



Portrait of the Fishery of Red Hind *Epinephelus guttatus* in Puerto Rico during 1988-2001

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ABSTRACT

The Puerto Rico Department of Natural and Environmental Resources (DNER) is responsible to conserve and manage all the Island's natural resources, including the fishery resources. The DNER's Commercial Fisheries Statistics Program (CFSP) collects and analyzes the dependent fisheries data. The CFSP has been collecting data since 1971. During the 1980's decade, it was observed that the Puerto Rico's commercial fishery resources had shown overfishing symptoms (e.g. decrease in landings pounds, change in catch composition, decrease in the size of some important species).

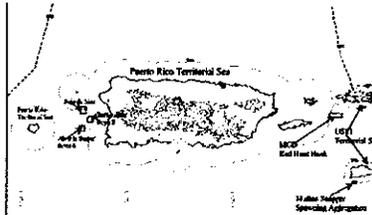
Groupers (Serranidae) are an important resource in the Puerto Rico's commercial fishery. Grouper species share a number of life history characteristics believed to render them particularly vulnerable to human exploitation. Several groupers species in the Caribbean and Western Atlantic are known to aggregate for spawning at specific times and locations. The fishing activity of these resources during their aggregation periods make these groupers very vulnerable to be over exploited.

The red hind, *Epinephelus guttatus*, has become the most important species of grouper taken commercially in Puerto Rico. *Epinephelus guttatus* is a protogynous hermaphrodite and forms spawning aggregations. However this species is also heavily fished during the spawning aggregation. During the last 12 years there are many studies reporting *E. guttatus* as an overfished species. Since 1995, three spawning aggregation sites of the red hind in the west coast of Puerto Rico have been closed to all fishing activity. The Caribbean Fishery Management Council and the DNER worked together to enforce this action.

The objective of this study is to describe the fishery of *E. guttatus* thru the data collected by the CFSP (landings and biostatistics data) during 1988-2001. Length frequency distributions (LFD) of this species by years, fish traps, SCUBA diving and bottom line were compared.

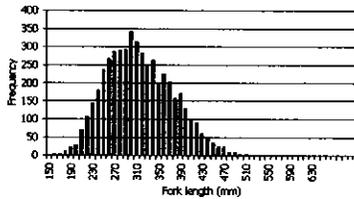
METHODS

- > Two types of dependent data were used:
 - Landings collected by port samplers from fish houses and/or fishers.
 - Biostatistics
- > Landings and biostatistics entered in computers using Microsoft Fox Pro and NMFS Trip Interview Program (TIP).
- > The data were analyzed using length frequency distribution (LFD) of this species by year fish traps, bottom line and SCUBA divers.
- ✓ Kolmogorov-Smirnov Two Sample Test, $P < 0.05$ (Sokal and Rohlf, 1981) was used to know if there is any significant difference among the comparisons.

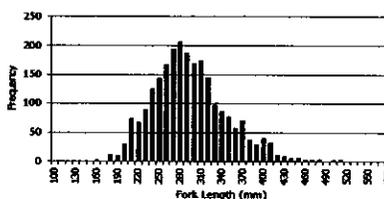


Since 1995, three spawning sites of red hind in the west coast of Puerto Rico have been closed to all fishing activities.

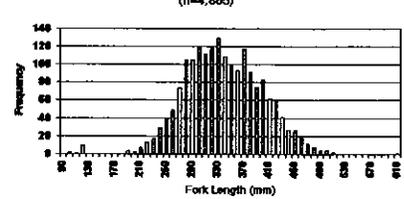
Length Frequency Distribution for Red Hind caught in Puerto Rico by Bottom Line during 1988-2001. (n=4,898)



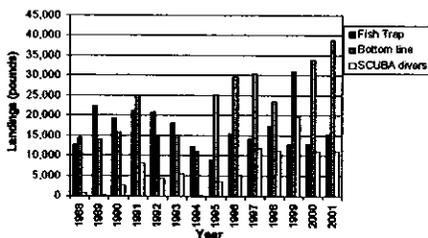
Length Frequency Distribution for Red Hind caught in Puerto Rico by Fish Trap during 1988-2001. (n=2,373)



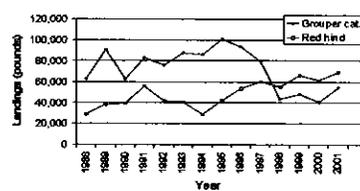
Length Frequency Distribution for Red Hind caught in Puerto Rico by SCUBA divers during 1988-2001. (n=4,865)



Landings Reported of Red Hind by Fish Trap, Bottom Line and SCUBA divers in Puerto Rico during 1988-2001



Landings Reported of Grouper Category and Red Hind in Puerto Rico during 1988-2001.



CONCLUSIONS

- The CPUE data confirms the increase in the fishery pressure over the red hind. During 1988-1994 fish traps fishing trips had an average of hauling 28.5 fish traps and an average catch of 62.8 pounds/trip. On the other hand during 1995-2001 fish traps fishing trips had an average of hauling 41.4 fish traps and an average catch 78.7 pounds/trip.
- Bottom lines are more efficient gear to catch red hind (47%), fish traps (33%) and SCUBA diving (14%).
- In this study the red hind were caught bigger during 1995-2001, and it is probable that closed areas to protect spawning aggregations in the west coast help improve the fishery resource.
- The DNER fishing regulation (No. 6766, March 12, 2004) established a closed season for the red hind in all Puerto Rico waters during December 1st to February 28th of every year. This study confirms the need of the management action.
- The red hind had a minimum size of sexual maturation (MSSM) of 215mm FL. Data analysis shows that only 2% of red hind were caught before reaching MSSM.
- The mean FL for red hind caught by fish traps during 1988-2001 was 291mm, for bottom line was 313mm and for SCUBA divers was 336mm.
- Percent of individuals by gear before reaching sexual maturity:
 - Fish Traps 5%
 - Bottom line 2.6%
 - SCUBA diving 0.3%

Job V. Historical Landings and Biostatistical CFSP Data Analysis for Five Important Species.

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by

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INTRODUCTION

The Puerto Rico Department of Natural and Environmental Resources (DNER) is responsible to conserve and manage all the Island's natural resources, including the fishery resources. The DNER's Commercial Fisheries Statistics Program (CFSP) collects and analyzes the dependent fisheries data. The CFSP has been collecting data since 1971. Matos-Caraballo (in press a and b) mentioned that during the 1980's decade, it was observed that the Puerto Rico's commercial fishery resources had shown overfishing symptoms (e.g. decrease in landings pounds, change in catch composition, decrease in the size of some important species). Species considered in the market as trash during the 1970's, today have been considered a second class market species (Matos-Caraballo (in press a and b).

Groupers (Serranidae) are an important resource in the Puerto Rico's commercial fishery. Grouper species share a number of life history characteristics believed to render them particularly vulnerable to human exploitation (Mannoch, 1987). Sadovy (in press a) mentioned that groupers are carnivores, have relatively long life span, large size of sexual maturation, slow growth, and appear to be relatively easy to catch, being susceptible to a wide range of sizes and types of fishing gear. Many species of groupers exhibit adult sex change. Several groupers species in the Caribbean and Western Atlantic are known to aggregate for spawning at specific times and locations. The fishing activity of these resources during their aggregation periods make these groupers very vulnerable to be over exploited. The Nassau grouper *Epinephelus striatus* was the main grouper species landed in Puerto Rico by commercial fishers since 1900 to 1970's (Everman, 1900; Suárez-Caabro, 1970). This species was heavily fished during his spawning aggregations resulting in a gradual decrease of the mentioned landings. Since middle 1980's, this species is considered to be extinct for commercial fishery purposes (Sadovy, in press b).

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, 1999). *Epinephelus guttatus* is a protogynous hermaphrodite and forms spawning aggregations. However this species it is also heavily fished during the spawning aggregation. The result of this activity would cause the same fate of *E. striatus*. During the last 12 years there are many studies reporting *E. guttatus* as an overfished species (Appeldorn, et. Al. 1992; Sadovy and Figuerola, 1992; Rosario, 1996; Matos-Caraballo, 2002). *Epinephelus guttatus* forms spawning aggregations around the full moon of December, January and February. Since 1995, *E. guttatus* three spawning aggregation sites in 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. Matos-Caraballo (2000), discussed how the mentioned regulation significantly improved the *E. guttatus* population.

The objective of this study is to describe the fishery of *E. guttatus* thru the data collected by the CFSP (landings and biostatistics data) during 1988-2001. Length frequency distributions (LFD) of this species by years, fish traps, SCUBA diving and bottom line were compared.

METHODS

This report will discuss the *E. guttatus* fishery using two types of dependent data collected by CFSP thru 1988-2001. First, the landings data were collected by CFSP's port samplers. The commercial fishers and/or fish houses reported their catch in a ticket. Unfortunately, some reports of this species had been reported as groupers or first class fishes.

The second type of data used in this study was biostatistics. That data were also collected by CFSP's port samplers. They visited the fishing centers and randomly selected commercial landings. Then they proceed to identify by species all the catch to obtain data about composition. Then port samplers measured fish's fork length (FL) in mm. If possible the whole catch was individually measured and sex is also registered. CFSP's port samplers collect catch per unit effort data (CPUE) when they do the biostatistics sampling. The total landings by trip and by gear, number of traps hauled and nets length in fathoms was recorded.

Port samplers delivered the landings and biostatistics data to CFSP and statistical clerks edited and entered in computers using Microsoft FoxPro and NMFS Trip Interview Program (TIP). The data were analyzed using length frequency distribution (LFD) of this species by years, fish traps, SCUBA diving and bottom line. LFD for both species by years and by gears were analyzed. Kolmogorov-Smirnov Two Sample Test, $P \leq 0.05$ (Sokal and Rohlf, 1981) was used to know if there is any significant difference among the LFD's.

RESULTS

Landings data show that a total of 680,601 pounds of *E. guttatus* were reported to the CFSP during 1988-2001 (Figure 1). During late 1980's started

the process to educate commercial fishers to report the red hind landing. This fact explains why it is observed an increase during 1988-91. The Figure 1 includes the grouper category because many fishers reported red hind in grouper category, besides red hind was the main grouper caught in Puerto Rico during the time period of this study. The number of pounds reported of red hind represented a 1.7% from the total catch reported during the mentioned period. However it is known by the CFSP personnel that a significant percentage of the pounds reported as first class were also red hind. For this paper only the red hind data were used. Since 1988-94, red hind reported represented 1.7% of the total pounds reported of fish and shellfish. Since 1995-2001, red hind reported represented a total of 2.0% of the total pounds reported of fish and shellfish. During 1988-2001, red hind reported represented 1.9% of fishes. For this period the red hind was in the first 10 categories of fish and shellfish reported landings.

Figure 2 shows the trend of landings reported by fish traps, bottom lines and SCUBA divers during 1988-2001. Landings reported by the mentioned gears show that fish traps caught 33% of the 680,601 pounds of red hind reported during 1988-2001. For the same time period bottom lines caught 47% and SCUBA divers caught 14% of the total landed pounds of red hind reported. Figure 2 shows that fish trap decreased the landings reported from 1995-2001. On the other hand bottom line and SCUBA divers show an increase in landings reported during 1995-2001.

Biostatistical data show that from 1988-2001, a total of 8,861 individuals of red hind were measured by CFSP's port samplers. Red hind measured during 1988-94, has a FL mean of 306.5mm (Figure 3) and during 1995-2001 was 318.5mm (Figure 4). Kolmogorov-Smirnov Test shows a significant difference in the LFD among both periods of time ($D_{max} = 0.0981$).

The mean FL for red hind caught by fish traps during 1988-2001 was 291mm (Figure 5). For the same time period red hind caught by hook and line had a mean FL of 313mm (Figure 6). Kolmogorov-Smirnov Test shows a significant difference in the red hind LFD among fish traps and hook and line during 1988-2001 ($D_{max} = 0.1321$). The mean FL for red hind caught by SCUBA divers during 1988-2001 was 336mm (Figure 7). Kolmogorov-Smirnov Test shows a significant difference in the red hind LFD among hook and line and SCUBA divers during 1988-2001 ($D_{max} = 0.1163$).

A total of one-hundred biostatistics interviews were randomly selected to obtain red hind CPUE estimates data analysis. All interviews include reports of red hind and other reef fishes. However the red hind was significant in number of individuals and weight in the catch composition. CFSP data show that during 1988-94, the fish traps had an average catch of 62.8 pounds/trip. During this period of time fishing trips had an average of hauling 28.5 fish traps and the average soak time was 5.6 days. It was estimated that every fish trap catch 0.40 pound/day. On the other hand, for the period of 1995-2001, fish traps shows a landings increase obtaining an average of 78.7 pounds/trip. During this period of time bottom lines fishing trips had an average of hauling 41.4 fish traps and the average soak time was 5.4 days. It was estimated that every fish trap catch 0.37 pound/days. Bottom lines CFSP data show that during 1988-94, had an average catch of 44.2 pounds/trip. During this period of time fishing trips had an average of 6.5 hooks and the average fishing time was 8.5 hours. It

was estimated that bottom lines catch 0.80 pound/hook/hour. On the other hand, for the period of 1995-2001, bottom lines shows a landings increase obtaining an average of 64.8 pounds/trip. During this period of time reef fishes fishing trips had an average of 7.0 hooks per trip and the average fishing time was 9.5 hours. It was estimated that bottom lines catch 0.97 pound/hook/hour. CFSP SCUBA divers data shows that during 1988-94, had an average catch of 31.4 pounds/trip. During this period of time fishing trips had an average of 1.8 divers with an average fishing time was 3.9 hours. It was estimated that a diver catch 8.1 pound/hour. On the other hand, for the period of 1995-2001, SCUBA divers shows a landings increase obtaining an average of 44.7 pounds/trip. During this period of time reef fishes fishing trips had an average of 1.37 SCUBA divers per trip and the average fishing time was 3.5 hours. It was estimated that SCUBA divers catch 12.8 pound/hour.

DISCUSSION

Puerto Rico's commercial fishery of red hind has shown that marketing and demand for this species continues to be one of the most important during the last 15 years. The data analyzed in this report show that a high fishing pressure occurred on red hind during 1988-2001. The landings data show trends of increase in red hind landings during 1995-2001. However, it is necessary to mentioned that before 1987 red hind was reported as grouper category. It is assumed that during 1988-1989, most fishers probably still report re hind as grouper category. Starting 1995, three red hind's spawning aggregation areas has been closed in Puerto Rico's west coast. Matos-Caraballo (2002) mentioned that during 1995-98, an increased of pounds of red hind were reported, also larger individual were caught compared to 1992-1994. The CPUE data also confirms the increase in the fishery pressure over the red hind. Bottom lines are more efficient gears to catch red hind (47%) than the fish traps (33%) and SCUBA divers (14%). However, fish traps shown a decrease during 1989-1995, during this time a decrease in fish traps gear was also observed (Matos-Caraballo, *in press c*), Fishing census). Also it is interesting to observe that the same census shows an increase in bottom line gears and SCUBA divers in Puerto Rico's commercial fishery.

Matos-Caraballo (2002) mentioned that individuals of red hind were significant larger in their LFD for 1988 than for 1992. In this study the red hind were caught bigger during 1995-2001 than 1988-1995. It is very probable that the closed areas to protect the spawning aggregations in the west coast help to improve the fishery resource (Matos, 1999; 2002). The DNER fishing regulation established a close season to red hind during December 1st to February 28th of every year. This close season will help to improve the fishery population of the red hind.

Sadovy and Figuerola (1992) reported that red hind has a minimum size of sexual maturation (MSSM) of 215mm FL. The data analysis shows that only 2% of red hind were caught before reach the MSSM during 1988-2001. Biostatistics data shows that 5% of red hind caught by fish traps were caught before they reach MSSM during 1988-2001. In contrast the bottom lines caught only 2.6% of red hind before reach the MSSM and 0.3% for SCUBA divers. The mentioned facts evidence that the juvenile mortality for this species is very

low. However, it is necessary to mention the need of bycatch data for these gears.

The landings data and biostatistics data presented in this study show that red hind can be considered as a overfished resource when it is compared with the 1970's data (Sadovy and Figuerola, 1992). However the data presented during 1988-2001, show that red hind's population has not change significantly. Due to the fact that red hind it is a very important component of the Puerto Rico's commercial fishery and also is a fragile species because is a protogynous hermaphrodite species, the CFSP must continue the monitoring of this species.

The average number of fish traps increase from 28.5 in 1988-1994 to 41.4 in 1995-2001. The bottom lines also show an increase in the number from 1988-94 (6.5 hooks) to 1995-2001 (7.0 hooks). Also an average 1 hour increase from the same two periods 7.5 hours to 9.5 hours. The CPUE increased from 1988-94 to 1995-2001. Again it is probable that the closed spawning aggregation in the west coast helped the red hind population to recover from the fishing pressure.

ACKNOWLEDGEMENT

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Figure 1. Landings Reported of Grouper Category and Red Hind in Puerto Rico during 1988-2003.

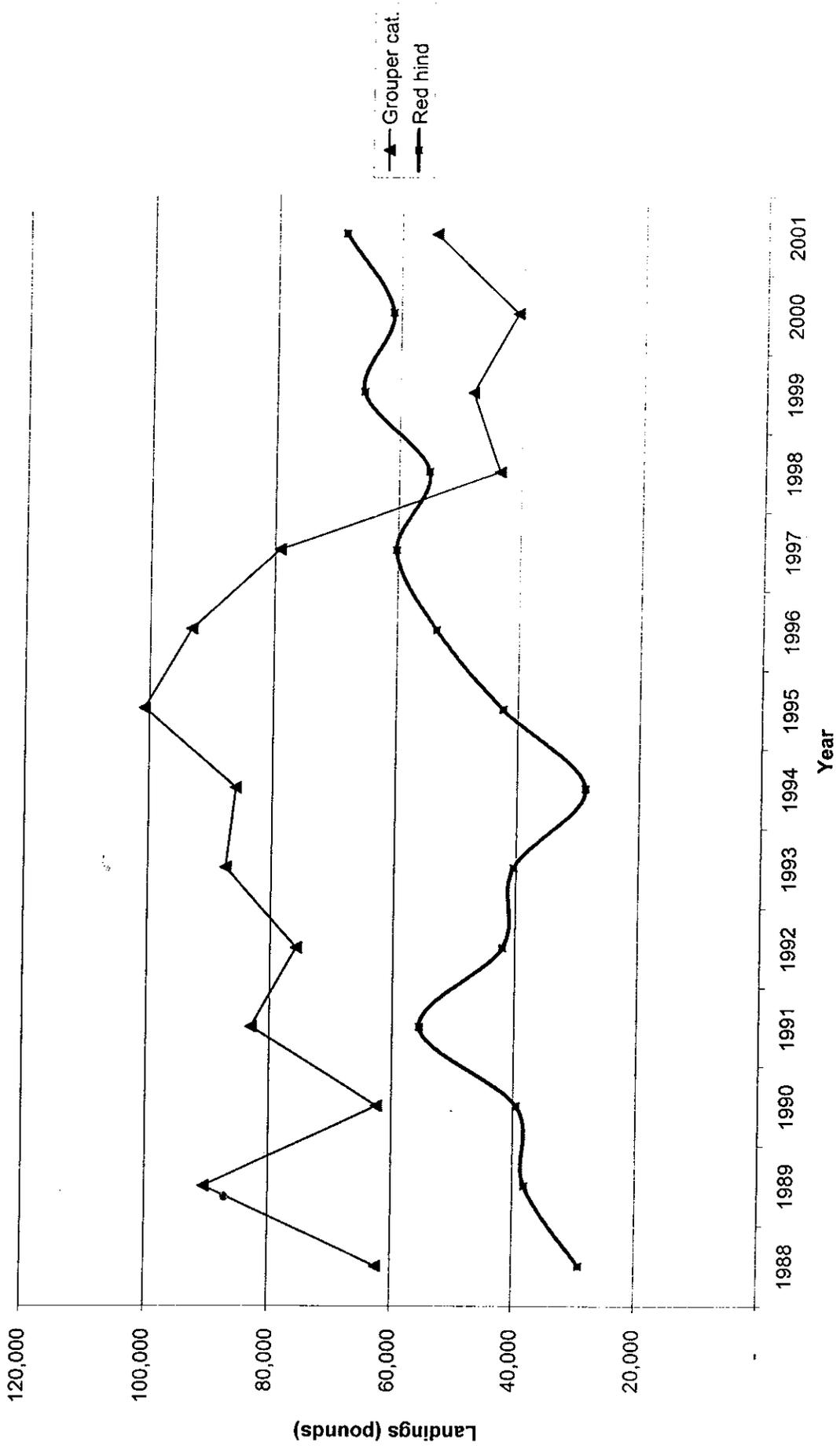


Figure 2. Landings Reported of Red Hind by Fish Trap, Bottom Line and SCUBA Divers in Puerto Rico during 1988-2001

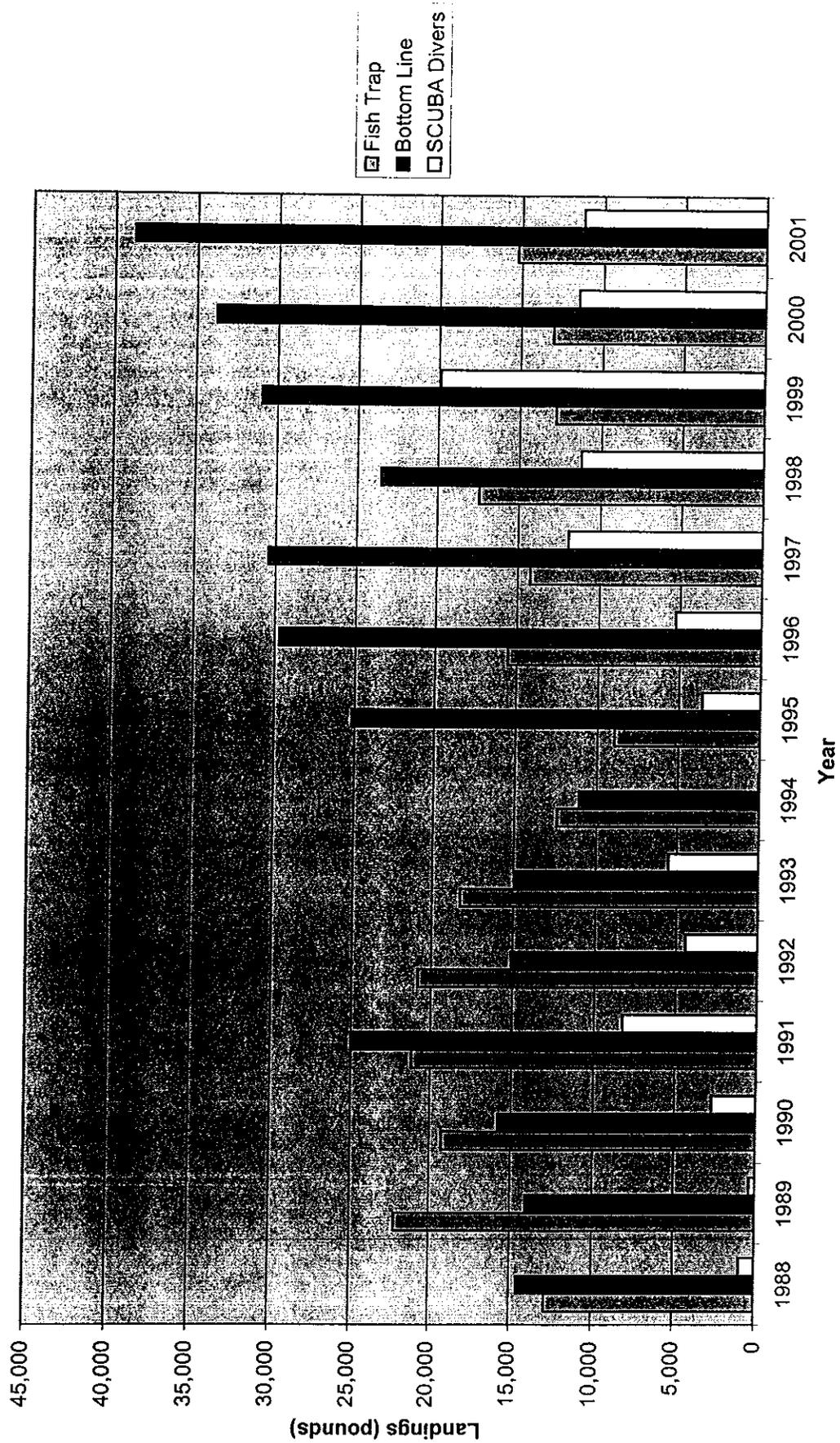


Figure 3. Length Frequency Distribution for Red Hind caught in Puerto Rico during 1988-1994. (n=4,865)

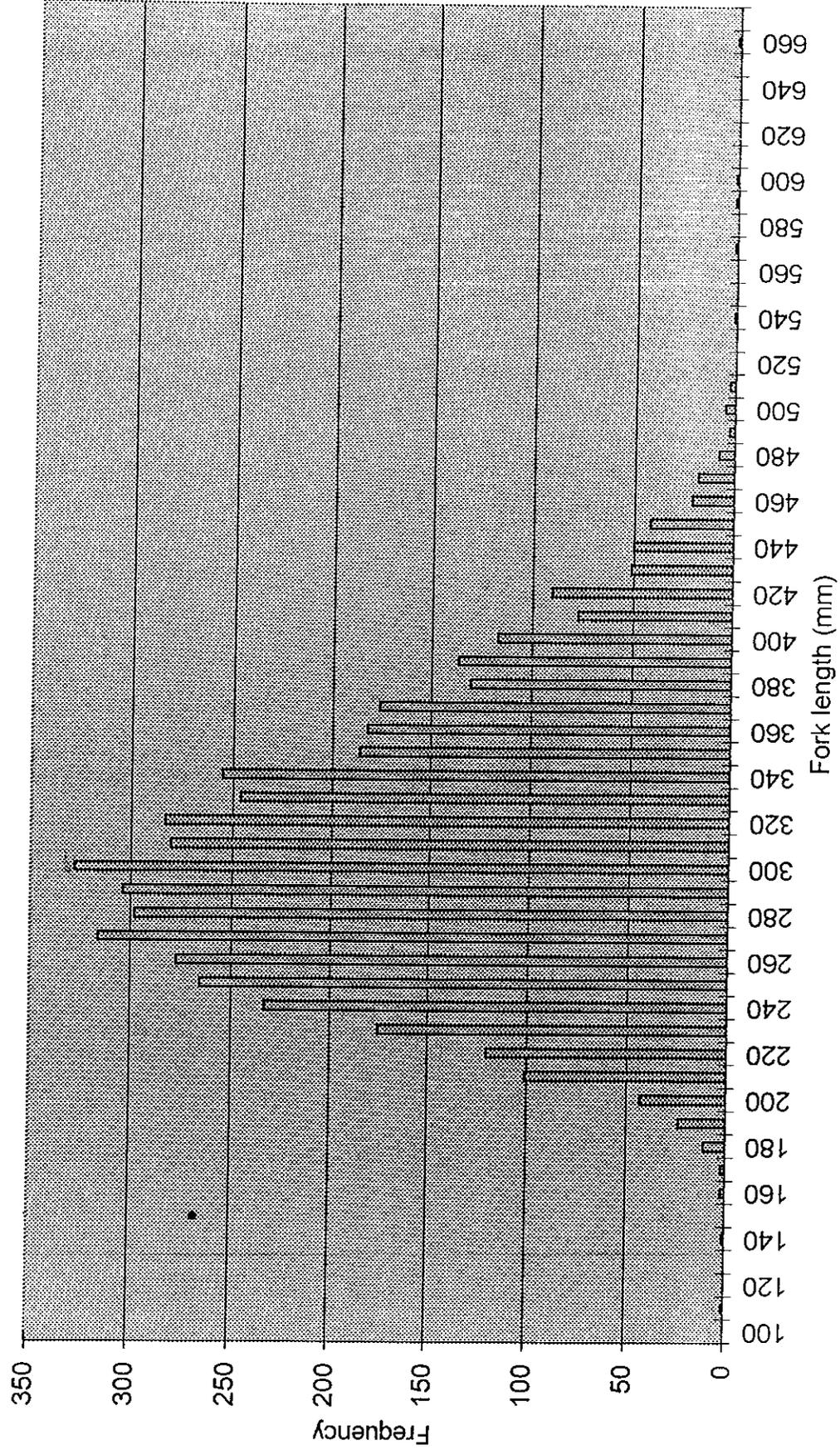


Figure 4. Length Frequency Distribution for Red Hind caught in Puerto Rico during 1995-2001. (n=3,984)

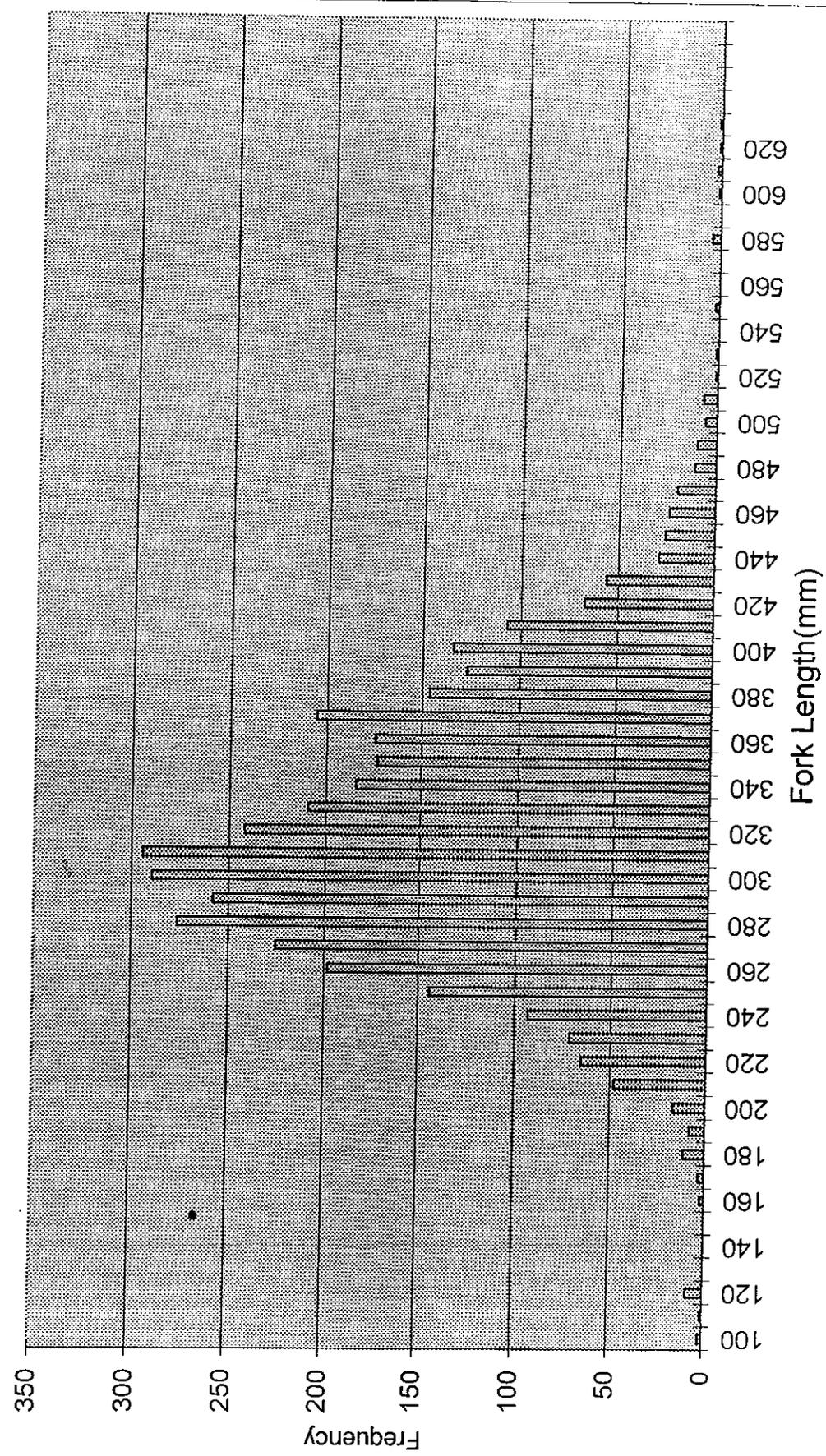


Figure 5. Length Frequency Distribution for Red Hind caught in Puerto Rico by Fish Trap during 1988-2001. (n=2,373)

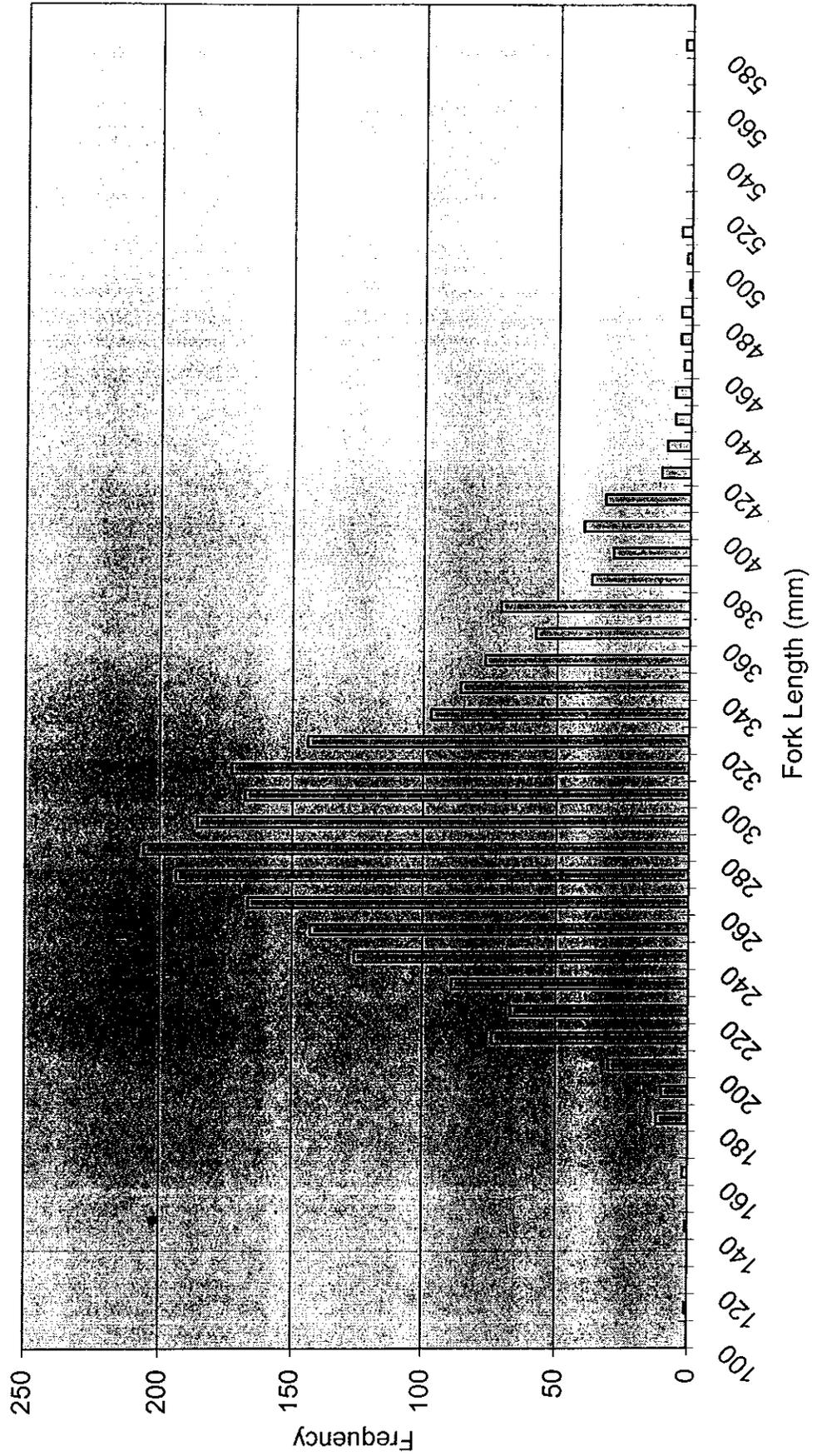


Figure 6. Length Frequency Distribution for Red Hind caught in Puerto Rico by Bottom Line during 1988-2001. (n=4,896)

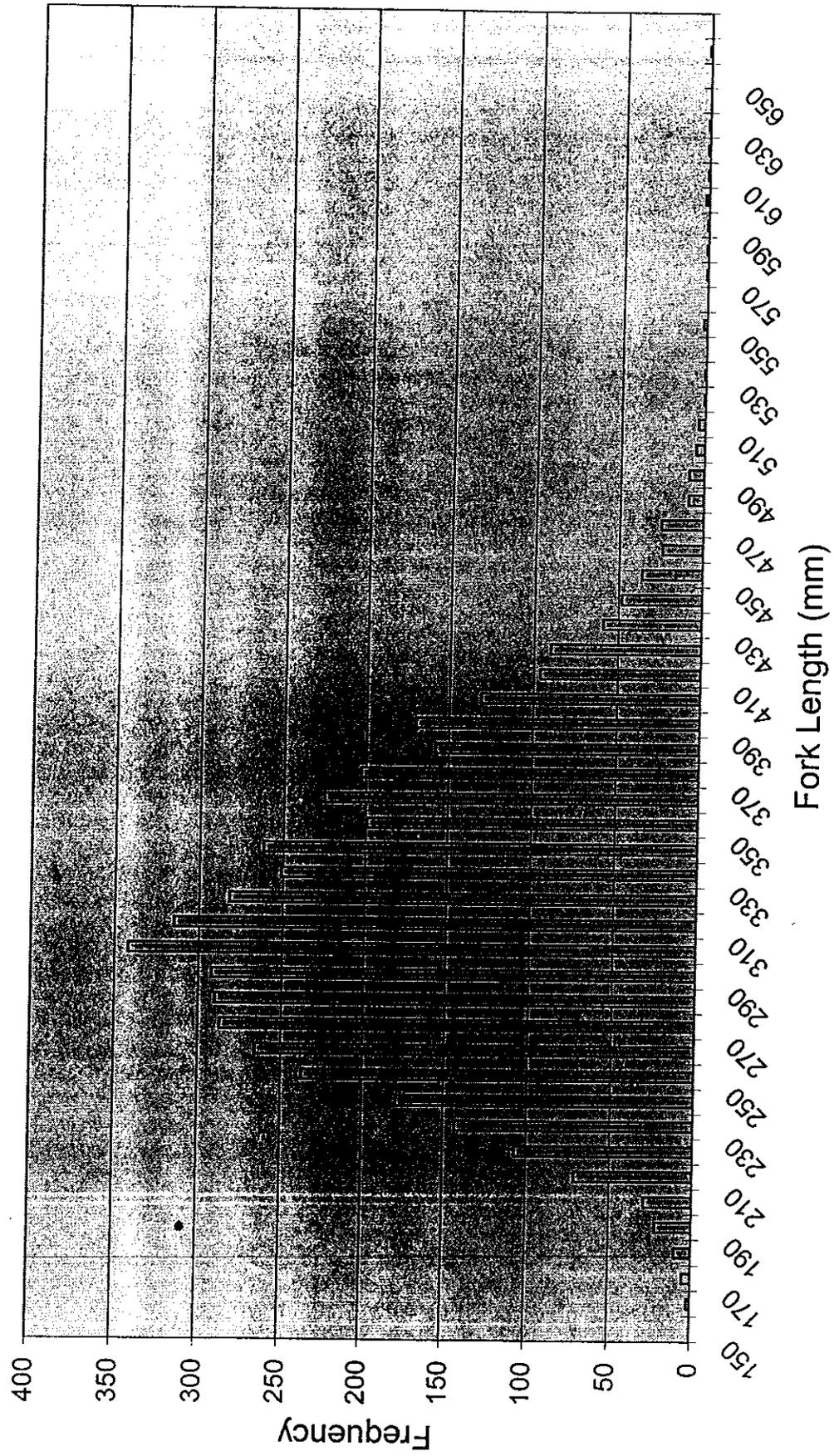


Figure 7. Length Frequency Distribution for red Hind caught in Puerto Rico by SCUBA Divers during 1988-2001. (n=4,865)

