

**HURRICANES IRMA AND MARIA DAMAGE ASSESSMENT:**

**PROVISIONAL RESULTS FOR THE PUERTO RICAN**

**COMMERCIAL AND FOR-HIRE FISHERIES**



Photo Credit: DNER/Daniel Matos-Caraballo

60-day Interim Report

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## **1. INTRODUCTION**

Hurricanes Irma and Maria struck Florida, Puerto Rico and the U.S. Virgin Islands (USVI) in September 2017. On February 9, 2018, the Secretary of Commerce declared a federal fisheries disaster in the Florida, Puerto Rico and the USVI, citing Magnuson–Stevens Fishery Conservation and Management Act (MSA) Section 315 and Interjurisdictional Fisheries Act (IFA) Section 308(d).

This report provides results from a rapid appraisal of impacts to fishing communities in Puerto Rico from Hurricanes Irma and Maria; separate reports are being prepared for USVI and Florida. This report also serves as NOAA Fisheries (NMFS) 60 day assessment of impacts from these storms, a requirement for disaster declarations filed under MSA 315. More specifically, MSA 315 requires that within two months after a catastrophic regional fishery disaster, the Secretary of Commerce, through NOAA Fisheries, will provide the Governors of affected states (in this case USVI, Puerto and Florida) an economic and socio-economic evaluation of the affected region’s fisheries using the best information available. The goals of this evaluation are to assess the impacts of Hurricanes Irma and Maria in affected communities in Puerto Rico that are involved in commercial or charter fishing, and characterize the effects of the storm on fishing-related businesses and infrastructure.

The damage assessment underlying this report was developed by Puerto Rico’s Department of Natural and Environmental Resources (DNER) with the assistance of the National Oceanic and Atmospheric Administration (NOAA). MER Consulting and HJR Reefscaping fielded the rapid assessment of the losses to the fishing sector. This assessment provides provisional estimates of the economic losses to commercial fishermen, for-hire operators (charters), and fishing-related business, namely fishing cooperatives (or “villas pesqueras” as locally known), fisher associations (“asociación de pescadores”), seafood stores (“pescaderías”), and marinas brought about Hurricanes Irma and Maria. In total, 695 commercial fishermen, 19 charters, 12 marinas and 54 fishing cooperatives, fisher associations, and seafood stores were surveyed between October 16 and December 13, 2017.

Preliminary estimates from this study suggest that economic losses amounted to \$20.5 million and that 174 full-time jobs were lost, at least in the short term. Readers should be cautioned that the estimated economic losses attributed to seafood stores is partial and likely severely underestimates its true impact since we did not have a sound estimate of the universe of seafood stores around the island.

## **2. FISHERY BACKGROUND**

The Commonwealth of Puerto Rico is an archipelago consisting of the main island of Puerto Rico and several smaller islands and cays surrounded by the Atlantic Ocean to the north and the Caribbean Sea to

the south (Suarez-Caabro, 1979). The archipelago has area of 3,515 square miles and a coastline that extends for 311 miles. The main island of Puerto Rico is the smallest and easternmost of the Greater Antilles (Figure 1).

Puerto Rican fisheries are small-scale in nature but are an important source of sustenance, revenue, employment and cultural heritage to many coastal communities (Griffith and Valdés-Pizzini, 2002; Griffith et. al, 2007; Matos-Caraballo and Agar, 2011). Most small-scale fishing is family-based. Most households are small in size. Griffith et al. (2007) reported an average household size of 3.2 members, including the fisherman. Matos-Caraballo and Agar (2011) reported an average household size of 3.1 members, including the fisherman, although household size ranged from 1 to 10 persons.

Most commercial fishermen are middle-aged and have fished for most of their adult life. The average age of commercial fishermen was 50 years old with 29 years of fishing experience (Matos-Caraballo and Agar, 2011). A slight majority of commercial fishermen have a high school education or higher. Matos-Caraballo and Agar (2011) found that 53% of fishermen had a high school or college degree, received professional training or attended some college. Approximately 47% did not complete high school (Matos-Caraballo and Agar, 2011).

Local fisheries support about 1,200 fishermen who use a number of gears such as hook and lines, spears, traps, and nets to catch reef-fish, spiny lobster, queen conch, and miscellaneous coastal pelagic species (Matos-Caraballo and Agar 2011). Most of the fishing vessels are small with moderate levels of mechanization. The average vessel is 20 feet (ft.) long and has an 80 horsepower (hp) engine (Matos-Caraballo and Agar, 2011).

Between 2010 and 2015, fishermen landed, on average, about 2.4 million pounds of finfish and shellfish with dockside revenues of \$8.6 million per year (NMFS 2017). Regionally, the west coast is the most productive region accounting for about 40% of the landings and revenues during the same period (NMFS 2017). The south and east coasts generate about 25% and 20% of the landings and 23% and 22% of the revenues, respectively. The north coast is the least productive region, producing 15% of the landings and 14% of the revenues.

Recreational fishing is a popular activity that provides food and enjoyment for residents and tourists. Recreational fishing remains primarily an activity of residents in Puerto Rico. In 2013, over 95% of the anglers were from the Commonwealth of Puerto Rico (NMFS, 2015). Lovell et al. (2013) found residents of Puerto Rico were the biggest spenders making investments in marine recreational angling, and spending

proportionally more money on private boat trips and shore trips than non-residents. In contrast, non-residents spent mostly on for-hire angling trips (Lovell et al., 2013).

A NOAA study estimated that total angler expenditures on marine recreational fishing amounted to \$72 million in 2011 (or \$81 million in today's dollars). Trip expenditures accounted for about 22% of the total expenditures and durable good expenses for the remaining 78%. For-hire fishing trip expenditures totaled \$1.5 million (\$1.7 million in today's dollars), private boat trip expenditures totaled \$11 million (\$12.4 million), and shore fishing trips totaled \$3.5 million (\$3.9 million).

Marinas, nautical clubs, and sport fishing tournaments are important to recreational fishermen and recreational fishing. Marinas provide a location to convene fishermen and to dock, launch and land recreational vessels. Nautical clubs bring recreational fishermen together and sponsor sport fishing tournaments. The Marine Recreational Information Program estimated that 2,350 charter trips were taken in 2015.

Puerto Rican fisheries are managed by the DNER and the Caribbean Fishery Management Council (CFMC). DNER is responsible for managing fisheries out to nine nautical miles (nm) from the shore and the CFMC is responsible for those fisheries in surrounding waters extending from 9 to 200 nm.

Most fisheries are under a regulated open access regime with the exception of the limited entry deep-water snapper-grouper fishery. Fishery managers use a variety of management measures including quotas, trip limits, gear restrictions, seasonal and area closures, size limits, and other miscellaneous restrictions. The Commonwealth also uses seasonal sales bans to prohibit trade of regulated species during spawning seasons. These usually begin shortly after closure starts so that fishermen and dealers can exhaust their inventory.

### **3. METHODS**

#### **3.1. Survey Development**

To assess the damages, two survey instruments were developed based on damage assessment interviews conducted in Texas and Florida after Hurricanes Harvey and Irma struck earlier in the season. One survey instrument was designed for commercial fishermen and charter operators and the other for businesses.

The original mainland forms were translated into Spanish by the DNER with the following changes to better reflect Puerto Rican fisheries (Figures 2 and 3). The modifications included:

#### *Fishermen form*



1. Questions added: Vessel type and size, motor type and horsepower.
2. Question added: Did you have any loss of fish or bait due to the hurricane? <sup>1</sup>
3. Question added (following previous question): If yes, how much could you have sold it for? <sup>1</sup>
4. The question “What prevented you from continuing to fish?” was translated to “Why haven’t you been able to return to fishing?” and three more options were included: electricity, water or buyer.
5. Question added: Would you be fishing today if you had somewhere to sell your fish? <sup>1</sup>
6. Daniel Matos from DNER added new questions to the NOAA survey (see Figure 3).<sup>1</sup>
  - a. Basic information
    - i. Fishing license number
    - ii. Landing site and municipality
  - b. Contact information
    - i. What is the best way to contact you? Call, text message, email, mail
  - c. What type of fish do you catch?
    - i. Lobster, conch, reef fish, bait fish, pelagic fish, deep water fish
  - d. What gear do you use and how much?
    - i. Fish traps, # traps, Lobster Traps, # of traps
    - ii. Scuba, # of tanks, Freediving, gaff, lobster snare
    - iii. Cast net, seine net, trammel net, gill net
    - iv. Drop line/buoy line, long line, trolling, rod and reel, hand line, winch
  - e. Where do you sell your fish? (fish house, buyer, restaurant, public)
    - i. Name of fish house, buyer, restaurant
    - ii. Address of fish house, buyer, restaurant
    - iii. Municipality of fish house, buyer, restaurant

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<sup>1</sup> These questions were added after the first round of interviews in October. Attempts were made to contact fishers and update interviews, but in some cases, fishers couldn’t be contacted again. There are approximately 75 interviews in which these questions were not asked.

### Businesses form

1. To better reflect the market dynamics in Puerto Rico, some business categories were changed.
  - a. Processor was changed to fish house (“pescadería”) because large scale processing of fish is not common in Puerto Rico. Fish houses buy and sell a significant amount of the fish landed on the island.
  - b. Dealer was changed to buyer (“comprador”) because a majority of sales are done to individuals rather than large scale dealers. In the end this category was not used because all buyers were associated with a fish house.
  - c. Dive shop (“tienda de buceo”) was added because many fishermen in Puerto Rico are divers and depend on dive shops to fill their tanks.
  - d. Marine supply and bait and tackle were combined into the category Fishing Gear (“equipo de pesca”).
2. The question “Relative to last year, how much revenue have you lost to date because of Irma?” was split into two parts.<sup>1</sup>
  1. What percentage of your income comes from the local fishing industry?
  2. How much total revenue have you lost due to the hurricanes?
3. Three questions were added to the end of the interview.<sup>1</sup>
  - i. If you sell fish to restaurants, please indicate which restaurants.
  - ii. Address of restaurant
  - iii. Municipality of restaurant

### **3.2. Fieldwork**

#### Contacting fishermen and businesses

Following the hurricanes, MER Consulting and HJR Reefscaping, were hired to assist the DNER in conducting a rapid assessment of the damages to the fishing industry. Interviews were conducted between October 16 and December 13, 2017. A variety of survey techniques including site visits, regional and site specific announced/organized meetings, phone calls, and communicating with community leaders were used to reach as many fishermen and fishing-related businesses as possible.

Throughout the interviewing period, interviewers visited landing sites they were familiar with at peak times in hope of intercepting fishermen and posting announcements for the project and upcoming

meetings. On-site interview times were scheduled for all high use landing areas around the island, including the island of Vieques. Flyers with these interview times were posted at all known landing sites around the island. Initially, sign-up sheets were included with flyers so that fishermen could share their name and contact information if they were unable to be present at the posted interview time. Later, interviewer phone numbers were included on flyers instead since fishermen rarely used sign-up sheets.

Presidents of fishing associations, owners of fish houses, and other leaders in the fishing community were enlisted to help bring fishermen together to be interviewed. Phone numbers of interviewers were shared among fishermen and later posted on flyers so that fishermen could call and be interviewed over the phone or arrange times for groups of fishermen to be interviewed.

Daniel Matos from DNER provided a list of active fishermen. The list included all fishermen who have turned in at least one fishing trip report to DNER over the last two years, with phone numbers and reported landing sites. Attempts were made to interview each fisher on the list by asking community leaders and other fishermen if they could help contact or knew the status of fishermen on the list, and by calling all fishermen on the list who had not already been interviewed.

As a final push to interview as many fishermen as possible, ‘last chance’ meetings were scheduled around the island for the final days of data collection (Dec 11 & 12). A multi-pronged approach was used to ensure that the news of the meetings was broadly distributed: flyers were posted at fishing centers, an announcement was posted on Facebook, community leaders were contacted, and the meetings were announced on two different radio interviews by Rene Estevez (PR Sea Grant Program). The meeting announcements also contained the phone number of our interviewers so that any fisher that couldn’t attend could call to insure their information was collected.

Attempts were made to list and interview all non-corporate fishing-related businesses in coastal areas of the island including fish houses and buyers, dive shops, and businesses selling fishing gear, ice or gasoline. A list of all “villa pesqueras” around the island was secured from the Department of Agriculture. A list of marinas used as stations for reporting captures of highly migratory species was secured from Sea Grant. Fishermen were asked what businesses they frequent. Businesses were asked about similar businesses. To supplement the list, internet searches were used to find more marinas, fishing charters, dive shops and tackle shops.

### Conducting Interviews

#### Fishermen

When a fisher was approached either in person or by phone, they were told the interviewer was interested in contacting all commercial fishermen and charter operators to conduct an assessment of damages caused by Hurricanes Irma and Maria. If the fisher agreed, they were asked the questions on the interview forms (Figures 2 and 4).

If a fisher responded that they were no longer fishing commercially (or taking passengers in the case of the charter operators), they were asked if that was true before the hurricane. If they answered that they were not fishing commercially before the hurricane, they were not interviewed.

As interviews were completed and attempts were made to contact fishermen, each record on the list of active fishermen was marked with one of 8 categories.

- a) Interviewed: The interview was completed
- b) No answer: Attempts were made to call the fisher. No interview was conducted with the fisher.
- c) Wrong number/not in service: An attempt was made to call the fisher. Either someone answered and said the phone number was not for the fisher or the call would not go through. No interview was conducted with the fisher.
- d) Not fishing: The fisher was contacted. The interviewer explained that they were doing damage assessment interviews with commercial fishermen and the fisher responded that he was no longer fishing commercially. The interview was not conducted.
- e) Refused: The fisher answered, but did not want to be interviewed. The interview was not conducted.
- f) Deceased: No interview was conducted with the fisher.
- g) No phone number: No phone number was provided on the list sent to us by DNER. No interview was conducted with the fisher.
- h) Duplicate: This was a duplicate record on the DNER list.

### Businesses

The first question asked of a business was whether the business derived revenue from the local fishing industry, including commercial fishermen, and charter operations. If the business said no, then no interview was conducted. Otherwise, a full interview was conducted.

### **3.3. Analysis**

Due to the absence of probability samples, we resorted to an average cost (or loss) method to provide provisional monetary damage estimates. In applying this method, we initially calculated an average loss

per damage category by dividing the sum of all the self-reported losses for given damage category by the total number of respondents in that damage category. Damage categories included vessel, fishing gear, facilities and bait losses as well as forgone revenue arising from non-participation in fishing and/or fishing related activities due to capital, infrastructure and/or market (customer) losses.

After calculating the average loss per category, we estimated the population of “impacted” fishermen (or entities) by weighing our best estimate of the actual universe of fishermen (or entities) by the percentage of fishermen (or entities) that reported damages in the rapid assessment since not every fisher (or entity) suffered damages. For example, if the entity universe was 100, and only 8 out of the 10 entities surveyed reported damages, then the number of “impacted” entities would be equal to 80.

Afterwards, we multiplied the estimate of the “impacted” population by the average loss per category to come up with aggregate damage estimates for the entire Commonwealth of Puerto Rico. Estimates of the universe of commercial fishermen, for-hire operators, fishing cooperatives/fisher organizations and marinas were provided by DNER. The total number of businesses that retail locally-caught seafood is presently unknown. Last, for the sake of brevity, we present the profile of respondents from the DNER add-on in Appendix A.

## **4. RESULTS**

### **4.1. Economic losses incurred by commercial fishermen**

DNER records show that there are 1,263 licensed fishermen; however, not all of these fishermen suffered losses due to the hurricanes. The number of “impacted” fishermen was estimated by multiplying the total number of licensed fishermen by proportion of fishermen reporting damages (82%) and forgoing fishing revenue (99%) in the rapid assessment. Damage estimates do not account for insurance since most respondents reported not having insurance.

Table 1 shows that the economic losses triggered by the hurricanes were estimated at \$8.4 million, including lost fishing revenue. If we aggregate the economic loss figures by loss category in Table 1, we find that damages accounted for 64% of the economic losses and forgone fishing revenue for the remaining 36% (see last column in Table 1).

Remarkably, the rapid assessment suggests that immediate job losses were moderate (Table 2). Multiplying the total number of pre-storm jobs by the time that respondents reported it would take them to re-open, we estimated that 148 full-time job equivalents were temporarily lost; however, we remain

skeptical about this last estimate because the rapid assessment found that about 71% of the 695 commercial fishermen interviewed reported that they had not fished since the hurricanes hit for a variety of reasons, including damage to their boats and fishing gear, power outages, lack of basic inputs such as fuel, ice and bait, and a declining customer base.

Table 1: Economic losses incurred by commercial fishermen.

Loss Categories	Estimated number of “impacted” commercial fishermen	Average loss (\$)	Total loss (\$)	Share of total loss (%)
Damage				
Vessel	1,039	2,289	2,378,271	28%
Fishing gear	1,039	2,554	2,653,606	31%
Bait	1,039	236	245,204	3%
Facilities	1,039	106	110,134	1%
Forgone fishing revenue	1,247	2,436	3,037,692	36%
Total economic loss (\$)			8,424,907	
Number of immediate jobs lost			148	

Table 2: Descriptive statistics on crew size (commercial fishermen).

Variable	Mean	Median	Minimum	Maximum	Sum	Used obs.	Total Obs.
Crew size before	2.0	2.0	0	8.0	1,390.0	693	695
Closed days	55.3	46.0	2.0	360	27,451.0	496	695
Jobs lost (FTE)	0.3	0.2	0	2.0	147.7	496	695

#### 4.2. Economic losses incurred by for-hire operators (charters)

Building on a DNER list of for-hire operations supplemented with charter operations discovered during the fieldwork and an online search, 47 charter operators were identified. No headboat operations were identified. About 84% of the for-hire operators surveyed reported damages and all of them reported forgoing fishing revenue. Damage estimates do not account for insurance since most respondents reported not having insurance.

Economic losses from the hurricanes were estimated at slightly above \$1.3 million, including lost fishing revenue (Table 3). The last column of table 3 shows that forgone fishing revenue accounted for about 55% of the economic losses and damages for the remaining 45%.

The rapid assessment suggests that job losses were minor. Multiplying the total number of pre-storm jobs times the time that respondents reported it would take them to re-open, we estimated that 6 full-time jobs were temporarily lost (Table 4).

Table 3: Economic losses incurred by for-hire operators.

Loss Categories	Estimated number of “impacted” for-hire fishermen	Average loss (\$)	Total loss (\$)	Share of total loss (%)
Damage				
Vessel	40	13,727	543,308	41%
Fishing gear	40	809	32,034	2%
Bait	40	-	-	-
Facilities	40	347	13,729	1%
Forgone fishing revenue	47	15,413	724,419	55%
Total economic loss (\$)			1,313,490	
Number of immediate jobs lost			6	

Table 4: Descriptive statistics on crew size (for-hire operators).

Variable	Mean	Median	Minimum	Maximum	Sum	Used obs.	Total Obs.
Crew size before	2.4	2.0	1.0	6.0	46.0	19	19
Closed days	55.6	54.0	10.0	180	1,000.0	18	19
Jobs lost (FTE)	0.3	0.3	0.0	1.0	6.1	18	19

#### 4.3. Economic losses incurred by fishing cooperatives and seafood retailers.

The rapid assessment collected information on 35 fishing cooperatives and fisher associations and 19 seafood stores. DNER estimates that there are about 55 fishing cooperatives and fisher associations and 18 “commercial” landings sites (mainly docks), but it is uncertain about the total number of seafood stores around the island. Therefore, our provisional estimates only considered the DNER universe of fishing cooperatives, fisher associations and “commercial” landing sites, and the 19 seafood stores surveyed, which severely underestimates the total number of seafood stores. Damage estimates do not account for insurance since most respondents reported not having insurance. Economic losses from Hurricanes Irma and Maria were assessed at \$6.8 million, including lost fishing revenue (Table 5).

Table 5: Economic losses incurred by fishing cooperatives, fisher associations, commercial landing sites and seafood stores.

Loss Categories	Estimated number of "impacted" entities	Average cost (\$)	Total cost (\$)	Share of total cost (%)
Fishing cooperatives and fisher associations				
Damage				
Facility	55	27,861	1,532,363	30%
Seafood and bait loss	53	3,461	183,427	4%
Equipment	55	2,713	149,207	3%
Dock	55	50,290	2,765,950	55%
Forgone fishing revenue	50	8,086	404,303	8%
Total economic loss			5,035,249	
Number of immediate jobs lost			10	
Commercial landing sites				
Damage				
Facility	-	-	-	-
Seafood and bait loss	17	3,461	58,837	5%
Equipment	-	-	-	-
Dock	18	50,290	905,220	82%
Forgone fishing revenue	18	8,086	145,548	13%
Total economic loss			1,109,605	
Number of immediate jobs lost			3	
Seafood stores (partial)				
Damage				
Facility	19	9,105	172,995	25%
Seafood and bait loss	19	7,209	136,971	20%
Equipment	19	2,089	39,691	6%
Dock	19	3,921	74,499	11%
Forgone fishing revenue	19	14,368	272,992	39%
Total economic loss			697,148	
Number of immediate jobs lost			5	
Total economic loss			6,842,002	
Number of immediate jobs lost			18	

Table 6: Descriptive statistics on jobs (fishing cooperatives).

Variable	Mean	Median	Minimum	Maximum	Sum	Used Obs.	Total Obs.
Number of jobs before	3.1	2.0	0.0	23.0	107.0	34	35
Closed days	55.8	47.5	2.0	180.0	1,451	26	35
Jobs lost (FTE)	0.4	0.2	0.0	1.4	9.6	26	35



Table 7: Descriptive statistics on jobs (seafood stores).

Variable	Mean	Median	Minimum	Maximum	Sum	Used Obs.	Total Obs.
Number of jobs before	2.7	2.0	0.0	16.0	52.0	19	19
Closed days	37.7	35.0	0.0	120.0	603.0	16	19
Jobs lost (FTE)	0.3	0.1	0.0	2.6	5	16	19

#### 4.4. Economic losses incurred by marinas with for-hire and commercial fishing operations

DNER estimated that there are 23 marinas with for-hire and commercial fishing operations. During our rapid assessment, 75% of the marinas reported losing fishing revenue because of the hurricanes.

Economic losses from the hurricanes were estimated at \$3.9 million, including lost fishing revenue (Table 8). The last column of table 8 shows that damages accounted for 87% of the economic losses and forgone fishing revenue for the remaining 13%. Damage estimates do not account for insurance since most respondents reported not having insurance. The rapid assessment suggests that job losses were relatively minor (2; Table 9).

Table 8: Economic losses incurred by marinas with a commercial and/or for-hire fishermen component.

Loss Categories	Estimated number of "impacted" marinas	Average loss (\$)	Total loss (\$)	Share of total loss (%)
Damage				
Facility	15	81,401	1,221,015	31%
Seafood and bait loss	23	942	21,666	1%
Equipment	23	83	1,909	0%
Dock	17	125,755	2,137,835	55%
			-	
Forgone fishing revenue	17	30,500	518,500	13%
Total economic loss (\$)			3,900,925	
Number of immediate jobs lost			2	

Table 9: Descriptive statistics on jobs (marinas).

Variable	Mean	Median	Minimum	Maximum	Sum	Used Obs.	Total Obs.
Number of jobs before	7.1	2.0	0	32.0	78.0	11	12

Variable	Mean	Median	Minimum	Maximum	Sum	Used Obs.	Total Obs.
Closed days	33.5	34.0	0.0	66.0	134.0	8	12
Jobs lost (FTE)	0.5	0.0	0.0	2.0	2.0	8	12

Of the 12 marinas surveyed, 11 marinas (92%) reported that their business and/or installation had been impacted by the hurricanes but only 3 marinas (25%) remained closed.

## 5. CONCLUSIONS

This report provides provisional damage estimates for the Commonwealth of Puerto Rico based on a rapid assessment conducted between October 16 and December 13, 2017. In total, 695 commercial fishermen, 19 for-hire operators, 12 marinas and 54 fishing cooperatives, fisher association, and seafood stores were surveyed. The study estimated that the economic losses amounted to \$20.5 million and that 174 full-time jobs were lost, at least in the short-term.

Readers should be cautioned that the estimated economic losses attributed to seafood stores is partial and likely severely underestimates its true impact since we did not have estimates of the universe of seafood stores around the island. Moreover, there are numerous bait and tackle shops across the island that cater to the recreational fisher, including chain stores and cooperative family-owned shops that likely were impacted, as well. Finally, as noted earlier, the number of commercial fishermen who lost jobs appears to be low given the size of the population and the hardships reported.

Table 10: Economic losses incurred by key segments of the fishing sector.

Fishery segment	Damages (\$)	Forgone Revenue (\$)	Total Losses (\$)	Immediate job losses
Commercial fishermen	5,387,215	3,037,692	8,424,907	148
For-hire operators	589,071	724,419	1,313,490	6
Fishing cooperatives and seafood stores (partial)	6,019,160	822,843	6,842,003	18
Marinas	3,382,425	518,500	3,900,925	2
Grand total	15,377,871	5,103,454	20,481,325	174

## 6. REFERENCES

Griffith, D., M. Valdés-Pizzini. 2002. *Fishers at Work, Workers at Sea: A Puerto Rican Journey through Labor and Refuge*. Philadelphia: Temple University Press.

Griffith, D., M. Valdés-Pizzini, and C. Garcia-Quijano. 2007. Entangled Communities: Socioeconomic Profiles of Fishers, Their Communities and Their Responses to Marine Protective Measures in Puerto Rico. NOAA Series on U.S. Caribbean Fishing Communities, NMFS-SEFSC-556.

Lovell, S. J., S. Steinback, and J. Hilger. 2013. The Economic Contributions of Marine Angler Expenditures in the United States, 2011. U.S. Department of Commerce. NOAA, NMFS. NOAA Technical Memorandum. NMFS-F/SPO-134. September 2013.

Matos-Caraballo, D. and J. Agar. 2011. Census of Active Commercial Fishermen in Puerto Rico: 2008. Marine Fisheries Review 73(1): 13-27.

National Marine Fisheries Service, NOAA. 2015. Fisheries of the United States 2014. Current Fishery Statistics No. 2012. U.S. Department of Commerce, NOAA, NMFS. Silver Spring, MD.

Suárez-Caabro, J. A. 1979. El Mar de Puerto Rico: una introducción a las pesquerías de la Isla. Editorial Univ., Universidad de Puerto Rico (Río Piedras), 259 p.

## 7. APPENDIX A

In total, 695 commercial fishermen and 19 for-hire operators were interviewed (Table 11). Seventy-seven percent of respondents were owners (

Table 12). About 95% of the for-hire interviewees self-identified as captains and 77% of the commercial fishermen interviewed self-reported to be captains.

Table 11: Number of commercial fishermen and for-hire operators interviewed by coastal region.

Respondent type	East	North	South	West	Total
Commercial fisher	140	215	160	180	695
For-hire operator	5	11	2	1	19
Other	-	1	-	1	2
<b>Total</b>	<b>145</b>	<b>227</b>	<b>162</b>	<b>182</b>	<b>716</b>

Table 12: Self-reported role in fishing operation by coastal region.

Respondent type	East	North	South	West	Total
Captain	111	195	105	142	553
Crew	34	31	55	39	159
Other	-	1	2	1	4
<b>Total</b>	<b>145</b>	<b>227</b>	<b>162</b>	<b>182</b>	<b>716</b>

The survey also collected data on 86 seafood related businesses; however, because of the relatively small sample of some of businesses (such as dive shops, and fishing gear, ice, and fuel retailers) our analysis focused only on “fish houses”, which included seafood stores (or “pescaderías”), fishing cooperatives (“villas pesqueras”), and fisher associations (“asociación de pescadores”), and marinas (Table 13).

Table 13: Number of seafood-related businesses sampled by coastal region.

Seafood related business type	East	North	South	West	Total
“Fish houses”	12	13	15	14	54
Marinas	-	4	6	2	12
Fishing gear	-	6	-	3	9
Dive shops	-	1	2	4	7
Fuel	-	-	3	-	3
Ice	-	-	-	1	1
<b>Total</b>	<b>12</b>	<b>24</b>	<b>26</b>	<b>24</b>	<b>86</b>

### Commercial fishermen.

The DNER add-on inquired about species targeted, fishing gears used and main markets. The rapid assessment found that a high number of fishermen targeted reef-fish (52%), deep-water species (47%), lobster (42%) and pelagic species (38%; Table 14). A small number of respondents said that they fished for queen conch (22%), and bait-fish (20%).

Table 14: Number of commercial fishermen targeting the following species by coastal region.

Species (or species group)	East	North	South	West	Total
Lobster	106	64	60	60	290
Conch	44	25	45	40	154
Reef-fish	121	100	67	73	361
Pelagic species	14	126	61	65	266
Bait-fish	4	49	54	34	141
Deep-water species	34	159	63	72	328

The add-on also inquired about fishing gear use (Table 15). About 21% of the respondents said they fished with SCUBA, 9% free dive, 3% gaffs, and 9% lobster snares. About one in four interviewees (26%) said they used fish traps and 4% stated they used lobster traps. On average, fishermen in the South and East coasts had more fish and lobster traps as well as SCUBA tanks than their counterparts (Table 16).

About 23% of the respondents said that they fished cast nets, 5% seine nets, 3% trammel nets and 15% gillnets. In terms of hook and line gears, 22% of interviewees said they fished with drop/buoyed line, 14% longlines, 23% trolling, 36% rod and reel, 42% handlines, and 29% winches. Few fishermen reported using miscellaneous gears such as crab traps and octopus tickle sticks.

Table 15: Number of commercial fishermen targeting the following species by coastal region.

Fishing gear ownership	East	North	South	West	Total
Diving					
SCUBA	57	24	24	43	148
Free diving	2	31	31	2	66
Snare	2	32	19	8	61
Gaff	0	11	9	1	21
Traps					
Fish traps	80	41	39	20	180
Lobster traps	6	3	18	0	27
Nets					
Cast net	3	100	47	11	161
Seine net	2	9	20	7	38
Trammel net	0	3	8	10	21
Gillnet	15	35	41	13	104
Hook & Line					
Buoyed line	4	60	35	54	153
Longline	4	45	23	23	95
Trolling	7	63	57	33	160
Rod and reel	22	133	62	32	249
Handline	55	115	65	58	293
Winch	19	111	27	48	205
Other gears		1	2	1	4

Table 16: Descriptive statistics on ownership of fish traps, lobster traps and SCUBA tanks by coastal region.

Coast	Variable	Mean	Median	Minimum	Maximum	Std. Dev.	Sum	Used Obs.	Missing Obs.	Total Obs.
East	Fish traps	43.6	30	10	164	33.8	1,307	30	110	140
	Lobster traps	42.0	30	10	110	39.6	210	5	135	
	SCUBA tanks	4.4	4	3	10	1.7	106	24	116	
North	Fish traps	24.4	10	1	360	56.0	999	41	174	215
	Lobster traps	13.3	15	5	20	7.6	40	3	212	
	SCUBA tanks	3.8	4	1	8	1.9	84	22	193	
South	Fish traps	47.7	30	7	300	52.6	1,861	39	121	160
	Lobster traps	33.4	20	4	150	35.1	602	18	142	
	SCUBA tanks	5.3	4	2	14	2.9	111	21	139	
West	Fish traps	28.6	10	2	118	38.6	457	16	164	180
	Lobster traps	.	.	.	.	.	.	0	180	
	SCUBA tanks	3.7	4	2	4	0.6	41	11	169	

The rapid assessment also documented that respondents use multiple avenues to market their catches. Respondents stated that they sold their catch to fish stores, restaurants, the public, and, to a lesser extent, to fishing cooperatives, fisher associations, and dealers. A substantial percentage of respondents peddled their catch themselves. Matos and Agar (2011) note that fish peddlers use multiple marketing strategies, including delivering fish orders to the homes of their regular clients, packing their catch in iced fiberglass boxes and hauling them to strategic locations where they are put up for sale, and selling directly from their homes.

#### For-hire operators

The add-on found that most for-hire operators primarily targeted pelagic and reef-fish species (Table 17). The most common pelagic species are tunas and mackerels.

Table 17: Number of for-hire operators targeting the following species by coastal region.

Species (or species group)	East	North	South	West	Total
Lobster	1	-	-	-	1
Conch	-	-	-	-	-
Reef-fish	4	1	-	-	5
Pelagic species	5	7	-	-	12
Bait-fish	-	-	-	-	-
Deep-water species	-	-	-	-	-

The most popular fishing gears were hook and line gears, especially rod and reel and trolling lines (Table 18).

Table 18: Number of for-hire operators using the following fishing gears by coastal region.

Fishing gears	East	North	South	West	Total
Diving					
SCUBA	-	-	-	-	-
Free diving	-	1	-	-	1
Snare	-	-	-	-	-
Gaff	-	-	-	-	-
Traps					
Fish traps	1	-	-	-	1
Lobster traps	-	-	-	-	-
Nets					
Cast net	-	8	-	-	8
Seine net	-	-	-	-	-
Trammel net	-	-	-	-	-
Gillnet	-	-	-	-	-
Hook & Line					
Buoyed line	-	-	-	-	-
Longline	-	-	-	-	-
Trolling	4	5	-	-	9
Rod and reel	5	10	-	-	15
Handline	4	-	-	-	4
Winch	2	-	-	-	2
Other gears	-	1	-	-	1

Figure 1: Map of the Commonwealth of Puerto Rico.

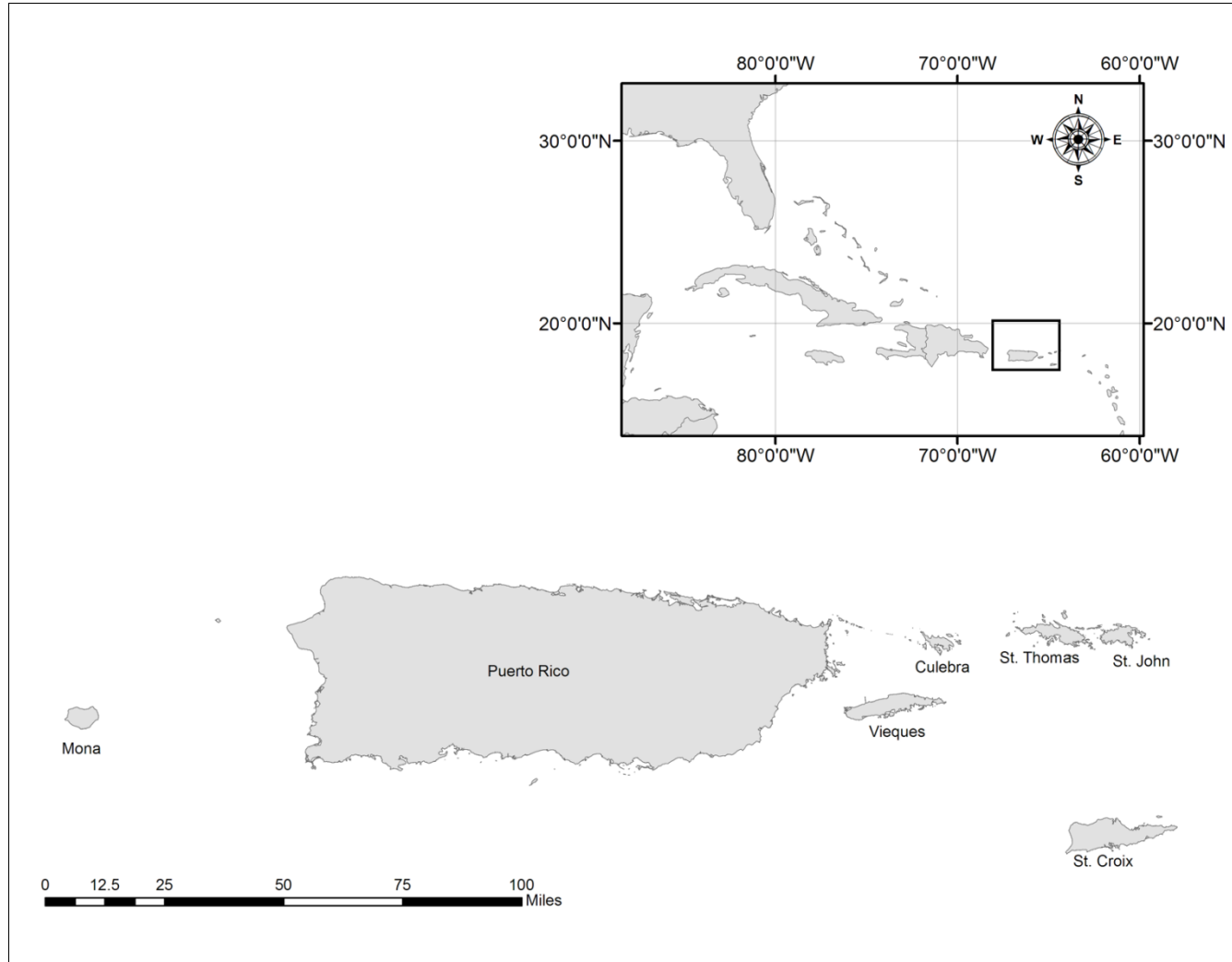




Figure 2: Fisher interview form.

FORMULARIO: PESCA COMERCIAL - EMBARCACIONES															
Nombre/número de la embarcación: _____						Commercial <input type="checkbox"/> Charter <input type="checkbox"/>		Entrevistador(a): _____ Fecha: _____							
Tipo de embarcación: _____				Tamaño: _____		Tipo de motor: _____		Caballos de fuerza (Hp): _____							
Nombre del entrevistado: _____						# de telefono: _____		dirección: _____							
(marca uno) Dueño: <input type="checkbox"/>		Miembro de la tripulación (no dueño): <input type="checkbox"/>				Ciudad/Estado: _____									
DAÑOS A EMBARCACIONES															
Número de embarcaciones (pesca comercial)? <input type="checkbox"/>															
Su embarcación sufrió daño tras el paso del Huracán María (o Irma)? (Sí/No) <input type="checkbox"/>															
--Si no, entra \$0/0% en daños abajo y sigue con la sección "Pérdida/daños al equipo de pesca"															
--Si sufrieron daños, pide un estimado de los daños y que parte está cubierta por algún seguro para cada embarcación. Si el pescador no puede responder en terminos de \$, pide un estimado del % dañado/cubierto.															
Daño a embarcación principal / Seguro				embarcación 2				embarcación 3				embarcación 4			
Daños		Cubierto por seguro		Daños		Cubierto por seguro		Daños		Cubierto por seguro		Daños		Cubierto por seguro	
\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%
PERDIDA/DAÑOS AL EQUIPO DE PESCA: (Incluye pérdida/daños al equipo o artes de pesca que estaban en uso o guardado. Anote cada arte de pesca															
Tuvo Ud. alguna pérdida de pescado (o carnada) tras el paso del Huracán María (o Irma)? Si hubieras podido vender este pescado, cuanto hubieras ganado? _____															
Tuvo Ud. alguna pérdida o daño al equipo (o artes) de pesca tras del paso del Huracán María (o Irma)? (Sí o No) <input type="checkbox"/>															
--Si no, entra \$0/0% en daños abajo y sigue con la sección "Daños a edificios y/u otras facilidades".															
--Si sufrieron daños, pide un estimado de los daños sufridos. Si el pescador no puede responder en terminos de \$, pide un estimado del % dañado/cubierto.															
Equipo 1:				Equipo 2:				Equipo 3:				Equipo 4:			
Daño/Perdida		Cubierto por seguro		Daño/Perdida		Cubierto por seguro		Daño/Perdida		Cubierto por seguro		Daño/Perdida		Cubierto por seguro	
\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%
DAÑOS A EDIFICIOS y/u OTRAS FACILIDADES:															
Ud. es dueño o renta algún edificio y/u otra facilidad (pescadería, muelle etc.) relacionado a la pesca comercial? (Sí/No) <input type="checkbox"/>															
Si sufrieron daños, apunta información de daños y seguro. Si no, sigue con la sección "Estatus de la Pesca".															
				Daños		Cubierto por seguro									
				\$		\$						\$			
ESTATUS DE LA PESCA:															
Durante esta época del año, normalmente que tipo de pesca Ud. realiza (arte, especies, etc.)? (Apunta todos.) _____															
Desde el Huracán María (o Irma), Ud. ha regresado a pescar? (Sí/No) <input type="checkbox"/> Si ya regresó, en que día? _____															
Si no, cuanto tiempo Ud. estima que pasará hasta que regrese a la pesca? (Escoge uno.) Semanas <input type="checkbox"/> Meses <input type="checkbox"/>															
Porque no ha podido regresar a la pesca? Daños a embarcación o equipo <input type="checkbox"/> Falta de: combustible <input type="checkbox"/> carnada <input type="checkbox"/> hielo <input type="checkbox"/> luz <input type="checkbox"/> Otra causa: _____															
(marca todos los que aplican) comprador para el pescado <input type="checkbox"/> agua <input type="checkbox"/>															
Estaría pescando hoy si tuviese en dónde vender el pescado? (Sí/No) <input type="checkbox"/> Ud. ha tenido que cambiar el lugar de desembarco debido al Huracán? (Sí/No) <input type="checkbox"/>															
Ud. está pescando diferentes especies debido al Huracán María (o Irma)? (Sí/No) <input type="checkbox"/> Gana menos pescando estas especies? (Sí/No) <input type="checkbox"/>															
Comparado con el año pasado, cuanto ingreso has perdido debido al Huracán María (o Irma)? (Incluye pérdidas por cambiar de especie.) \$ _____															
EMPLEO FUERA DE LA PESCA COMERCIAL						NÚMERO DE PERSONAS EN EMBARCACIÓN PRINCIPAL (incluyendo el capitán)									
Ud. es pescador de tiempo completo? (Sí/No) <input type="checkbox"/>						Antes del Huracán María (o Irma): <input type="checkbox"/> Después del Huracán María (o Irma): <input type="checkbox"/>									

Figure 3: Business interview form.

FORMULARIO: NEGOCIOS RELACIONADOS CON LA PESCA COMERCIAL															
NOMBRE DEL NEGOCIO _____						entrevistador(a): _____			Fecha: _____						
Tipo de empresa:    Pescadería <input type="checkbox"/> Comprador <input type="checkbox"/> Marina <input type="checkbox"/> Equipo de pesca <input type="checkbox"/> Tienda de buceo <input type="checkbox"/> Combustible <input type="checkbox"/> Hielo <input type="checkbox"/> (marca todos los que aplican): OTRO TIPO DE NEGOCIO: _____															
Nombre del entrevistado: _____						Teléfono: _____									
Dirección: _____															
DAÑOS ESTRUCTURALES															
Su negocio o facilidad sufrió daño tras el paso del Huracán María (o Irma)? (Sí/No) <input type="checkbox"/> --Si no, entra \$0/0% en daños abajo y sigue con la sección "Estatus de operaciones". --Si sufrieron daños, pide un estimado de los daños y que parte está cubierta por algún seguro. Si el entrevistado no puede responder en terminos de \$, pide un estimado del % dañado/cubierto. --Después, pregunta si hubo otros daños que afectan las operaciones (pescado, carnada, equipo, muelles, rampas, acceso al mar etc.)															
Daños a empresa o facilidad				Perdida de pescado o carnada				Perdida de equipo de pesca				Daños a muelles			
Daño/Perdida		Cubierto por seguro		Daño/Perdida		Cubierto por seguro		Daño/Perdida		Cubierto por		Daño/Perdida		Cubierto por seguro	
\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%
ESTATUS DE OPERACIONES															
El negocio permanece cerrado desde el Huracán María (o Irma)? (Sí/No) <input type="checkbox"/> --Si no, sigue con la sección "Número de empleados". --Si el negocio estaba cerrado, indique la fecha en que abrió de nuevo o cuando Ud. cree que va a poder abrir.      Fecha que abrió: _____ Cuando Ud. cree que va a abrir:    Semanas <input type="checkbox"/> Meses <input type="checkbox"/>															
Si Ud. compra y vende pescado, está comprando diferentes especies de menos valor debido al Huracán María (o Irma)? (Sí/No) <input type="checkbox"/>															
Cuál porcentaje de su ingreso viene de la industria pesquera local? <input type="text"/> %															
A consecuencia del Huracán María (o Irma), cuanto dinero ha dejado de ganar en total? (Incluye perdidas por cambiar de especie.) \$ <input type="text"/>															
NÚMERO DE EMPLEADOS															
Antes del Huracán María (o Irma): <input type="text"/> Después del Huracán María (o Irma): <input type="text"/>															
<b>VENTAS</b> Si vende pescado a restaurantes, podría indicar cual o cuales? (nombre y dirección): _____															
Notas: _____															

Figure 4: DNER fisher background add-on to survey form.

<b>Nombre completo:</b> _____	
<b>Número de licencia de pesca:</b> _____	
<b>Lugar y municipio de desembarco:</b> _____	
<b>Información de contacto</b>	<b>Cual es la mejor forma de contactarlo?</b>
Teléfono _____	llamar <input type="radio"/> mensaje de texto <input type="radio"/>
Correo electrónico _____	<input type="radio"/>
Correo postal _____	<input type="radio"/>
<b>¿A cuál tipo de pesca se dedica?</b> (Marca todos los que aplican.)	
Langosta <input type="radio"/>	Carrucho <input type="radio"/>
Peces de arrecife <input type="radio"/>	Peces para carnada <input type="radio"/>
Peces pelágicos <input type="radio"/>	Peces de aguas profundas <input type="radio"/>
<b>¿Qué artes de pesca usa, y qué cantidad?</b> (Marca todos los que aplican.)	
Nasas <input type="radio"/>	Núm.: _____
Cajones <input type="radio"/>	Núm.: _____
Buceo con tanque <input type="radio"/>	Núm.: _____
Buceo sin tanque <input type="radio"/>	Bichero <input type="radio"/>
	Laso <input type="radio"/>
Redes de Pesca <input type="radio"/>	¿Qué tipo de red usa?
	Attarraya <input type="radio"/>
	Chinchorro de arrastre <input type="radio"/>
	Mallorquin <input type="radio"/>
	Trasmallo (filete, chinchorro de ahorque) <input type="radio"/>
Línea y anzuelo <input type="radio"/>	¿Qué tipo de pesca con línea usa? (Marca todos los que aplican.)
	Cala o Boya <input type="radio"/>
	Palangre <input type="radio"/>
	Silga (de corrida, "trolea") <input type="radio"/>
	Caña <input type="radio"/>
	Línea de mano <input type="radio"/>
	Malacate <input type="radio"/>
<b>En donde vende el pescado?</b>	
Pescadería, comprador, restaurante, público, otro:	
Nombre (de la pescadería, comprador, restaurante, etc): _____	
Dirección (de la pescadería, comprador, restaurante, etc): _____	
Notas: (Si el pescador usa varias artes o vende en varios sitios se puede incluir la información aquí.)	