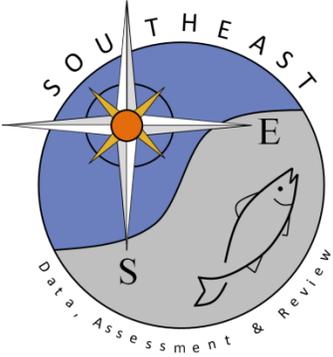


Portrait of the commercial fishery of red hind, *Epinephelus guttatus*, in  
Puerto Rico during 1992-1999

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# **Portrait of the Commercial Fishery of the Red Hind, *Epinephelus guttatus*, in Puerto Rico During 1992 - 1999**

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## **ABSTRACT**

Puerto Rico's fishery has shown symptoms of overfishing for the last fifteen years. Groupers (Serranidae) represented 4% of the total catch reported in Puerto Rico. The red hind, *Epinephelus guttatus*, is the grouper most reported in the landings of the commercial fishery and also is a very important component of the recreational fishery. *E. guttatus* is a protogynous hermaphrodite and forms spawning aggregations. This event occurs around the full moon of December, January and February. The spawning aggregation sites are well known by commercial fishermen, leading to a high exploitation rate of *E. guttatus*. This activity affects negatively the reproduction of this species.

Since 1995, three *E. guttatus* spawning aggregation sites off the west coast of Puerto Rico have been closed to all fishing activity. This paper analyzes the landings, catch per unit effort (CPUE), and length frequency distributions during 1992 - 1999 to evaluate the status of *E. guttatus*.

**KEY WORDS:** Commercial fisheries, *Epinephelus guttatus*, fishery management

## **INTRODUCTION**

Puerto Rico's fishery has been monitored through the Fisheries Statistics Project (FSP) uninterrupted since 1967. The FSP is a program of the Puerto Rico's Department of Natural and Environmental Resources (DNER). FSP is located at the DNER's Fisheries Research Laboratory (FRL). The objective of the FSP is to provide data to know the conditions of the fishery resources found in the Territorial Sea of the Commonwealth of Puerto Rico and contiguous Federal Fishery Conservation Zone waters. The scientific data obtained by the FSP helps to implant management plans to protect the fishery resources.

Groupers (Serranidae) are an important resource in the Puerto Rico's commercial and recreational reef fishery. Grouper species share a number of life history characteristics believed to render them particularly vulnerable to human exploitation (Manooch 1987). Sadovy (1944) mentioned that groupers are carnivores, have a relatively long life span, attain a large size at sexual maturation, exhibit slow growth, and appear to be relatively easy to catch, being susceptible to a wide range of sizes and types of fishing gear. Many exhibit a sexual pattern incorporating adult sex change. Several western Atlantic grouper species are known to aggregate for spawning at specific times and locations. The exploitation of

grouper resources during spawning aggregations make them very vulnerable. In Puerto Rico, some grouper species spawn in large numbers at well-defined times and locations each year.

Nine species of the genus *Epinephelus* and two species of the genus *Mycteroperca* had been reported in Puerto Rico's commercial fishery. The Nassau grouper (*Epinephelus striatus*) was reported as one of the most common grouper caught in Puerto Rico since 1900 (Everman 1900). In 1970, *E. striatus* was reported as the fourth most commonly landed of all shallow water species in the Puerto Rico's commercial fishery (Suárez Caabro 1970). This species was heavily fished during the period of spawning aggregations. Now the species is considered to be extinct for commercial fishery purposes (Sadovy 1999). During 1992 - 1999, the FSP collected biostatistics data of approximately 75,000 fishes measured, less than 100 were *E. striatus* (Matos-Caraballo 2000).

The red hind, *Epinephelus guttatus*, has become the most important species of grouper taken commercially in Puerto Rico, following the decline of *E. striatus* (Matos-Caraballo and Sadovy 1990, Sadovy 1993, Matos-Caraballo 1997). Studies indicated that this species it is overfished (Appeldoorn, et. al. 1992, Sadovy and Figuerola 1992, Rosario, 1996). The red hind is the most reported grouper species in the landings of the commercial fishery and also is a very important component of the recreational fishery. The red hind is a protogynous hermaphrodite and forms spawning aggregations. This event occurs around the full moon of December, January and February. The spawning aggregation sites are well known by commercial fishermen, leading to a high exploitation rate of red hind. This activity affects negatively the reproduction of this species.

Since 1995, three red hind spawning aggregation sites off the west coast of Puerto Rico have been closed to all fishing activity (Tourmaline Bank, Abrir la Sierra Bank and Bajo de Sico Bank). The Caribbean Fishery Management Council and the DNER worked together to enforce this action. To evaluate the status of red hind this paper analyze the landings, catch per unit effort (CPUE), and length frequency distributions during 1992 - 1999. Also, data analysis to evaluate if the closed areas are improving this fishery resource in Puerto Rico.

## METHODS

### Commercial Landings

Commercial fishery landings data were collected weekly by four port agents and the principal investigator of the FSP. The data was collected voluntarily from fishermen, fish buyers, and fishing associations from 42 coastal municipalities of Puerto Rico. Landing trip tickets were provided by the fishermen. Through the landing trip tickets system, fishermen reported the following information:

- i) Fishing date and municipality where catch was landed,
- ii) Fishing center (municipality fishing area),
- iii) Name of fishermen and name of helper (if any),

- iv) Hours spent fishing,
- v) Number of trips,
- vi) Species caught,
- vii) Weight in pounds of each species caught and price per pound (US \$), and
- viii) Gear type and number of gears used.

Confidentiality was maintained for individual fishermen or businesses that cooperated by providing data to the program. Fishes were usually landed in the round (not eviscerated).

Port agents delivered commercial landings data to the FRL. Data were then entered in MS-DOS PC using Microsoft FoxPro. Subsequently, data were revised, corrected and analyzed using Microsoft FoxPro and Microsoft Excel. Catch per unit effort of the red hind was calculated using the landings data.

### **Biostatistical Data**

Four port agents and the principal investigator of the FSP visited randomly the 42 coastal municipalities of Puerto Rico to collect biostatistical data. They visited different fishing centers three days per week, and randomly selected commercial landings. If the fishermen voluntarily cooperated, the port agent proceeded to identify at the species level every individual of fish and lobster caught. Fish were measured in fork length (FL) in millimeters, and weighed in grams. FSP's personnel collected information for each sample about fishing area, fishing depth (fathoms), fishing effort (gear type, number of gear, time spent fishing) and total catch in pounds. They delivered biostatistical data to the FRL. Data were entered in MS-DOS PC using "Trip Interview Program (TIP)", a National Marine Fisheries Service (NMFS) software. Data were then revised, corrected and analyzed using Microsoft Excel. The data was sorted by all Puerto Rico samples and west coast only. The last category is due to the fact of the closed areas to protect the red hind are on the west coast. This category includes the landings of the municipalities of Cabo Rojo, Mayagüez, Añasco, Rincón, Aguada and Aguadilla.

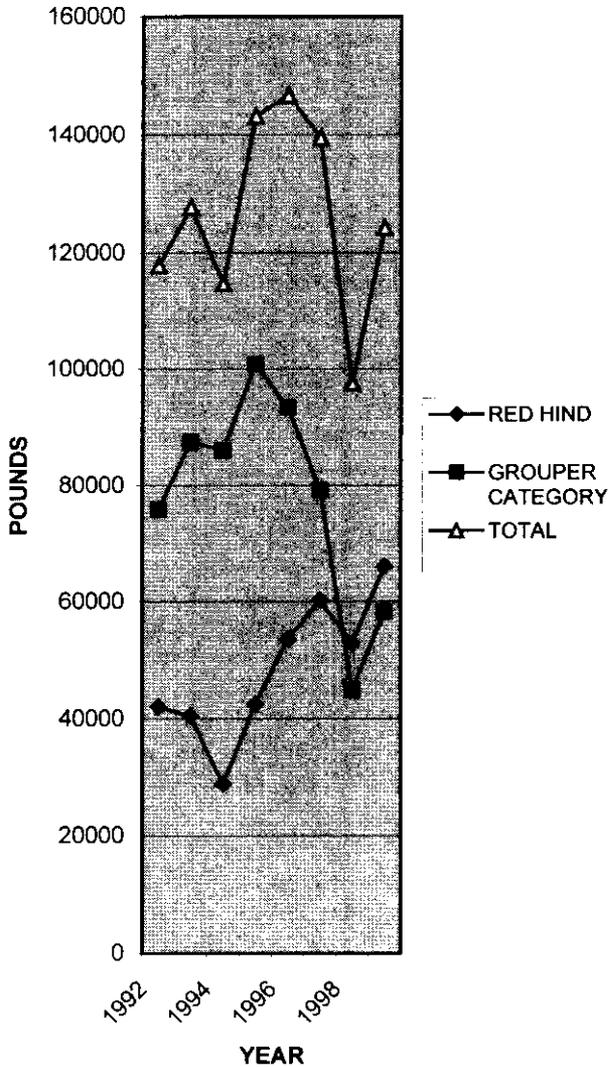
## **RESULTS**

### **Commercial Landings**

Due to market limitations, the red hind is reported by fishermen mostly in the red hind category and grouper category. Figure 1 shows the reported landings in pounds during 1992 - 1999 and the sum of red hind and grouper is the total landings reported for those categories. This Figure indicates a decrease in landings reported for the red hind from 1992 (42,015 pounds reported) to 1994 (28,738 pounds reported), but an increasing trend during 1995 (42,383 pounds) to 1999 (66,065 pounds).

To determine how the closed areas for the protection of the red hind have affected the resource, landings reported of the red hind for all of Puerto Rico were compared to the west coast only (Figure 2). In this figure it is observed that the

west coast shows a drastic decrease the landings from the year 1993 (21,620 pounds) to 1994 (11,312 pounds). The landings reported continued a similar for years 1995-97. An increase trend was observed for years 1998 (22,903 pounds) and 1999 (26,441 pounds). Another similar trend is observed for the all Puerto Rico sample of this species.



**Figure 1.** Landings reported (pounds) of red hind and grouper category in Puerto Rico during 1992 - 1999.

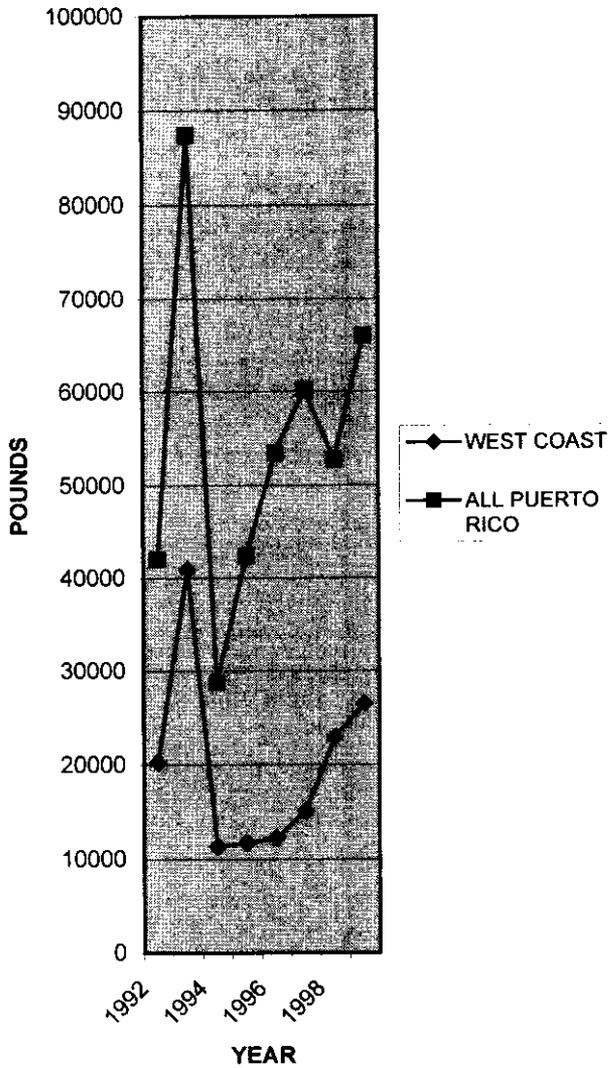
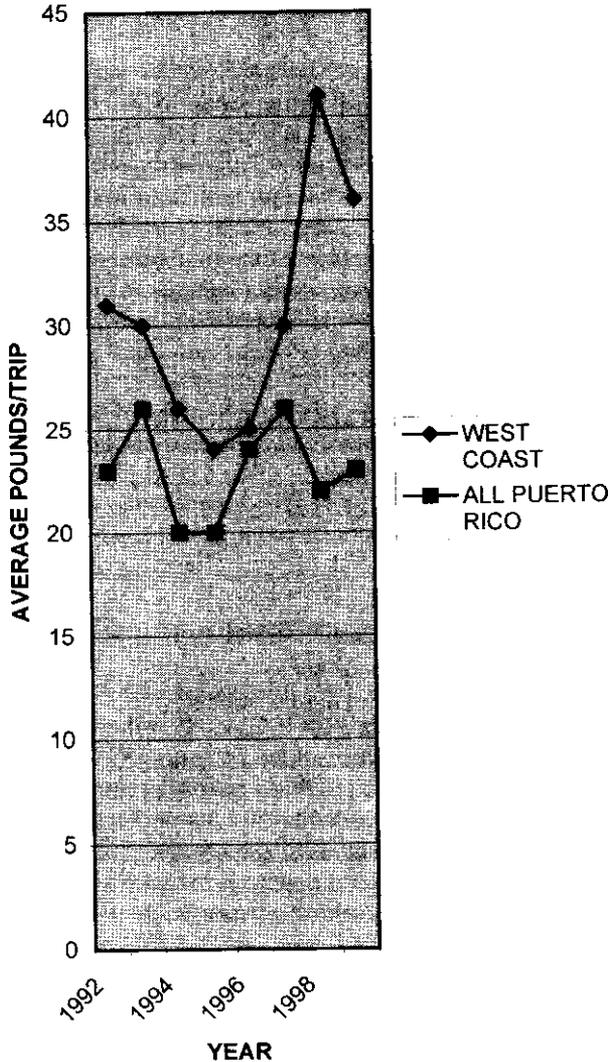


Figure 2. Landings reported (pounds) of red hind for all Puerto Rico and for the west coast during 1992 - 1999.

Catch per unit effort has been estimated in the red hind average pounds reported per trip. Figure 3 shows small differences among years 1992 - 1999 in the

CPUE for the all Puerto Rico's red hind. On the other hand, for the west coast sample the CPUE shows an increase for years 1996-99. Another interesting fact observed in this figure is that the west coast sample caught higher average pounds landed per trip than the all Puerto Rico.



**Figure 3.** Catch per unit effort (average pounds/trip) of red hind for all Puerto Rico and west coast during 1992 - 1999.

**Biostatistical Data**

Average fork length (FL) for red hind from years 1992 - 1999, for all Puerto Rico and for the west coast only is shown in Figure 4. This figure shows that the average length for both categories ranged from 269 mm to 330 mm FL. For the years 1997, 1998 and 1999 both categories show a trend to increase the average reaching the peak of each category (330mm for the all Puerto Rico and 319 for west coast only).

Length frequency distribution (LFD) for red hind for all Puerto Rico (Figure 5) and for the west coast only (Figure 6) during 1992 - 1995, show that the peak of the frequencies occurred between 280 - 320 mm. LFD for red hind for all Puerto Rico (Figure 7) and for the west coast only (Figure 8) during 1996 - 1999, shows that the peak of the frequencies occurred very similar to the 1992 - 1995 (among 270 - 320 mm). The average FL of the red hind for the all Puerto Rico for the years 1992 - 1995, was 305 mm. The average for the individuals caught during 1996 - 1999 was 320 mm. Although it was observed a tendency to catch larger individuals during 1996 - 1999, the t-Test Two Sample Assuming Unequal Variances shows no significant difference between 1992 - 1995 and 1996 - 1999 ( $t = 8.49$  and  $p = 1.65$ ,  $\alpha 0.05$ ).

On the other hand the average FL of the red hind for the west coast only for the years 1992 - 1995, was 301 mm. This average for the individuals caught for 1996-99 was 314 mm. The t-Test Two Sample Assuming Unequal Variances shows a significant difference between 1992 - 1995 and 1996 -1999 ( $t = -4.00$  and  $p = 2.3$ ,  $\alpha 0.01$ ).

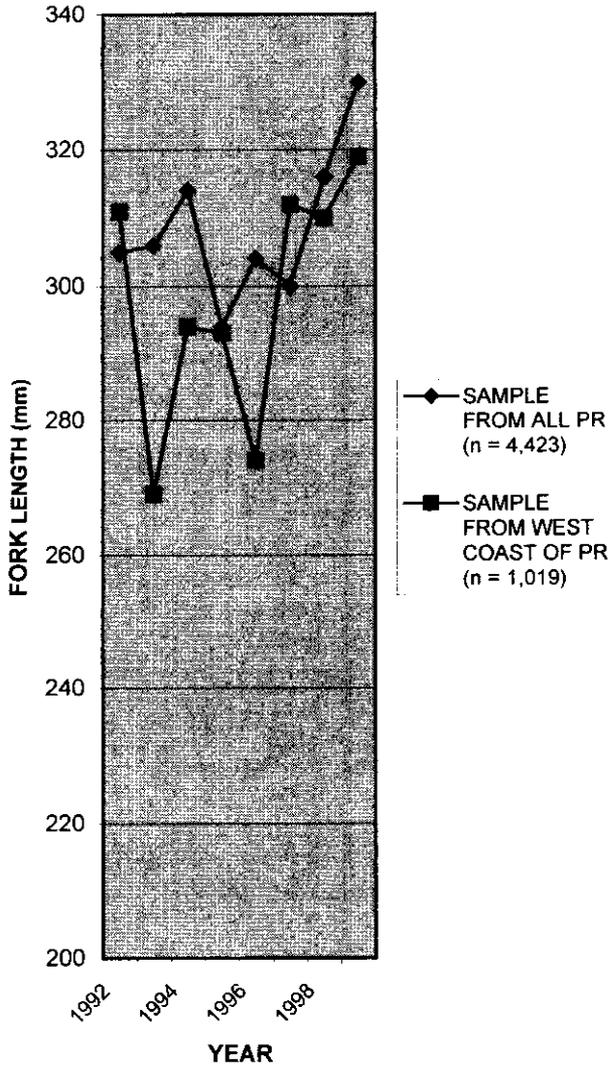
## DISCUSSION

**Commercial Landings**

The FSP landings data collected from 1992 - 1999, indicates that more landings of the red hind were reported in Puerto Rico for years 1998 and 1999. The west coast CPUE shows an increasing trend in the average pounds landed/trip. Some commercial fishers of the west coast mentioned to the author that they noted that the size of the red hinds are larger after the closing of the spawning areas. This tendency is probably to the management action described in this paper. It is necessary to continue the collection of the data in the future years to observe if this trend continues.

**Biostatistical Data**

Results of LFD of the red hind indicate that the individuals of this species were larger for the years 1996 - 1999 (average FL of 320 mm) than for 1992 - 1995 (average FL of 304 mm). The statistical analysis confirmed this fact for the west coast during 1996 - 1999, and it is likely linked with the three closed areas in the west coast. Again this data collection must be continued for several years to determine if this trends will continue.



**Figure 4.** Red hind average fork length for all Puerto Rico samples and for the west coast during 1992 - 1999.

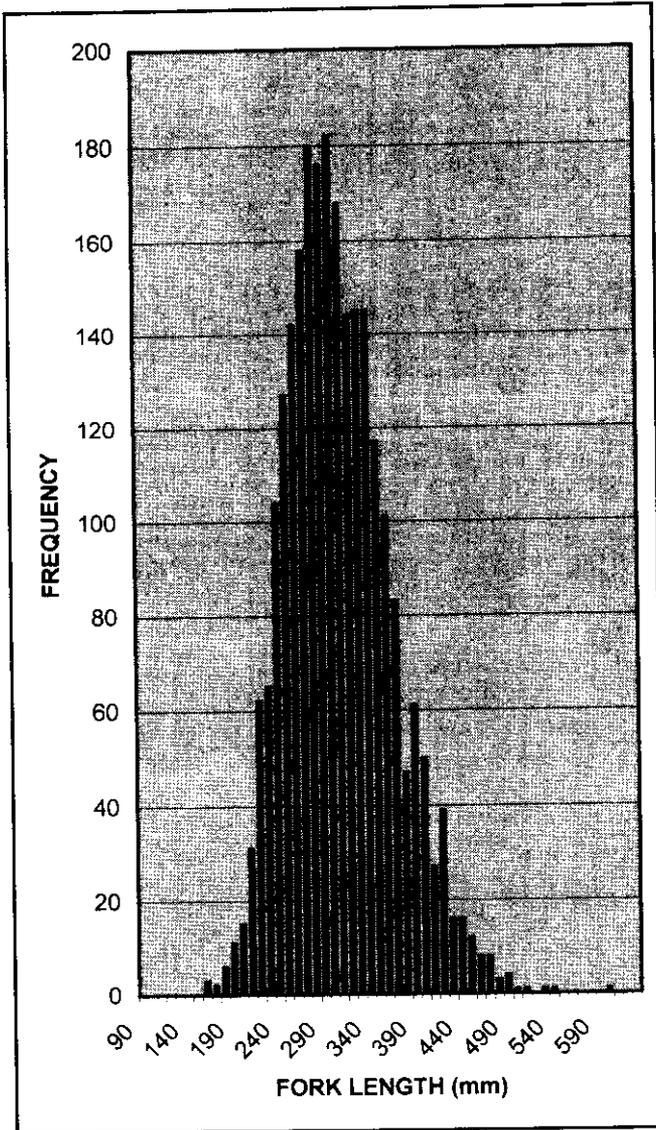
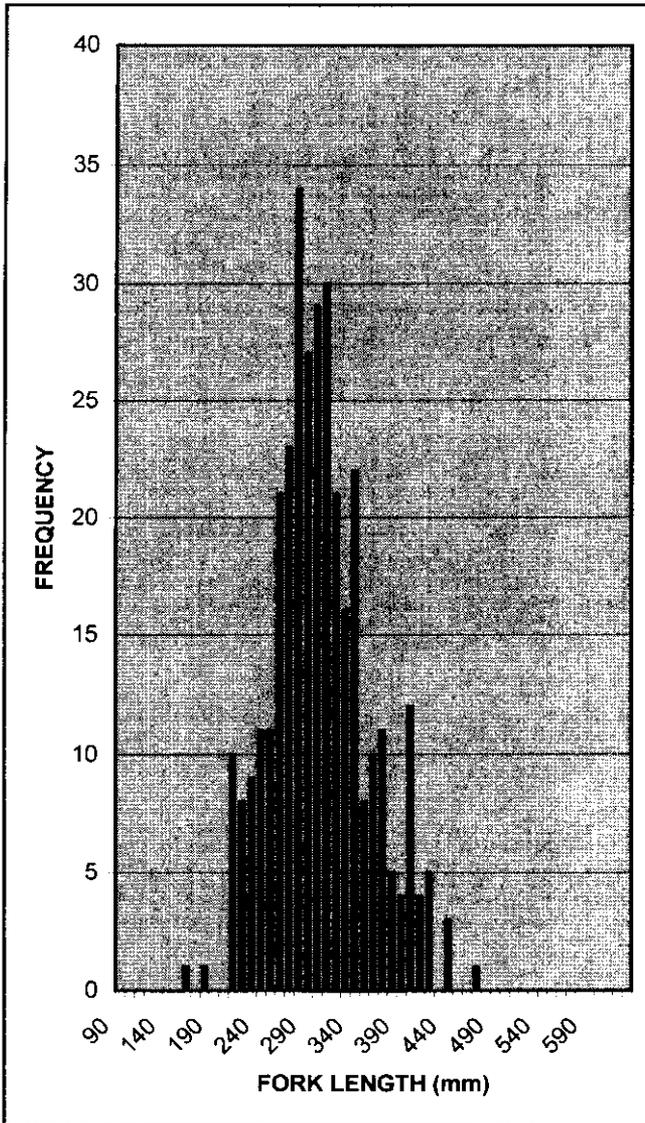


Figure 5. Length frequency distribution of red hind in all Puerto Rico during 1992 - 1995 (n = 2,463).



**Figure 6.** Length frequency distribution of red hind in the west coast of Puerto Rico during 1992 - 1995 (n = 336).

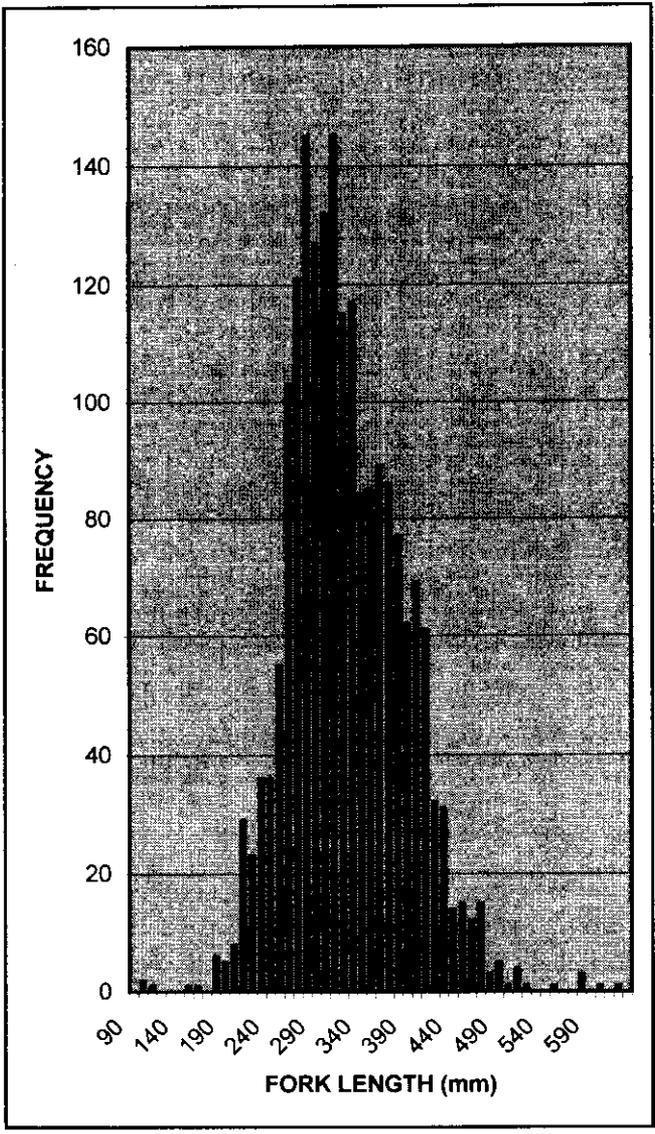
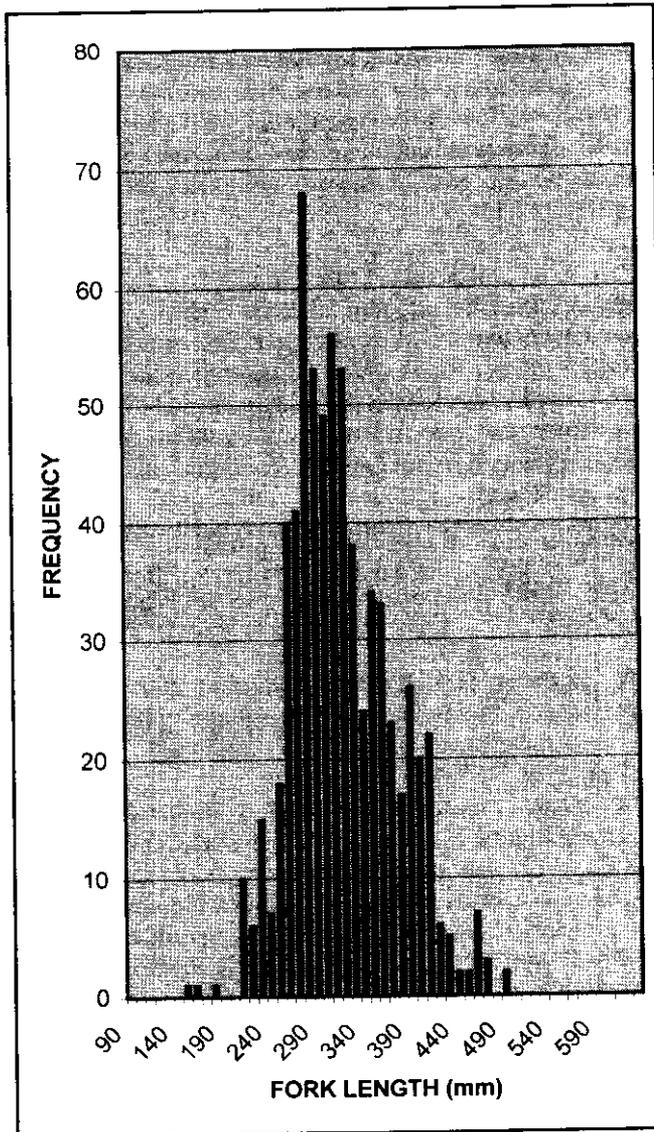


Figure 7. Length frequency distribution of red hind in all Puerto Rico during 1996 - 1999 (n = 1,960).



**Figure 8.** Length frequency distribution of red hind in the west coast of Puerto Rico during 1996 - 1999 (n = 336).

### CONCLUSION

The red hind fishery resource of Puerto Rico seems to be improving for the years 1996 - 1999. The three spawning aggregations designated as closed areas for this species on the west coast of Puerto Rico, are helping to reduce the decline of this resource. However, more studies are necessary in the near future to see if this trend will continue. If this trend continues, the DNER must consider the action to close other areas in the east or south coast of Puerto Rico to help this important resource.

### ACKNOWLEDGEMENTS

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### LITERATURE CITED

- Appeldoorn, R., J. Beets, J. Bohnsack, S. Bolden, D. Matos-Caraballo, S. Meyers, A. Rosario, Y. Sadovy and W. Tobias. 1992. Shallow water reef fish stock assessment for the U.S. Caribbean. NOAA Technical Memorandum. NMFS-SEFSC-304. 70 pp.
- Evermann, B.W. 1900. *Fishes and Fisheries of Puerto Rico*. United States Commission of Fish and Fisheries, Washington, D.C. USA. 350 pp.
- Manooch, C.S., III. 1987. Age and growth in snappers and groupers. Pages 329 - 373 in: J.J. Polovina and S. Ralston (Eds). *Tropical Snappers and Groupers: Biology and Fisheries Management*. West View Press, Boulder, Colorado.
- Matos-Caraballo, D. 1997. Status of the Groupers in Puerto Rico, 1970 - 1995. *Proceedings of the Gulf and Caribbean Fisheries Institute* 47:340-353.
- Matos-Caraballo, D. [2000] Puerto Rico/NMFS Interjurisdictional Fisheries Program 1997-99. Final Report to NMFS. P.R. Dept. Nat. Env. Res. 73 pp
- Matos-Caraballo, D. and Y. Sadovy. 1990. Overview of Puerto Rico's small scale fisheries statistics 1988 - 1989. Technical Report. CODREMAR. 1(14):1-17.
- Rosario, A. [1996] Caribbean/NMFS Cooperative SEAMAP Program. Annual Report to NMFS. January, 1996. 133 pp.
- Sadovy, Y. 1994. Summary of papers presented at the grouper symposium of the 43<sup>rd</sup> annual meeting of the Gulf and Caribbean Fisheries Institute in Miami, Florida (November 6, 1990). *Proceedings of the Gulf and Caribbean Fisheries Institute* 43:482-486.

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- Sadovy, Y. 1999. The case of disappearing grouper: *Epinephelus striatus*, the Nassau grouper in the Caribbean. *Proceedings of the Gulf and Caribbean Fisheries Institute* 45:5-22.
- Sadovy, Y. [1993] Biology and Fishery of the red hind in Puerto Rico and the United States Virgin Islands. Technical Report. CFMC. July, 1993. 66 pp.
- Sadovy, Y. and M. Figuerola. 1992. The status of the red hind fishery in Puerto Rico and St. Thomas, as determined by yield-per-recruitment analysis. *Proceedings of the Gulf and Caribbean Fisheries Institute* 42:23-38.
- Suárez-Caabro, J.A. 1970. Estadísticas Pesqueras de Puerto Rico 1968-69. Reporte técnico del Departamento de Agricultura de Puerto Rico. *Contribuciones Agropecuarias y Pesqueras* 2 (1):1-38.