

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

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## ABSTRACT

Puerto Rico's fishery is artisanal, multispecies, multi-gear 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) each species.

Approximately 3,200 spiny lobsters (*Panulirus argus*) caught by commercial fisheries around the island of Puerto Rico between 1989-91 were measured. 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 this species is currently protected by the Lobster Fishery Management Plan (LFMP). One LFMP's regulation consists of a minimum size of capture at 89 mm 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 92 mm and 88 mm 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 (89 mm) while 50% of the total individuals caught by diving were under the minimum size.

Stronger law enforcement and more effective education programs directed toward commercial fishermen and the general public are 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, multi-gear and multispecies. Most fishermen concentrate their efforts on shallow water reef fish and shellfish. Matos and Sadovy (1990) state that since the 1980s, 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 1930s 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 prior to 1947, *P. argus* was mostly used as bait for traps. Overfishing indications in the *P. argus* fishery had been observed since the early 80s, and due to this a Lobster Fishery Management Plan (LFMP) was implemented in 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 89 mm 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 landed. The gears used foremost throughout 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 around the island were measured and weighed.

The objectives of this research were: 1) to determine if there were significant differences in the length (carapace) frequency distribution (LFD) between *P. argus* caught by traps and those caught by diving; and 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's landings to collect biostatistical data of fish and lobster. They identified individuals caught (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 a commercial version of DBASEIII+. The LFD data was checked for possible errors using regression and residual plots analysis. All the analyses were made using software Lotus 1-2-3 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). The percentage of *P. argus* caught under 89 mm 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 88 mm for individuals caught by traps and 92 mm 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 ( $D_{\max} = 0.989$ ). 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 (89 mm) 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 7% of the total taken by diving. 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 117 mm in 1951 (Mattox, 1952) to 107 mm in 1957 (Feliciano, 1958), and the present 1989-91 mean CL was 88 mm for traps and 92 mm 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

**Table 1.** Lobster mean carapace length by gear, and by sex during 1989-91.

Gear	FEMALES								
	1989			1990			1991		
	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

Gear	MALES								
	1989			1990			1991		
	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

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 to be 135,786 individuals.

Traps caught smaller spiny lobsters than diving. Matos (1996) 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 commercial species in traps should be carefully studied and some type of regulation must be established.

This research demonstrated that *P. argus* males (92 mm mean CL) caught by traps and diving, were larger than females (87 mm 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 127 mm and females had a mean CL of 117 mm. Feliciano (1958) did not report data concerning length differences between *P. argus* sexes, but he mentioned that males had mean weights of 2.3 pounds and for females 1.7 pounds Rosario (1987) analyzed LFD data of *P. argus* from 1982-83, and found 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 not yet been effective. 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 from state and federal

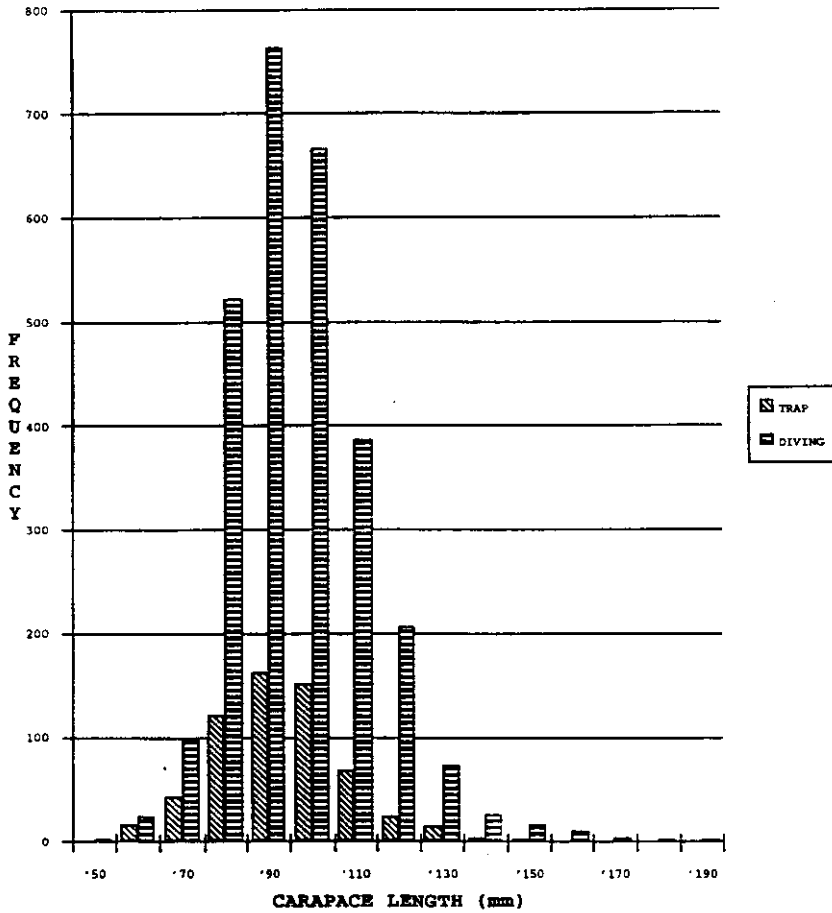


Figure 1. Length frequency distribution for *Panulirus argus* taken by traps and diving, during 1989-91.

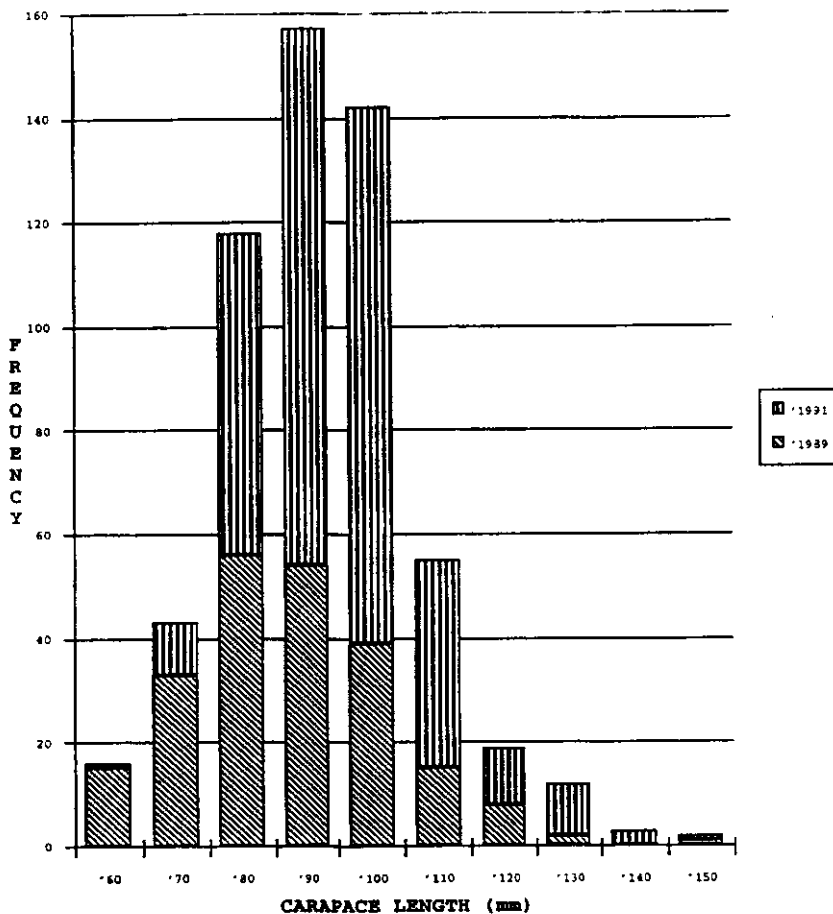


Figure 2. Length frequency distribution for *Panullirus argus* taken by traps, during 1989 and 1991.

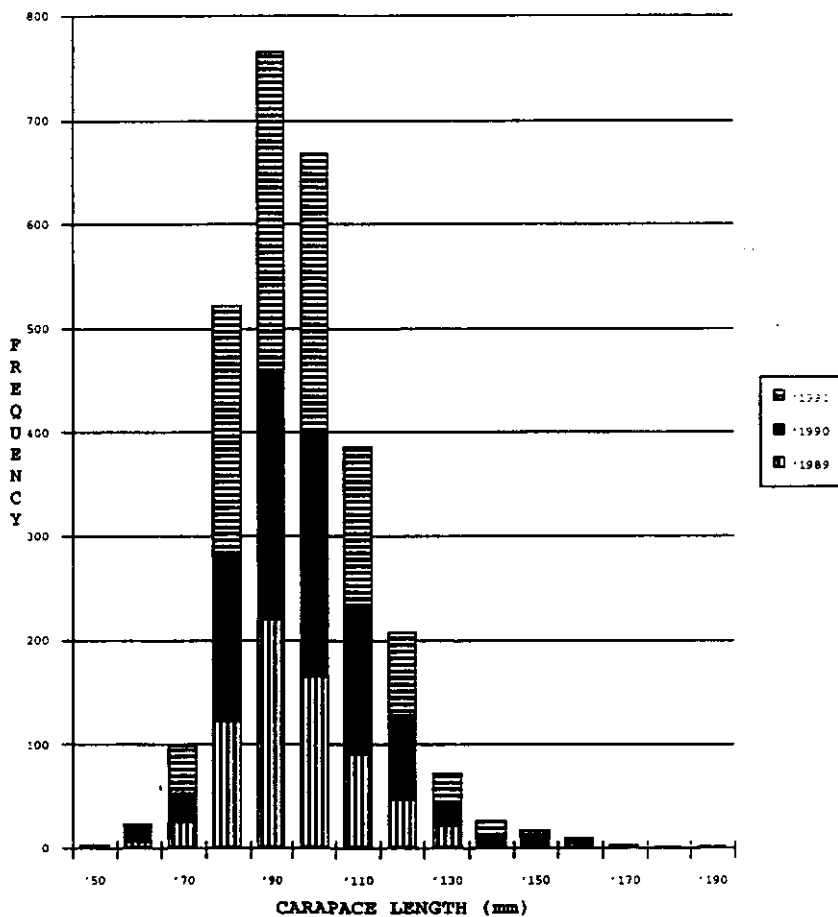


Figure 3. Length frequency distribution for *Panulirus argus* taken by diving, during 1989-91.

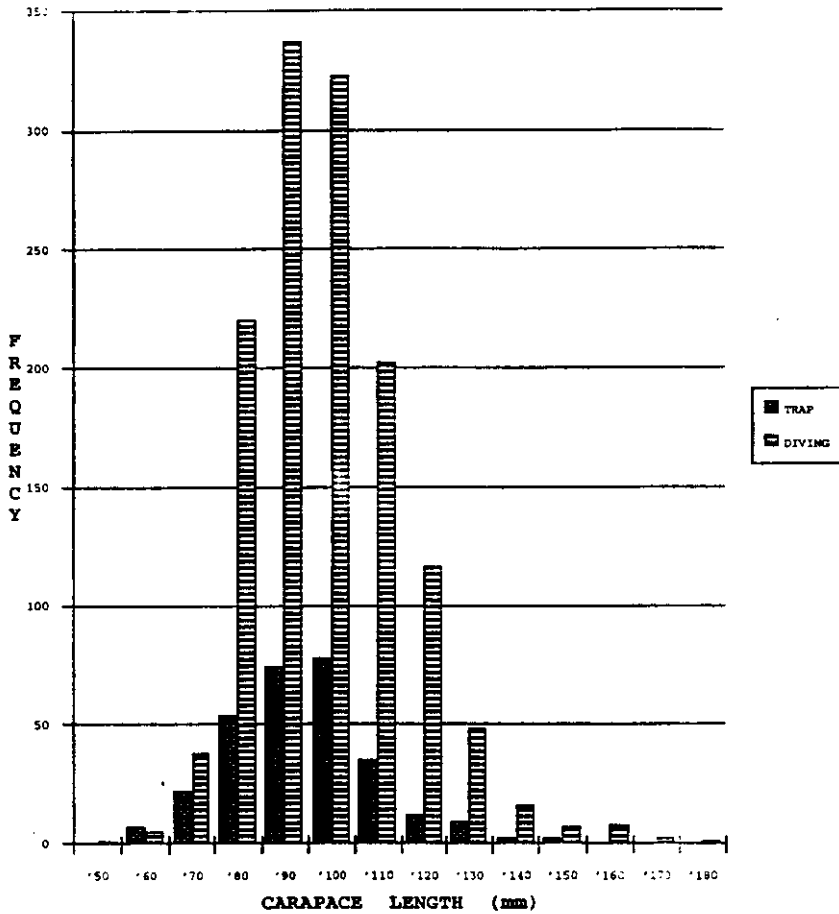


Figure 4. Length frequency distribution for *Panulirus argus* males taken by traps and diving, during 1989-91.



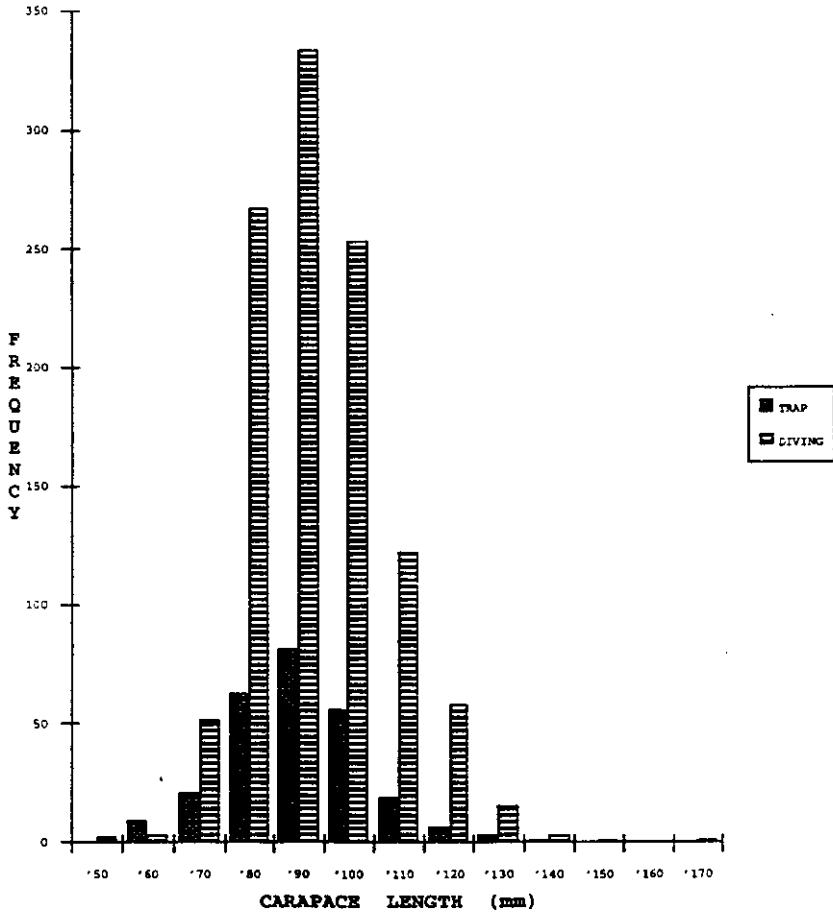


Figure 5. Length frequency distribution for *Panulirus argus* females taken by traps and diving, during 1989-91.

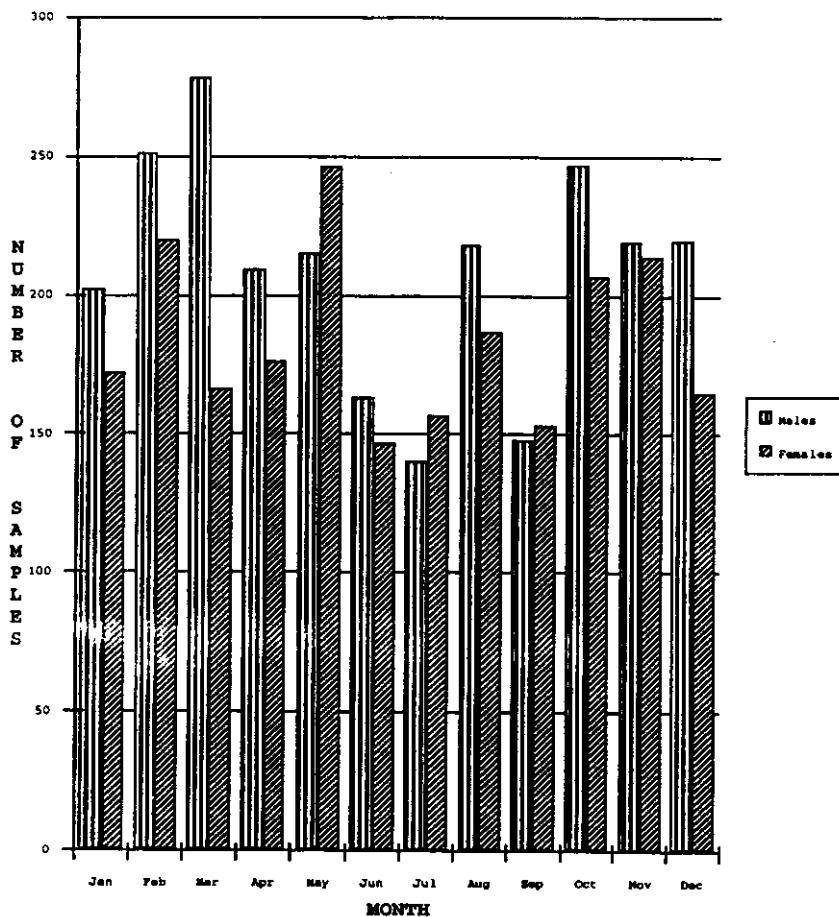


Figure 6. Number of *Panulirus argus* taken by traps and diving, sampled by month and by sex during 1989-91.

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 extensive communications media is absolutely necessary to convince the *P. argus* users to follow the LFMP.

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