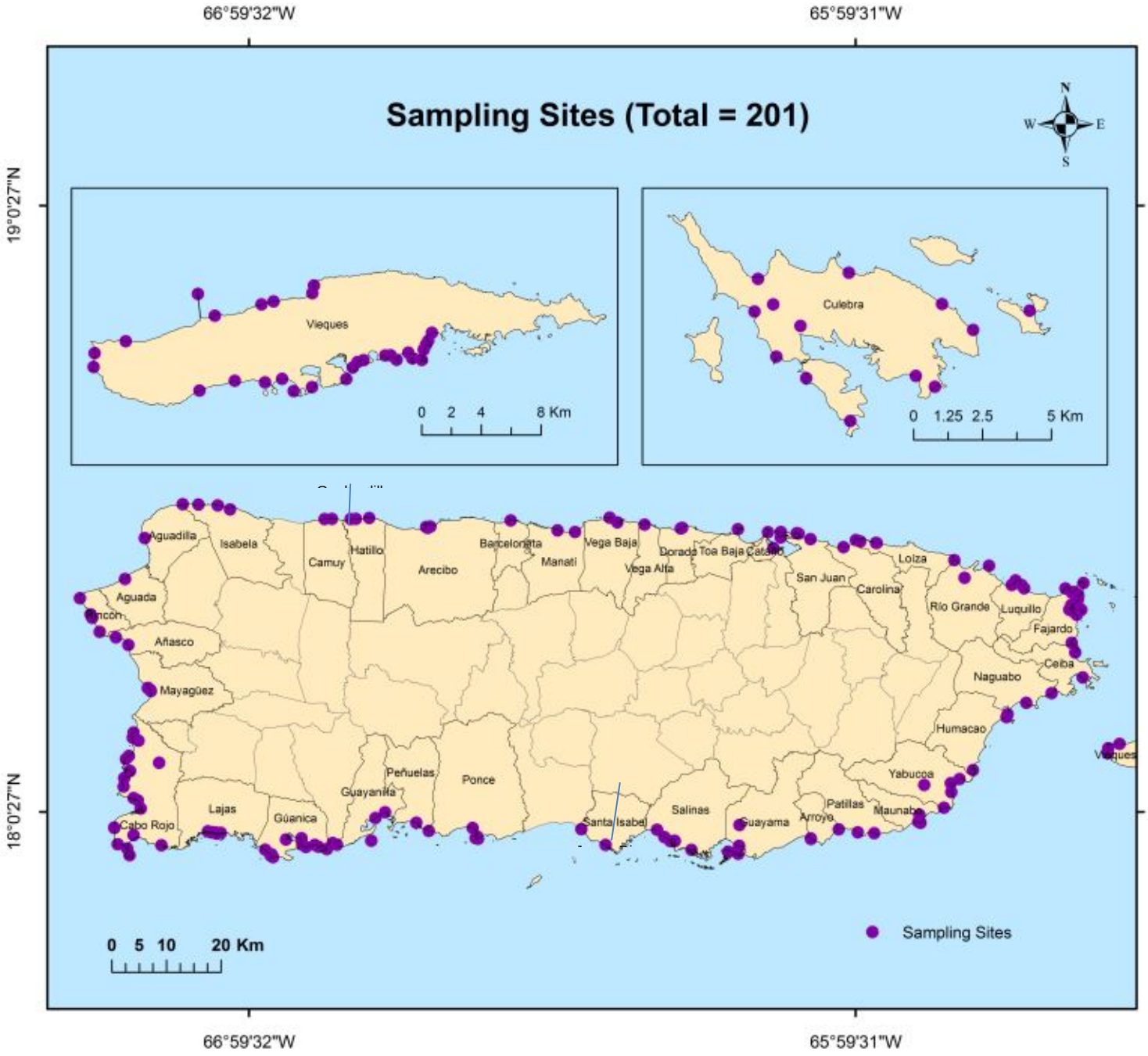
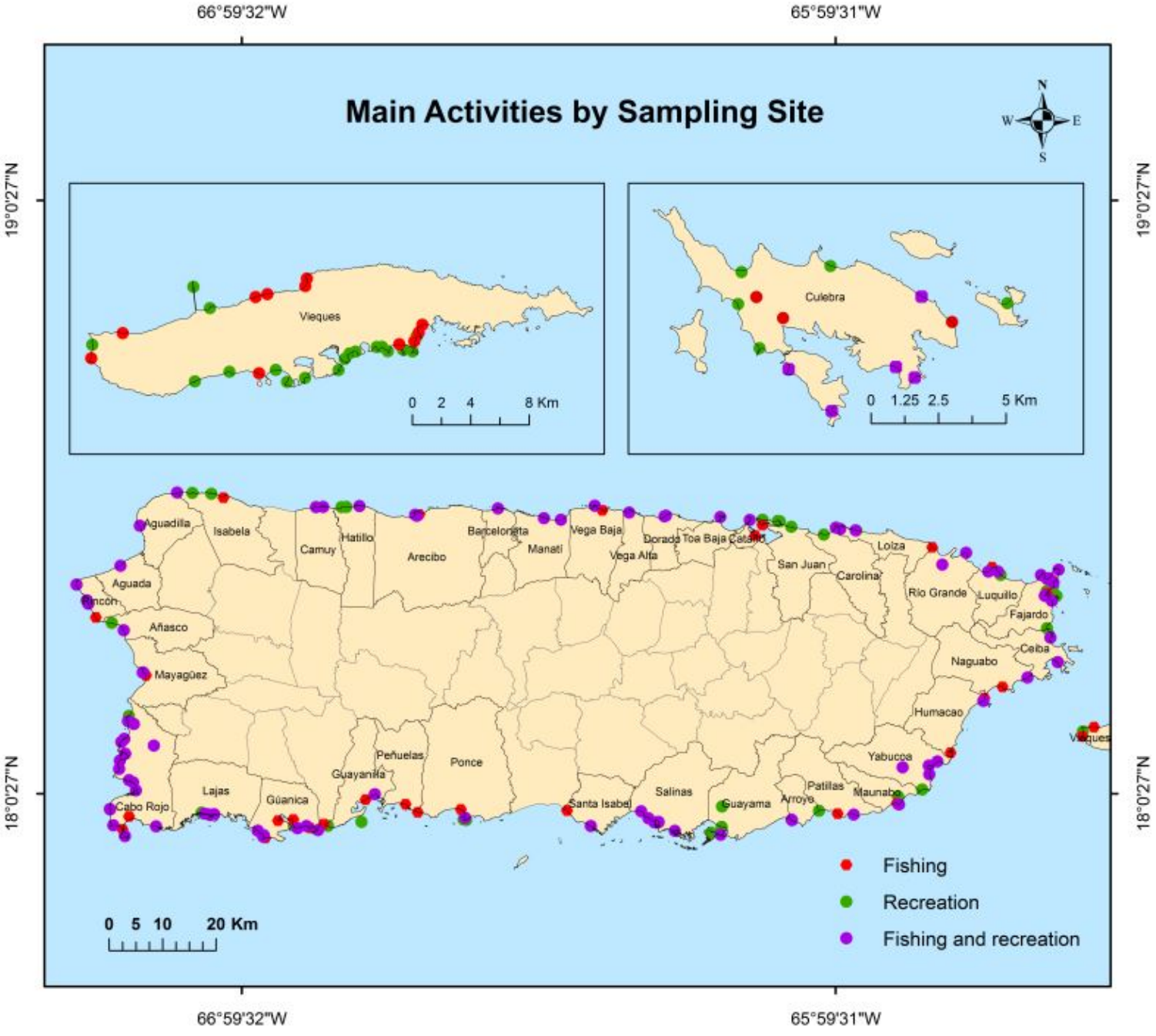
8 Maps

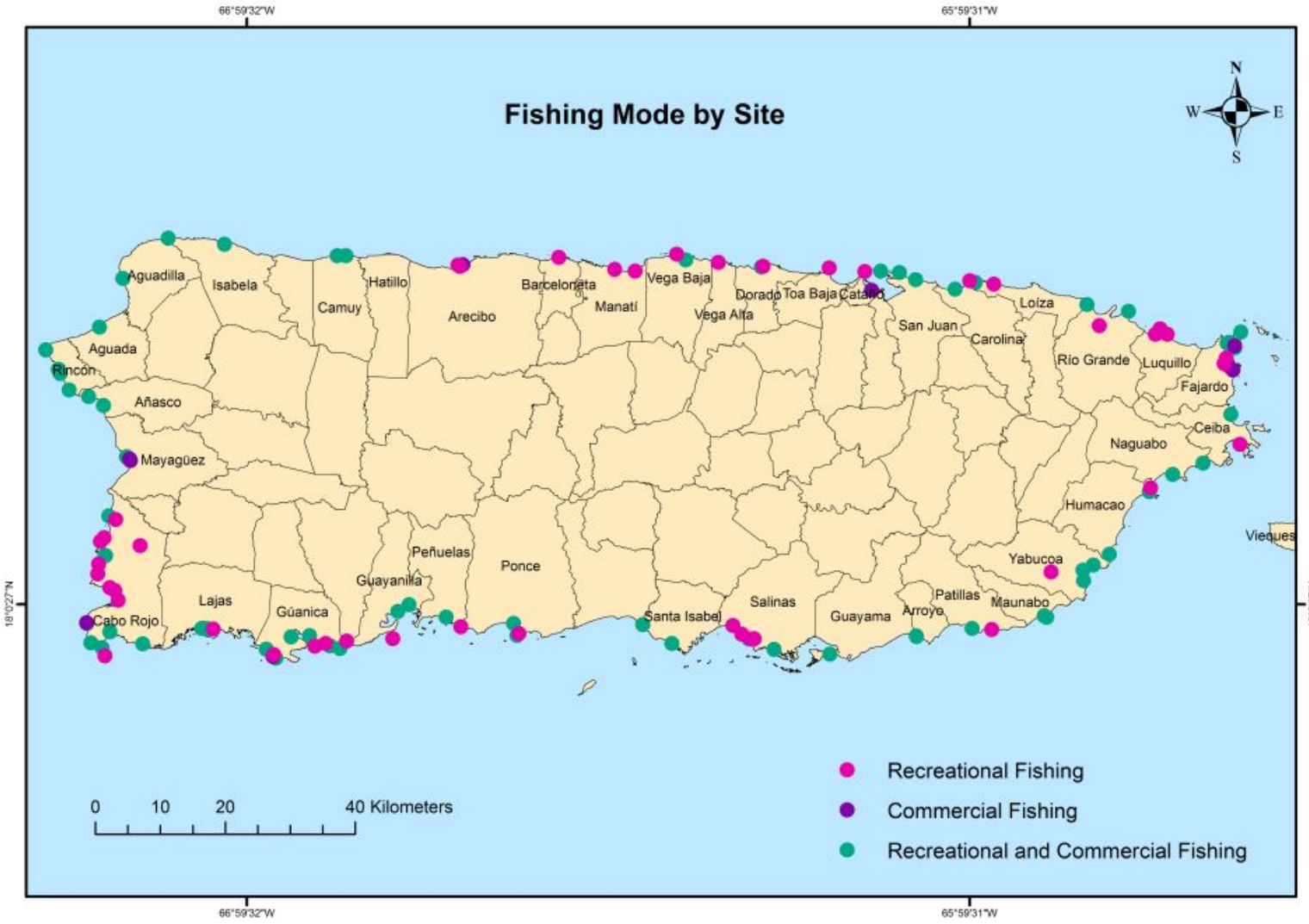
1. Sampling sites
2. Activities: fishing, recreation, both.
3. Fishing modes: recreational, commercial, both.
4. Sampling intensity: number of surveys (visits) per site during the study.
5. Sub-aquatic activities: diving, snorkeling, both
6. Fishing sites:
   6.1. Lobster, Queen Conch, Fish
   6.2. Lobster
   6.3. Conch
   6.4. Finfish
   6.5. Other species
7. Fishing gears:
   7.1. Main fishing gears
   7.2. Lines
   7.3. Underwater gears (dive, snorkel, gaff, snear, by hand)
   7.4. Other fish gears (spear, net)
   7.5. Traps
8. Fishing Sites by municipality
   8.1. Lobster
   8.2. Conch
   8.3. Fish
9. Number of interviews by species (conch and/or lobster) and species associations.
10. Potential sites with IUU fishing activity
11. Number of potential IUU sites by municipality



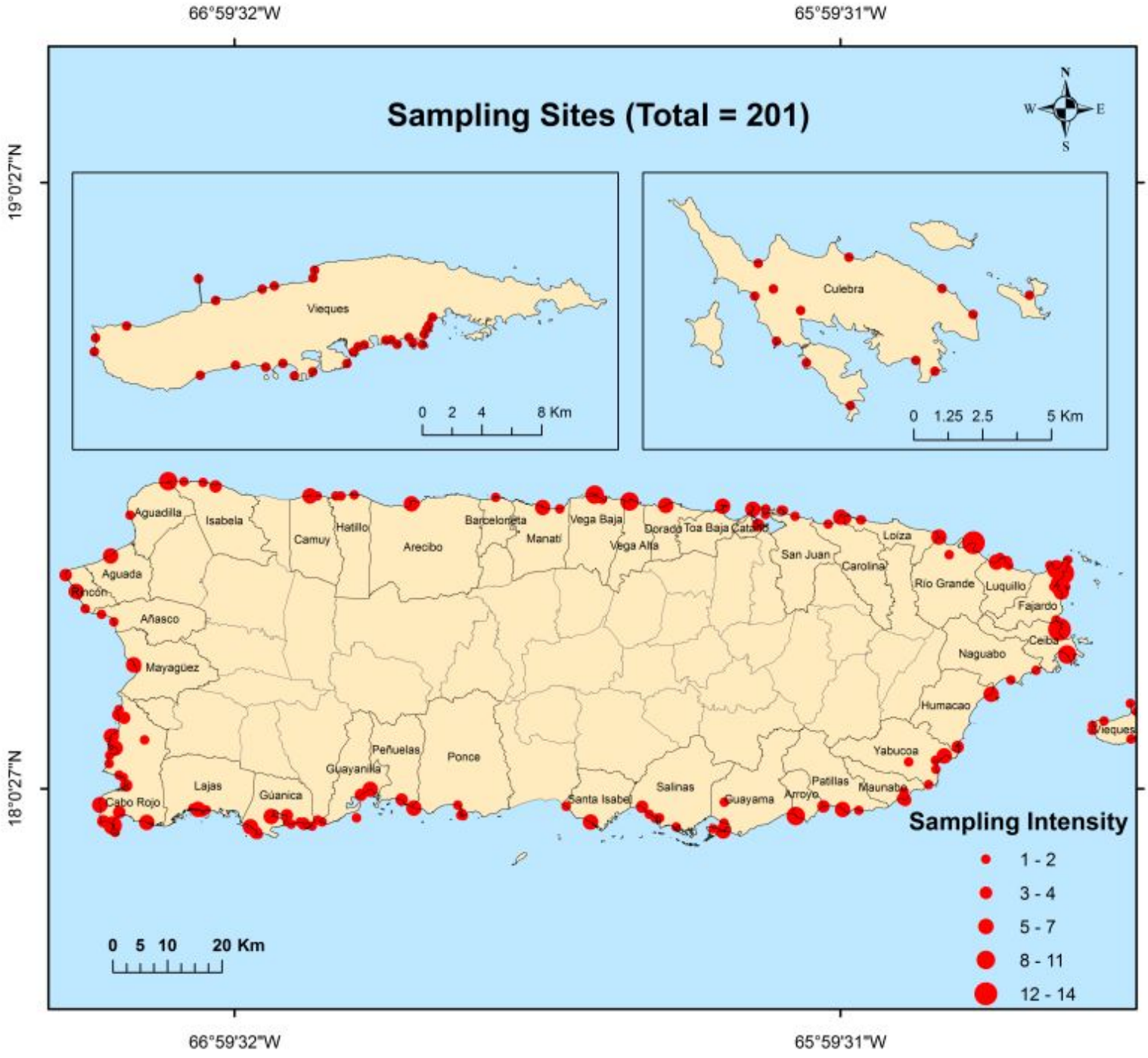
Map 1. Sampling Sites in Puerto Rico, Vieques, and Culebra.



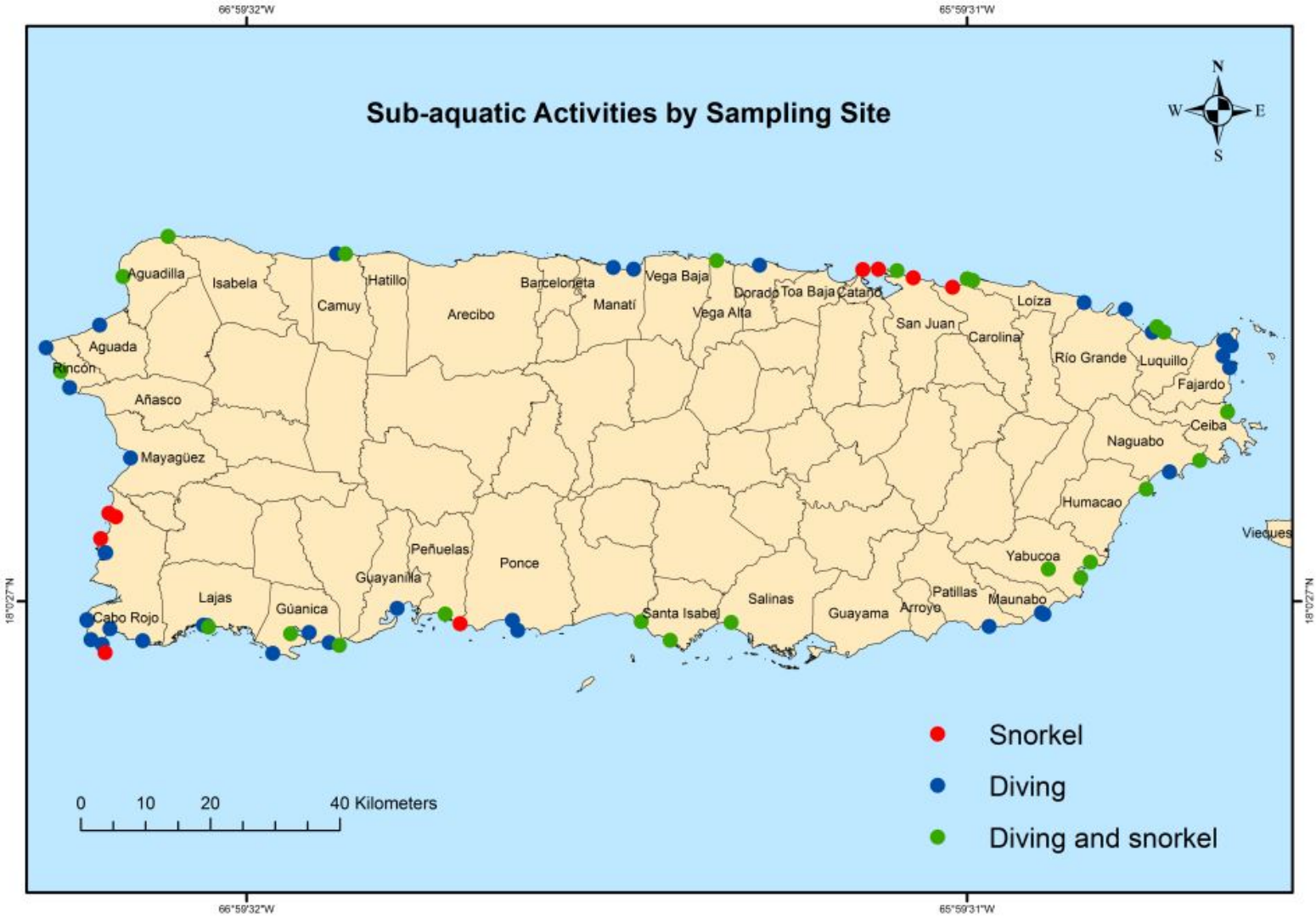
Map 2 Main activities by sampling site: fishing, recreation, both.



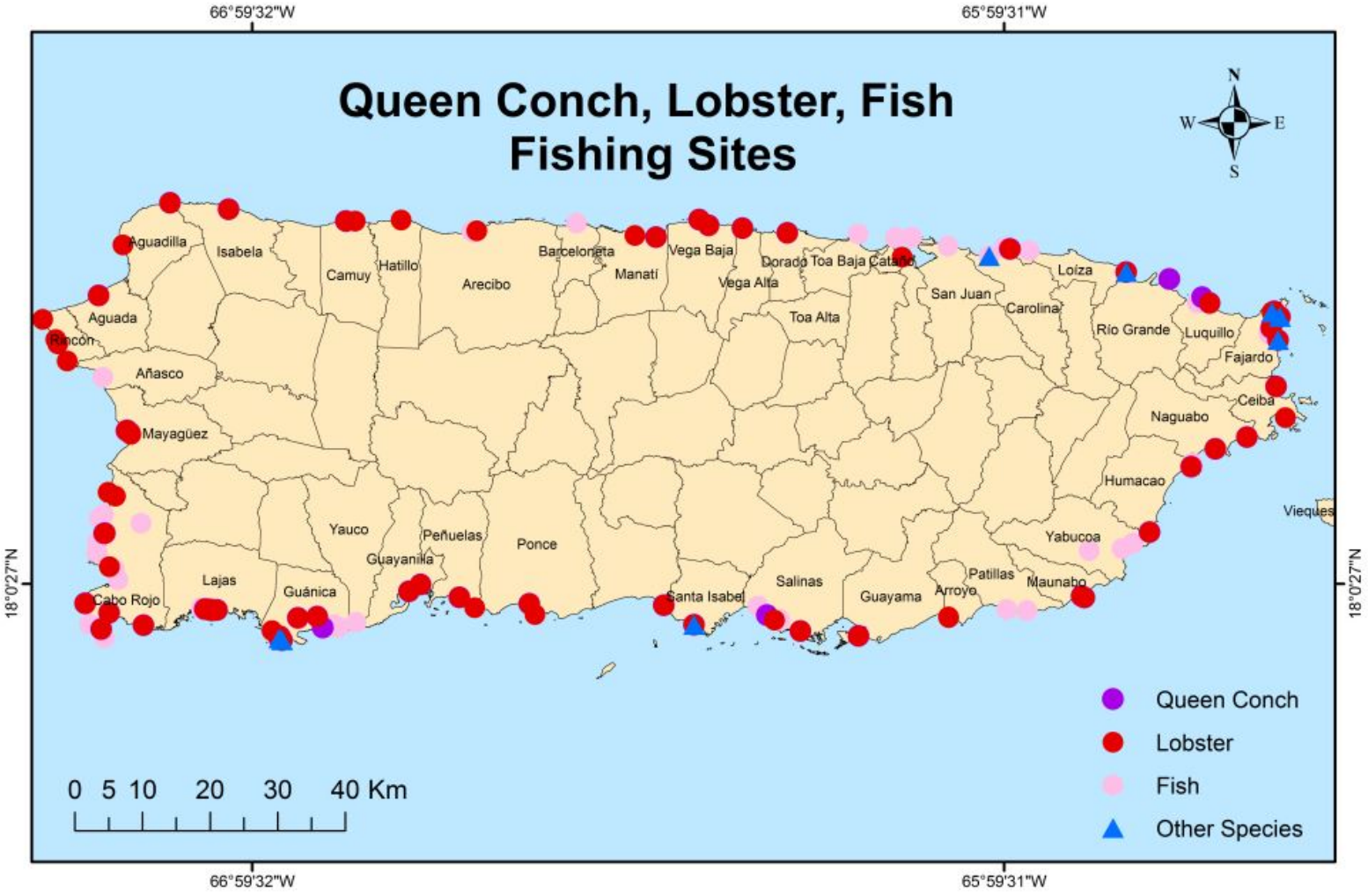
Map 3. Fishing mode by site: recreational, commercial fishing, or both.



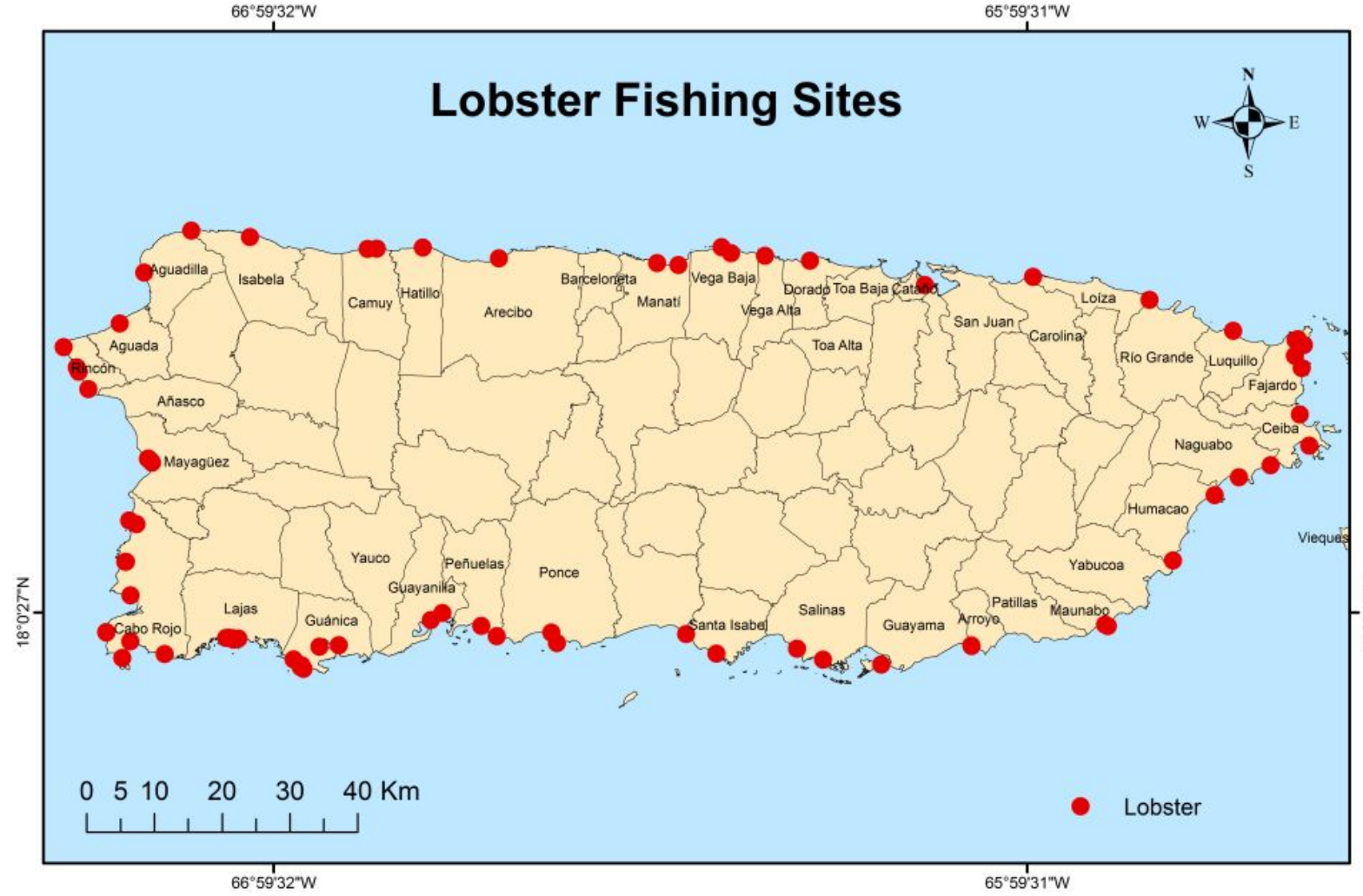
Map 4. Sampling intensity in number of surveys per site (the size of the dots represents the number of trips).



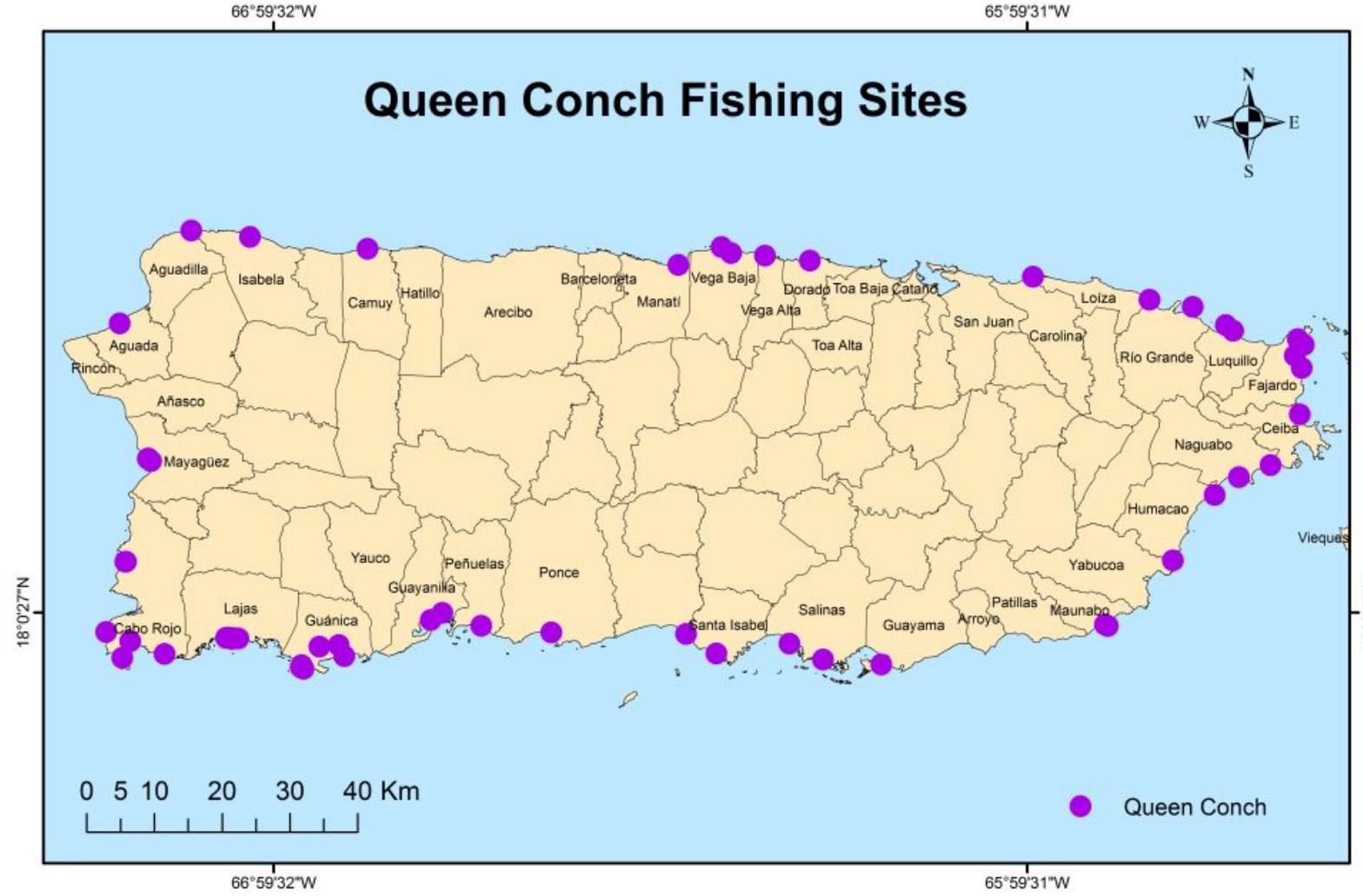
Map 5. Sub-aquatic activities by site: diving, snorkeling, or both.



Map 6.1: Fishing sites: Lobster, Queen Conch, Fish



Map 6.2: Fishing sites: Lobster.



Map 6.3: Fishing sites: Queen Conch.

Map 6.4: Fishing sites: Finfish

Map 6.5: Fishing sites: Other species (octopus, top shells, other mollusks).

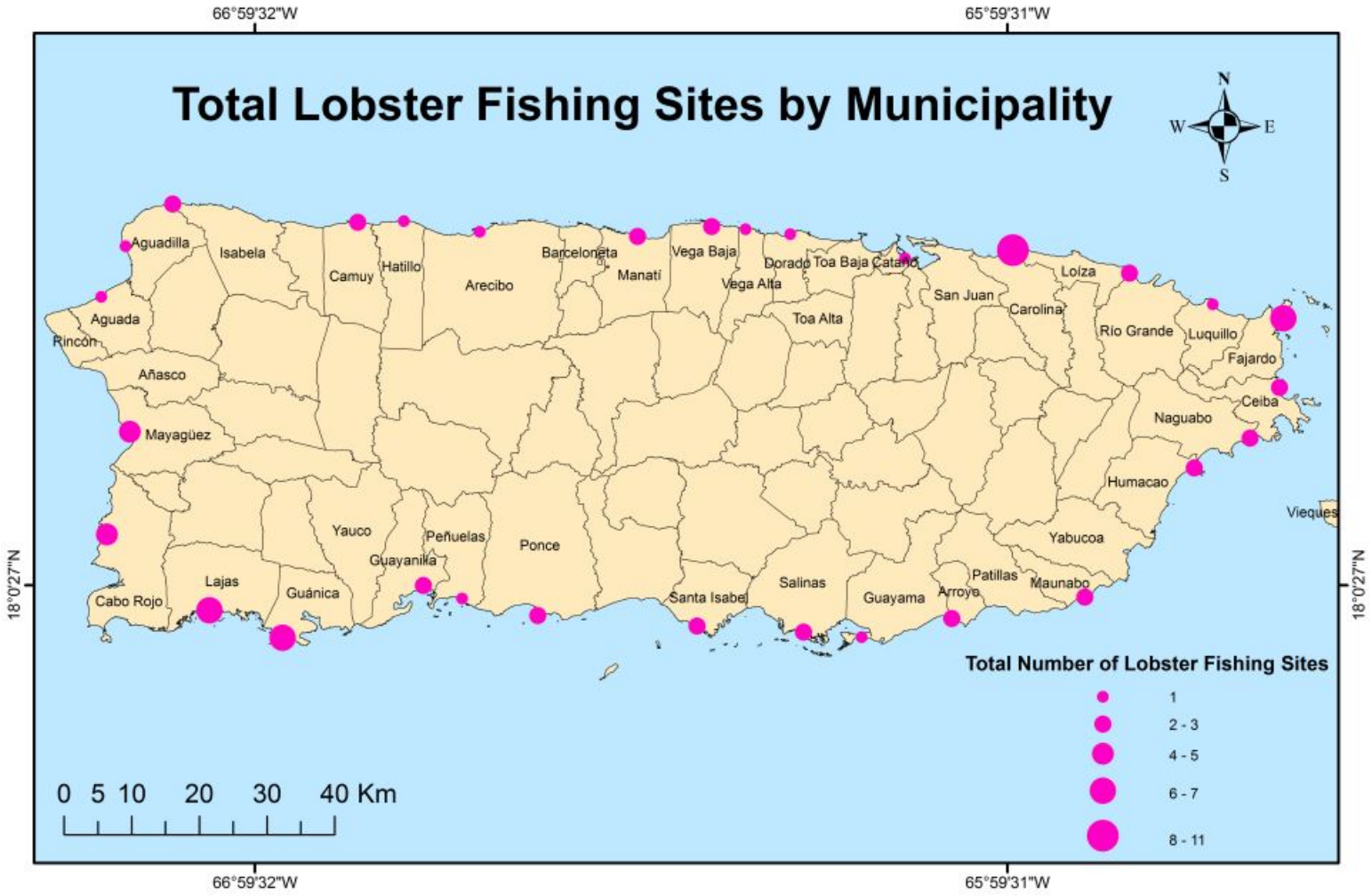
Map 7.1. Main fishing gears: Lines, Underwater gears (dive, snorkel, gaff, snare, by hand), Other fish gears (spears, nets, traps), and only Traps. (Note: SNARE, not snear).

Map 7.2.Main fishing gears: Lines

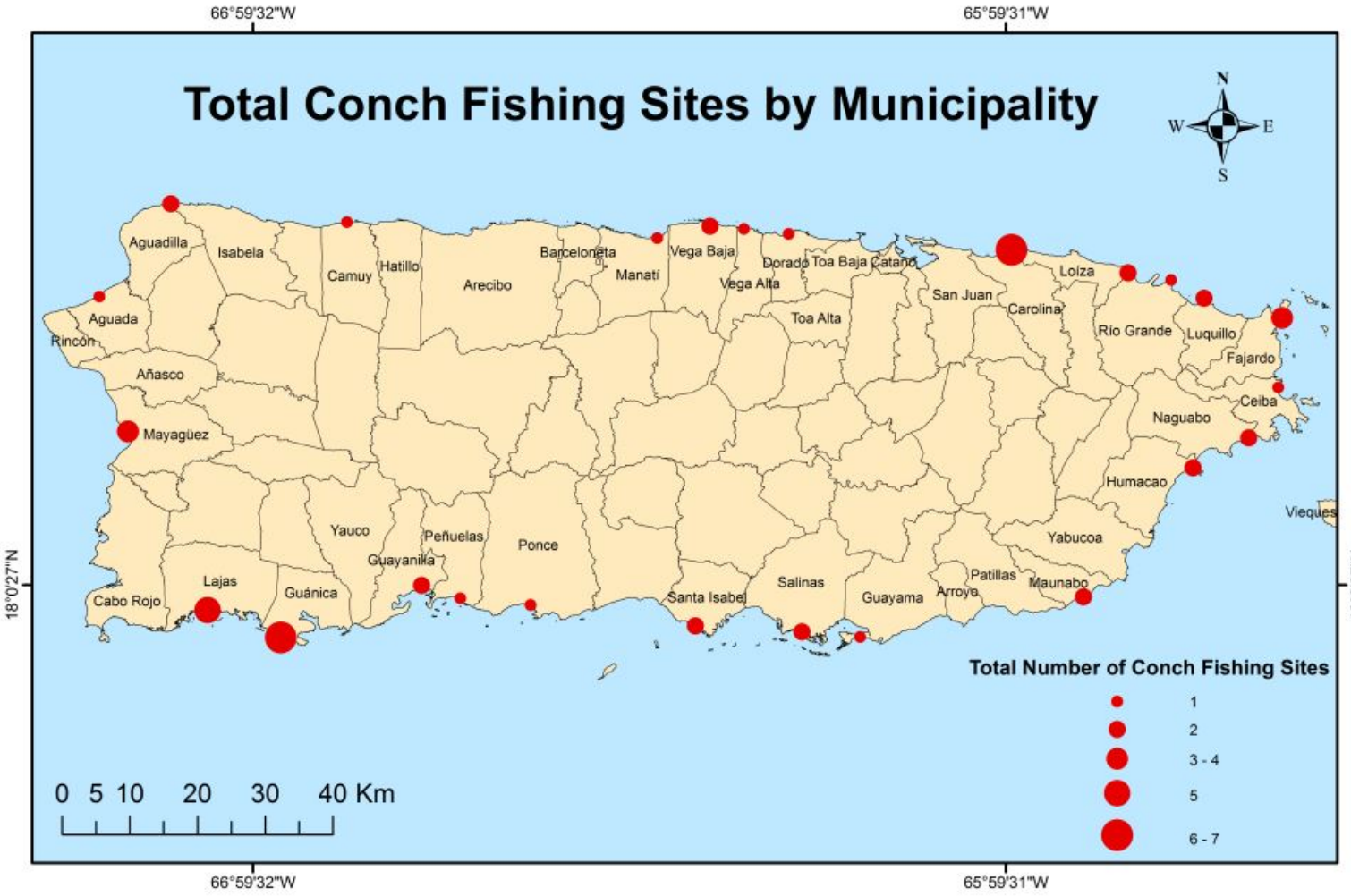
Map 7.3. Fishing gears: Underwater gears (dive, snorkel, gaff, snare, by hand). (Note error: SNARE, not snear).

Map 7.4. Fishing gears: Other fish gears (spears, nets, traps).

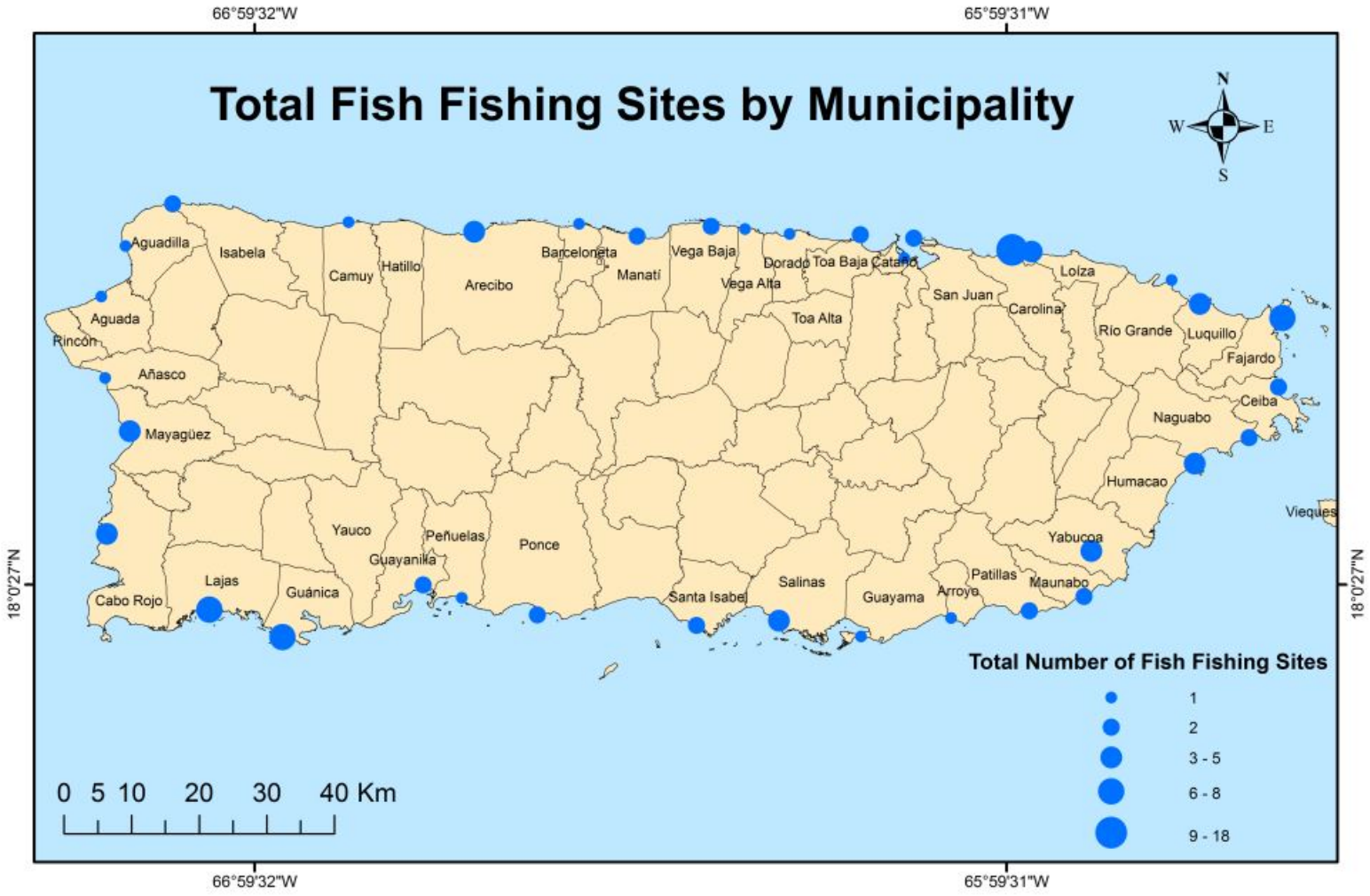
Map 7.5. Fishing gears: Traps



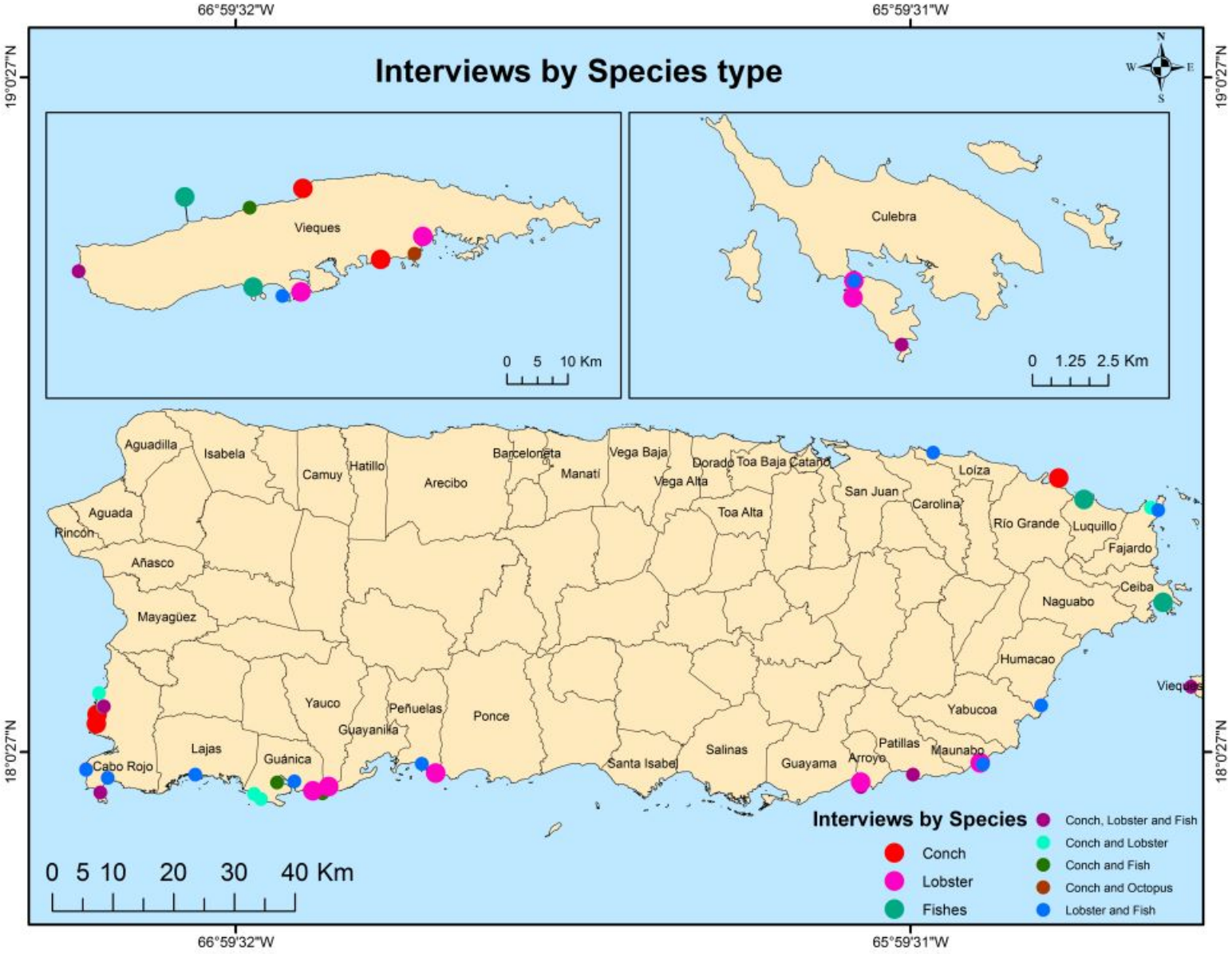
Map 8.1. Fishing sites by municipality: Lobster (the size of circles represents the number of sites).



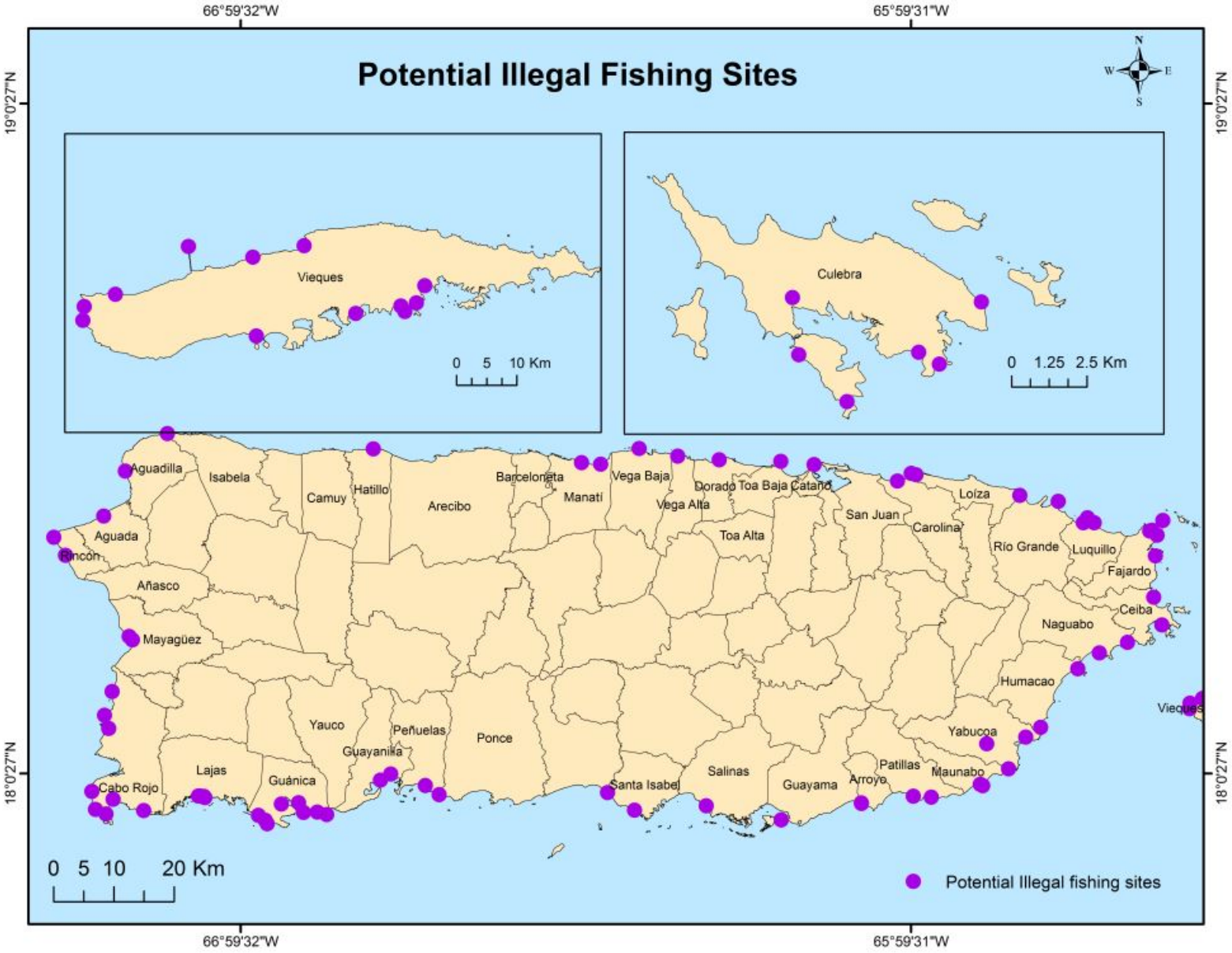
Map 8.2. Fishing sites by municipality: Queen Conch (the size of circles represents the number of sites).



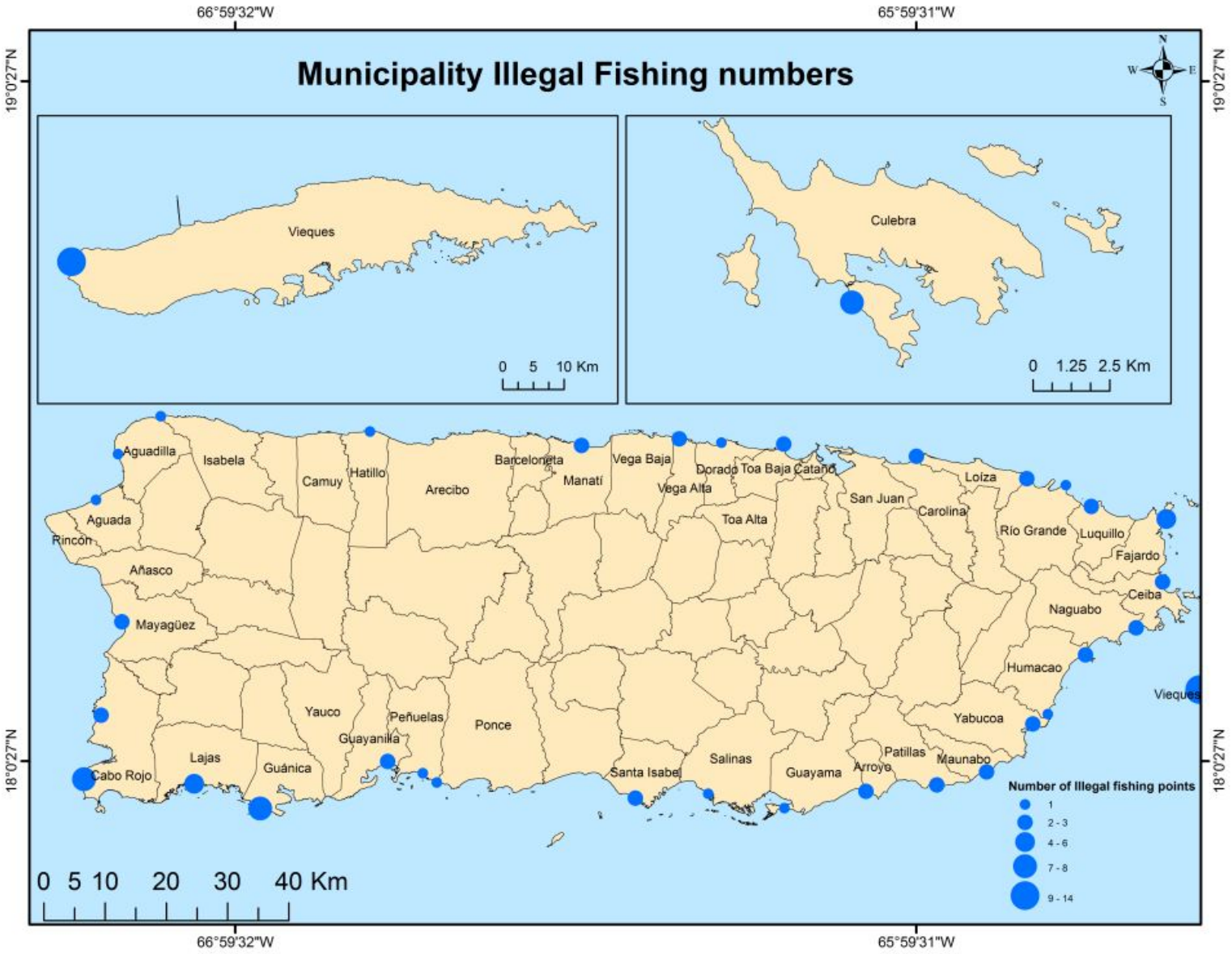
Map 8.3. Fishing sites by municipality: Finfish (the size of circles represents the number of sites).



Map 9. Number of interviews by species and species associations per site (all species, conch and lobster, conch and fish, conch and octopus, and lobster/fish).



Map 10. Potential sites with IUU fishing activity.



Map 11. Number of potential IUU fishing sites by municipality.

The size of circles indicates the sum of sites with potential IUU fishing in each municipality.

9 Appendix A. Outreach documents.

9.1 Letter to introduce project staff to fishermen and stakeholders

10051 5th Street N., Suite 105
St. Petersburg, Florida 33702-2211
Tel: (727) 563-9070, Fax: (727) 563-0207
Email: MRAG.Americas@mragamericas.com
Web: http://www.mragamericas.com/
President: Andrew A. Rosenberg, Ph.D.

15 de septiembre de 2014.

Estimado Potencial Colaborador:

MRAG Americas, Inc. es una compañía consultora especializada en el manejo integral de recursos acuáticos. MRAG fue contratada por la NOAA y el DRNA para recopilar información del "**Proyecto Piloto para la Evaluación de la Pesca Recreativa de Carrucho (*Strombus gigas*) y Langosta Espinosa (*Panulirus argus*) en Puerto Rico**". El objetivo es comprender la dimensión y la localización de esta actividad, para posteriormente iniciar una evaluación formal bajo el Programa de Información Marina Recreativa (MRIP) de la NOAA. Esto proporcionará una imagen más completa de las capturas totales (comerciales y recreativas) y ayudará a lograr un mejor aprovechamiento de estos recursos.

La participación de miembros del sector, como lo es usted, es la clave del éxito del proyecto, ya que ustedes realizan actividades recreativas habitualmente y conocen bien las características de la pesca. La parte fundamental del proyecto consistirá en realizar entrevistas a pescadores comerciales y recreativos y a guías de buceo, en playas, rampas, muelles, marinas, tiendas de buceo y otros sitios de desembarque de pesca recreativa alrededor de la isla, para responder a las siguientes preguntas:

¿Qué tan significativa es la pesca recreativa de carrucho y langosta en Puerto Rico? ¿En qué sitios se realiza? ¿Cuándo ocurre (horas del día, días de la semana, temporadas del año, etc.)? ¿Cuántos pescadores recreativos capturan estas especies? ¿Qué métodos y artes de pesca utilizan? ¿Dónde desembarcan la captura? ¿Se capturan otras especies de caracol o langosta?

Los consultores de MRAG harán visitas de campo a los sitios de mayor actividad, solicitarán una entrevista de 15-20 minutos a personas seleccionadas, identificarán la captura, tomarán fotografías y harán algunas mediciones (tamaño, peso) de los carruchos y las langostas. Las entrevistas y el trabajo de campo se iniciarán a partir de la fecha actual y continuarán por 8 meses, hasta fines de mayo de 2015.

Cabe resaltar que las entrevistas NO SON UNA AUDITORIA del gobierno, ni se buscan sanciones ni multas, ni tampoco regular la actividad. El proyecto es una caracterización de la pesca recreativa de estas especies.

Si tiene usted alguna pregunta durante la visita de los consultores de MRAG, o si desea más información sobre el proyecto, no dude en ponerse en contacto conmigo o el Dr. Trumble al 727-563-9070 o al correo monica.valle@mragamericas.com. Agradeceremos mucho su colaboración.

Atentamente,

Dra. Mónica Valle Esquivel
Bióloga Pesquera, Coordinadora del Proyecto
MRAG Americas, Inc.

9.2 Identification badges

9.3 Articles in “La Regata”

Article published in April, 2014[22]

[22] https://issuu.com/benitopinto/docs/1403

Article published in October, 2013[23]

[23] https://issuu.com/benitopinto/docs/1308

10 Appendix B. Training plan

Training for the Pilot Study of the Queen Conch and Spiny Lobster Recreational Fishery in Puerto Rico

September 2014

Dr. Mónica Valle

MRAG Americas

This pilot study will conduct port sampling interviews at recreational fishing sites around Puerto Rico for a maximum of a six-month period, spanning from mid-September 2014 through mid-March 2015. This period includes 1.5 months of the closed fishing season for queen conch, which ends on October 31st. The fishery re-opens on November 1st. We anticipate that the project will involve the steps described below, based in the methodology described in the original project proposal. This document focuses on step 2: Training of interviewers.

1. Outreach activities to inform and involve recreational fishers before the project begins.
2. **Training of interviewers**
3. Exploratory survey (interviews at recreational landing sites).
4. Identification and stratification of recreational fishing sites (Conch-Lobster strata) based on interviews.
5. Sampling recreational catch directly from fishers
6. Sampling conch species and sizes from shell mounds on the shore.
7. Intercept sampling
8. Data entry, analysis, and reporting of recreational survey data
9.

2.Training of interviewers

The main purpose of the training is to familiarize the interviewers with the project and for them to understand the methodology.

a) Dates: September 11-13, 2014.

b) Locations:

- Meeting on Thursday, September 11 and Friday, September 12 at a conference room at the Laboratorio de Investigaciones Pesqueras

Departamento de Recursos Naturales y Ambientales
Laboratorio de Investigaciones Pesqueras
Joyuda, Cabo Rojo Puerto Rico
Contactos: Craig Lilyestrom/ Grisel Rodríguez/ Daniel Matos

- A commercial fish house in Cabo Rojo to measure specimens (coordinated with Daniel Matos and Luis Anibal from the DNER).
- Recreational fishery sites near Cabo Rojo.

c) Activities during the training will include:

- Presentation of the project: concepts, objectives, methodology.
- Introduction of team members.
- Conch and lobster species identification (from literature and/or at fish houses)

- Review of interview forms: 1) Main survey instrument, 2) Conch/ Lobster data forms
- Database/ data-entry training.
- Measurement of conch (if available during to the closed season) and lobster specimens (at a fish house).
- Conduct preliminary interviews with port agents, dive-masters, MRIP staff and biologists, commercial and recreational fishermen at pre-selected sites (Training sites will be selected with DRNA's help before the training).
- Distribute brochures at sites visited during the training (distribution will continue over the first few weeks of sampling).
- Review maps and locations that will be surveyed during the study.
- Organize the team members and their activities for the months of September-October, 2014.

d) Materials needed for the training: rulers, calipers, clip boards, notebooks, digital cameras.

e) Schedule of training activities:

Day 1- Thursday, September 11, 2014 (9am-5pm)

- Presentation of the project: concepts, objectives, methodology.
- Conch and lobster species identification (from literature and/or at fish houses)
- Review of interview forms: 1) Main survey instrument, 2) Conch/ Lobster data forms
- Introduction to database/ data-entry training (*A Webinar focused on the Database will be provided during the week of September 22nd)
- Review maps and locations that will be surveyed.
- Team organization/ Work plan

Day 2- Friday September 12, 2014 (9am-5pm)

- Visits to fish houses (coordinated by Daniel Matos and Luis Anibal) to learn species identification and take measurements of specimens (lobster and queen conch, if available during the closed season).
- Conch shells will be measured at the laboratory for practice, and the project coordinator will provide training if necessary when the conch season re-opens.
- Practice interviews. Team members will conduct practice interviews with each other at the DNER.
- Review maps and locations that will be surveyed (cont.)
- Team organization/ work plan/ distribution of regions / sites by team member (cont.).
- Plan sampling locations for the months of September/ October 2014.

Day 3- Saturday September 13, 2014 (8am-5pm)

- Conduct preliminary interviews with port agents, dive-masters, MRIP staff and biologists, commercial and recreational fishermen at pre-selected sites in the Mayaguez-Cabo Rojo region.
- Review of the data collected during initial interviews.

11 Appendix C. Survey Forms

11.1 Spanish version

FORMA 1. CENSO DE EMBARCACIONES

Entrevistador_____ Sitio _____ Municipio _____ Fecha _____

Embarcación Número	Número de Personas	Actividad Principal (*) y Actividades Realizadas (✓)	Licencia Comercial (SI/ NO)	Pescó o pesca Carrucho y/o Langosta habitualmente? (SI/NO)	Áreas Visitadas en el Mar
		( ) Pesca ( ) Buceo ( ) Snorkel ( ) Pasear ( ) Nadar ( ) Jet Ski ( ) Ski Acuático ( ) Kayak ( ) Paddleboard ( ) Otras: _____			
		( ) Pesca ( ) Buceo ( ) Snorkel ( ) Pasear ( ) Nadar ( ) Jet Ski ( ) Ski Acuático ( ) Kayak ( ) Paddleboard ( ) Otras: _____			
		( ) Pesca ( ) Buceo ( ) Snorkel ( ) Pasear ( ) Nadar ( ) Jet Ski ( ) Ski Acuático ( ) Kayak ( ) Paddleboard ( ) Otras: _____			
		( ) Pesca ( ) Buceo ( ) Snorkel ( ) Pasear ( ) Nadar ( ) Jet Ski ( ) Ski Acuático ( ) Kayak ( ) Paddleboard ( ) Otras: _____			
		( ) Pesca ( ) Buceo ( ) Snorkel ( ) Pasear ( ) Nadar ( ) Jet Ski ( ) Ski Acuático ( ) Kayak ( ) Paddleboard ( ) Otras: _____			

FORMA 2. ENCUESTA SOBRE PESCA RECREATIVA DE CARRUCHO Y LANGOSTA EN PUERTO RICO[24]

MRAG Americas

Entrevistador: _____ Fecha: _____
Sitio/ Municipio: _____ Hora: _____
Numero de entrevista:_____

1) **Tiene licencia comercial? Sí/ No**
2) **Está vigente? Si/ No**
3) **Intención de la pesca-Qué hace usted con las capturas ?**
   a. Consumir_____ b. Usar para carnada_____ c. Vender_____ d. Tirar_____
   e. Intercambiar_____ f. Regalar_____ g. Otro uso:_____

4) **Modalidad de pesca-¿ Desde dónde pescó hoy?**
   A. <u>De la orilla</u>
   (1) Muelle, Embarcadero
   (2) Malecón, Rompeolas
   (3) Puente, Avenida
   (4) Otra estructura (Especificar)_____
   (5) Playa, ribera
   <u>B. De una embarcación</u>
   (1) Lancha de buceo
   (2) Headboat
   (3) Charterboat
   (4) Bote privado o rentado

5) **Datos de la Embarcación**
   Número de embarcación (misma que en el Censo):_____ Número de personas_____
   Nombre:_____ Tamaño (pies)_____
   Tipo:_____ Caballos de fuerza (HP): _____
6) **Datos de la persona entrevistada**
   <u>Modalidad de orilla</u> (Pescador) independiente_____ Groupo_____
   <u>Modalidad embarcación</u> Capitán _____ Dueño_____ Ambos_____ Visitante_____
   Punto de salida:_____(pueblo, municipio, sitio)
   Género: __M/F___ Edad:_____
   Ocupación (opcional):_____

7) **Actividad principal (*) y otras actividades realizadas (✓)**
   ( ) Pesca( ) Buceo ( ) Snorkel ( ) Pasear ( ) Nadar ( ) Jet Ski
   ( ) Ski Acuático ( ) Kayak ( ) Paddleboard
   ( ) Otras: _____

8) **Principal método de pesca utilizado y esfuerzo aplicado**
   SCUBA __<u>Sí/ No</u>_ Núm. Tanques_____ PSI_____ Núm. Pescando_____
   BUCEO A PULMÓN__<u>Sí/ No</u> Núm. Pescando_____
   A MANO __<u>Si/ No</u> Núm. Pescando_____

[24] Formato de entrevista modificado a partir de Appeldoorn y Valdez-Pizzini (1996) y 2013MRFSS Intercept Survey- Puerto Rico

9) Arte de pesca

Bichero/Gancho_____ Fisga_____ Nasas_____
Cordeles y Anzuelos_____ Caña y Carrete_____ Redes_____

10) Tiempo invertido en la pesca

Horas Pescando:

a. Tiempo efectivo de pesca _____ (Hrs)
b. Duración total del viaje _____(Hrs)

11) ¿Qué especies prefiere pescar? (Especies objetivo)

a. No tiene preferencia/ Cualquiera_____
b. Carrucho_____
c. Langosta_____
d. Peces_____ Cuáles? ____(Nombres comunes)_____

12) Si los peces son su objetivo principal, entonces ¿con qué frecuencia captura carrucho y/o langosta?

< 50% de los viajes_____ > 50% de los viajes _____

13) La captura de hoy (número ó peso):

a. Carruchos y otros caracoles/moluscos _____
b. Langostas y otros crustáceos_____
c. Peces_____

14) ¿Con qué frecuencia sale usted a pescar?

a. Entre semana (Lunes a Viernes), fin de semana, festivos o toda la semana?
b. Por temporadas? (Verano, Invierno, todo el año)
c. Cuántos viajes por semana/mes/ temporada? ___(número)____

15) Horario preferido de pesca?

Madrugada, mañana, medio día, tarde o noche?

16) Sitios donde capturó carrucho y langosta en este viaje (Nombre/ descripción: bahía, golfo, mar abierto, aguas profundas, estuario, río, etc.). Indicar la distancia de la costa (<10 millas, >10 millas)

a. Carrucho i._____Distancia:_____
ii. _____Distancia:_____
iii. _____Distancia:_____
b. Langosta i._____Distancia:_____
ii. _____Distancia:_____
iii. _____Distancia:_____

17) En un día típico de pesca, ¿a qué sitios va a pescar carrucho y/ ó langosta? (Indicar nombre o descripción del sitio)

a. Carrucho i._____
ii._____
iii._____

b. Langosta i._____
ii._____
iii._____

18) ¿Además de este punto de salida, utiliza otras playas, rampas, muelles, marinas, etc? (Favor de dar nombre y localización).

a._____
b._____
c._____

19) **¿Otros comentarios sobre su experiencia en la pesca recreativa de carrucho y langosta?**
_____
_____

20) **Información biológica-** ¿Me permitiría tomar observaciones y medidas de los carruchos y langostas que capturó?

FORMA 3. Datos biológicos de CARRUCHO (*Strombus gigas* y otras especies).

ESPECIE	TAMAÑO		SEXO (M/F)	MADUREZ SEXUAL (J/ I / A)
	SL (cm)	LT (mm)		
S. gigas				
Otras especies				

Leyenda:
SL= Shell Length- Longitud de la concha
LT= Lip Thickness – Grosor del labio de la concha
Sexo: M= Macho, F= Hembra
Madurez Sexual: J= Juvenil (sin abanico), I=Intermedio (abanico en formación), A=Adulto (con abanico).

Lista de especies en el Plan de Manejo de Carrucho (Queen Conch FMP) del Caribe de US.

Nombre Científico	Nombre Común (Español)	Nombre Común (Inglés)
Strombus gigas	Carrucho	Queen conch
Otras Especies		
Strombus raninus	Carrucho ala de águila	Hawk-wing conch
Strombus (Lobatus) costatus	Carrucho lechoso	Milk conch
Strombus (Lobatus) gallus	Carrucho cola de gallo	Roostertail conch
Strombus pugilis	Carrucho luchador	West Indian fighting conch
Astraea (Lithopoma) tuber	Turbante verde	Green starsnail (star-shell)
Charonia variegata	Tritón Atlántico	Atlantic triton's trumpet
Cassis madagascarensis	Casco imperial	Cameo helmet
Fasciolaria tulipa	Tulipán verdadero	True tulip

FORMA 4. Datos biológicos de LANGOSTA (Langosta espinosa, *Panulirus argus* y otras especies)

ESPECIE	TAMAÑO (CL) (mm)	TAMAÑO (TL) (mm)	PESO TOTAL (g)	SEXO (M/F)	HEMBRA OVIGERA (SI/ NO)
Langosta Espinosa					
Otras especies					

Leyenda:
LC= Carapace Length- Longitud del cefalotórax

LT= Longitud total
Sexo: M= Macho, F= Hembra

Lista de especies en el Plan de Manejo de Langosta Espinosa del Caribe de US (Spiny Lobster FMP)

Nombre Científico	**Nombre Común (Español)**	**Nombre Común (Inglés)**
Panulirus argus	Langosta espinosa	Caribbean spiny lobster
Panulirus guttatus	Langosta manchada , Langosta verde	Spotted spiny lobster
Panulirus laevicauda	Langosta verde	Smoothtail spiny lobster, Brazilian lobster

11.2 English version

FORM 1. BOAT CENSUS

Interviewer _____ Site_____ Municipality _____ Date _____

Vessel Number	Number of People	Main Activity (*) and Other Activities Conducted (✓)	Commercial License (YES/ NO)	Did you catch or usually catch Conch and/or Lobster (YES/NO)	Locations visited at sea
		( ) Fishing ( ) Scuba diving ( ) Skin diving ( ) Cruising ( ) Swimming ( ) Jet Ski ( ) Water Ski ( ) Other: _____			
		( ) Fishing ( ) Scuba diving ( ) Skin diving ( ) Cruising ( ) Swimming ( ) Jet Ski ( ) Water Ski ( ) Other: _____			
		( ) Fishing ( ) Scuba diving ( ) Skin diving ( ) Cruising ( ) Swimming ( ) Jet Ski ( ) Water Ski ( ) Other: _____			
		( ) Fishing ( ) Scuba diving ( ) Skin diving ( ) Cruising ( ) Swimming ( ) Jet Ski ( ) Water Ski ( ) Other: _____			
		( ) Fishing ( ) Scuba diving ( ) Skin diving ( ) Cruising ( ) Swimming ( ) Jet Ski ( ) Water Ski ( ) Other: _____			
		( ) Fishing ( ) Scuba diving ( ) Skin diving ( ) Cruising ( ) Swimming ( ) Jet Ski ( ) Water Ski ( ) Other: _____			

FORM 2. PUERTO RICO RECREATIONAL CONCH/ LOBSTER SURVEY[25]

MRAG Americas/ Puerto Rico DNER

Interviewer: _____ Date: _____

Site/ Municipality: _____ Time: _____

Intercept No.:_____

1) Fishing Mode-Fisher is fishing from:

Shore

( ) Pier, Dock

(..) Jetty, Breakwater, Breachway

( ) Bridge, Causeway

( ) Other man-made structure (Specify)_____

(..) Beach or Bank

Vessel

( ) Dive boat

( ) Headboat

(..) Charterboat

( ) Private or rental boat

2) Vessel Information

Vessel Number (same as in Boat Census):_____ Number of People:_____

Name:_____ Size (ft):_____

Type:_____ HP (Horse Power): _____

3) Person interviewed

Shore mode Independent (fisher)_____

Vessel mode Pilot of the boat_____ Owner_____ Both_____ Visitor_____

Point of departure:_____(town, municipality, place)

Gender: __M/F___ Age:_____

Occupation (optional):_____

4) Main activity (*) and other activities conducted (✓)

( ) Fish ( ) Scuba dive ( ) Snorkel ( ) Ride ( ) Swim

( ) Jet Ski ( ) Water Ski …….Other:_____

5) What gear was primarily used? (Fishing Gear/ Effort)

SCUBA __Y/ N___ Number of tanks_____ PSI_____ People fishing_____

SKIN DIVING__Y/ N_ People fishing_____

BY HAND __Y/ N_ People fishing_____

OTHER GEAR: Hook/Line_____Rod/Reel_____ Net_____

Gaff_____ Spear gun_____ Trap_____

[25]Survey format modified from Appeldoorn and Valdez-Pizzini (1996) and 2013 MRFSS Intercept Survey- Puerto Rico

6) Time fishing

Shore Mode:

a. How many hours have you spent fishing today?_____
b. How many additional hours do you expect to fish today?_____

Vessel Mode:

c. Effective time fishing _____ (Hrs)
d. Total trip duration _____(Hrs)

7) What species do usually target?

e. No particular species/ Anything_____
f. Queen Conch_____
g. Spiny Lobster_____
h. Fishes_____ Which ones? ____(Common names)_____

8) If you mainly target Fish, how often do you catch Conch and/or Lobster ? _

< 50% of the trips_____ > 50% of the trips _____

9) Today's catch (numbers):

d. Queen conch and other snails/mollusks _____
e. Lobsters and other crustaceans_____
f. Fish_____

10) What do you do with the catch?

a. Consume_____ b. Use for bait_____ c. Sell_____ d. Throw away_____
e. Trade_____ f. Give away_____ g. Other purpose:_____

11) How often do you go out fishing?

d. Weekly _____
e. Monthly_____ Months preferred?_____Jan- Dec_____
f. Seasonal _____ When?____Spring, Summer, Autumn, Winter___
g. Number of trips per week/month/ season? ___(number)____

12) What days of the week do you prefer to fish?

a. Weekdays (Monday to Friday) _____
b. Weekends/ Holidays_____

13) Preferred time to fish?

From _____ To _____ AM/ PM

14) Sites where you captured conch and/or lobster today (Name/ Description: bay, gulf, open ocean, sound, estuary, river, etc.). Indicate distance from shore: <10 miles, > 10 miles)

c. Conch i._____Distance:_____
ii. _____Distance:_____
iii. _____ Distance:_____

d. Lobster i._____Distance:_____
ii. _____Distance:_____
iii. _____Distance:_____

15) On a "typical" fishing/angling trip what other areas do you normally target for fishing conch and/or lobster (Name/Description of sites).

c. Conch i._____
ii._____
iii._____

d. Lobster i._____
ii._____
iii._____

16) ¿Do you use other beaches, ramps, docks, piers, marinas, etc. as points of departure? (Provide names and locations)

a._____
b._____
c._____

17) Other comments on your recreational for conch/ lobster fishing experience?

_____
_____

18) Biological Information- May I look at your (shellfish) catch and take measurements?

FORM 3. Biological data for CONCH (Queen Conch, *Strombus gigas,* and other species).

SPECIES	SIZE		SEX (M/F)	SEXUAL MATURITY (J/ I / A)
	SL (cm)	LT (mm)		
Queen Conch				
Other species				

Legend:
SL= Shell Length
LT= Lip Thickness
Sex: M= Male, F= Female
Sexual Maturity: J= Juvenile (lip flare not formed), I=Intermediate (flare developing),
A=Adult (with flared lip).

List of species in the US Caribbean Queen Conch Fishery Management Plan.

Scientific Name	Common Name (Spanish)	Common Name (English)
Strombus gigas	Carrucho	Queen conch
Other Species		
Strombus raninus	Carrucho ala de águila	Hawk-wing conch

Strombus (Lobatus) costatus	Carrucho lechoso	Milk conch
Strombus (Lobatus) gallus	Carrucho cola de gallo	Roostertail conch
Strombus pugilis	Carrucho luchador	West Indian fighting conch
Astraea (Lithopoma) tuber	Turbante verde	Green starsnail (star-shell)
Charonia variegata	Tritón Atlántico	Atlantic triton's trumpet
Cassis madagascarensis	Casco imperial	Cameo helmet
Fasciolaria tulipa	Tulipán verdadero	True tulip

FORM 4. Biological data for LOBSTER (Spiny Lobster, *Panulirus argus,* and other species)

SPECIES	SIZE (CL) (mm)	SIZE (TL) (mm)	TOTAL WEIGHT (g)	SEX (M/F)	BERRIED FEMALE (Y/ N)
Spiny Lobster					
Other Species					

Legend:
CL= Carapace Length
TL= Total Length
Sex: M= Male, F= Female

List of species in the U.S CaribbeanSpiny Lobster Fishery Management Plan.

Scientific Name	Common Name (Spanish)	Common Name (English)
Panulirus argus	Langosta espinosa	Caribbean spiny lobster
Panulirus guttatus	Langosta manchada , Langosta verde	Spotted spiny lobster
Panulirus laevicauda	Langosta verde	Smooth tail spiny lobster, Brazilian lobster

12 Appendix D. Dive shop survey

SPANISH

Entrevista con dueños de tiendas de buceo y/o guías/instructores de buceo.

Preguntas:

1. Sí ellos conocen ó identifican la presencia de la pesca recreativa o furtiva de Carrucho y Langosta en las áreas que ellos frecuentan?
    a. Qué áreas usualmente frecuentan para sus actividades de Buceo o snorkeling?
    b. En su experiencia en el negocio del buceo han visto algún cambio en el numero de individuos en la las poblaciones de Carrucho y langosta a través de los años?
2. Conocen algún lugar fuera de las áreas que frecuentan en dónde se observe la pesca recreativa o furtiva de Carrucho y Langosta?
3. Dentro de los viajes que ofrecen para bucear y/o snorkeling, las personas que ustedes llevan pueden pescar (Langosta/ Carrucho/ Peces)?
    a. Lo hacen en todas las épocas del año o en alguna época en especial para cada una de las especies de Interés?
        i. Langosta; cuándo?
        ii. Carrucho; cuándo?
4. Ustedes venden en sus tiendas artes de pesca (Figas, arpones, etc.)?

ENGLISH

Interview with dive shop owners and/or dive operators (guides/instructors).

Questions:

1. Does recreational or illegal fishing for Queen Conch and Lobster occur in the areas that you normally visit?
    a. What areas do you normally visit during diving or snorkeling trips?
    b. In your experience in the diving business, have you observed changes in the number of individuals in the Conch and Lobster populations over the years you have been in the business?
2. Do you know any locations outside of the areas that you visit regularly where illegal or recreational fishing for Conch and Lobster takes place?
3. In the dive/ snorkel tours that you offer, are people allowed to fish (Lobster/ Conch/ Fish)?
    a. Does this take place on certain season of the year or is there a specific season for each of the species of interest?
        i. Lobster, when?
        ii. Conch, when?
4. Do you sell fishing gear at your dive shop (spears, hooks, etc.)?

13 Appendix E. Complete list of sites visited [26]

Site ID	Municipality	Zone PR	Site Name	Times Visited	COORDINATES	
					Lat	Long
1	Aguada	W	Guaniquilla	7	18.39165	67.19625
2	Aguadilla	W	Playa Crash Boat	2	18.459083	67.163833
3	Anasco	W	Sector La Playa	1	18.28295	67.19085
4	Anasco	W	Caguabo	1	18.295433	67.211183
5	Arecibo	N	Balneario y Rampa	6	18.477667	66.700067
6	Arecibo	N	Club Nautico	1	18.475883	66.697333
7	Arecibo	N	Asociacion de Pescadores	1	18.477983	66.693233
8	Arroyo	S	Malecon de Arroyo	10	17.962833	66.065667
9	Arroyo	S	Sector San Felipe	1	17.96377	66.06601
10	Barceloneta	N	Rampa Recreativa	1	18.488267	66.560583
11	Cabo Rojo	W	Villa Pesquera de Boqueron	2	18.453583	65.98425
12	Cabo Rojo	W	Rampa Balneario Boqueron	3	18.0131	67.170433
13	Cabo Rojo	W	Club Nautico de Boqueron	2	18.0265	67.17515
14	Cabo Rojo	W	Villa Taina	2	18.03035	67.182033
15	Cabo Rojo	W	Villa Pesquera de Combate	7	17.981583	67.214167
16	Cabo Rojo	W	Rampa Publica de Combate	5	17.98095	67.214
17	Cabo Rojo	W	Villa La Mela	2	18.063167	67.197617
18	Cabo Rojo	W	Playa Buye	1	18.04935	67.198617
19	Cabo Rojo	W	Playa Sucia	1	17.935933	67.18875
20	Cabo Rojo	W	Villa Pesquera de Punta Aguila	11	17.94725	67.192867
21	Cabo Rojo	W	Playa punta Agula	3	17.95412	67.20838
22	Cabo Rojo	W	Club Deportivo del Oeste (Joyuda)	2	18.0998	67.189967
23	Cabo Rojo	W	Punta Ostiones	5	18.094533	67.194983
24	Cabo Rojo	W	Pelayo Marine- Joyuda	1	18.08855	67.140033
25	Cabo Rojo	W	Laguna Joyuda	2	18.138317	67.182267
26	Cabo Rojo	W	Joyuda Pier	4	18.1248	67.173967
27	Cabo Rojo	W	Pescaderia Rosas, Puerto Real	2	18.07495	67.187867
28	Cabo Rojo	W	Rampa Publica Puerto Real	5	18.0748	67.1887
29	Cabo Rojo	W	Atras restaurante Pelicans - Joyuda	3	18.129783	67.183617
30	Cabo Rojo	W	Pescaderia Krazy Fish, El Corozo	3	17.969067	67.182117
31	Cabo Rojo	W	Manglares de La Pitahaya	5	17.952417	67.136467
32	Camuy	N	Frente al Cayo Brusi	2	18.49075	66.8551
33	Camuy	N	Pescaderia y Rampa (El Membrillo)	6	18.490633	66.867183
34	Carolina	E	Cangrejos Yatch Club	6	18.4558	65.991583
35	Carolina	E	Playa Pine Groove	1	18.44416	66.01204
36	Catano	N	Villa Pesquera y Pescaderia Cataño (cortina)	4	18.442717	66.127767
37	Ceiba	E	Playa Los Machos	13	18.270633	65.630117
38	Ceiba	E	Muelles de Roosevelt Roads	8	18.229267	65.617733
39	Dorado	E	y Rampa Comercial	6	18.475	66.280217
40	Dorado	N	Asociación de Pesca Deportiva	1	18.476083	66.277917
41	Fajardo	E	Las Croabas	14	18.363083	65.62495
42	Fajardo	E	Balneario Seven Seas	10	18.36945	65.63565
43	Fajardo	E	Bahia Las Cabezas	1	18.37062	65.63265
44	Fajardo	E	Muelle de Puerto Real	2	18.3324	65.627517
45	Fajardo	E	Pescaderia de Puerto Real (Maternillo)	7	18.33235	65.62745
46	Fajardo	E	Marina Puerto del Rey	1	18.286333	65.635867
47	Fajardo	E	Puerto Real - Isleta Marina	1	18.340717	65.61985
48	Fajardo	E	Marina de Puerto Chico	2	18.348617	65.636567
49	Fajardo	E	Sea Lover's Marina	1	18.348833	65.6339
50	Fajardo	E	Sun Bay Marina	1	18.338917	65.633467

[26] Coordinates (Latitude and Longitude) are provided in decimal format (ddd.ddddd)

					COORDINATES	
Site ID	**Municipality**	**Zone PR**	**Site Name**	**Times Visited**	**Lat**	**Long**
51	Fajardo	**E**	Asociacion de Pescadores de Parcelas Beltran (Sumbay)	3	18.33825	65.633733
52	Fajardo	**E**	Villa Marina	1	18.341133	65.639667
53	Fajardo	**E**	Conquistador Marina	1	18.357183	65.625717
54	Fajardo	**E**	Asociacion de Pescadores de Sardinera	1	18.345183	65.636433
55	Fajardo	**E**	Asociacion de Pescadores en Las Croabas	1	18.36555	65.625067
56	Fajardo	**E**	Playa Escondida	1	18.376069	65.646097
57	Fajardo	**E**	Playa al lado de las Cabezas de San Juan	1	18.385026	65.616434
58	Guanica	**S**	Playa Santa	2	17.937633	66.9551
59	Guanica	**S**	Playa Encallado (Atolladora)	1	17.956267	66.854133
60	Guanica	**S**	Malecon de Guanica	4	17.96395	66.905433
61	Guanica	**S**	Playa El Jaboncillo	1	17.95325	66.9043
62	Guanica	**S**	Playa Los Congres	2	17.949433	66.8982
63	Guanica	**S**	Playa Tamarindo	1	17.953333	66.846967
64	Guanica	**S**	San Jacinto	3	17.95	66.877633
65	Guanica	**S**	Balneario Cana Gorda	1	17.953	66.883367
66	Guanica	**S**	Playa El Manglillo	2	17.932667	66.952433
67	Guanica	**S**	Asociacion de Pescadores de Guanica	3	17.964	66.9055
68	Guanica	**S**	La Jungla	6	17.945267	66.965417
69	Guanica	**S**	Asociacion de pescadores de Playa Santa	3	17.935067	66.956183
70	Guanica	**S**	Ensenada, Sector Guaypiao	7	17.9621	66.931133
71	Guanica	**S**	Bahía Ballenas	1	17.94617	66.86354
72	Guayanilla	**S**	Rampa de Botes El Tiangulo en Guayanilla	5	18.006833	66.767833
73	Guayanilla	**S**	Sector El Faro	3	17.99755	66.783383
74	Guayama	**S**	Villa Pesquera - Pozuelo	6	17.938283	66.185383
75	Guayama	**S**	Balneario de Pozuelo	2	17.985917	66.183217
76	Guayama	**S**	Club Nautico	2	17.941883	66.201767
77	Guayama	**S**	Fishing Club	2	17.951567	66.18385
78	Hatillo	**N**	Playa Sardinera	1	18.492317	66.793883
79	Hatillo	**N**	Malecon de Hatillo	1	18.490667	66.8158
80	Hatillo	**N**	Punta Manglillo	1	18.49055	66.82425
81	Humacao	**E**	Muelle de Boca Prieta	1	18.168783	65.74155
82	Humacao	**E**	Muelle de Punta Santiago	7	18.16376	65.743233
83	Humacao	**E**	Palmas del Mar	4	18.076517	65.798617
84	Isabela	**N**	Playa Shacks	11	18.514983	67.101083
85	Isabela	**N**	Villa Pesquera	4	18.506367	67.023217
86	Isabela	**N**	Playa Middles	1	18.512983	67.043533
87	Isabela	**N**	Costa cerca de Jobos	1	18.514367	67.07515
88	Lajas	**S**	Villa pesquera La Parguera	5	17.974	67.0521
89	Lajas	**S**	Club Nautico La Parguera	2	17.97285	67.0386
90	Lajas	**S**	Rampa Las Crayolas	3	17.9739	67.054833
91	Lajas	**S**	Muelle Magueyes	3	17.9716	67.045167
92	Lajas	**S**	El Varadero, La Parguera	2	17.975583	67.060033
93	Lajas	**S**	Pescaderia Froilan, Parguera	1	17.973517	67.046483
94	Lajas	**S**	Muelle frente a Froilan	3	17.972483	67.047183
95	Loiza	**E**	Playa Aviones	1	18.45135	65.95833
96	Loiza	**E**	Pescaderia Boca Herrera	7	18.422833	65.82955
97	Loiza	**E**	Balneario de Pinones	1	18.451083	65.957217
98	Loiza	**E**	Cooperativa de Torrecillas	3	18.453583	65.98425
99	Luquillo	**E**	Balneario de Fortuna (Kiosko's Beach)	5	18.381667	65.734733
100	Luquillo	**E**	Punta Embarcadero	1	18.389283	65.728417

					COORDINATES	
Site ID	**Municipality**	**Zone PR**	**Site Name**	**Times Visited**	**Lat**	**Long**
101	Luquillo	**E**	Playa Azul	4	18.381667	65.718517
102	Luquillo	**E**	Playa La Pared	1	18.3762	65.71415
103	Manati	**N**	Mar Chiquita Beach	7	18.471717	66.483083
104	Manati	**N**	Los Tubos Beach	2	18.4693	66.45475
105	Maunabo	**E**	Villa Pesquera - Sector La Playa	3	17.9914	65.888717
106	Maunabo	**E**	Sector Emajagua	1	18.002717	65.886633
107	Maunabo	**E**	El Faro de Punta Tuna Villa Pesquera y villa pesquera	4	17.989367	65.885017
108	Mayaguez	**W**	El Seco	7	18.21205	67.158217
109	Mayaguez	**W**	Pescaderia la llave del mar	2	18.208783	67.15455
110	Mayaguez	**W**	Club Nautico	1	18.211767	67.15895
111	Mayaguez	**W**	El Doki	2	18.206867	67.153517
112	Naguabo	**E**	Sector El Corcho	1	18.20333	65.66889
113	Naguabo	**E**	Hucares	1	18.18745	65.7108
114	Patillas	**E**	Playa Inches	2	17.972367	65.961433
115	Patillas	**E**	Puerto de Patillas	3	17.978633	66.019917
116	Patillas	**E**	Balneario de Patillas	6	17.97375	65.988467
117	Peñuelas	**S**	El Boquete Penuelas: Villa Pesquera: Santo Cristo de la Salud	4	17.989717	66.71625
118	Ponce	**S**	Rampa La Guancha	2	17.966917	66.616
119	Ponce	**S**	Villa Pesquera de Ponce	2	17.98095	66.623333
120	Ponce	**S**	Sector Tallaboa o Las Cucharas	6	17.976083	66.695867
121	Ponce	**S**	Yatch Fishing Club	2	17.96315	66.614283
122	Ponce	**S**	Club de pesca de Ponce	1	17.964133	66.618467
123	Rincon	**W**	Rampa Publica Rincon	4	18.0748	67.1887
124	Rincon	**W**	Sector Pueblo (detras de Econo)	5	18.333267	67.2531
125	Rincon	**W**	El Faro	3	18.360017	67.270583
126	Rincon	**W**	Barrero - Villa pesquera	1	18.30455	67.238017
127	Rincon	**W**	Sector El Sombrero	1	18.327517	67.25055
128	Rio Grande	**E**	Punta Las Picuas	14	18.413583	65.772283
129	Rio Grande	**E**	Pescaderia y Asociacion de Pescadores	1	18.39365	65.812417
130	Salinas	**S**	La Marina de Salinas	1	17.959133	66.2947
131	Salinas	**S**	Guarderia-Costa Sur (Antigua Marina Full Fishing)	1	17.959933	66.2903
132	Salinas	**S**	Guarderia Villa Velero	1	17.959467	66.290133
133	Salinas	**S**	Las Mareas Pier	2	17.94495	66.262767
134	Salinas	**S**	Las Ochenta	3	17.977967	66.319467
135	Salinas	**S**	Camino de Playa predios del Rest. Ladin	1	17.965983	66.307233
136	Salinas	**S**	Sector playa	1	17.95939	66.29742
137	San Juan	**E**	Paseo la Princesa (La Puntilla)	1	18.460217	66.115533
138	San Juan	**E**	Balneario del Escambron	2	18.467233	66.089133
139	San Juan	**E**	Punta Escambron	1	18.466683	66.086117
140	San Juan	**E**	La perla	1	18.46927	66.11516
141	San Juan	**E**	Playa del Condado	1	18.45727	66.06665
142	Santa Isabel	**S**	Rampa al lado del Malecon en Santa Isabel. Rampa Santa Isabel (Antiguo Club Nautico)	7	17.952983	66.40435
143	Santa Isabel	**S**	Rampa al lado Restaurante La Barca	1	17.959883	66.790317
144	Santa Isabel	**S**	Playita Cortada	1	17.978983	66.444383
145	Toa Baja	**N**	Balneario Punta Salinas	7	18.473717	66.186067
146	Toa Baja	**E**	Isla de Cabras	5	18.468867	66.136683
147	Vega Alta	**N**	Balneario Cerro Gordo y Pescaderia	9	18.481367	66.339833
148	Vega Baja	**N**	Club Nautico Vega Baja	2	18.484917	66.384917
149	Vega Baja	**N**	Balneario Puerto Nuevo	8	18.492733	66.39765
150	Yabucoa	**E**	Villa Pesquera de Yabucoa	2	18.052033	65.879033

Site ID	Municipality	Zone PR	Site Name	Times Visited	COORDINATES	
					Lat	Long
151	Yabucoa	E	Puerto de Yabucoa	2	18.054699	65.835292
152	Yabucoa	E	Playa Palmas de Lucia	1	18.040033	65.834383
153	Yabucoa	E	Playa Guayanes	6	18.06185	65.820833
154	Yabucoa	E	Playa El Cocal	1	18.014533	65.84655
155	Culebra	E	Playa Tamarindo	1	18.31789	65.31748
156	Culebra	E	Playa Dátiles	1	18.29609	65.30056
157	Culebra	E	Playa Larga	1	18.3119	65.2461
158	Culebra	E	Borde Reserva	1	18.32024	65.31135
159	Culebra	E	Playa El Cable	1		0
160	Culebra	E	Playa Melones	1	18.30316	65.31033
161	Culebrita	E	Playa Tortuga	1	18.31817	65.22762
162	Culebra	E	Playa Zoni	1	18.3203	65.25626
163	Culebra	E	Playa Brava	1	18.33063	65.28665
164	Culebra	E	Punta Soldado	1	18.28214	65.2862
165	Culebra	E	Playa Mosquito	1	18.29686	65.26477
166	Culebra	E	Playa Manzanillo	1	18.29332	65.25858
167	Culebra	E	Anfiteatro	1	18.31318	65.30247
168	Culebra	E	Playa Flamenco	1	18.32859	65.3163
169	Culebra	E	Villa Pesquera	1	18.30104	65.30031
170	Vieques	E	Punta Arenas	1	18.11247	65.5757
171	Vieques	E	Balneario Sun Bay	1	18.09703	65.46261
172	Vieques	E	Playa Media Luna	1	18.08958	65.45566
173	Vieques	E	Playa La Esperanza	1	18.09485	65.47294
174	Vieques	E	Playa Negra	1	18.09587	65.49119
175	Vieques	E	Playa Caracas	1	18.10827	65.41351
176	Vieques	E	Cerro Playuela	1	18.10391	65.42004
177	Vieques	E	Rampa Tres Palmitas	1	18.12006	65.37452
178	Vieques	E	Playa la Chiva	1	18.11279	65.38661
179	Vieques	E	Playa Escondida	1	18.11466	65.37733
180	Vieques	E	Playa la Plata	1	18.11766	65.3759
181	Vieques	E	Ensenada Honda	1	18.124881	65.372278
182	Vieques	E	Rompeolas	1	18.14827	65.51344
183	Vieques	E	Playa atras Laguna Kiani	1	18.11969	65.55698
184	Vieques	E	Playa Berdiales	1	18.09693	65.42393
185	Vieques	E	Playa Media Luna	1	18.08958	65.45566
186	Vieques	E	Playa Navio	1	18.09203	65.44458
187	Vieques	E	Playa Grande	1	18.0899	65.51241
188	Vieques	E	Playa Gallito hasta Ensenada Claque	1	18.14195	65.47506
189	Vieques	E	Playa Plata Prieta	1	18.11112	65.40053
190	Vieques	E	Playa la Platita	1	18.1146	65.37729
191	Vieques	E	Punta Galindez	1	18.10856	65.39368
192	Vieques	E	Cayo Chiva	1	18.10946	65.38419
193	Vieques	E	Esperanza	1	18.09485	65.47294
194	Vieques	E	Playa al Este de Punta Arenas	1	18.104177	65.57643
195	Vieques	E	Cayo Chivita	1	18.10837	65.37839
196	Vieques	E	Playa Secreta	1	18.1113	65.39722
197	Vieques	E	Playa Garcia	1	18.10717	65.41715
198	Vieques	E	Punta Caballo	1	18.13507	65.5033
199	Vieques	E	Playa Sea-Glass	1	18.14876	65.44436
200	Vieques	E	Punta Martineau	1	18.14376	65.46781
201	Vieques	E	Pescaderia Angeliz	1	18.15337	65.4434

14 Appendix F. List of selected recreational sites[27].

SITE NUMBER	SITE	COUNTY	SITE NAME
1	NEW	AGUADA	GUANIQUILLA
2	NEW	ARECIBO	ASOCIACION DE PESCADORES DE ARECIBO
3	1603	ARECIBO	RAMPA ARECIBO
4	2002	ARROYO	MALECON DE ARROYO
5	2020	CAB0 ROJO	PUERTO REAL SOUTH
6	2233	CABO ROJO	COMBATE RAMP AND PIER(VILLA PESQUERA)
7	2232	CABO ROJO	JOYUDA PIER BESIDE "PELICANS RESTAURANTE"
8	2294	CABO ROJO	PLAYA OSTIONES
9	2097	CABO ROJO	PUERTA REAL PUBLIC RAMP
10	NEW	CABO ROJO	VILLA PESQUERA - EL COROZO
11	NEW	CABO ROJO	VILLA PESQUERA - PUNTA AGUILA
12	2249	CABO ROJO	VILLA PESQUERA DE BOQUERON
13	2270	CAMUY	EL MEMBRILLO y PESCADERIA SON EL MISMO LUGAR!!
14	2009	CAROLINA	CANGREJOS YACHT CLUB
15		CATANO	PESCADERIA DE CATANO
16		CEIBA	BASE ROOSEVELT ROADS
17	2286	CEIBA	PLAYA LOS MACHOS
18	2016	DORADO	ASOCIACION DE PESCA DEPORTIVO
19	2017	DORADO	DORADO BEACH JETTY
20	NEW	FAJARDO	ASOCIACION DE PESCADORES DE FAJARDO
21	2092	FAJARDO	LAS CROABAS PARK AND RAMP
22	NEW	FAJARDO	PLAYA ESCONDIDA
23	2287	FAJARDO	PLAYA PUERTO REAL
24	2267	FAJARDO	SEVEN SEAS BEACH AND BALNEARIO
25	2039	GUANICA	ASOCIACION DE PESCADORES
26	2231	GUANICA	EL MALECON DE GUANICA
27	2035	GUANICA	ENSENADA
28	2290	GUANICA	LA JUNGLA
29	2307	GUANICA	LOS CONGRES
30	2292	GUANICA	PLAYA JABONCILLO
31	2033	GUANICA	PLAYA MANGLILLO
32	2032	GUANICA	PLAYA SANTA
33	2037	GUANICA	SAN JACINTO
34	2044	GUAYAMA	CLUB NAUTICO DE GUYAMA
35	2041	GUAYAMA	PESCADERIA DE GUAYAMA

[27] Note: “List selected from original MRIP list (with MRIP site number). Selected sites are “Likely” sites and “Less likely” sites (highlighted in pink).

SITE NUMBER	SITE	MUNICIPALITY	SITE NAME
36	NEW	GUAYANILLA	EL FARO
37	2308	GUAYANILLA	RAMPA GUAYANILLA SECTOR TRIANGULO
38	2047	HUMACAO	MUELLE Y PLAYA PUNTA SANTIAGO
39	NEW	ISABELA	PLAYA SHACKS
40	2272	ISABELA	SECTOR VILLA PESQUERA
41	2052	LAJAS	MAGUEYES RAMP (CIENCIAS MARINAS)
42	2010	LAJAS	MANGLARES DE LA PITAHAYA
43	NEW	LAJAS	MUELLE FRENTE A FROYLAND
44	2090	LAJAS	PARGUERA PUBLIC RAMP
45	2051	LAJAS	PESCADARIA DE PARGUERA
46	1600	LAJAS	PESCADERIA HERNANDEZ
47	2254	LAJAS	RAMP BET URB FLAMINGO & URB. TERRAZA
48	2050	LAJAS	VILLA PARGUERA
49	NEW	LOIZA	COOPERATIVA DE TORRECILLAS
50		LOIZA	PESCADERIA BOCA HERRERA
51	2266	LUQUILLO	LUQUILLO KIOSKO BEACH
52	2055	MANATI	MAR CHIQUITA
53	2281	MAUNABO	BARRIO EL FARO
54	2243	MAYAGUEZ	CLUB NAUTICO: MAYAGUEZ(PIER- RAMP)
55	2108	MAYAGUEZ	EL DOKI
56	2261	MAYAGUEZ	RAMPA SECTOR EL SECO
57	2288	NAGUABO	PLAYA EL CORCHO BARR
58	2277	PATILLAS	BALNEARIO PATILLAS
59	2058	PATILLAS	PUERTO DE PATILLAS
60	2223	PENUELAS	EL BOQUETE (PLAYITA ALEGRIA)
61	1606	PONCE	LAS CUCHARAS, BO LOS QUENIPOS
62	2062	PONCE	PONCE YACHT FISHING CLUB
63	2244	PONCE	RAMPA- GUANCHA
64	NEW	RINCON	DETRAS DEL ECONO
65	NEW	RINCON	FARO
66	NEW	RINCON	PESCADERIA COMUNIDAD ESTELLA
67	2063	RINCON	RINCON'S PUBLIC RAMP
68		RIO GRANDE	PLAYA LAS PICUAS
69	2065	SALINAS	LAS OCHENTA
70	NEW	SANTA ISABEL	PLAYITA CORTADA
71	2067	SANTA ISABEL	SANTA ISABEL RAMP/PIER AND NAUTIC CLU
72	2074	TOA BAJA	PUNTA SALINAS
73	2112	VEGA ALTA	CERRO GORDO BEACH & ASSOC. DE PESCA
74	1640	VEGA BAJA	CLUB NAUTICO DE VEGA BAJA
75	2029	VEGA BAJA	VEGA BAJA BEACH & ROCKS
76	2284	YABUCOA	MUELLE PLAYA GUAYANES
77	NEW	YABUCOA	PLAYA EL COCAL

15 Appendix G. Interview sites

Table F.1.Interview Sites /landing sites, areas fished, and other areas where interviewed fishers harvest conch and lobster in Puerto Rico.

Zone	Municipality	Landing Sites (Sites of Interviews)	Areas Fished	Conch Sites fished	Lobster Sites fished	Other Conch Sites	Other Lobster Sites
EAST	**Ceiba**	Roosevelt Roads	Roosevelt Roads, Ceiba				
	Culebra	Culebra Culebra Villa Pesquera Culebra	Culebra, 1.5 mile offshore East of Vieques Culebra coastline, departing from the bay	Culebra, 1.5 mile offshore	Culebra, 1.5 mile offshore East of Vieques		
	Fajardo	Las Croabas Seven Seas	Keys off of Fajardo Seven Seas- offshore	Keys off of Fajardo Seven Seas	Keys off of Fajardo Seven Seas	 Playa Escondida, Playa Roja	 Playa Escondida, Playa Roja
	Humacao	Palmas Del Mar Humacao	Palma del Mar, 1/2 mile offshore		Palma del Mar, 1/2 mile offshore		
	Loiza	Playa Aviones/ Tocones	Reef Playa Aviones/ Playa Tacones		Reef Playa Aviones/ Playa Tocones		Playa Chatarra
	Luquillo	Playa Fortuna	Reefs off Playa Fortuna and Balneario Luquillo		Reefs off Fortuna Beach and Luquillo Beach		
	Maunabo	Pescaderia, Sector La Playa Maunabo Sector La Playa	Coast of Maunabo, Beril, Patillas, Vieques, Negada, Culebra Reefs Southeast of Fajardo		Beril, Patillas, Vieques, Negada, Culebra Reefs Southeast of Fajardo		 Areas close to Vieques, Virgin Islands
	Patillas	Balneario de Patillas	Balneario de Patillas- 3 miles offshore	Keys near Balneario Patillas	Keys near Balneario Patillas	Keys near Balneario Patillas	Keys near Balneario Patillas
	Rio Grande	Las Picuas	Vieques	Vieques	N/A	Sites close to Rio Grande	
	Vieques	Esperanza La Plata Pescaderia Angelyz Ramp Fishing Village Seawall, Vieques Vieques	Areas East and South of Vieques, Punta del Este La Plata, Vieques East of Culebra and Vieques La Profesora (area between Vieques and Culebra) Puerto Angelyz, 1 mile offshore Area between Vieques and Culebra Seawall, Vieques Shallow area south of Vieques	Areas East and South of Vieques Blue Beach La Profesora Puerto Angelyz, 1 mile offshore Area between Vieques and Culebra Shallow area south of Vieques	Areas East and South of Vieques, Punta del Este East of Vieques Puerto Angelyz, 1 mile offshore Area between Vieques and Culebra Shallow area south of Vieques	Offshore of Blue Beach El Limon 1.5 miles Coasts of 2 islands Behind the airport South, East, or West of Vieques	 Punta Arenas, El Tiro La Profesora Behind the airport

Zone	Municipality	Landing Sites (Sites of Interviews)	Areas Fished	Conch Sites fished	Lobster Sites fished	Other Conch Sites	Other Lobster Sites
SOUTH	**Arroyo**	Malecon de Arroyo	Arroyo Coast, 1-5 miles offshore, deep waters	1-5 miles offshore, deep waters	Open water, deep waters	Keys or reefs closebay	Keys or reefs closebay
	Guánica	Ensenada (Guaipao) Guánica Malecon de Guanica Playa Santa Sector Guapiao	Guaipao Reefs Bahía Ballena El Malecon, Guanica/La Parguera, Cabo Rojo Playa Santa Sector Guapiao	Guaipao Reefs Bahía Ballena Malecon Playa Santa Isla de Guilligan, Playa Santa, from La Parguera to Las Cucharas.	Guaipao Malecon, Guanica Bay Playa Santa Ventana, Guanica Bay	 Jabón, Arenal in front of Ballena, Ventana Parguera, Lajas	 Los Congres, Guánica Playa Tamarindo, Yauco Guayanilla Reefs Tamarindo, Guayanilla, Ventana, Barril, Ballena, Guillen, Joya Parguera, Lajas
	Guayanilla	Villa Pesquera Santo Cristo de la Salud	Ventana - Guayanilla	Isla Ratones, Ventana	Ventana, Las Hojitas, Caja del Muerto		
	Lajas	Villa Pesquera La Parguera	Villa Pesquera La Parguera		Punta Aguila, Cabo Rojo across from lighthouse	Across from la Parguera, off of Guanica, Playa Santa	
	Peñuelas	El Boquete	Isla Cardona, Ponce/Ventana, Guayanilla	Isla Ratones, Ponce	Isla Cardona, Ponce/Ventana, Guayanilla		
	Ponce	Sector Las Cucharas	Arrecife Sector Las Cucharas		El Peñon, Ventana, Cayo Mogote, María Lalanga		
WEST	**Cabo Rojo**	El Corozo Puerto Real Punta Aguila	El Corozo Puerto Real Punta Aguila	 Puerto Real Punta Aguila	El Corozo Puerto Real Punta Aguila	 Parguera, Lajas	 Parguera, Lajas