

Overview of Puerto Rico's Small-Scale Fisheries Statistics 1998-2001

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ABSTRACT

A total of 13,620,481 pounds (6,178 metric tons) of fish and shellfish were reported in Puerto Rico during 1998-2001. The mentioned landings have a market value of approximately \$27,407,302. The most important fish group, in terms of percentage of total pounds landed (fish and shellfish), for 1998 - 2001, were the deep water snappers (mainly *Lutjanus vivamus* and *Etelis oculatus*) 9 %, yellowtail snapper (*Ocyurus chrysurus*) 7 %, lane snapper (*Lutjanus synagris*) 7 %, mackerel species (*Scomberomorus cavalla* and *Scomberomorus regalis*) 5 %, various species of tuna 5 %, various species of grunts mainly the white grunt (*Haemulon plumieri*) 4 %, dolphinfish (*Coryphaena hippurus*) 4 %, groupers, principally red hinds (*Epinephelus guttatus*), reported 4 %, parrotfishes 3 %, and various species of trunkfish 3 %. The most important of the shellfish species were the spiny lobster (*Panulirus argus*) accounting for 9 % of total reported landings, and the queen conch (*Strombus gigas*) 8 %.

The gear type which accounted for the highest percentage of landings by weight of the total catch during 1998-2001, were lines (hand line, troll line, long line and rod and line) with 40 %. Lines were followed by traps (fish pot and lobster pot) with 24 %, nets (beach seine trammel net, gill net and cast net) with 21 % and diving (skin and SCUBA) with 14 %. Other gears were < 1 % of the total landings reported.

Highlights of the biostatistical data for most caught species in Puerto Rico's fishery will be discussed.

KEY WORDS: Biostatistical data, commercial fishery statistics, Puerto Rico.

Description de las Estadísticas de la Pesca Artesanal in Puerto Rico 1998-2001

Un total de 13.678.567 libras (6.204,6 toneladas métricas) de pescados y de crustáceos fue divulgado en Puerto Rico durante 1998-2001. Los aterrizajes mencionados tienen un valor comercial de \$26.946.777. Los grupos más importantes de los pescados de términos del porcentaje de las libras totales aterrizadas (los pescados y los crustáceos incluidos) para 1998-2001, eran el snapper de rabo amarillo (chrysurus) de *Ocyurus* el 9 %, los snappers profundos del agua (principalmente *vivamus* de *Lutjanus* y *oculatus* de *Etelis*) el 7 %, la especie de la caballa (*cavalla* de *Scomberomorus* y los *regalis* del *S.*) el 5 %, varia especie del atún

el 5 %, dolphinfish (*hippurus*) de *Coryphaena* el 4 %, varia especie de los groupers (principalmente *guttatus* de *Epinephelus*) el 4 %, varia especie de parrotfishes el 3 % y varia especie del trunkfish el 3 %. Aterrizado más por los crustáceos del peso era la langosta espinosa (*Panulirus argus*) el 9 % y conch de la reina (*gigas*) de *Strombus* el 7 %. Los resultados de los aterrizajes de la especie por el engranaje y por la costa serán demostrados y discutidos. También, los toques de luz de los resultados biostatistical de los datos para la mayoría de las especies cogidas serán discutidos en este papel.

PALABRAS CLAVES: Industrias pesqueras en reducida escala, estadística de industrias pesqueras, Puerto Rico.

INTRODUCTION

The Fisheries Research Laboratory (FRL) of the Puerto Rico Department of Natural and Environmental Resources (DNER) monitors the commercial landings of fish and shellfish in Puerto Rico. The Fisheries Statistics Program (FSP) was implemented in 1967 under the Commercial Fisheries Research and Development Act of 1964 (PL 88-309) to collect data on the commercial fishery. Currently, this project is supported by the NOAA/National Marine Fisheries Service (NMFS) through the State/Federal Cooperative and Interjurisdictional Fisheries Programs and the DNER.

The objective of the Puerto Rico Fisheries Statistics Program is to maintain reporting services on the commercial finfish and shellfish resources of Puerto Rico, as well as manage and disseminate the fisheries statistics through coordination of activities between NMFS, FRL/DNER and other interested groups. The principal goals of this program are:

- i) Collect landings data from the island of Puerto Rico ensuring coverage of all coastal municipalities and their major fishing centers.
- ii) Determine the total weight of principal finfish and shellfish landed in Puerto Rico each month.
- iii) Determine the ex-vessel value of principal finfish and shellfish species landed in Puerto Rico each month.
- iv) Manage, correct, evaluate, summarize data and prepare semiannual and annual performance reports.
- v) Collect and analyze biostatistical data of the Puerto Rico's commercial fishery.

PROCEDURES

Commercial Landings Data

Commercial fishery landings data were collected from Puerto Rico's fishermen, fish buyers and fishing associations, whom voluntarily cooperate with the FSP. Four

port samplers and the principal investigator visited the 42 coastal municipalities including the islands of Vieques and Culebra, and the 88 identified fishing centers. The data collected from January 1998 - December 2002 are presented in this paper. Efforts were made to collect the following data: fishing date, name of fish buyer, fisherman and/or helper (to avoid data duplication), municipality, fishing center (municipality landing area); number of trips; gear type; fishing effort (hours spent fishing); weight in pounds by species or taxonomic family; market value to the fisherman (price in U.S. dollars/pound); maximum and minimum fishing depth and fishing area. Trip tickets were completed using species common names and identification was possible by using an amended version of the bilingual technical report "Common Names of Fishes in Puerto Rico" (Erdman 1987). A numerical system of species identification was developed to correspond with species codes used in Erdman's publication. Fishermen usually landed fishes in the round (not eviscerated), except deepwater snapper and large grouper that they usually landed gilled and gutted. Lobster, oyster and octopus were also landed in the round, and conch weights included meat only. Land crab statistics were reported in number of dozens with each dozen assumed to produce 1 lb. of meat. Some landings were reported as one of four classes of fish (first, second, third and "trash" fish) reflecting their market value: "trash" fish are perceived to have little or no market value. Classification varied somewhat by region but the following descriptions were used to characterize each class broadly: first class fish included large snapper, grouper, grunt, trunkfish and hogfish; second class included small snapper and grouper, parrotfish, goatfish, and triggerfish; third class included smaller individuals of second class fish and large squirrelfish. The "trashfish" category included butterflyfish, angelfish, surgeonfish, small squirrelfish and small fishes of a large number of species (Matos-Caraballo and Sadovy 1990).

Catch per unit of effort (CPUE) was evaluated for landings data by calculation of total pounds per trip, making a subsample by month, using only those landings trip tickets that clearly indicated a single trip.

Landings data was entered in computer, using Microsoft FoxPro 2.6, checked against the original landing trip tickets, corrected and analyzed using Microsoft FoxPro 2.6 and Microsoft Excel. All data presented in this report are raw data. As in previous years (1988-97) a correction factor was used in calculations to correct for under-reporting. The correction factor was expressed as the percentage of fishermen that regularly cooperated with statistics divided by the total number of active fishermen in the Island of Puerto Rico. A total of 1,758 commercial fishermen were active during 1994 - 1997 (Matos-Caraballo 1996). The correction factor for 1998 and 1999 was 78 %, for 2000 was 57 % and for 2001 was 68 %. Correction factors before 1989 are discussed in Matos-Caraballo and Sadovy (1990; 1991) and Matos-Caraballo (1992; 1993; 1995; 2001).

Commercial Biostatistical Data

Biostatistical data of finfish and spiny lobster were collected by port agents. Each individual was identified by species to determine catch composition. Finfishes

were measured in fork length (FL) and spiny lobster in carapace length (CL), both in millimeters (mm), and weighed in grams. Data were recorded on data sheets form. The form was designed to facilitate entry and processing of effort data. Biostatistical data were entered in Trip Interview Program (TIP) developed by NMFS Southeast Fishery Science Center. Later, the data stored in TIP was converted to FoxPro and analyzed using Microsoft Excel. The data collected include date, name of fisherman, fishing area, depth, gear, species, length, weight and effort by gear type. When possible, sex and gonad stage were visually inspected

RESULTS

Commercial Landings Data

In Puerto Rico during 1998, it was estimated that a total of 4,427,467 pounds of fish and shellfish were landed, with a market value of \$8,946,870 (using the correction factor of 78 %). During 1999, it was estimated that a total of 4,265,435 pounds of fish and shellfish were landed, with a market value of \$8,795,880 (using the correction factor of 78 %). For 2000, it was estimated that a total of 5,756,130 pounds of fish and shellfish were landed, with a value of \$11,793,159 (using the correction factor of 57 %). In 2001, it was estimated that a total of 5,233,859 pounds of fish and shellfish were landed, with a value of \$10,800,657 (using the correction factor of 68 %). The correction factor of 78 % of total fishermen cooperating with the Program in 1998-99 is the highest since 1988 when 56 % of fishermen cooperated.

Reported data show that from January-December 1998, a total of 3,453,424 pounds were reported, in 1999 was a total of 3,327,039 pounds were reported, for 2000 a total of 3,280,994 pounds and for 2001 a total of 3,559,024 pounds (Table 1).

A total of 32,839 trip tickets were collected during 1998, 35,545 throughout 1999, 38,887 for 2000 and 41,949 for 2001. Landings were principally comprised by five species of shellfish and 45 groups of species or families of finfish, although a total of 155 finfish groups and/or species and 10 shellfish species were reported by fishermen.

A total of 13,620,481 pounds (6,178 metric tons) of fish and shellfish were reported in Puerto Rico during 1998-2001. The mentioned landings have a market value of approximately \$27,407,302. The most important fish group, in terms of percentage of total pounds landed (fish and shellfish), for 1998-2001, were the deepwater snappers (mainly *Lutjanus vivamus* and *Etelis oculatus*) 9 %, yellowtail snapper (*Ocyurus chrysurus*) 7 %, lane snapper (*Lutjanus synagris*) 7 %, mackerel species (*Scomberomorus cavalla* and *Scomberomorus regalis*) 5 %, various species of tuna 5 %, various species of grunts mainly the white grunt (*Haemulon plumieri*) 4 %, dolphinfish (*Coryphaena hippurus*) 4 %, groupers, principally red hinds (*Epinephelus guttatus*), reported 4 %, parrotfishes 3 %, and trunkfishes 3 % (Table 1). The most important of the shellfish species were the spiny lobster (*Panulirus*

argus) 9 % of total reported landings, and the queen conch (*Strombus gigas*) 8 % (Table 1).

Table 1. Landings reported by species and coast in Puerto Rico during 1998 - 2001

SPECIES	1998		1999		2000		2001	
	POUNDS	*P/P	POUNDS	*P/P	POUNDS	*P/P	POUNDS	*P/P
FISH								
Tuna								
Blackfin tuna	480	1.28	982	1.05	3,274	1.10	25,288	1.05
Little tunny	21,078	0.85	16,210	0.85	17,175	1.03	20,323	1.08
Striped tuna	51,622	1.12	46,318	1.18	32,174	1.14	36,301	1.07
Yellowfin tuna	41,693	1.21	46,813	1.22	45,755	1.17	35,362	1.31
Tuna category	53,720	1.13	45,820	1.14	36,165	1.28	26,147	1.33
Ballyhoo	49,448	1.28	50,649	1.24	55,834	1.27	60,805	1.25
Questa	115,813	1.51	118,255	1.52	118,344	1.46	185,641	1.43
Hopfish	46,843	2.10	45,819	2.10	55,419	2.17	66,843	2.25
Trunkfish	90,893	1.82	83,854	1.79	83,785	1.89	77,814	1.78
Dolphinfish	137,038	1.80	130,055	1.82	137,729	1.87	111,075	1.88
Squidfishes	18,598	1.29	14,885	1.85	16,036	1.27	18,813	1.23
Mullet	53,451	1.30	81,935	1.22	54,105	1.25	61,128	1.23
Jack								
Bar jack	27,186	1.38	40,895	1.43	43,285	1.35	50,546	1.41
Horse-eye jack	6,121	1.45	5,108	1.42	7,588	1.85	6,807	1.40
Yellow jack	3,313	1.39	2,021	1.24	2,490	1.06	3,934	1.29
Jack Category	81,517	1.57	38,774	1.62	30,405	1.46	36,188	1.41
Parrotfishes	97,669	1.43	80,718	1.47	73,873	1.55	98,255	1.46
Groupers								
Coney	13,920	1.80	10,254	1.82	11,871	2.00	15,981	1.85
Red hind	84,974	2.08	85,912	2.05	81,230	2.09	80,988	2.18
Misty grouper	5,508	2.26	5,717	2.13	5,284	2.12	6,222	2.18
Nassau grouper	19,085	1.54	14,857	1.63	12,863	1.85	15,705	1.85
Yellowfin grouper	1,781	1.80	3,348	2.18	11,208	2.10	3,708	2.18
Grouper category	40,388	2.04	47,283	2.05	40,781	2.18	54,180	2.22
Mojeres	19,383	1.57	22,072	1.85	18,249	1.89	19,445	1.80
Snappers								
Lane snapper	238,888	1.87	188,493	2.05	211,517	2.04	189,225	2.12
Yellowtail snapper	282,018	2.02	279,378	2.12	363,508	1.93	328,988	2.14
Blk snapper	213,124	2.72	228,277	2.78	196,483	2.88	281,722	2.89
Mutton snapper	77,388	2.05	86,348	2.11	85,807	2.03	80,663	2.13
Queen snapper	46,088	2.85	86,882	2.84	82,888	2.78	107,671	2.88
Vermillion snapper	18,881	2.35	17,237	2.43	22,367	2.30	44,661	2.34
Wenchman	2,302	2.44	3,544	2.33	4,822	2.31	7,731	2.72
Snapper category	58,545	2.03	69,031	2.04	60,237	1.98	80,114	2.08
Triggrfishes	64,382	1.56	48,821	1.56	41,888	1.59	80,620	1.50
Berytus	33,784	1.68	24,838	1.47	25,058	1.50	18,888	1.80
Porgies	26,545	1.57	34,577	1.52	28,853	1.52	37,031	1.51
Brooks	160	1.18	138	1.63	384	1.77	11,830	1.80
Tierpon	2,343	1.21	2,974	1.04	394	1.08	2,185	0.87
Goatfishes	15,008	1.68	26,203	1.87	20,703	1.85	22,475	1.85
Seahees	23,885	1.22	27,821	1.25	25,251	1.14	25,388	1.20
King Macareus	108,407	1.84	127,887	1.82	124,488	1.70	101,672	1.84
Care	71,403	1.84	83,924	1.88	83,788	1.80	84,711	1.92
Ray	18,181	0.86	3,149	0.84	10,201	0.87	3,637	1.07
Sharks	47,408	1.52	45,878	1.52	43,077	1.44	45,198	1.57
Whale	1,184	2.30	6,687	1.88	2,180	1.95	8,344	1.80
CLASSIFIED								
First Class	137,858	1.50	103,248	1.77	85,884	1.79	86,838	1.98
Second Class	120,050	0.77	108,771	0.70	36,483	0.81	32,775	1.31
Third Class	85,703	1.14	33,880	1.18	48,882	1.17	48,885	1.01
Trash	86	1.09	475	1.29	588	1.48	515	1.52
Other fishes	143,840	0.29	115,481	0.28	98,079	0.47	83,872	0.80
Total Fishes	2,830,487	1.81	2,725,070	1.82	2,876,880	1.82	2,887,488	1.70
SHELLFISH								
Conch	280,880	2.22	213,738	2.25	281,702	2.23	326,457	2.44
Lump crab	4,884	13.87	2,800	14.88	2,130	18.71	6,322	14.28
Lobster	298,388	5.24	338,814	5.27	258,154	5.05	288,018	2.83
Octopus	30,483	2.45	43,801	2.58	45,703	2.76	35,839	2.88
Marine crabs	2,478	3.84	2,813	2.41	2,211	2.06	3,251	2.80
Other shellfish	16,883	3.14	12,802	3.80	13,014	3.16	14,241	3.83
Total Shellfish	622,837	4.98	601,888	5.20	606,814	5.00	671,338	4.88
TOTAL	3,453,324	2.02	3,327,058	2.08	3,483,694	2.05	3,558,826	2.05

Matos-Caraballo (2001) observed that during 1993 - 1997, several fish and shellfish species that in the past were usually discarded by fishermen, have gained commercial importance. These species did not have market value years ago, now are easily sold at reasonable prices. During 1998 - 2001 this trend was observed. For example, Table 1 shows that the squirrelfish (e.g. *Holocentrus ascensionis* and *H. rufus*) was sold in 1997 at an average price of approximately \$1.29 per pound. Shellfish species in the same situation are marine crabs, *Carpilius corallinus*, and *Myithrax spp* were sold at approximately \$3.00/pound. On the other hand, species that have no market in Puerto Rico, *Acanthurus spp*, *Holocanthus ciliaris*, *Pomacanthus arcuatus*, and *P. paru* are fished in the municipality island of Vieques, to be sold in the market of Saint Croix, USVI.

The gear types (as defined in Matos-Caraballo and Torres-Rosado 1989), which accounted for the highest percentage of landings, by weight during 1998-2001, were lines (hand line, troll line, long line and rod and line together) taking 40 % of the total catch (Tables 2-5). Lines were followed by traps (fish trap and lobster trap) taking 21 % of the total reported catch (Tables 2-5). Traps were followed by nets (beach seine, gill net, cast net and trammel net) that accounted for 20 % of the total reported catch (Tables 2-5). Nets were followed by diving (skin and SCUBA), this gear class fished 19 % of the total reported catch (Tables 2-5).

During 1998 - 2001, prices varied markedly by municipality (Table 6). For example, in 1999, the lowest average price per pound for fish and shellfish was obtained on the north coast, in the municipality of Isabela at \$1.18, and the highest average price was obtained in the south coast, in the municipality of Patillas with \$3.17/pound in 2001 (Table 6). The most productive of the 42 municipalities during 1998-2001, was Cabo Rojo accounting for 18 % of the total landings, by weight (Table 6). The west coast, reported 34 % of the total weight, being the most productive, followed by the south, 32 %, the east, 21 % and the north, 13 % (Tables 6).

From a total of the trip tickets collected during 1998-2001, approximately 82 % clearly indicated that the catch referred to a single fishing trip (number of trips = 1). A subsample of these data by month was made. Fishing trips are generally of a half-day duration. The CPUE for landings was 54 pounds per trip (ppt) in 1998, 53 ppt in 1999, 71 ppt in 2000, and 68 ppt in 2001.

Table 3. Landings reported by species and by gear in Puerto Rico during 1999

SPECIES	BEACH SEINE (Pounds)	FISH TRAP (Pounds)	LOBSTER TRAP (Pounds)	GILL NET (Pounds)	BOTTOM LINE (Pounds)	TROLL LINE (Pounds)	LONG LINE (Pounds)	LAND CRAB TRAP (Pounds)	CAST NET (Pounds)
FISH									
Tunas									
Blackfin tuna	0	0	0	500	78	404	0	0	0
Little tunny	4,151	0	0	327	1,774	12,058	0	0	0
Striped tuna	2,399	0	0	2,362	8,146	25,246	55	0	25
Yellowfin tuna	0	0	0	1,039	3,991	43,915	0	0	0
Tuna category	1,494	0	0	1,829	13,344	29,724	60	0	124
Ballyhoo	236	189	0	47,478	1,534	520	73	0	539
Grunts	3,611	50,025	15	34,660	14,567	314	790	0	5
Hogfish	0	10,756	0	1,863	2,152	121	30	0	0
Trunkfish	95	56,520	853	4,979	3,464	64	44	0	68
Dolphinfish	0	0	0	1,541	14,791	113,303	275	0	0
Squerefishes	39	7,005	0	1,942	5,272	108	107	0	25
Mullet	2,175	1,586	96	83,585	1,857	140	187	0	2,129
Jacks									
Bar Jack	3,914	2,095	0	17,342	14,382	2,101	399	0	135
Horse-eye jack	15	91	0	919	3,802	109	36	0	17
Yellow jack	0	139	0	722	1,020	55	0	0	0
Jack Category	9,269	708	0	12,127	14,427	325	247	0	1,046
Parrotfishes	110	20,369	46	18,868	0	0	5	0	318
Groupers									
Coney	0	3,832	7	1,284	4,809	72	48	0	0
Red hind	30	12,746	26	1,326	30,939	66	288	0	48
Musty grouper	0	649	0	360	4,685	39	472	0	0
Nassau grouper	14	4,330	0	547	9,238	46	63	0	0
Yellowfin grouper	0	148	0	63	623	1	0	0	0
Grouper category	62	9,810	0	2,491	25,075	219	336	0	108
Mojarra	937	1,248	0	16,930	1,460	35	20	0	1,187
Snappers									
Lane snapper	3,133	71,484	0	32,005	51,991	0	33,853	0	1,508
Yellowtail snapper	4,117	22,711	5	14,170	227,099	0	6,781	0	127
Silk snapper	0	62,407	0	0	173,957	0	2,913	0	0
Mutton snapper	1,211	22,836	30	10,888	53,361	0	2,029	0	106
Queen snapper	0	1,371	0	0	54,919	0	10,383	0	0
Vermilion snapper	0	3,177	0	0	14,038	0	25	0	0
Wenchman	0	104	0	0	3,078	0	464	0	0
Snapper category	2,043	9,201	9	12,259	19,984	804	689	0	10
Triggerfishes	188	24,084	15	1,373	10,595	147	7	0	36
Barracudas	5,422	0	0	5,573	8,882	4,379	31	0	77
Porgies	1,244	12,841	0	13,761	5,445	69	72	0	0
Snooks	0	0	0	49	90	0	0	0	0
Tarpon	0	0	0	1,836	463	0	0	0	0
Goatfishes	0	11,784	0	11,041	3,036	86	12	0	75
Sardines	789	0	0	2,573	1,827	0	0	0	22,632
King Mackerels	1,887	0	0	12,771	61,168	46,138	1,290	0	164
Cero	1,804	0	0	15,273	25,783	18,995	1,173	0	879
Rays	91	0	0	421	587	0	0	0	0
Sharks	595	0	0	6,314	27,405	1,084	4,883	0	22
Wahoo	0	0	0	4,003	273	2,421	0	0	0
CLASSIFIED									
First Class	1,703	34,250	55	5,882	15,005	292	0	0	0
Second Class	1,800	34,811	0	9,189	1,051	0	0	0	0
Third Class	117	21,288	0	210	4,560	29	0	0	0
Trash	0	295	0	150	30	0	0	0	0
Other fishes	8,303	31,525	47	56,886	9,963	3,863	846	0	795
Total Fishes	62,809	536,021	1,004	443,643	953,401	313,904	69,073	0	32,197
SHELLFISH									
Conch	0	0	0	0	0	0	0	0	0
Land crab	0	0	0	0	0	0	0	2,600	0
Lobster	456	130,003	30,207	2,797	0	0	0	0	191
Octopus	69	2,067	204	558	0	0	0	0	54
Marine crabs	0	1,584	19	74	0	0	0	0	96
Other shellfish	54	5,801	0	2,443	0	0	0	0	0
Total Shellfish	579	139,275	30,430	5,842	0	0	0	2,600	341
TOTAL	63,388	675,296	31,434	449,485	953,401	313,904	69,073	2,600	32,538

Table 4. Landings reported by species and by gear in Puerto Rico during 2000

SPECIES	BEACH SEINE (Pounds)	FISH TRAP (Pounds)	LOBSTER TRAP (Pounds)	GILL NET (Pounds)	BOTTOM LINE (Pounds)	TROLL LINE (Pounds)	LONG LINE (Pounds)	LAND CRAB TRAP (Pounds)	CAST NET (Pounds)
FISH									
TUNES									
Blackfin tuna	0	0	0	36	164	3,044	0	0	0
Little tunny	4,264	0	0	1,203	769	10,262	0	0	0
Striped tuna	1,207	0	10	2,183	4,328	24,440	0	0	0
Yellowfin tuna	0	0	0	1,145	1,982	43,309	0	0	0
Tuna category	2,643	0	0	649	7,007	27,056	0	0	0
Ballyhoo	3,556	0	18	49,750	1,044	1,227	20	0	312
Grunts	10,924	41,019	0	36,871	17,046	117	647	0	410
Hogfish	296	11,293	10	1,799	1,655	37	3	0	0
Trunkfish	1,616	55,395	491	5,502	3,404	136	143	0	8
Dolphinfish	0	0	0	1,304	13,373	120,003	2,436	0	0
Squidfishes	770	5,284	0	2,148	7,029	273	86	0	29
Mullet	3,072	640	77	45,969	2,290	166	118	0	1,367
Jacks									
Bar jack	3,426	2,014	0	22,201	14,315	1,430	423	0	205
Horse-eye jack	64	228	0	1,802	5,181	157	21	0	30
Yellow jack	51	380	0	567	1,100	0	40	0	20
Jack Category	3,391	720	8	14,119	11,094	317	166	0	100
Parrotfishes	165	19,278	0	20,971	154	7	0	0	12
Groupers									
Coney	0	3,741	0	1,511	5,624	233	25	0	0
Red hind	8	12,974	0	2,021	33,782	320	199	0	80
Mtely grouper	0	590	0	163	2,801	0	1,177	0	27
Nassau grouper	0	2,311	16	496	9,052	243	80	0	6
Yellowfin grouper	0	6,775	0	144	373	0	28	0	0
Grouper category	602	7,156	0	1,635	19,038	370	1,065	0	111
Mojaras	895	1,468	27	12,166	1,012	91	540	0	1,543
Snappers									
Lane snapper	1,240	63,738	35	37,377	74,142	175	24,746	0	4,995
Yellowtail snapper	6,782	26,098	31	18,134	302,168	156	3,707	0	1,212
Silk snapper	0	62,208	0	690	126,350	0	20,367	0	0
Mutton snapper	390	21,364	27	15,219	39,722	0	2,652	0	174
Queen snapper	0	427	0	107	32,518	0	49,725	0	91
Vermilion snapper	10	6,331	0	720	16,499	0	637	0	0
Wenchman	24	62	0	1,159	3,461	0	246	0	0
Snapper category	139	7,631	10	14,450	19,032	46	458	0	60
Triggrfishes	334	19,803	16	1,614	6,616	236	85	0	13
Bermudians	2,578	445	0	11,968	6,323	4,299	10	0	22
Porgies	741	11,441	0	11,930	3,746	122	19	0	18
Shooks	140	0	0	86	15	128	0	0	10
Tarpon	0	0	0	311	25	16	0	0	0
Goatfishes	18	15,103	0	2,884	2,347	0	3	0	62
Sardines	776	173	0	1,506	1,272	0	2,277	0	19,018
King Mackerels	1,164	0	0	13,524	61,977	44,696	303	0	158
Cero	296	0	0	13,017	32,088	6,611	145	0	502
Fluys	0	0	0	238	81	96	0	0	0
Sharks	121	0	0	4,933	18,726	1,362	8,970	0	0
Wahoo	0	0	0	0	576	1,564	0	0	0
CLASSIFIED									
First Class	406	26,745	228	3,006	9,390	29	0	0	0
Second Class	4,467	22,802	0	4,892	1,678	0	0	0	0
Third Class	0	19,363	0	62	3,646	0	0	0	0
Trash	0	199	0	220	103	30	0	0	0
Other fishes	5,563	32,848	20	41,932	11,975	2,673	163	0	725
Total Fishes	64,070	600,144	1,019	426,141	940,096	295,596	121,850	0	31,431
SHELLFISH									
Conch	36	0	0	175	0	0	0	0	0
Land crab	0	0	0	0	0	0	0	2,130	0
LOBSTER	314	93,809	18,906	2,599	0	0	18	0	42
Octopus	3	1,421	13	837	0	0	0	0	93
Marine crabs	0	1,452	0	12	79	0	3	0	35
Other shellfish	480	3,004	44	4,212	1,410	145	0	0	1,037
Total Shellfish	633	99,696	18,965	7,635	1,489	145	21	2,130	1,207
TOTAL	64,903	699,830	19,984	433,776	941,545	295,641	121,871	2,130	32,638

Table 5. Landings reported by species and by gear in Puerto Rico during 2001

SPECIES	BEACH SEINE (Pounds)	FISH TRAP (Pounds)	LOBSTER TRAP (Pounds)	GILL NET (Pounds)	BOTTOM LINE (Pounds)	TROLL LINE (Pounds)	LONG LINE (Pounds)	LAND CRAB TRAP (Pounds)	CAST NET (Pounds)
FISH									
Tunas									
Bonito tuna	406	0	0	818	2,905	20,455	705	0	0
Little tunny	5,205	0	0	2,224	4,348	8,451	87	0	0
Skipjack tuna	707	0	0	3,673	8,702	24,222	0	0	0
Yellowfin tuna	199	0	0	530	2,542	30,844	1,159	0	0
Tuna category	978	0	0	2,428	6,387	10,375	340	0	0
Ballyhoo	578	606	185	56,695	1,951	82	0	0	478
Grunts	16,573	57,938	205	40,607	21,025	2,191	414	0	89
Hardhead	436	14,108	49	2,400	3,702	134	0	0	118
Trunkfish	2,175	54,624	520	6,997	3,285	171	32	0	121
Dolphinfish	0	0	0	1,815	20,117	84,649	1,781	0	0
Squirrelfishes	1,498	7,362	25	2,088	5,954	427	15	5	136
Mullet	1,800	1,037	19	51,993	2,975	591	20	0	2,389
Jacks									
Bar jack	3,663	3,261	21	20,244	18,294	1,121	355	0	272
Horse-eye jack	51	850	0	1,090	4,044	319	10	0	30
Yellow jack	697	177	1	1,050	697	30	0	0	0
Jack Category	6,629	1,722	0	10,290	16,290	2,125	43	0	381
Parrotfishes	864	23,695	17	21,365	841	55	31	0	344
Groupers									
Coney	0	4,978	0	1,947	7,017	0	241	0	101
Red hind	0	15,244	0	2,739	36,785	0	530	0	177
Misty grouper	0	636	0	519	3,672	0	1,134	0	0
Nassau grouper	34	2,406	0	722	9,756	0	32	0	8
Yellowfin grouper	0	553	0	391	1,222	0	0	0	0
Grouper category	100	18,630	0	2,928	21,872	249	879	0	10
Mojama	279	1,000	0	14,620	1,648	40	19	0	1,381
Snappers									
Lane snapper	4,480	56,339	336	32,503	66,559	571	17,482	0	148
Yellowtail snapper	12,858	23,371	175	15,700	265,728	354	2,577	0	162
Slit snapper	0	106,003	0	0	177,003	0	5,716	0	0
Mutton snapper	2,800	20,511	111	12,508	48,329	0	1,241	0	218
Queen snapper	0	2,724	0	0	94,581	0	10,386	0	0
Vermilion snapper	0	27,845	0	0	17,014	0	32	0	0
Wenchmen	0	1,784	0	0	5,860	0	117	0	0
Snapper category	844	8,904	13	12,496	24,896	529	800	0	159
Triggerfishes	50	29,325	57	2,283	12,159	1,015	288	0	132
Barracudas	4,775	0	0	6,316	6,384	1,614	72	0	58
Pomies	516	13,100	8	17,134	4,319	382	57	0	47
Snooks	1,241	0	0	7,017	2,638	793	0	0	110
Tarpon	152	0	0	1,833	142	66	0	0	0
Goatfishes	0	16,932	0	3,803	1,422	0	12	0	0
Sardines	1,051	699	0	3,246	2,539	0	211	0	17,662
King Mackerels	526	0	0	14,620	53,528	28,044	248	0	134
Caro	548	0	0	10,023	36,773	30,415	283	0	23
Rays	255	0	0	490	1,095	0	0	0	0
Sharks	631	0	0	7,267	21,088	993	9,311	0	200
Wahoo	0	141	0	28	6,365	1,180	0	0	0
CLASSIFIED									
First Class	80	45,353	151	427	14,475	102	16	0	0
Second Class	180	20,701	559	1,501	1,162	0	0	0	0
Third Class	533	26,402	0	221	7,811	0	0	0	0
Trash	0	124	0	26	130	27	0	0	0
Other fishes	5,773	20,896	28	45,308	7,923	1,019	37	0	586
Total Fishes	80,378	637,293	2,450	444,151	1,091,958	253,644	56,512	5	25,827
SHELLFISH									
Conch	0	0	0	203	0	0	0	0	0
Land crab	0	0	0	0	0	0	0	5,322	0
Lobster	281	102,003	32,198	1,480	0	0	0	0	317
Octopus	0	1,482	363	212	0	0	0	0	10
Marine crabs	15	1,903	15	157	0	0	0	0	10
Other shellfish	9	3,747	3	1,418	0	0	0	0	829
Total Shellfish	305	109,135	32,579	3,470	0	0	0	5,322	1,186
TOTAL	80,681	746,428	35,029	447,621	1,091,958	253,644	56,512	6,327	26,793

Table 6. Landings reported by municipality and by coast in Puerto Rico during 1998 - 2001

LOCATION	1998		1999		2000		2001	
	POUNDS	P/P*	POUNDS	P/P*	POUNDS	P/P*	POUNDS	P/P*
NORTH	436,026	1.84	420,522	1.82	342,113	1.81	569,893	2.14
Isabela	13,690	1.52	12,963	1.18	7,849	2.46	11,735	3.56
Quebradillas	0	0.00	0	0.00	0	0.00	0	0.00
Camuy	22,910	1.84	5,927	1.78	6,613	1.70	4,060	2.68
Hatillo	4,580	1.98	5,184	1.95	1,762	1.48	4,232	2.28
Arecibo	40,980	2.05	58,206	2.13	38,480	2.20	73,812	2.47
Barceloneta	37,280	2.23	19,198	2.13	21,858	1.88	36,736	2.26
Manati	18,326	2.33	14,127	1.91	11,901	1.97	17,361	2.04
Vega Baja	35,898	2.90	28,412	2.15	35,899	2.37	68,169	2.41
Vega Alta	15,371	2.13	9,071	2.19	17,596	2.10	28,694	2.15
Dorado	13,884	2.04	15,794	2.75	13,576	2.24	28,069	2.70
Toa Baja	1,136	1.23	2,819	1.41	4,848	2.31	1,010	1.49
Cataño	42,650	2.12	46,418	2.24	21,097	2.18	23,769	2.34
San Juan	80,590	2.25	96,594	2.15	91,082	1.98	133,003	2.10
Carolina	28,135	1.78	32,789	1.80	27,054	1.83	56,785	1.73
Loiza	43,099	1.52	28,568	1.88	10,950	1.87	43,752	1.97
Río Grande	16,570	2.31	32,583	1.99	21,188	1.85	34,254	2.08
Luquillo	20,975	1.94	13,847	1.78	10,762	2.13	4,452	2.05
EAST	608,379	1.88	650,043	2.05	664,287	2.24	848,758	2.37
Fajardo	135,003	1.77	150,003	2.06	128,003	2.22	179,003	2.20
Ceiba	67,064	1.76	58,111	1.81	78,839	2.34	139,003	2.42
Naguabo	86,869	1.97	159,003	2.19	159,003	2.35	178,003	2.53
Humacao	83,415	2.14	99,565	2.46	101,003	2.67	111,003	2.71
Yabucoa	12,886	1.88	30,289	2.18	48,568	2.03	39,869	2.03
Maunabo	25,911	1.87	67,827	1.65	21,689	1.89	23,120	2.20
Culebra	451	1.71	28,977	2.06	24,179	2.17	21,754	2.39
Vieques	215,000	1.95	56,288	1.98	103,003	2.24	257,003	2.47
SOUTH	1,059,601	2.03	1,090,326	1.96	1,243,346	2.02	1,040,871	2.43
Padillas	36,876	2.55	32,863	2.51	48,081	2.51	47,939	3.17
Arroyo	42,353	1.83	43,845	1.74	41,700	1.80	56,850	2.15
Guayama	145,656	2.05	142,003	2.01	107,003	1.84	106,582	2.26
Salinas	91,035	2.13	79,822	2.14	95,842	2.10	83,587	2.40
Santa Isabel	52,611	2.31	53,647	2.34	62,297	2.32	54,892	2.77
Juana Díaz	183,003	1.84	135,003	1.99	135,003	2.01	143,003	2.60
Ponce	112,003	1.96	94,244	1.93	137,003	1.87	103,003	2.18
Peñuelas	53,129	2.43	53,008	2.16	68,427	3.09	69,042	3.26
Guaynilla	21,929	1.42	54,988	1.08	60,004	1.13	69,747	1.53
Guánica	124,003	2.01	157,003	1.83	247,003	1.75	107,003	2.42
Lajas	215,003	1.81	243,500	1.78	221,003	1.85	199,003	1.89
WEST	1,349,418	1.81	1,168,148	1.86	1,031,248	1.87	869,502	2.14
Cabo Rojo	755,003	2.02	629,003	2.18	545,003	2.18	491,082	2.27
Mayaguez	105,003	1.78	107,003	1.86	84,643	1.85	87,763	2.04
Añasco	89,316	2.47	34,524	2.29	45,625	2.14	44,847	2.68
Rincón	88,355	1.82	106,003	2.09	121,003	1.84	122,003	2.58
Aguada	93,738	1.51	79,612	1.41	79,871	1.81	96,824	1.71
Aguadilla	238,003	1.23	210,003	1.33	145,003	1.43	157,003	1.54
TOTAL	3,453,424	1.88	3,327,039	1.92	3,280,984	2.01	3,558,024	2.27

Commercial Biostatistical Data

A total of 53,027 individuals caught by commercial fishers were measured and weighed during 1998-2000. Sex determination of fishes in the field has been difficult due to the reluctance of fishermen to permit this activity, and the general limitation in available time for measuring samples, and difficulties in assessing any but the ripest individuals, for sex.

The species most frequently measured from 1998 - 2000 were: *Ocyurus chrysurus*, *Haemulon plumieri*, *Lutjanus synagris*, *Pamulirus argus*, *Epinephelus fulvus*, *Epinephelus guttatus*, *Sparisoma chrysopterus*, *Lutjanus vivanus*, *Sparisoma viride* and *Scomberomorus cavalla*.

Figuerola et. al, (1998) indicated that *Ocyurus chrysurus* females reach Minimum Size of Sexual Maturation (MSSM) at around 248 mm FL and males at 224 mm FL. During 1998 - 2000, approximately 15 % of *O. chrysurus* individuals were taken below 224 mm FL.

Pamulirus argus has been protected under federal and local government management plans, for approximately the last 18 years. These management plans prohibit the capture and/or possession of *P. argus* below 89 mm (3.5 inches) of carapace length. During 1998 - 2000, approximately 18 % of the total individuals sampled by FSP were taken below the minimum legal size (MLS).

Epinephelus guttatus is the most abundant grouper species reported in Puerto Rico. Sadovy et. al. (1994) studied *E. guttatus* from 1987 - 1992, reporting that MSSM is 215 mm FL. *E. guttatus* taken below 215 mm FL, were approximately 3 % of the biostatistical samples during 1998 - 2000.

Figuerola (1991) reported that *Lutjanus vivanus* females reach MSSM at 410 mm FL. Biostatistics data of 1998 - 2000 show that approximately 97 % of total individuals of *L. vivanus* (males and females) were taken below the MMS of 410 mm.

DISCUSSION

Commercial Landings Data

The most reported groups by weight in the commercial fisheries landings for 1998 - 2001, showed that snappers, grunts, groupers, parrotfishes, mackerels, dolphinfish and trunkfishes. Reported commercial landings data reported have been around two millions pounds per year from 1987 - 94 (Matos-Caraballo in press). Since 1995, 96 and 97, an increase has been observed in the number of fishermen that cooperated with the FSP, resulting in 3.7, 3.6 and 3.8 millions pounds reported, respectively. Stability of this landings reports were consistent for 1998 - 2001. Approximately a total of 400 more commercial fishermen cooperated with FSP during 1997 than 1994. One possible reason to explain the increased landings reported might be due to an increase in the number of fishermen cooperated with the FSP during 1995 - 1997. This increase in participation probably occurred because the PRDNER and the Puerto Rico Department of Agriculture have provided

economical help to fishermen who cooperate on a regular basis to the FSP. Usually a certification from FSP is required. When we compare the landings reported in late 1970s and early 1980s (around 5 million-7 million pounds), with the reported landings of 1987 - 1997, an indication of overfishing is observed.

Another symptom of overfishing was observed in several species discarded by fishermen in the past that now have become commercial species (e.g. *Holocentrus ascensionis*, *H. rufus* and *Acanthurus spp.*). These species are now marketable due to the decrease in landings of preferred species, and an increase in the demand of more fresh fish products.

The fish market of Saint Croix USVI purchase the Vieques landings of *Acanthurus spp.*, *Holocentrus ciliaris*, *Pomacanthus. arcuatus*, *P. paru* and many juvenile reef fish species. The mentioned species are subject to severe fishing pressure.

The municipality of Cabo Rojo and the west coast have continued to be the most productive municipality and coast respectively since 1972 (Weiler and Suárez-Caabro 1980, Collazo and Calderón 1988, Matos-Caraballo and Sadovy 1990 and 1999, Matos-Caraballo 1993, 1995, 1997). However, the west coast has shown a tendency to decrease the percentage of total landings reported from 52 % in 1983 to 37 % in 1997, and 34 % in 1998 - 2001. For years 2000 and 2001 the south coast reported more landings than west coast for the first time since 1972. Cabo Rojo shows the same tendency (Table 6). Biostatistical data of FSP indicate that the fishing resources in the west coast are overfished (Matos-Caraballo in press). The mentioned tendencies are evidence of the need of effective management and enforcement to preserve the fishing resources of Puerto Rico.

Pots continued to show a decreasing trend in their catch percentages since 1982 (Matos-Caraballo and Sadovy 1990 and 1991, Matos-Caraballo 1992, 1993, 1995; and 1997), when fish traps alone caught 71.2 % of the total pounds reported (Collazo and Calderón 1988) to 24 % during 1994 - 1997, and continues decreasing to 21 % for the period of 1998 - 2001. On the other hand, an increasing trend was observed in the percentage of reported landings taken by all lines combined, when compared with 1982, in which the percentage was 12.4 % (Collazo and Calderón 1988) to 44 % during 1994 - 1997, 40 % for the period of 1998 - 2001. Nets have shown a similar trend. For example, the gill nets and trammel nets caught 2.7 % in 1982 (Collazo and Calderón 1988), while in 1998 - 2001 they caught 20 %. Young fishers were observed using SCUBA divers. They are very active, fishing 4-5 days per week and their main target are conch and lobsters. The diver gears reported 19 % of the landings during 1998 - 2001.

Average annual catch per unit effort (CPUE) in was estimated to be 63ppt - 80ppt during 1994 - 1997, for 1998 - 2001 was reported 53 - 71ppt. Collazo and Calderón (1988) mentioned that during 1979 - 1982, the CPUE for the vessels of 21-25 ft was 122.74 pounds/trip. It was observed that vessel over 30 feet length have almost disappeared from the Puerto Rico's commercial fishery. This is another evidence of the overfishing symptoms of Puerto Rico's fishery resources.

Commercial Biostatistical Data

The commercial biostatistical for *L. vivanus* data indicates that the Puerto Rico fishery resource is overfished. *P. argus* in Puerto Rico has a minimum legal size of 89 mm carapace length. During 1994 - 1997, a total of 36 % of *P. argus* sampled was caught below minimum legal size. However, for the period of 1998 - 2000, only 18 % of *P. argus* were caught before minimum legal size. This improvement occurred probably due to effective enforcement by the FMP and because this resource has a strong resilience to a high fishing pressure.

CONCLUSION

In 1979, reports of landings in Puerto Rico recorded 7,212,000 pounds of fish and shellfish. During the decade of the eighties, landings decreased consistently. During 1995 - 2001, reported landings ranged between 3.2 million and 3.8 million pounds of fish and shellfish. The vessels of >30 foot length have been diminishing. The Puerto Rico Fishery Census is in process and probably will result in a decrease of 500 commercial active fishers compared to the 1996 commercial fishery census. Landings information has shown that several fish and shellfish species that fishermen discarded in the past because they did not have market value are now easily sold. These species now have market value because of the decreased landings of the traditional valuable species. Another symptom of overfishing is evidenced in the CPUE data. During 1979 - 1982, average pounds per trip was 122.73 and in 2001, it had declined to 68 pounds per trip.

Another set of problems associated with the fishery resources is observed thru biostatistical data, which show that *L. vivanus* are consistently taken below the -MSSM. *P. argus* is protected by FMP that seems to be working, although this species is under heavy fishing pressure.

After the analysis of these facts, it is concluded that during 1998 - 2001, several fishery resources in Puerto Rico have continued to decline, despite an increase in the number of landings reported, due to an increase in the number of fishermen that cooperates with FSP. The information presented in this report urges the need for measures to protect the fishery resources of Puerto Rico, including the improvement of the enforcement of the existing fishing regulations and Fishery Management Plans.

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