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**Title** Comparison of Size Capture by Gear and by Sex of Spiny Lobster  
(Panulirus argus) in Puerto Rico during 1989-91

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GULF AND CARIBBEAN FISHERIES INSTITUTE, Inc.  
45TH MEETING, MERIDA MEXICO

COMPARISON OF SIZE OF CAPTURE BY GEAR AND BY SEX OF SPINY  
LOBSTER (*PANULIRUS ARGUS*) IN PUERTO RICO DURING 1989-91.

by

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## ABSTRACT

Puerto Rico's fishery is artisanal, multispecies, multigear and shows several indications of overfishing. To evaluate resource status and to enable the development of effective resource management it has been necessary to obtain size frequency data by species and by gear type.

Throughout 1989-91, port agents of the Fisheries Research Laboratory of the Puerto Rico Department of Natural Resources, randomly selected complete landings, identified all fish and lobster by species, measured (fish in fork length, lobster in carapace length (CL), both in millimeters) and weighed (in grams).

Approximately 3,200 spiny lobsters (Panulirus argus) caught by commercial fisheries were measured around the island of Puerto Rico between 1989-91. Landings reported by commercial fishermen during 1989-91 were approximately 530,000 pounds with an estimated value of \$2,120,500.00. Historical data of Panulirus argus has shown indications of overfishing and is currently protected by the Lobster Fishery Management Plan (LFMP). One LFMP's regulation consists in a minimum size of capture at 89mm CL, which is related to the minimum size of sexual maturity. Comparison of length (carapace) frequency distribution by most used gear types in lobster fisheries, the traps (fish and lobster pots) and diving (skin and SCUBA) were made using Kolmogorov-Smirnov test at  $p > 0.05$ .

Results indicate that Panulirus argus taken by diving during the three-year investigation were significantly larger than those

taken by traps,  $D_{max} = 0.0669$ . The average CL of Panulirus argus taken by diving was 92mm and 88mm for traps. Diving caught significantly larger males and females than traps ( $D_{max} = 0.0989$  and  $D_{max} = 0.0794$  respectively). Fifty-nine percent of the total individuals caught by traps were under the LFMP's minimum CL (89mm) while 50% of the total individuals caught by diving were under the minimum size.

Stronger law enforcement and more effective éducation programs directed toward commercial fishermen and the general public is recommended to promote the protection of the Panulirus argus.

Key words: Fisheries, Diving, Management, Panulirus argus, Traps.

## INTRODUCTION

The fishery of Puerto Rico is artisanal, multigear and multispecies. Most fishermen concentrate their efforts on shallow water reef fish and shellfish. Matos and Sadovy (1990) mentioned that since the 1980's, the Island fishery has shown indications of overfishing (e.g. changes in species catch composition, decreasing length of some species and a markedly decrease in landings reported).

Currently, spiny lobster (Panulirus argus) is one of the most expensive fishery products (\$4.50 U.S. dollar/pound average price) in Puerto Rico. Jarvis (1932) mentioned that in the early 1930's fishermen caught P. argus but did not have a good market for them, probably because it spoiled faster than other type of fishes. Valuable marketing for P. argus started approximately in the year 1947 (Feliciano, 1958). Many old commercial fishermen interviewed by the author mentioned that previous to year 1947, P. argus fished was mostly used as bait for traps. Overfishing indications in P. argus fishery had been observed since the early 80's, and due to this fact a Lobster Fishery Management Plan (LFMP) was implemented since 1985 in territorial waters (10.35 nautical miles from shore) and in federal waters (10.35 - 200 nautical miles from shore) of Puerto Rico. One LFMP's regulation consists in a minimum size of capture at 89mm of carapace length (CL), which is related to the minimum size of sexual maturity. Another important regulation is the prohibition to kill, possess, or disturb females with attached eggs.

During 1989-91, a total of 530,000 pounds of P. argus with an estimated value of 2,120,500.00 were reported. The foremost used gears through-out this period for the spiny lobster fishery were; traps (including fish and lobster pots) that fished 60% of reported landings, and diving (including skin and SCUBA) that fished 34%. During this study period, approximately 3,200 individuals of P. argus caught by commercial fisheries were measured and weighed around the Island.

The objectives of this research were: 1) to determine if there were significant differences on the length (carapace) frequency distribution (LFD) between P. argus caught by traps and those caught by diving; 2) to evaluate the efficiency of the LFMP for traps and diving commercial fishery gears.

#### METHODS

From 1989 to 1991 five port agents of the Fisheries Research Laboratory (FRL) of the Puerto Rico Department of Natural Resources visited landing areas around Puerto Rico's coastal areas including the municipality islands of Vieques and Culebra. Port agents visited different fishing centers four days per week and randomly selected fishermen landings to collect biostatistical data of fish and lobster. They proceeded to identify individuals caught (down to species level), fish were measured in fork length and lobster in CL, both in millimeters and weighed in grams. In this research data analysis was restricted only to P. argus. Observations about sex, females with attached eggs and/or sperm were registered. Port

agents delivered the data collected to the FRL, where the data was entered in the PC IBM format using commercial version of DBASEIII+.

The LFD data was checked for possible errors using regression and residual plots analysis. All the analysis were made using software Lotus 123 and Microsoft Excel. Comparison of CL frequency distribution by most commonly used gear types in lobster fisheries (traps and diving) and by sex were made using Kolmogorov-Smirnov test at  $p > 0.05$  (Sokal and Rohlf, 1981). Percentage of P. argus caught under 89mm and number of females with eggs and/or sperm were determined.

#### RESULTS

Table 1 shows P. argus mean CL by gear and sex for 1989-91. The mean size of CL of P. argus during the three year study was 88mm for individuals caught by traps and 92mm for individuals taken by diving. Table 1 also shows that mean size of CL P. argus males taken by diving were larger than P. argus taken by traps and that males caught by diving were also larger than females.

Figure 1 shows LFD for P. argus taken by traps and diving between 1989-91. Figure 2 shows LFD for P. argus taken by traps and by year. Figure 3 shows LFD for P. argus taken by diving and by year. Data from figures 1-3 were analyzed statistically using Kolmogorov-Smirnov two sample test. The test demonstrated that diving caught significantly larger individuals than traps and also had very different distributions ( $D_{max} = 0.0669$ ).

Figure 4 shows LFD for P. argus males caught by traps and by



diving. Figure 5 shows LFD for P. argus females caught by traps and diving. Kolmogorov-Smirnov two sample test demonstrated that males caught by diving were significantly larger than males caught by traps (Dmax = 0.989). The same test was made for females taken by traps and diving, resulting in no significant difference.

Percentage of P. argus caught below minimum legal size (89mm) was: 59% for traps and 50% for diving. Percentage of females with eggs attached (berried) taken by traps was 18% of the total individuals caught and by diving it was 7%. Females with attached sperm (tar patch) taken by traps accounted for 4% of the total individuals and was 21% for diving.

Figure 6 shows P. argus sampling by month and by sex throughout 1989-91. No pattern or seasonality was observed in the lobster fishery.

#### DISCUSSION

P. argus mean CL decreased from 117mm in 1951 (Mattox, 1952) to 107mm in 1957 (Feliciano, 1958), and the present 1989-91 mean CL was 88mm for traps and 92mm for diving. According to Mattox (1952), there were a total of 213 commercial fishermen catching P. argus during 1951. He estimated that 466,800 pounds of P. argus were fished, accounting for 200,000 individuals. On the other hand, the present 1991 data from the FRL indicates that there were 576 commercial fishermen fishing P. argus. They reported 211,941 pounds of lobster estimating that 135,786 individuals.

Traps caught smaller spiny lobsters than diving. Matos (in

press) compared LFD for traps, hooks and gill nets for reef fishes Haemulon plumieri, Lutjanus synagris, L. vivanus, Ocyurus chrysurus, and Epinephelus guttatus. The results also showed that traps caught significantly smaller fish than hooks and gill nets. Avoidance or minimization of catching sexually immature organisms in traps should be carefully studied and some type of regulation must be established.

This research demonstrated that P. argus males (92mm mean CL) caught by traps and diving, were larger than females (87mm mean CL). A tendency to catch males larger than females was reported by Mattox (1952). He found that in 1951 males had a mean CL of 127mm and females had a mean CL of 117mm . Feliciano (1958) did not report data concerning length differences between P. argus sexes, but he mention that males had a mean weight of 2.3 pounds and 1.7 pounds for females. Rosario (1987) analyzed LFD data of P. argus from 1982-83, finding a statistically significant difference between males and females.

The fact that 59% of P. argus caught by traps and 50% caught by diving were sexually immature, clearly indicates that the LFMP has been helpless. Another issue to be considered is that while berried lobsters are protected under the LFMP, 18% of the females caught in traps, and 7% collected by diving were berried. The absence of enforcement functionaries from state and federal governments around the landing areas was noted by FRL port agents and also mentioned to the author by commercial fishermen in the field. The LFMP regulations are appropriate but can not be

successful until current enforcement levels are expanded. Development of educational programs in schools, landing areas and the massive communications media is absolutely necessary to convince the P. argus users to follow the LFMP.

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TABLE 1-LOBSTER MEAN CARAPACE LENGTH BY GEAR,  
AND BY SEX DURING 1989-91.

Females									
1989			1990			1991			
Gear	Mean	STD	n	Mean	STD	n	Mean	STD	n
Trap	80.7	14.7	107	***	***	***	87.7	13.5	162
Diving	88.1	14.1	288	89.2	13.2	300	89.3	13.8	535

Males									
1989			1990			1991			
Gear	Mean	STD	n	Mean	STD	n	Mean	STD	n
Trap	85.1	16.3	116	***	***	***	91.6	14.6	194
Diving	95.1	17.5	427	93.9	14.5	285	94.5	17.3	632

STD = Standard Deviation

\*\*\* = n < 50

#### LIST OF FIGURES

- Figure 1. Length frequency distribution for Panulirus argus taken by traps and diving, during 1989-91.
- Figure 2. Length frequency distribution for Panulirus argus taken by traps, during 1989 and 1991.
- Figure 3. Length frequency distribution for Panulirus argus taken by diving, during 1989-91.
- Figure 4. Length frequency distribution for Panulirus argus males taken by traps and diving during 1989-91.
- Figure 5. Length frequency distribution for Panulirus argus females taken by traps and diving during 1989-91.
- Figure 6. Number of Panulirus argus taken by traps and diving sampled by month and by sex during 1989-91.













