

Comprehensive Census of the Marine Commercial Fishery of Puerto Rico, 2008

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ABSTRACT

Puerto Rico's Law 278 of November 29th, 1998, also known as Puerto Rico's Fishing Law, defines that a full-time commercial fisher is a person that receives 50% or a higher income from the fishing activity. A part-time commercial fisher (CF) receives less than 50% of their income from the fishing activity. The Regulation 6768, known as Puerto Rico's Fishing Regulation, established that a part-time CF has a minimum of 20% of the total income must be produced by his fishing activity. The mentioned definitions required that the CF must submit their IRS documents to receive a commercial fisher license. Most CF did not like to report their income to the IRS because they believe that they are poor, thus they do not have the income to contribute to the local government. During 2004-07, the DNER Commercial Fisheries Statistics Program (CFSP) observed that many CF left the fishing activity. Also they observed that many CF were active but they did not obtain the commercial fishing license. The mentioned facts conclude the necessity to realize this fishing census.

During January-November 2008, the CFSP personnel realized a fishing census at the 42 coastal Puerto Rico's municipalities. The census goals were: obtain data to determine the total number of active CF, socioeconomic information, number and length of active commercial vessels, number of motors and the motor's horsepower and determine the number and type of active gears. All goals were reached and results are discussed in this paper.

KEY WORDS: Commercial, fishers, fishery, socioeconomics, Puerto Rico

Censo Comprensivo de la Pesquería Marina Comercial de Puerto Rico, 2008

La Ley 278 de Noviembre 29 de 1998, conocida como Ley de Pesca de Puerto Rico, define un pescador comercial (PC) a tiempo completo como el que obtiene un 50% o más de sus entradas por la pesca. Un PC a tiempo parcial quien obtiene menos de un 50% de sus entradas de la pesca. El Reglamento 6768, conocido como Reglamento de Pesca de Puerto Rico, establece que un PC a tiempo parcial obtiene un mínimo de 20% de sus entradas de la pesca. Estas definiciones establecen que los PC tienen que someter sus Planillas de Contribución sobre Ingresos al Departamento de Hacienda. La mayoría de los PC no les gusta hacer este requisito por entender que son muy pobres y que no tienen entradas para pagar al gobierno local. Durante el 2004-07, personal del Programa de Estadísticas Pesqueras Comerciales (PEPC) del DRNA observó que muchos PC se retiraron de la actividad pesquera. También observaron que muchos PC se mantenían activos en la pesquería pero no adquirieron su licencia. Los mencionados factores concluyen la necesidad de realizar un censo pesquero en Puerto Rico.

Durante Enero – Noviembre de 2008, personal de PEPC realizaron un censo de pesca comercial en los 42 municipios costaneros de Puerto Rico. Los objetivos del censo fueron: obtener datos para determinar el número total de PC activos, información socioeconómica, número y longitud de embarcaciones, número de motores y sus caballos de fuerza, y determinar el número y tipo de artes. Todos los objetivos fueron alcanzados y son discutidos en este reporte.

PALABRAS CLAVE: Comercial, pescador, pesquería, socioeconómica, Puerto Rico

Le Recensement Complet de la Pêche Commercial Marine de la Porto Rico, 2008

MOTS CLÉS: Commercial, poissons, pêche, Porto Rico

INTRODUCTION

Puerto Rico's fishery is artisanal. Important features of Puerto Rico's (PR) fishery include multispecies nature, multigear competition, population pressure, technological change and often the absorption of unemployed or part-time laborers. The fishery resource of Puerto Rico has to date shown the classic signs of overfishing which include reduced total landings, declining catch per unit effort, shifts to catch per unit effort, shifts to catch smaller sized individuals and recruitment failures (Matos-Caraballo 2005).

PR's Law 278 of November 29th, 1998, also known as Puerto Rico's Fishing Law, defines that a full-time commercial fisher is a person that receives 50% or higher of this income from the fishing activity. A part-time commercial fisher receives less than 50% of their income from the fishing activity. The Regulation 6768, known as PR's Fishing Regulation, established that a part-time commercial fisher has a minimum of 20% of the total income must be produced by his fishing activity. The mentioned definitions required that the commercial fishers must submit their IRS documents to receive a commercial fisher license. Most commercial fishers did not like to report their income to the IRS because they think they are poor and do not have the income to contribute to the local government. Also, many fishers retired by age of 62 or higher were very angry, because they are not supposed to pay taxes. Even though the PR's Department of Agriculture concedes that the full-time fishers will have a tax deduction of 90% of their income, most fishers were angry with the definitions. In March 12, 2004, the Department of Natural and Environmental Resources (DNER) implemented the Regulation 6768, that describes the commercial fisher definitions and many closed seasons for various species of fish and

shellfish, marine reserves, banning the beach seine, and other important management actions to conserve the overexploited fishing resources. The fishers were very angry with the DNER because of these conservation actions (Matos-Caraballo In press) that resulted in a decreased of fishing activity. Immediately the Commercial Fisheries Statistics Program (CFSP) port sampler and the author received hostility from many commercial fishers. Also, many commercial fishers stopped to submit their landings to CFSP. Many others did not cooperate with port sampler collection of the biostatistics data. However, the hostility decreased during 2006. During 2004 - 2007, CFSP observed that many commercial fishers left the fishing activity for many reasons.

The mentioned facts confirm the necessity to realize this fishing census. The complexity of Puerto Rico's fishery and to the continuing and constant changes in the fishing communities, assessing the status of the artisanal fishery in Puerto Rico is necessary through a census (Matos Caraballo et. al. 2005).

Information on the universe of commercial fishing in Puerto Rico (number of active commercial fishers, vessels, gears, and socioeconomic data) will provide fishery managers with precise and accurate data. This data will enable them to formulate measures that will be applicable to the current operations of the fishery and result in a better management of the fishery resources. Thus, the objective of this project is to describe the universe of the commercial fishery in Puerto Rico in order to help fishery managers in the formulation of the management strategies. The goals of this project are:

- i) Collect data to determine the total number of active commercial fishers,
- ii) Obtain socioeconomic information (for example to classify each commercial fishers in his corresponding category as: full time or part time),
- iii) Collect data to determine the number and length of active commercial vessels, number of motors and the motor's horsepower, and
- iv) Collect data to determine the number and type of active gears.

MATERIALS AND METHODS

Personnel from the CFSP realized the census. Three port samplers, two statistics clerk and principal investigator interviewed all fishers. They visited the 42 coastal municipalities and the 92 fishing centers (landing areas), to identify and interview every active commercial fisherman (Figure 1). The coastal municipalities of Quebradillas, Manatí and Toa Baja do not have commercial fishing activity during 2007 - 2008.

The CFSP personnel organize commercial fishers meetings in every fishing center. All the commercial fishers that attended were interviewed. The fishers that did not assist to the meeting were identified. Later, the port samplers tried to reach these fishers at the dock or at their home. Identified commercial fishers that did not cooperate were accounted. The CFSP personnel tried to get the information about the vessels and gears from other fishers that know the elusive person. Every included questions to determine the following information:

- i) Fishing center
- ii) Fisher name
- iii) Nickname
- iv) Age
- v) Fishing Center
- vi) Municipality where the fisher lives
- vii) Postal address and telephone number
- viii) License number
- ix) Number of hours spent weekly in a fishery. Less than 40 hours was considered a part time fisherman. Forty or more hours were considered full time.
- x) Fishing association belonging to.
- xi) Number of vessels used in the commercial fishery
- xii) Length of each vessel (feet)
- xiii) Horsepower for every motor
- xiv) Fishing categories (e.g. reef fish, pelagic, deep snapper, bait)
- xv) Catch handling (gutted, iced, nothing)
- xvi) Fish marketing: sells the catch to a fishing association, private fishing enterprise, a restaurant, own business, walking)

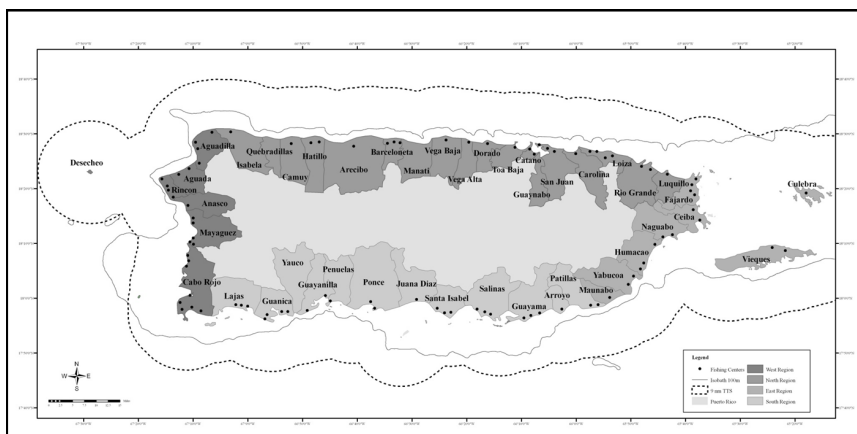


Figure 1. Distribution of fishing centers in Puerto Rico.

- xvii) Number and description by gear type (e.g. fish trap, trammel net, hand line).
- xviii) Socioeconomic information (number of dependents, highest education reached, socioeconomic problems that affected his business).
- xix) How fishers feel about the status of the fishery resource compared with the past (better, same, worst)

All the information was entered in Microsoft Access format. Later the information was analyzed using Microsoft Excel. The results were compared with previous census, to note if a significant difference or trends occurred during the last census of 2002.

The individual fishers and/or business that cooperated giving information to this project are protected by Magnuson Act's confidential regulations and PR's Fishing Law. On the other hand, this census is the first that includes interviews to the commercial marine ornamental fishers.

Table 1. Commercial Fishers by Category, Average Age and Municipality during 2008.

<i>Location</i>	<i>Captain</i>	<i>Helper</i>	<i>Full Time</i>	<i>Part Time</i>	<i>Average Age (years)</i>	<i>Total Fishers</i>
NORTH	129	33	105	57	44	162
Isabela	9	4	4	9	51	13
Quebradillas	0	0	0	0	0	0
Camuy	6	3	3	6	48	9
Hatillo	3	1	0	4	48	4
Arecibo	27	3	25	5	49	30
Barceloneta	6	0	6	0	60	6
Manatí	0	0	0	0	0	0
Vega Baja	13	2	9	6	48	15
Vega Alta	8	1	8	1	57	9
Dorado	11	1	5	7	52	12
Toa Baja	0	0	0	0	0	0
Cataño	10	0	9	1	56	10
San Juan	19	9	23	5	60	28
Carolina	1	0	1	0	62	1
Loíza	8	4	5	7	50	12
Río Grande	2	0	2	0	59	2
Luquillo	6	5	5	6	53	11
EAST	125	30	122	34	55	155
Fajardo	37	6	37	7	52	43
Ceiba	3	0	3	0	67	3
Naguabo	19	8	21	6	54	27
Humacao	4	0	4	0	61	4
Yabucoa	2	0	2	0	51	2
Maunabo	10	1	10	1	49	11
Culebra	11	1	1	11	57	12
Vieques	39	14	44	9	45	53
SOUTH	168	65	176	56	48	233
Patillas	4	0	0	3	42	3
Arroyo	4	0	4	0	66	4
Guayama	12	3	11	4	39	15
Salinas	25	11	25	11	55	36
Santa Isabel	2	2	3	1	57	4
Juana Díaz	15	4	15	4	49	19
Ponce	22	1	17	6	57	23
Peñuelas	13	4	13	4	52	17
Guayanilla	10	8	13	5	53	18
Guánica	21	14	27	8	42	35
Lajas	40	18	48	10	54	58
WEST	216	102	252	66	50	318
Cabo Rojo	105	45	136	14	46	150
Mayaguez	33	10	25	18	54	43
Añasco	8	6	9	5	47	14
Rincón	40	23	46	17	41	63
Aguada	6	5	9	2	56	11
Aguadilla	24	13	27	10	55	37
TOTAL	638	230	655	213	49	868

RESULTS

A total of 868 commercial fishers were interviewed by the port samplers (Table 1). A 75% (655) of persons mentioned that they were full time fishers and 25% (219) mentioned that they were part time fishers (Table 1). The west coast had the highest number of fishers by coast, with 318 (37%). The municipality that reported more fishers was Cabo Rojo, with 150 (Table 1). A total of 74% were captains (owner of his own fishing vessel) and 26% were helpers. A total of 528 commercial fishers (60%) mentioned that they belong to fishing association.

Average age for all PR's commercial fishers was 49 years old (Table 1). The older average age by coast was the east coast, with 55 years old (Table 1). On the other hand, the younger average age by coast was the south and north coast with 44 years old (Table 1). The municipality of Ceiba reported the older population of fishers, with 67

years old and Guayama had the younger with an average of 39 years old.

Approximately 66% (578) of the interviewed fishers have DNER license (Table 2). Approximately 43% of the commercial fishers received an education below grade 12 or high school (Table 2). On the other hand, 40% percent (348 fishers) completed the high school (Table 2). Only 6% completed university and 3% obtained a technical profession (Table 2).

Table 3 shows the average hours dedicated weekly by commercial fishers to different fishing tasks during 2008. All coast combined shows that most of 30 hours weekly were dedicated to the fishing task (Table 3). On the other hand, vessels (5 hours average) and gear maintenance (5 hours average) take more hours than marketing with only four hours average weekly (Table 3). The result shows that fresh fish are easy to sell.

TABLE 2. Fishing License and Highest Scholarship Reached by Commercial Fishers by Municipality during 2008

LOCATION	Fishers with License	Fishers with no License	Scholarship (grade)										TOTAL
			6th	9th	12th	Univer sity	Post Graduate	Technical Profesion	Some University credits	Some graduate school	No formal education	No report	
NORTH	95	67	32	34	63	7	4	8	8	0	3	3	162
Isabela	3	10	3	5	4	0	0	0	1	0	0	0	13
Quebradillas	0	0	0	0	0	0	0	0	0	0	0	0	0
Camuy	3	6	0	4	5	0	0	0	0	0	0	0	9
Hatillo	1	3	1	1	2	0	0	0	0	0	0	0	4
Arecibo	21	9	5	9	13	1	1	0	0	0	0	1	30
Barceloneta	4	2	0	0	2	1	0	2	0	0	1	0	6
Manatí	0	0	0	0	0	0	0	0	0	0	0	0	0
Vega Baja	13	2	3	2	6	2	1	0	1	0	0	0	15
Vega Alta	5	4	3	2	2	0	0	2	0	0	0	0	9
Dorado	7	5	1	2	5	0	2	0	2	0	0	0	12
Toa Baja	0	0	0	0	0	0	0	0	0	0	0	0	0
Cataño	9	1	2	1	3	1	0	2	1	0	0	0	10
San Juan	18	10	6	5	10	2	0	1	2	0	2	0	28
Carolina	1	0	0	0	1	0	0	0	0	0	0	0	1
Loiza	6	6	4	2	4	0	0	0	0	0	0	2	12
Río Grande	2	0	1	0	1	0	0	0	0	0	0	0	2
Luquillo	2	9	3	1	5	0	0	1	1	0	0	0	11
EAST	117	39	28	36	68	9	0	7	3	0	0	3	155
Fajardo	40	4	8	11	21	2	0	2	0	0	0	0	44
Ceiba	3	0	1	0	1	1	0	0	0	0	0	0	3
Naguabo	19	8	4	6	13	1	0	1	0	0	0	2	27
Humacao	4	0	1	1	2	0	0	0	0	0	0	0	4
Yabucoa	2	0	0	2	0	0	0	0	0	0	0	0	2
Maunabo	7	4	7	3	1	0	0	0	0	0	0	0	11
Culebra	4	8	3	1	6	2	0	0	0	0	0	0	12
Vieques	38	15	4	12	25	3	0	4	3	0	0	1	53
SOUTH	138	95	52	41	100	12	2	4	12	0	9	1	233
Patillas	3	0	0	0	3	1	0	0	0	0	0	0	4
Arroyo	4	0	2	1	1	0	0	0	0	0	0	0	4
Guayama	11	4	2	3	6	0	1	1	1	0	1	0	15
Salinas	16	20	9	7	15	2	0	1	2	0	0	0	36
Santa Isabel	3	1	1	0	3	0	0	0	0	0	0	0	4
Juana Díaz	12	7	2	3	11	1	0	1	0	0	1	0	19
Ponce	19	4	3	3	12	1	0	1	1	0	2	0	23
Peñuelas	10	7	4	4	5	1	0	0	2	0	1	0	17
Guayanilla	9	9	7	4	7	0	0	0	0	0	0	0	18
Guánica	19	16	4	6	16	3	1	0	3	0	1	1	35
Lajas	32	26	18	10	21	3	0	0	3	0	3	0	58
WEST	228	90	84	77	111	12	4	9	12	0	5	4	318
Cabo Rojo	111	39	44	35	56	4	1	4	1	0	3	2	150
Mayaguez	31	12	7	15	12	3	1	0	4	0	1	0	43
Añasco	5	9	2	5	4	0	0	0	1	0	0	2	14
Rincón	44	19	11	9	28	5	2	3	5	0	0	0	63
Aguada	9	2	2	3	4	0	0	1	1	0	0	0	11
Aguadilla	28	9	18	10	7	0	0	1	0	0	1	0	37
TOTAL	578	291	196	188	342	40	10	28	35	0	17	11	868

Table 3. Average Hours Dedicated Weekly by Commercial Fishers to different fishing tasks by Coast during 2008.

Coast	Fishing	Vessel Maintenance	Gears Maintenance	Marketing	Total Interviews
North	30	4	4	4	162
East	32	4	4	4	155
South	31	5	6	5	233
West	33	7	7	4	318
Average for all coasts combined	32	5	5	4	868

TABLE 4. Percentage of Fish target by Commercial Fishers by Coast During 2008.

(Note: Because is a multi-gear fishery, the fishers are able to fish in more than one category)

Reef Fishes	Ornamental	Deep Water Snappers	Pelagic Fishes	Lobster	Conch	Octopus	Bait	Land crab	Sirajo gobies	Total of Interviews
88	1	72	65	28	13	2	53	9	8	162
76	2	72	67	65	35	0	33	11	0	155
88	1	4	30	57	45	19	31	6	1	233
65	2	52	27	47	35	1	19	2	0	318
77	2	56	42	49	33	6	31	6	2	868

Table 5. Percentage of Marine Fishing Locations Where Commercial Fishers Target their Catches During 2008. (Note: Because is a multi-gear fishery, the fishers are able to fish in more than one category)

Location	Shore	Shelf Break	Continental Shelf	Oceanic Waters	Total of Interviews
North	66	83	90	46	162
East	48	67	84	60	155
South	22	45	93	25	233
West	14	52	71	27	318
Percentage of all Coasts Combined	32	59	82	36	868

Table 6. Percentage of How Commercial Fishers Manage of the Fish and Shellfish Catch by Coast during 2008.

Coast	Gutted and Ice	Gutted with no Ice	Whole in Ice	Whole without Ice	Conserve alive in a Water Compartment	Total of Interviews
NORTH	10	0	72	13	2	162
EAST	8	3	53	13	21	155
SOUTH	37	28	19	17	0	233
WEST	24	41	15	19	5	318
Puerto Rico all Coasts Combined	22	23	34	16	6	868

Puerto Rico's fishery is multigear and multispecies. The commercial fishers target different categories of fish and shellfish and most of them fish more than one category. Table 4 shows percentage of fishers target categories by coast and all coast combined. Reef fishes were targeted by 77% of PR commercial fishers, 56% targeted deep water snapper, 49% lobster, 42% pelagic fishes, 33% conch and 31% bait (Table 4). Ornamental fishery was targeted by 2% (Table 4).

Due to the multispecies and multigear fishery, it was observed that most fishers exploited two or more fishing locations. A total of 32 % of the fishers interviewed fished on the shore, 82 % on the continental shelf, 59 % on the shelf edge and 36 % on oceanic waters (Table 5).

PR's commercial fishers manage the catch in different ways. Table 6 shows the percentage of catch management by coast and for all coast combined. Whole fish in ice was used by 34% of all commercial fishers, 22% used gutted and Ice (Table 6). Gutted and no ice was used by 23% of the total fishers, and whole without ice was used by 16%. In the west coast 41% of the fishers used gutted without ice (Table 6).

Commercial fishers would use two or more ways to market their catch. Fishing marketing results by coast is shown in Table 7. All coast shows that approximately 70% of the commercial fishers sell the whole catch using one market choice. On all coasts Fish Houses Fishing Association and Walking were the most used ways to sell the catch (Table 7).

A total of 670 active fishing vessels were reported in Puerto Rico during 2008 (Table 8). From this 53% were constructed since 1990 to 2008. A total of 49.7% of the fishing vessels has a length of 20 - 29 feet (Table 8), followed by 47.6% fishing vessels from 10-19 feet length. A total of 72% of the total vessels interviewed were constructed of fiberglass. The horse power (HP) average for motors in Puerto Rico was 80.1 HP.

Fishing vessels electronic equipment and haul equipment reported by coast are shown in Table 9. Results of fishing gear by coast are shown in tables 9. A total of 10,244 hook and line units were reported (Table 9). Hand lines were 56% of total hook and line gears, followed by troll lines to catch pelagic fishes was 13%, and the anchored bottom lines was 11% to fish deep water snapper. Most commercial fishers used hook and line gear to obtain their catch. On the other hand, net categories reported 1,712 units (Table 9). The beach seine was banned since March 12, 2007, due to this fact data from this gear was not asked in this census. From the total net gears, lobster trammel nets were 44%, gill nets were 21 %, fish trammel nets were only 6 %, and the cast nets were 29 % . Trap categories reported 9,597 units (Table 9C). From the total of traps the reef fish trap was 47 % , lobster trap was 41% and 12% was deep water snapper traps (Table 9). On the other hand 142 commercial fishers practiced skin diving and 246 practiced SCUBA diving. A total of 775 SCUBA

tanks, 375 harpoons or spears, and 322 snares to catch lobster, were reported (Table 9). Twelve of the mentioned divers were dedicated to practice commercial ornamental fishery, the equipment reported by them were the ornamental hand nets and slurp guns (Table 9).

The average number of crew per fishing vessel in the PR's commercial fishery was 2 (Table 10). The income produced by commercial fishing activity was grouped by 100% - 75; 74 - 50%; 49% - 20%; and less than 20% (because the PRFR established that a commercial fisher has a minimum 20%). A total of 80% of the interviewed commercial fishers mentioned that they produced an income greater than 50% from their fishing activity (Table 10).

The census asked commercial fishers about their perception of the fishery status in 2008, compared with the period when they began to fish. Only 8% of the commercial fishers reported that they had the perception that the fishery resources are better than in the past (Table 11). However, 45% of commercial fishers thought that fishery status is the same (Table 11). On the other hand, 46% of the commercial fishers thought the fishery resources are worst than in the past (Table 11). A total of 28.5% fishers think that the main reason that affected the worst fishery resource status was pollution (Table 11), followed by 12%;fishers that think habitat destruction was responsible (Table 11). Only 9% of commercial fishers think that overfishing is the main reason for the fishery resources declination (Table 11). In other causes that resulted in a worst status of fishery resource, 13% commercial fishers mentioned global warming and 10% mentioned that the DNER fishing regulations (Table 11).

The census asked commercial fishers to report the three most significant socioeconomic problems. The CFSP personnel conferred with all fishers to report their opinion in this report. Due to the mentioned fact, socioeconomic problems noted were grouped by different categories and subcategories (Table 11). Most of the census interviews occurred when the cost of gasoline and diesel were around \$4.00/gallon, thus 59.7% of the fishers mentioned the operational cost was very high and resulted in a decrease of fishing trips (Table 11). The next category most reported was the DNER Fishing Regulations 6768, a total of 35% of the fishers noted this category. The subcategory of whole Fishing Regulations was noted by 150 fishers, the subcategory of Closed Season was noted by 109 fishers. Marketing was noted by 146 fishers, especially the subcategory of Weak Economy, resulted in Slow Sales noted by 9% of the fishers.

DISCUSSION

In 1931, a total of 1,403 active commercial fishers were reported in Puerto Rico (Jarvis 1932). The number of active commercial fishers, vessels, and motors were very similar for the census of 1988, 1996 and 2002, although a decreased was observed in 2008 census show in Figure 2

Table 7. Percentage of How Commercial Fishers Marketing Their Catch During 2008.

	North Coast	East Coast			North Coast	East Coast		
	100 % - 75 %	74 % - 50 %	49 % - 25 %	< 24 %	100 % - 75 %	74 % - 50 %	49 % - 25 %	< 24 %
<i>Marketing</i>								
Fishing Association	26	10	0	0	21	4	0	0
Restaurants	2	0	1	0	3	2	2	0
Fish House	15	0	0	0	24	13	0	0
Owner of Fish House	5	0	0	0	1	0	0	0
Walking	28	10	0	2	28	11	4	0
	South Coast	West Coast			South Coast	West Coast		
	100 % - 75 %	74 % - 50 %	49 % - 25 %	< 24 %	100 % - 75 %	74 % - 50 %	49 % - 25 %	< 24 %
<i>Marketing</i>								
Fishing Association	28	1	0	0	20	3	0	0
Restaurants	0	1	0	0	9	1	1	0
Fish House	25	2	0	0	40	1	0	0
Owner of Fish House	6	0	0	0	4	0	0	0
Walking	36	2	2	0	23	2	1	0

Table 8. Vessel characteristics of commercial fishing fleet.

	North Coast	East Coast	South Coast	West Coast	Puerto Rico	N
Number of fishing vessels	134	124	176	236	670	868
Number of gasoline and diesel engines	132	134	181	255	702	868
Average length of primary vessel (ft)	18.8	21.0	19.2	19.9	19.7	624
Average total engine propulsion of primary vessel (hp)*	78.2	103.1	64.9	80.1	80.1	642
Average crew size	1.9	2.0	1.9	1.9	1.9	847
Percentage of primary vessels whose length lies between (ft)						
< 10	0	1.8	0.6	0	0.5	624
10-19.9	55.0	16.5	55.8	52.5	47.6	624
20-29.9	45.0	75.2	43	44.8	49.7	624
30-39.9	0	6.4	0.6	2.3	2.1	624
> = 40	0	0	0	0.5	0.2	624
Percentage of primary vessels being built between						
< = 1969	7.7	5.3	4.3	1.4	4.1	583
1970-1979	16.3	17.3	13.6	21.7	17.7	583
1980-1989	17.8	21.3	25.3	17.5	20.2	583
1990-1999	25.6	34.7	27.2	28.6	28.3	583
> = 2000	32.6	21.3	29.6	30.9	29.7	583
Percentage of primary vessels that have hulls made of						
Aluminum	1.5	0	1.2	0.4	0.8	641
Fiberglass	72	82.9	48.8	62.3	64.7	641
Wood	9.8	0.8	15.7	18.2	12.5	641
Fiberglass and wood	16.7	16.3	34.3	18.6	21.8	641

(Matos-Caraballo et. al. 1989, Matos-Caraballo 1997, Matos-Caraballo 2005). The decreased of active commercial fishers during 1996 – 2002 occurred mostly because of the overfishing resources (Matos Caraballo, 2007). On the other hand, the 2008 census shows another decreased in the number of only 868 active commercial fishers. This is the lowest number of active fishers in Puerto Rico since 1931. This event occurred primarily because of the fishing regulations established in 2004. The law 278 of November 29th, 1998, and the PR's Fishing Regulation 6768 established definitions for commercial fishers and required the every commercial fisher must submit the finance records to Hacienda Department (Puerto Rico's IRS). Many fishers claimed to CFSP personnel that they do not have a fishing license because they did not want to do their taxes to keep receiving the PR's welfare and health care. Most of the

mentioned persons were part-time fishers. Another requirement to commercial fisher is to monthly complete the sales tax report. Most persons did not like to write these reports, so they did not have the fishing license. Another burden for part-time fishers is that they have to pay taxes for the fishing income, while full-time fishers have tax free for 90% of their fishing income. On the other hand, most of full-time fishers have fishing licenses because of the Agriculture Department financial assistance and because of the DNER Rangers pressure. Another fact that incentive part-time fisher to move to other jobs was the implementation of the fishing regulations as closed seasons during the spawning aggregations that produced high profits and the minimum legal sizes. These regulations decrease the income of all fishers, but were most sensitive to part-time fishers. The percentage of full-time

Table 9. Number of primary vessels, fishing gear and equipment by coastal regions.

	North Coast	East Coast	South Coast	West Coast	Puerto Rico	N
Total lines	2,493	2,266	2,704	2,781	10,244	868
Total Skin/Scuba	42	118	91	108	359	868
Total traps	419	2,886	3,508	2,774	9,597	868
Total nets	318	340	543	511	1,712	868
Global Positioning System (GPS)	47	60	32	120	259	868
Depth finders	62	37	40	75	214	868
Fish finders	60	60	35	41	196	868
Radios	62	29	40	70	201	868
Emergency Position Indicating Radio Beacons (EPIRB)	0	6	5	24	35	868
Cellular phones	94	95	72	132	393	868
Electric reels	89	24	35	69	217	868
Hydraulic reels	1	8	10	17	36	868
Winches	22	41	26	37	126	868
Snares	23	101	78	120	322	868
Spears	52	85	136	102	375	868
Tanks	74	192	204	305	775	868
Gaffs	82	68	256	172	578	868
Baskets	12	70	82	111	275	868
Slurp guns	0	1	0	2	3	868

Table 10. Average Crew per fishing vessel and Number of Commercial Fishers by their Percentage of Income Produced from fishing Activity by Coast in 2008.

	Average Crew per Vessel	% of Income Produced by Fishing Activity					Total of Interviews
		100-75 %	74-50 %	49-20 %	Less than 20 %	NO REPORT	
NORTH	2	45	48	43	25	1	162
EAST	2	91	17	26	20	25	155
SOUTH	2	139	65	16	15	0	233
WEST	2	230	62	18	10	5	318
Puerto Rico all Coasts Combined	2	505	192	103	70	31	874

Figure 2. Number of Active Commercial Fishermen, Vessels, and Motors Reported in Puerto Rico's Fishing Census between 1988-2008

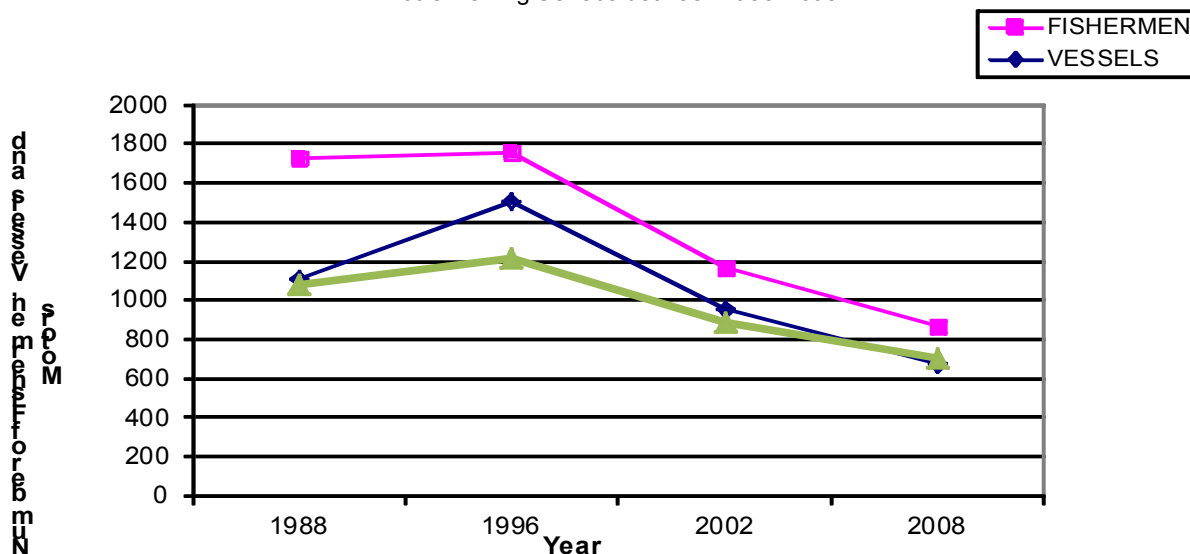


Table 11. Perceptions about the biological and socio-economic condition of the fishery by region.

	North Coast	East Coast	South Coast	West Coast	Puerto Rico	N
Perception of fish stock condition (%)						
Better off than other years	2.6	16.9	3.5	11.0	8.4	843
Same than other years	41.7	35.9	48.7	49.2	45.4	843
Worse off than other years	55.8	47.2	47.8	39.7	46.1	843
Reasons for the declining condition of fish stocks (%)						
Overfishing	10.5	5.8	9.4	9.7	9.1	868
Pollution	48.8	31.6	29.2	16.0	28.5	868
Habitat destruction	15.4	23.2	12.0	5.7	12.3	868
Other reasons	24.1	21.3	30.0	31.1	27.8	868
Other reasons for the declining condition of fish stocks						
Regulations	17.9	39.4	37.1	41.1	36.1	241
Weather and ocean conditions	46.1	24.2	35.7	26.3	31.9	241
Climate change	5.1	9.1	22.9	15.1	14.9	241
User conflicts	7.7	9.1	4.3	9.1	7.5	241
Coastal development	1.03	6.1	0	2.0	3.3	241
Main socio-economic issues						
High fuel costs	79.6	43.2	56.2	60.14	59.7	868
High fishing costs (excluding fuel)	15.4	20.0	26.6	27.7	23.7	868
Regulations	28.4	22.6	37.8	42.4	35.0	868
Weather and ocean conditions	15.4	10.3	20.6	9.8	13.8	868
Coastal development	13.6	1.9	6.9	4.1	6.2	868
User conflicts	1.23	2.6	2.6	2.5	2.3	868
High cost of life	15.4	13.5	4.7	3.8	7.9	868
Low fish prices and slow markets	14.2	25.2	5.11	5.0	10.4	868

fishers increased from 64 % in 2002 (Matos-Caraballo et al. 2007) to 75% in 2008. This fact is important because the reduction in active commercial fishers occurred mostly in part-time fishers. West coast (324) fishers and the municipality of Cabo Rojo (150 fishers) continued being the most active coast and municipality, respectively. Also, it is important to mention that 64% of the fishers had fishing licenses. During most of 2008, the cost of gasoline was over \$4.00/gallon, reducing the fishery activity, and resulting in less active commercial fishers.

For the 2002 census, it was observed that although 595 less active commercial fishers moved to other jobs, 3.5 millions of pounds have been reported per year in Puerto Rico since 1995 - 2002, meaning that fishery resource continue on high pressure during this period (Matos-Caraballo 2007). On the contrary, for 2008 fishery census fewer fishers and also landings reported decreased to 1.3 millions pounds. This occurred because of the fishing regulations (e.g. closed seasons) and for the decreased number of commercial fishers. The number of fishing vessels (Figure 2) and fishing gear decreased during the same period (Figure 3). Thus, it is concluded that the fishing pressure decreased during 2002 - 2008.

Average ages per coast show that the distribution of active commercial fishers varies from 44 to 57 years. The average age for all Puerto Rico's commercial fishers was 49 years. That means that most of commercial fishers are relatively old persons. The east coast had 253 active commercial fishers in 2002 (Matos-Caraballo et al. 2005), decreasing to only 155 in 2008. The average age for the east coast fishers was 55 years old. The commercial fishery in the east coast has been reducing dramatically during the last six years. If a significant number of young fishers do not enter to work in this profession in the next 10 years for Puerto Rico, the commercial fishery activity would disappear. On the other hand, in my experience I learned that every successful recreational fisher will sell his catch. In Puerto Rico, the number of recreational fishers was estimated in 200,000. Thus, it is very probable that many successful recreational fishers will enter into the commercial fishery in the following years. However, the DNER and NOAA must continue to monitoring this activity in the coming years.

Tropical marine waters have high biodiversity. Due to this fact, Puerto Rico's fishery is multispecies and multi-gear. The census data confirms that most fisher in Puerto Rico use two or more fishing locations and two or more fishing types and gears. Geographical site influences the fishing location and fishing type. For example Aguada and Aguadilla have a small continental shelf, the oceanic waters are close to the coast, and thus the fishers from those municipalities practice more pelagic fisheries. The north coast has approximately six months of strong surges that difficult vessel fishing trips, thus they practice more inshore fishing. The continental shelf contains the first two species most landed in pounds, lobster and conch, and

also contains all reef fish species. The use of the continental shelf was 70% in 1996, 83% in 2002 and 82% in 2008. The shelf break decreased from 43% in 1996 to 19% in 2002, increased to 59% in 2008. Since 1992, the CFSP mentioned that 90% of silk snapper *Lutjanus vivanus*, was caught before reaching the minimum size of sexual maturation, 410 mm Fork Length (Matos-Caraballo 2007). The fishing regulations established during 2004-2007, a minimum legal size. Since 2007, the minimum legal size was changed to closed season (October – December). CFSP biostatistics data analysis of deepwater snapper species including the silk snapper shows that the resource started to improve since 2004. It is expected that the closed season will help the recovery of silk snapper. However, queen snapper is also fished heavily at the shelf break. In 1996, a 46% of active commercial fishers exploited the oceanic waters, in 2002 48%, and in 2008 only 35%. The high cost of the fuel and the fishing regulations were responsible for the decrease in this practice. The use of the shore decreased from 31% in 1996 to 17% in 2002, increasing to 32% in 2008. Again, the high costs of fuel stimulate more fishers to fish on shore.

The target species shows that 77% of the fishers catch reef fishes, however, the CFSP shows that the most targeted species during the last five years were the lobster (\$6.00/pound) and conch (\$4.00/pound). A total of 72% of all fishers interviewed targeted at least one of these species, mostly because the fishers know that the cost per pound for these two species increases their earnings. Trammel nets and fish traps were targeting lobsters for the past five years, decreasing the pressure on reef fishes. The same reason explained why 58% of the fishers targeted the deep water snapper (\$3.50/pound). The market first class reef fish category cost only \$1.60/pound. Only 56% of commercial fishers used ice to healthy conserve their catch. Most SCUBA divers and pelagic fishers from the northwest mentioned that their catch is keeping alive when they arrive to the dock. On the other hand, the reef fishes and deep water snapper fishers mentioned that without ice it was very difficult to conserve the catch in healthy conditions (31%).

Data collected during this census, suggested that fishers learned to better market their catch. They spent an average of only four hours marketing their catch. Most fish buyers mentioned to CFSP personnel how difficult it is to keep fishers selling constantly to the same fish buyer. The problem is that one fish buyer increases the price, and the fishers immediately sell the catch to this person. Also, most fishers use two or more marketing strategies to increase their income. However, during 2008, approximately 66% of the fishers sold their catch to fishing associations, fish houses, or restaurants. Approximately 36% of the fishers sold their catch walking, but they mentioned that they had a number of customers that are easy to sell their catch. The percentage of fishers selling

by walking decreased from 41% in 1995 - 1996 to 28% in 2002, to 36% in 2008. The percentage of fishers that sold their catch to their own fish store changed from 13% in 1995 - 1996, to 3% in 2002, increasing to 6% in 2008. Many fishers claim that many restaurants are using fish products from USA, Brazil, or Mexico.

Significant changes occurred in the fishing gear used in Puerto Rico during 1988 - 2008 (Figure 43). Lines decreased for the first time since 1988 census (Figure 3). Nets and divers were very similar since 2002 - 2008 (Figure 3).

On the other hand, traps decreased dramatically since 1996, when 15,877 were reported to only 9,597 in 2008 (Figure 3). The fish trap was the most used gear in PR during the 1960s until 1982, when this gear reported approximately 50 - 70% of total landings (Juhl and Suárez-Caabro 1973, Matos-Caraballo In press). During the 2007 - 2008, traps reported only 15% of the total landings. Trap fishers mentioned many reasons for this decrease. First, commercial fishers think that fish trap's high cost limited the number of users. Second, trap fishers claim that many divers steal the traps underwater. Also, other trap's fishers steal traps belonging to their peers. The fish trap stealing issue has resulted in fisher fights offshore, and during the last three years approximately 10 diver's vessel were burned in criminal actions. Divers suspected that these criminal actions were organized by trap fishers, which believe that they steal their trap's catch. However, no one has been accused for the mentioned acts, and all divers claim that they did not steal from traps. On the other hand, the fish traps caught an average of 15 pounds/trap haul during late 1960s, and for the last years was an average of 1 pound/trap haul (Matos-Caraballo 2007). Another important reason for the decrease mentioned by some fishers, and confirmed by the CFSP data, is the overfishing reef fish resource.

The number of nets reported 1996 were similar to 2008. However, the beach seine has been banned since March 12th, 2007, due to this fact there is no mention of this gear included in this census. Even though, many fishers request reconsideration to use the gear again. They recommend increasing the seine mesh size and/or the DNER established specific locations for the use of this gear. On the other hand, many fishers mentioned that this gear destroys many juvenile species, such as mackerels, jacks, and snappers, thus the ban must continue. Other fishers recommend the elimination of the trammel net, because this gear is submerged for weeks to catch lobster. During the period, many fish species are caught and discarded, because when fisher checked the trammel only twice a day, so the fish die and are decomposed when the nets are pulled. The Fishery Regulation 6768, mentions that the trammel net must be submerged, but the owner must be near to the gear. Since March 2007, the beach seine is legally permitted by the DNER. The size of the beach seine net mesh increased from 0.5 in to 2 inches. In

future census, information about the beach seine must be collected.

A total of 2,505 more line units were reported in 2002 census than in 1995 - 1996 (Matos-Caraballo 1997, Matos-Caraballo et al. 2005). On the contrary, the line category decreased by 1,295 units in 2008 compared with the 2002 fishing census. This decrease is explained by the reduction of 286 fishers since the 2002 fishing census. Most fishers use lines, so that explains the reduction. Also, the part-time fishers that abandoned the commercial fishery use mainly lines. However, the line category is the most effective and efficient gear to catch commercial fish such as snappers, groupers, tunas, dolphin fish, and mackerels.

The divers (skin and SCUBA) were 36 % in 1996, and in 2002 increased to 53% of the total fishers (Matos-Caraballo et al. 2005). In 2008, divers were 41% of the total active commercial fishers. Due to the decrease in the fishery resource, the fishers were obligated to use more active gears to improve their catches. The divers' main targets are the lobster and conch. During 2004 - 2007, lobster and conch were the most reported landed species in Puerto Rico. Divers also have another advantage, they can fish when the weather hinders other fishing activities. Also, it has been observed that younger commercial fishers are divers.

The divers category included the ornamental fishers. Previous to the year 2001, when the DNER established a special permit for this activity and the implementation of the Regulation 6768 in 2004, the ornamental fishery was practiced with very little government intervention (Matos-Caraballo et al. 2008). After the mentioned period, they did have fishing licenses, did have to report their landings to the DNER/CFSP, and also needed a special permit to practice ornamental fishing. Because previous to the 2004 the CFSP had no contact with ornamental fishers, thus they were not interviewed in the 1988, 1996, and 2002 fishing census. They started to submit their reports in 2003, and they have been cooperative to CFSP. They also were very friendly and cooperative with the census personnel. Approximately 15 ornamental fishers were interviewed. In the group were high school and university students who practice the ornamental fishery as a part-time activity, using their profit to pay school tuition. Some ornamental fishers only practices skin diving, mostly in the northwest rocky beaches. The group mentioned that they practice conservation and claim to the DNER to add more species to be legally caught for this business. They also mentioned that the operational costs were too high, and importation of products from the Indo-Pacific makes the business very competitive. They mentioned that probably every Puerto Rico's pet shop that sells Caribbean ornamental fishes has one or two illegal ornamental fishers. They think that probably 20 or more illegal ornamental fishers are active. The census personnel tried to identify these fishers, interviewing pet shops owners, but they said that they bought from USA dealers. The census personnel recom-

mend to DNER Rangers a more aggressive surveillance and enforcement to characterize this illegal activity.

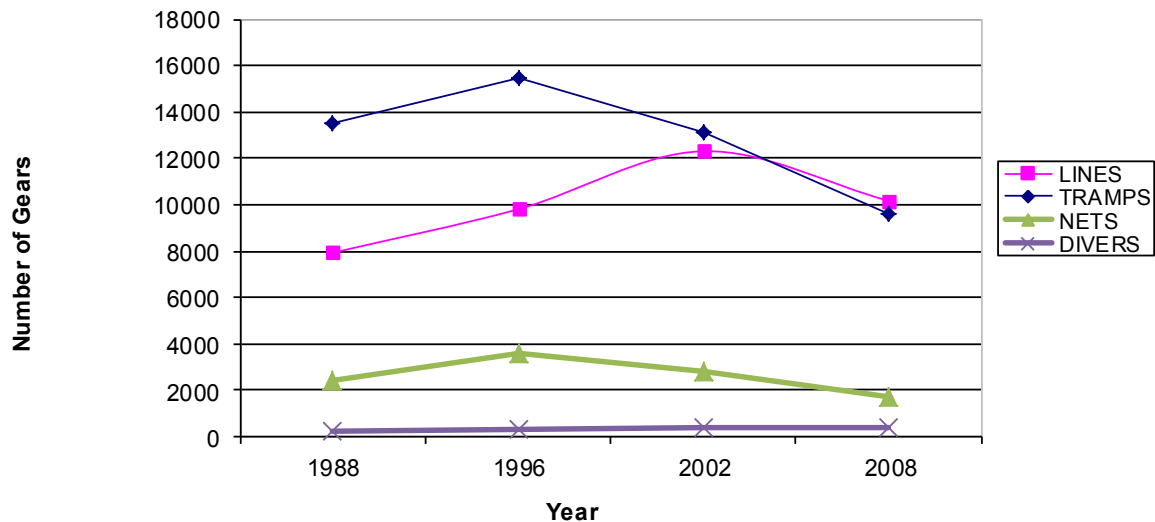
The average crew per fishing vessel in the PR's commercial fishery was two. It is known that divers fishing mostly has a crew composed of three fishers. That means that many fishers practice fishing activity alone. The fishing activity contains a personal high risk, thus fishing alone can have fatal results. During the fishing census, at least two lone commercial fishers died. On the other hand, a total of 80% of the interviewed commercial fishers produced an income higher by 50% from other fishing activity. That means 80% of the interviewed fishers consider themselves full-time commercial fishers, although 75% described themselves as full-time fishers.

The commercial fishers perception about the fishery status in 2008, shows that only 8% of them think the resource is better, 45% have the perception that it is the same compared with the period when they began to fish. On the other hand, 46% of the fishers reported that they thought the fishery resources are poorer than in the past. Twenty-eight percent of the interviewed fishers mentioned that the main reason that affected fishery resources is coastal pollution. On the other hand, 12% of the fishers think that habitat destruction was mainly responsible. Although they are correct in these conclusion, unfortunately most commercial fishers did not recognize that they over-exploit the fishing resources. Just 9% of commercial fishers think that overfishing is one of the main reasons for the poor status of fishery resources. Compared with 2002, when a total of 22% of the interviewed fishers mentioned that over-fishing was one of the main responsible factors for poor fishing resources, this represented a decrease of 10%. The data clearly show that Puerto Rico fishery has

been overfished since the 1980s (Matos-Caraballo 2007). Thus, the DNER must work harder to educate commercial fishers about overfishing resources. If they accepted the overfishing factor they will cooperate more with the conservationist fishing regulations. On the other hand, resulted very interesting observed that 15% of commercial fishers mentioned global warming as an important factor that affected the fishery results. They are correct because global warming cause coral reef bleaching and temperature changes and more hurricanes that affected the fishery resources. Hernandez, et al. (In press) describes that in 2005, a coral bleaching event affected PR's east coast and the Islands of Vieques and Culebra, resulting in the coral mass mortality. Hernandez et al. (In press) also mentioned that coral bleaching is direct a result from global warming. The 2005 PR's coral bleaching event declined the cover of coral reef living tissue around 60% - 95%. This event reduced the coral reef habitat. Also it is noted that global warming was a result of pollution. Is interesting to observe the contrast that how the fishers were well educated about global warming and uneducated about overfishing. The DNER has the challenge to educate commercial fishers about fishing regulations. One example that shows the mentioned need is that 36% of the interviewed commercial fishers mentioned that the DNER fishing regulations were responsible for the worst status of the fishery resource.

This group claims that the fishery resource is worst because of the closed seasons and minimum legal sizes. Regulations to conserve fishery resource can not be responsible to make worst the fishery resource. Again, the DNER must develop an educational program to commercial fishers.

Figure 3. Number of Lines, Tramps, Nets, and Divers Reported in Puerto Rico During 1988-2008



Commercial fishers reported many serious socioeconomic problems that affected them (Table 11); I will comment on the most significant. The main socioeconomic problem mentioned by 60% of interviewed fishers, was the high fuel cost that affected significantly their business. Because the cost of the gasoline was around \$4.00/gallon during the period of the census interview period, they mentioned they had to reduce the fishing trips. When the fuel cost is high in Puerto Rico, all other products prices also increase. Fishing lines, hooks, nets, wire to build traps, and the cost of air to refill SCUBA tanks increases. The cost of food, electricity, and water service increases too. In addition to the mentioned high cost, fishers claimed that because of the slow economy they cannot increase the fishing catch cost per pound. Even though they did not increase the price per pound, commercial fishers mentioned that the fish and shellfish sales were too slow. Although that the fuel price decreased for the last interviews to around \$2.00 per gallon, the operation cost continued to be considered high by fishers. The economy continues to be considered weak. Thirty-five percent of the interviewed fishers mentioned that the DNER Fishing Regulations 6768, reduce their fishing activity resulting in a decreased of their income (e.g. closed seasons, minimum legal size, etc.). This is a good sign, because three years ago probably 75% of the fishers thought that way. However, many fishers recognized today that closed seasons resulting in larger fishes and heavier catch. Those fishers support stronger enforcement to protect the closed season species. This is another good sign that the commercial fishers have accepted the benefits of the conservation actions in the DNER Fishing Regulations. On the other hand, the CFSP observed a decrease in landings reported from 2004 - 2006 (Matos-Caraballo 2007). Matos-Caraballo (In press) mentioned that the closed seasons will reduce the fishing activity and help to conserve fishery resources. Also, it is expected that the fishing regulations, such as closed seasons, will help to recover the Puerto Rico's overfished resources. Also, in the regulations issues, commercial fishers mentioned the license category was noted as a socioeconomic problem. Fishers claim the DNER fishing license process was too slow. They also mentioned they sent fishing applications to DNER and after 3 - 6 months they did not receive communication from DNER. Others mentioned they would like to eliminate the IRS section and/or the minimum percentage to be a commercial fisher. Another DNER activity that was mentioned by 8% of the commercial fishers was the ranger's interventions. They mentioned that many times they were boarded twice a day or three or more times per week. Commercial fishers claim that 90% of the intervention occurred for safety inspection (e.g. fire extinguisher, sailing lights, and Bengals lights) not due to fishing regulation. They recommend to the DNER to establish a form signed by the ranger and deliver to the commercial fisher after a safety inspection. If other rangers want to

inspect the boat again, the fisher just shows the inspection form, so the rangers do not have repeated the inspection in a couple of months. However, the rangers are free to inspect the fishing catch and the gear at any time.

CONCLUSION

The number of fishers in Puerto Rico did not show a significant change since 1931 - 1996. However, 595 less active commercial fishers were found in 2002, compared to 1996 census. Then in the 2008 census, reported 874 commercial active fishers that mean 295 less fishers compared with 2002. This is the lowest number since 1932. The mentioned reduction occurred for four main reasons:

- i) The CFSP, NOAA Fisheries have shown strong evidence that support the overfishing problem in Puerto Rico. Decrease in landings, catch of juvenile individuals, change in catch composition and change in gear used. Many fishers left the commercial fisheries because of the limited resources.
- ii) Also as many fishers claim there is evidence of habitat degradation and pollution that affected negatively the fishery resource (NOAA's Plan Development Team 1990). A total of 46% of commercial fishers in Puerto Rico mentioned that the fishery resource is worst that in the past. As a result of pollution, fishers mentioned the global warming effect that results in coral bleaching and coral mortality on the Puerto Rico east coast, Vieques and Culebra. These facts affected the fishery resources.
- iii) The implementation of the Puerto Rico's Fishing Regulations 6768 that contains closed seasons for many species, minimum legal sizes for other species and requires the Hacienda Department financial records. All those regulations discourage many fishers to continue in the commercial fishers.
- iv) During 2008 the fuel cost increased dramatically. This fact resulted in a decrease in commercial fishing effort because fishers reduce their fishing trips. However, they were not able to increase the fish and shellfish cost per pound because of the slow economy.

The implementation of Law 278 of November 28th, 1998 and the Puerto Rico's Fishing Regulations 6768 will help in the conservation of fishery resources. The immediate result was a decrease in number of fishers resulting in a decline of fishing effort on the resources (decrease in active fishers, boats and fishing gears). Also, fishers mentioned that the closed seasons improve the protected species. They recommend more surveillance to protect species during the closed seasons.

The DNER must develop outreach and education to commercial fishers to teach the importance of the conservation regulations. For example, any person before receiving his fishing license should participate in fishing conservation training. In this training, the person will receive education to conserve and know the fishing regulations. Also, the DNER rangers must develop a commercial fishing vessel safety inspection sheet to eliminate and/or diminish the multiple inspections to the same vessel in a short period (daily or weekly) by different rangers. However, the DNER can inspect the fishing catch every day for all fishing vessels.

Puerto Rico's commercial fisher's average age was 49 years old. Due to the old age of most commercial fishers, the future of this activity is uncertain. However, it is expected that a significant number of successful recreational fishers will enter into the commercial fishery to replace the retired commercial fishers. Puerto Rico's commercial fishery will continue to be a good business, 80% of those interviewed reported.

ACKNOWLEDGEMENT

I want to express my deep gratitude to all that made possible this fisheries census. To NOAA Fisheries, Caribbean Fishery Management Council and Puerto Rico's Department of Natural and Environmental Resources (DNER) that provided the funds. Also, I want to acknowledge Port Samplers Jesús León, Héctor Y. López, and Luis Rivera, who collected most of the data. To Statistics Clerks Alabaiz Mercado and Lucía T. Vargas, whom assisted port samplers to interview commercial fishers on the field, enter the data in computers and helped to create the tables and figures of this report. To Aida Rosario, Director of FRL and to Dr. Juan Agar, NOAA Fisheries for their valuable contributions to this report. To Graciela García Moliner and María de los Angeles Irizarry from the CFMC for their valuable help in the administrative issues. Finally, I want to acknowledge all the commercial fishers that participated during the data collection; without their support this project couldn't been a success.

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