Trends in Atlantic Billfish Fisheries in Puerto Rico (1954 - 2005)

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ABSTRACT

A description of the Atlantic Billfish fisheries was done based on data collected over the past 50 years in Puerto Rico. Data obtained from old fishing logs, tournament records, and commercial statistics records as well as recreational fisheries surveys were used for these analyses.

When data from different decades were analyzed, several trends were found. The most frequently landed species over these years was the blue marlin (*Makaira nigricans)*, followed by white marlin (*Tetrapterus albidus*). Sailfish (*Istiophorus albicans*) and longbill spearfish (*Tetrapturus pfluegeri*) were the least reported.

For blue marlin even though the average length has remained between 1,500 - 2,500 mm (LJFL), average weight has changed over the years. The 1950s were a decade characterized by small individuals, the 1960s by large individuals, and 1970 - 1980 showed a steady decrease in the average weight.

The late 1990s and early 2000s were characterized by higher average weight. This is mainly due to the regulations imposed in 1998 of a minimum size limit of 96 inches (2,438 mm). Also, during the late 1990s prohibitions were placed on harvest of longbill spearfish and minimum sizes were established for white marlin and sailfish.

Sex composition of blue marlin landed was recorded up to 1987. Males were the sex most frequently boarded (69.3% of the landed fish) whereas females were reported to be 30.3% of the sexed population.

Total weight of fish landed has increased over the past twenty years. Several factors such as higher number of fishermen targeting this species, and more high prized billfish tournaments have contributed to the increase in landings.

KEYWORDS: Billfish, Blue marlin, white marlin, sailfish, longbill spearfish fisheries, Puerto Rico

Aspectos de la Pesquería de Agujas en Puerto Rico (1954 - 2005)

Con datos recopilados por los pasados 50 años se describe la pesquería de agujas en la Isla de Puerto Rico. Estos datos fueron obtenidos de bitácoras de pesca, records de torneos de pesca, datos de estadística de pesca comercial, y datos obtenidos de censos de pesca recreativa.

Varios vertientes fueron encontradas al analizar los datos. La especie más capturada a través de los años es el aguja azul (*Makaira nigricans*), seguido por el aguja blanca (*Tetrapterus albidus*). El pez vela (*Istiophorus albidus*) y el pez espada (*Tetrapturus pfluegeri*) son los menos reportados.

A pesar que el tamaño promedio se ha mantenido entre 1,500 - 2,500mm (LJFL), el peso promedio ha variado a través de los años. Los años 50 son caracterizados por individuos pequeños, los sesentas por individuos de mayor tamaño y los años 1970 - 1980 muestran un descenso en el peso promedio.

A finales de los 90 y comienzos del 2000 el peso promedio es alto. Esto es como consecuencia de los reglamentos impuestos en 1998 de un tamaño mínimo de 96 pulgadas (2,438 mm). También, a finales de los años 90 se establecieron prohibiciones para la captura del pez espada y se establecieron tamaños mínimos para la aguja blanca y el pez vela.

La composición por sexo para las agujas abordadas fue reportada hasta 1987. Los machos dominan como el sexo más abordado (69.3%) mientras que las hembras componen el 30.3% de los individuos reportados.

El peso total de los individuos reportados ha aumentado en los últimos veinte años. Varios factores como el crecimiento en el número de pescadores, y de torneos de pesca han contribuido al aumento en individuos abordados.

PALABRAS CLAVES: Aguja azul, aguja blanca ,pez vela, pez espada, Puerto Rico

INTRODUCTION

Atlantic billfish such as blue marlin (*M. nigricans*), sailfish (*I. albicans*), white marlin (*T. albidus*), and longbill spearfish (T. *pfluregeri*) have been targeted in the Caribbean for the last 50 years by the recreational fishing communities, data on commercial fisheries indicates these to be fished until 1993 commercially. In the case of swordfish (*Xiphias gladius*) it has become recently of interest for recreational fisherman, although few are reported due to its behavior and mostly out of tournament nocturnal catch.

In Puerto Rico, a billfish fishery has been recognized

as a sport since 1950. In 1962, Erdman studied the sport fisheries of blue marlin off Puerto Rico, presenting observations on distribution, weight of the catch, sex ratio, food habits and fishing success from the catches from tournaments held at San Juan, Arecibo, Mayagüez, Parguera, and Ponce; these counties continue to be the basis for the blue marlin tournaments up to date. The results of that study still prevail with the peak of fishing of these species in the months recorded by Erdman.

Since the 1970, Atlantic billfish management strategies have been and continue to be guided by international and domestic considerations and mechanisms (Atlantic Highly Migratory Species – Fisheries Management Plan, 2005).

As a result of this interest, these fisheries had international agreements that have been developed for its management and conservation. Since 1971, NOAA fisheries have been monitoring billfish tournaments in the US Atlantic. In 1978, the preliminary Atlantic Billfish and Sharks Management Plan was first introduced to create international management plans for the species contained, minimize conflicts, and ensure the availability of billfishes and sharks in the US.

Atlantic billfish were again examined in 1983 in the Caribbean region to monitor trends in recreational fisheries in catch and effort. Since 1980, blue marlin and white marlin became of interest for studies of age and growth.

In 1988, Sailfish from the Western Atlantic, white marlin and blue marlin from the North Atlantic Ocean and Longbill from the Atlantic Ocean were included in the Atlantic Billfish Management Unit. Ban on possession of Atlantic billfish by commercial long line and drift nets were established, and the prohibition of sale of Atlantic billfish was established (with the exemption for Puerto Rico's small scale hand line fishery). By 1997, fishery resources, which included blue and white marlin, were found overfished, and in 1998 sailfish was added to this list. This created an international interest on reducing catch on these species. Minimum sizes for blue and white marlin were established by 1998.

These minimum size requirements went into effect in May 1999; commercial fishermen still had an exemption on the catch of Blue Marlin and measurements of the landed fish were not reported to the Commercial Fisheries Statistics Program (CFSP) of the Department of Natural and Environmental Resources. As previously stated, these were reported to the CFSP until 1993.

Data on recreational fishing of billfish was not recorded formally, only the individual marinas and associations kept their records and had data of their tournament activities

Until 1999, when the Recreational Fishing Statistics Survey started no information on the extent of the catch of billfish by recreational fishermen was known. At the same time, minimum size requirements were established for blue marlin, white marlin, and sailfish. This resulted in a decrease in the catch of these species. Blue Marlin continues to be targeted by recreational fishermen.

Recreational fishing for billfish has evolved over the last eight years due to the minimum size restrictions (1998) and permits required since 2003. Since 2001, some marinas have adopted the "all release" mode and some have established a "light tackle" mode for their tournaments. Of all the billfish captured, blue marlin and sailfish continue to be targeted for prizes in these activities. The number of fisherman has been increasing steadily in the Island (over 200,000) in 2004 (Rodríguez-Ferrer and Rodríguez-Ferrer 2005); approximately 18,468 fishermen take part in tournament related activities around the Island (this includes tournaments for other species) (Rodríguez-Ferrer and Rodríguez-Ferrer 2005). For the period of 2000 - 2004, a total of 61 blue marlin and 9 sailfish tournaments were held in the Island (Rodríguez-Ferrer and Rodríguez-Ferrer 2005). To date, over 200 boats have licensed permits to fish for National Marine Fisheries Service Highly Migratory Species Permit; this includes tunas, sharks, swordfish, and billfishes (Pers. comm. Capt. Víctor Ramos, Department of Natural and Environmental Resources).

The migratory nature of the species has created international interest and awareness on the lack of information on the species and the need of billfish conservation

Billfish are considered as a tourist attraction more than they are targeted for their meat. The thrill of the catch and fight attracts fishermen worldwide. Due to its rarity, large size, and powerful acrobatics blue marlin has become a prestigious catch among recreational fishermen. A multi-million industry has been developing and evolved around this species in the US, Venezuela, Bahamas, Brazil, the Caribbean and along the west Coast of Africa (Witzell and Scott 1990, ICCAT 2002, FAO 2002 in Tung 2003).

The objective of this paper is to create an overall perspective of billfish fishing in the Caribbean. This paper emphasizes the history of recreational billfish fishing in Puerto Rico over the last 50 years showing trends and changes (size, distribution, seasonality of the catch etc.) on the specie in Puerto Rico during the last five decades.

MATERIAL AND METHODS

Data obtained for the paper was gathered from F-42.5 project (*Marine Recreational Fisheries Statistic Survey*) (Rodriguez-Ferrer and Rodriguez Ferrer 2005). Data from 1983-1984 from datasheets of the Project *on Oceanic Game Fish*, and data from 1954-1972 came from tournament logbooks. Also, data on billfish catch from the *Commercial Fisheries Statistics Program* (CFSP) was gathered and analyzed for this paper.

Data Analysis

All available data was entered in a database created in Access 2000. In the data from F-42.5, the Oceanic Game Fish Investigation in 1983 - 1987 and the one from 1954 —

1973; landed fish were measured to the nearest millimeter (mm) and weighed in pounds during the tournaments and converted to kilograms for data analysis. All measurements were taken measuring in a straight line from the fish lower jaw to the fork length (LJFL). In the case of the data from commercial fisherman, measurements were not available and only weight of landed fish was used. Due to the regulations on commercial billfish, catch only data from 1988 - 1993 was available, after 1993 no billfish have been reported to the CFSP. The Kolmogorov Smirnov (Sokal *et. al*. 1981) test was used to compare the size frequency distribution.

To compare this data with the one available from 1983 Hook per unit effort (HPUE) was used. Hook per unit effort values were calculated by dividing the number of fish hooked by the number of hours spent trolling.

RESULTS

Blue Marlin

The total weight reported over the past fifty years ranges between 100 and 5,000 kg per year reported. In the 1980s, the interest in these fisheries increased and a peak on blue marlin landings (Figure 1). The total weight reported for tournaments in Puerto Rico was 37,134 kg (Figure 2). The average weight for the first decade of reported data is about 100 kg; the highest average weight for the fifty years is reported in the early 1970s (300 kg), in the mid-seventies a drop of 150 kg in the average weight was reported (Figure 3). In the early 1980s, the average weight increased to 200 kg, but then in the mid-eighties when the billfish landings increased while average weight decreased to less than 100 kg. After the size limit regulation, the average weight has remained stable between 150 and 200 kg (Figure 3).

The index of apparent relative abundance is based on the number of fish hooked per hour of trolling (HPUE). This index was used to be able to compare the data with was reported by Lopez et al. (1983). The HPUE for 1973, the earliest year data was collected, was 0.03; for 2004 the HPUE was 0.10, an increase of 42% (Figure 4).

During the first thirty years of these recreational fisheries, the majority, if not all, the fish were landed. In the 1980s, several fishermen adopted the tag and release practice. During last decade of data collection, the tag and release of fish dominated the fishing (Figure 5). The difference between the blue marlin caught in 1983 and 2004 is 67% versus 1.7% (Table 1).

The average length per year has been steady, ranging from 2,000 to 2,550 mm LJFL over the years. Several drops in the late 1960s and in the 1980s are noticeable. After the size limit regulation of 1998, the average length increased and has been steady ever since (Figure 6).

In the first four decades of data collection, the sex of the individuals landed was determined at the tournaments. Until the 1980s, most of the tournament landed fish were males (Figure 7).

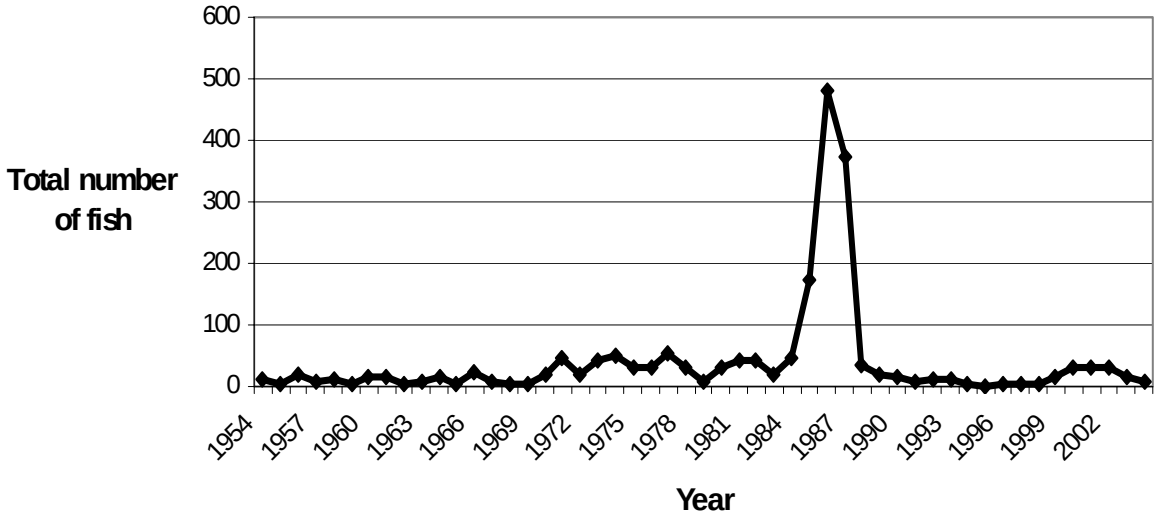

Figure 1. Landings for Blue Marlin (*Makaira nigricans*) (1954-2004).

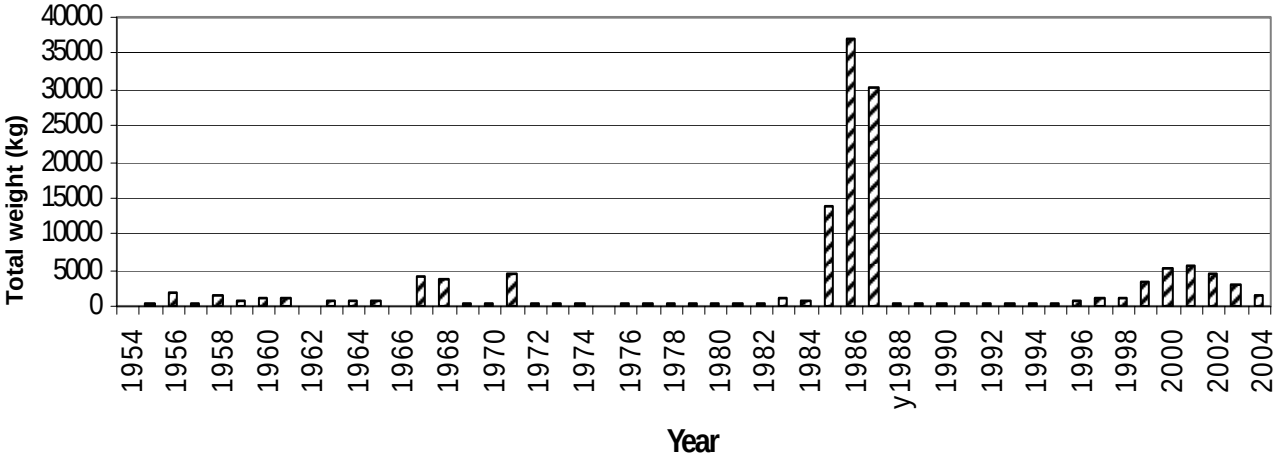

Figure 2. Total weight reported for Blue Marlin (*Makaira nigricans*) (1954 - 2004).

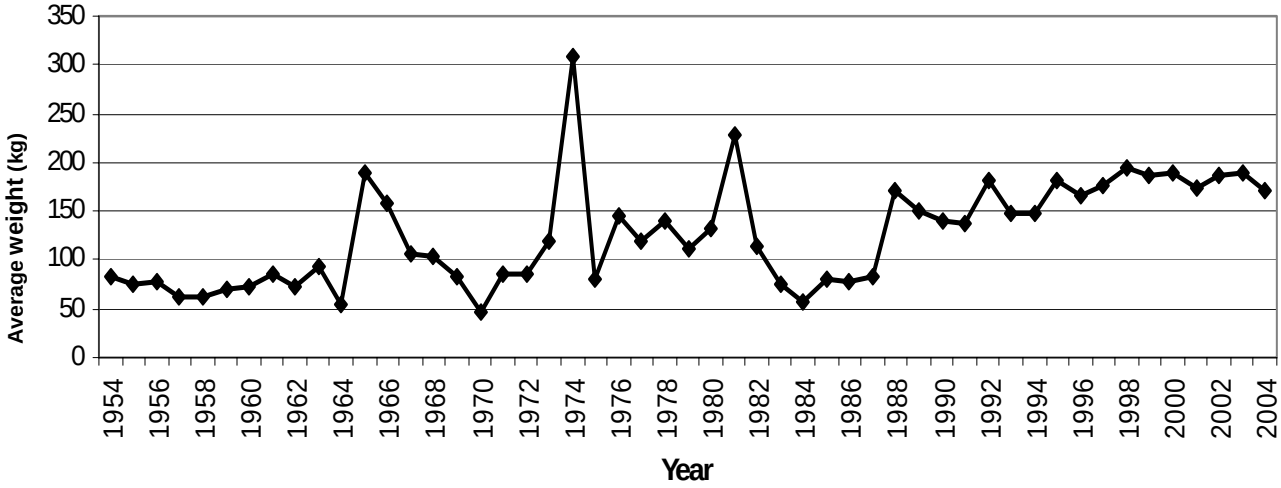

Figure 3. Average weight (kg) reported for Blue Marlin (*Makaira nigricans*).

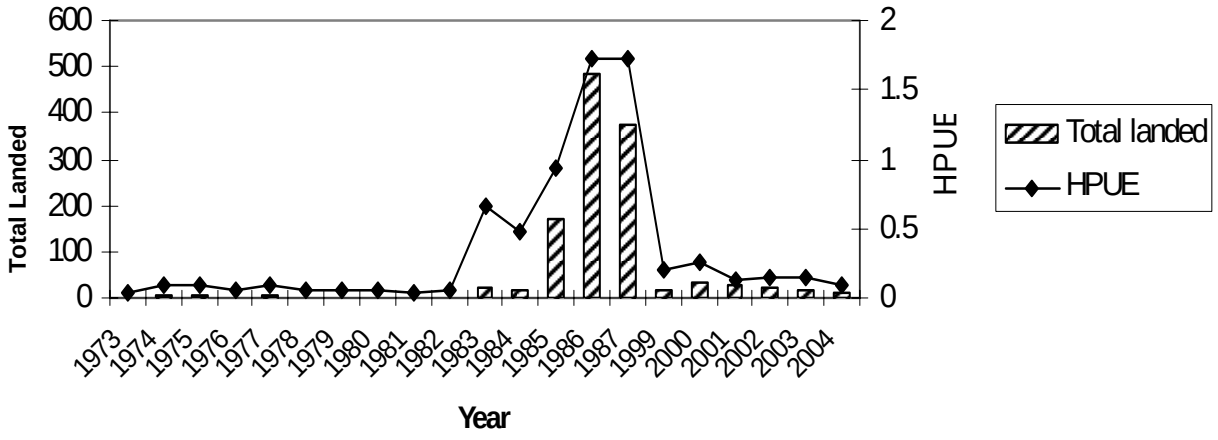

Figure 4. Hook per Unit Effort (HPUE) for reported tournaments (1973-2004).

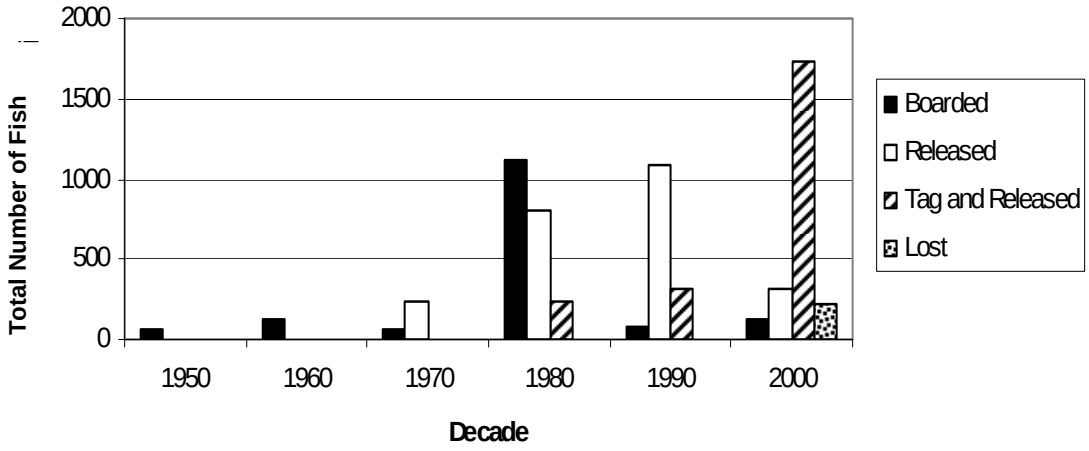

Figure 5. Blue Marlin(*Makaira nigricans*) Fishing Activity (1950-2004).

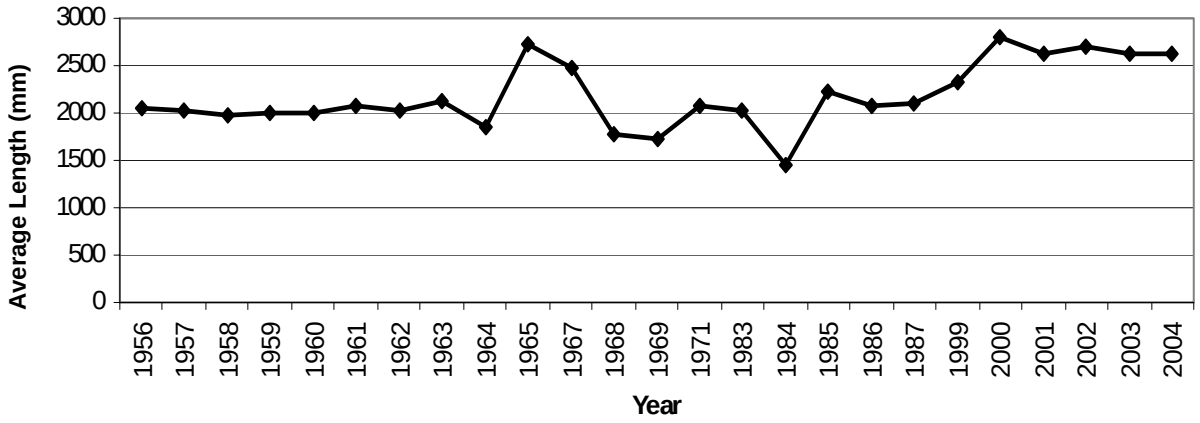

Figure 6. Average length for Blue Marlin (*Makaira nigricans*) (1954-2004).

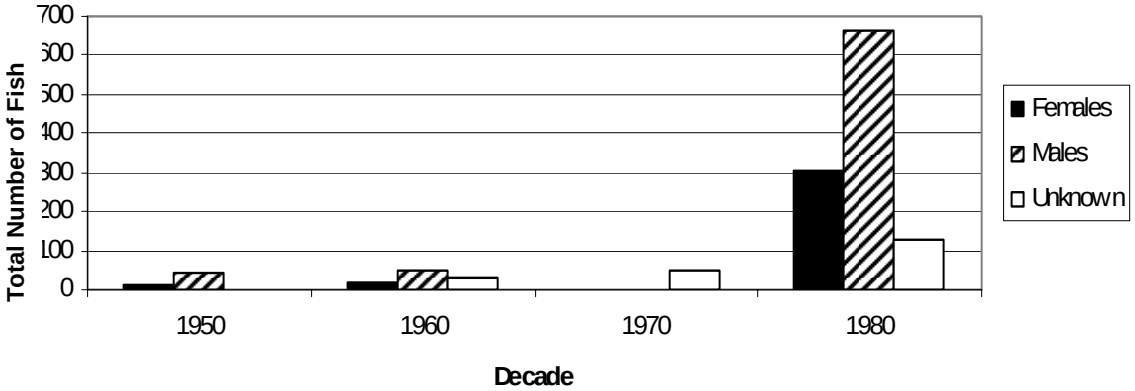

Figure 7. Sex distribution of Blue Marlin (*Makaira nigricans*) (1950-1980).

Table 1. Comparison of fishing activity (*from Lopez *et. al.* 1983).

Year	Hooked	Caught	% Caught
1983*	1092	737	67
2004	515	9	1.7

Commercial Fishing

Data on blue marlin commercial fisheries is scarce. The Commercial Fisheries Statistics Program has records from 1988 to 1993, when reporting of this fishery stopped (Figure 8). The total weight reported dropped from 5,500 kg in 1988 to 3,000 kg in 1993 (Figure 8).

Marine Recreational Fisheries Statistics Program

The Marine Recreational Fisheries Statistics Program started collecting data in Puerto Rico in the late 1990s. This data collection consists of two modes telephone and point intercept interviews (MRFSP 2004). From the data collected blue marlin landed ranged from 1,374 in 2000 to 752 in 2004 (Table 2).

Other Billfish Species

Sailfish, white, marlin and longbill spearfish can be considered secondary in fishermen preference. Other than blue marlin, sailfish has tournaments that target this species. For the three species, the 1960s was the decade with the most landings (Table 3). Afterwards, a steady decrease in these species landings is noted (Figure 9). By 2000 they are mainly tag and release, only sailfish are landed and weight at the tournaments (Figures 10,11,12).

Table 2. Marine Recreational Fisheries Statistics Program data from point intercepts and telephone interviews.

Year	Total catch	Avg. PSE.	Total released	Avg. PSE.	Total landed	Avg. PSE.	Total weight	Avg. PSE.
2000	12,247	25.2	10,748	66.32	1,374	100.5	215,627	74.1
2001	7,226	24.9	6,642	66.95	534	97.2	140,680	97.2
2002	9,252	23.1	7,505	62.40	1,747	78.55	101,913	NR
2003	6,085	26.3	5,536	68.95	550	100.1	256,152	NR
2004	4,662	28.5	3,879	78.22	782	70.8	NR	NR

*NR= not reported

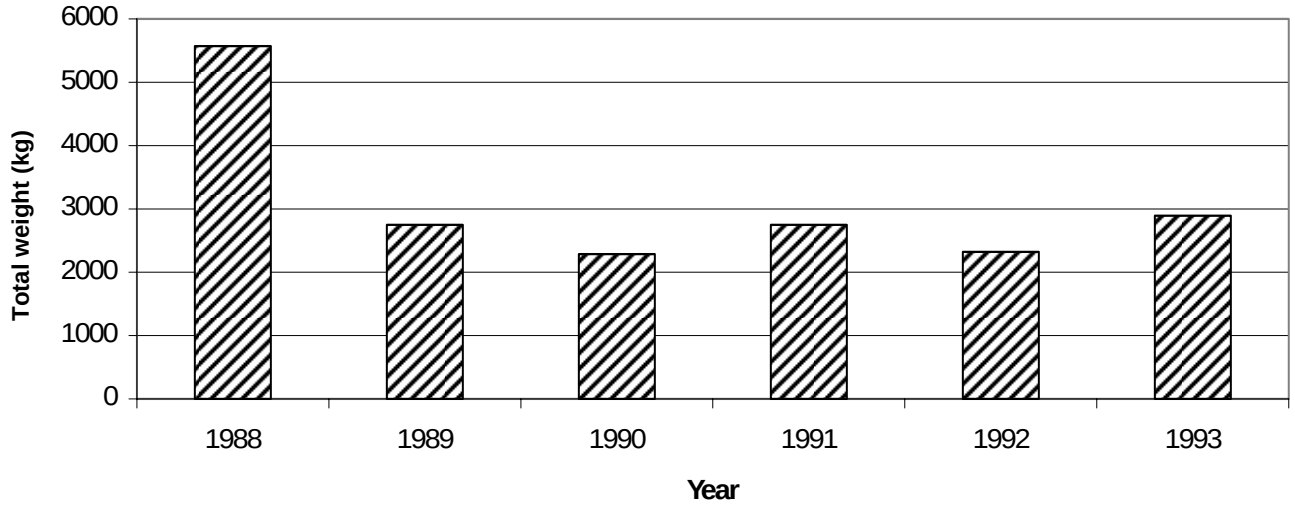

Figure 8. Total weight reported for commercial fishing (1988 - 1993).

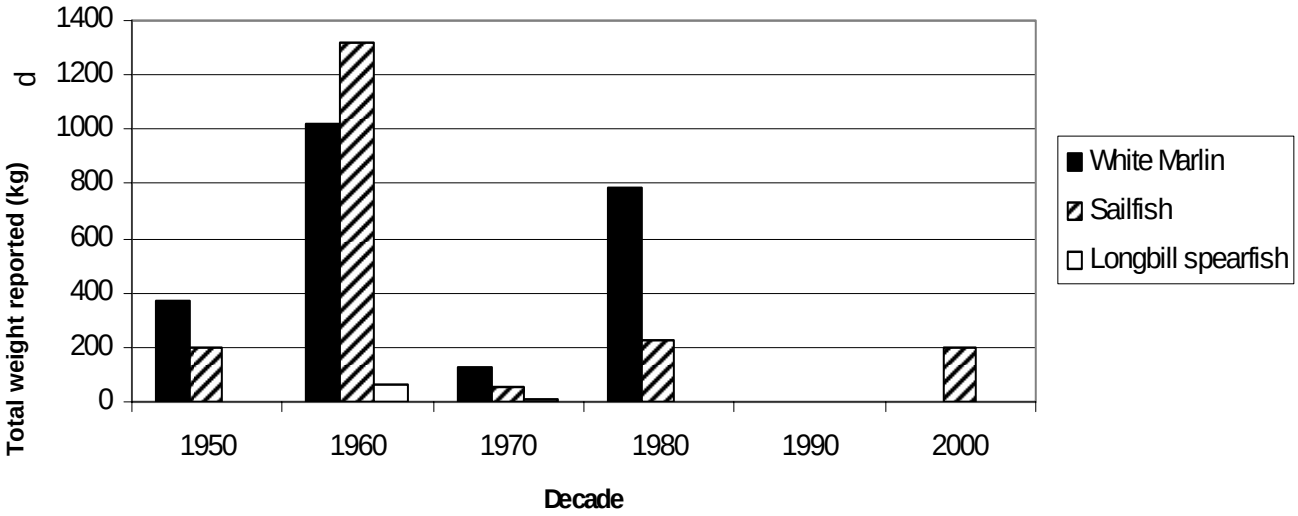

Figure 9. Total weight reported by species per decade.

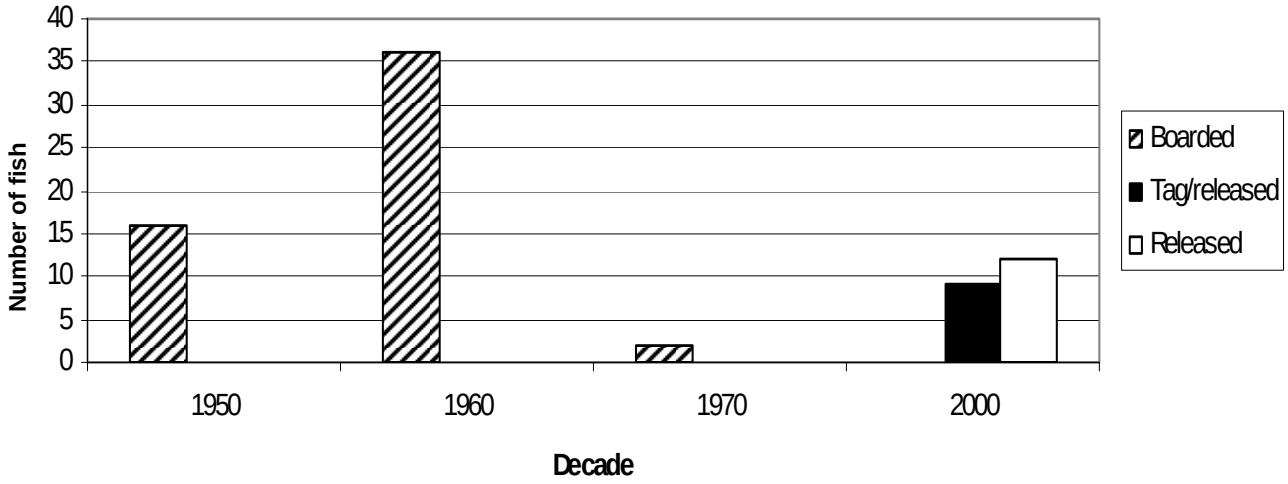

Figure 10. White marlin (*Tetrapterus albidus*) fishing activity per decade.

Table 3. Total weight reported per decade for white marlin (*T. albidus*), sailfish (*I. albicans*) and long-bill spearfish (*T.pfluegeri*) in Puerto Rico.

Decade	White Marlin	Sailfish	Longbill spearfish
1950	371.99	194.42	0
1960	1019.48	1318.49	62.48
1970	122.01	54.05	7.27
1980	783.58	223.35	0
1990	NR	NR	NR
2000	0	198.11	0

NR = not reported

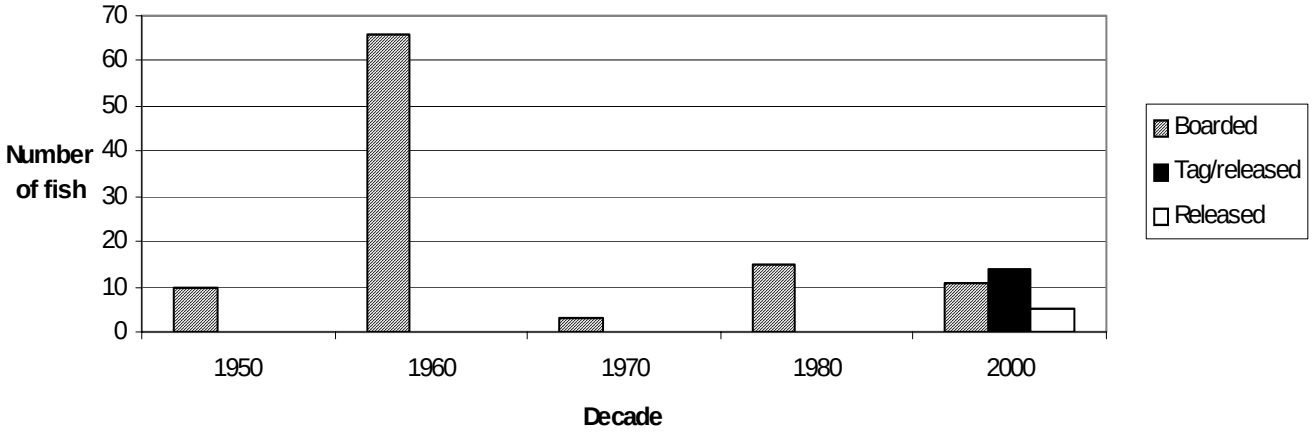

Figure 11. Sailfish (*Istiophorus albicans*) fishing activity per decade.

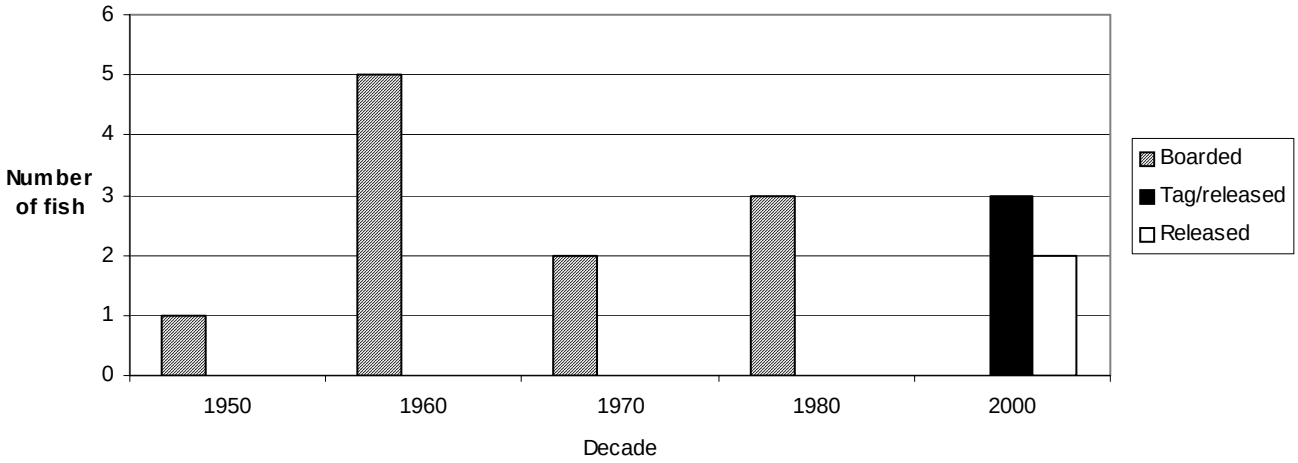

Figure 12. Longbill spearfish (*Tetrapturus pfluegeri*) fishing activity per decade.

DISCUSSION

For the most part, billfish fishing has been regarded as a recreational activity in Puerto Rico. Landings since 1954 mostly consists of blue marlin, followed by white marlin, sailfish, and longbill spearfish. Blue Marlin fishing is still a very important aspect of recreational fishing in Puerto Rico. The other species have been regarded as secondary in preference. Of all the other billfish species, only sailfish tournaments are held along the north coast. The others have been reported as released on these activities.

The practice of all release tournaments has become frequent around the north and west coast of the Island. Records of released fish have been established in the west coast in 2003 (178, blue marlin released) and 2005 (205, releases of blue marlin). Both records at the Light Tackle Tournament held at Club Deportivo del Oeste (Puerto Rico Sport Fishing Association Pers. comm.).

Little is known of the survival of these released fish, and the amount of recaptured tagged fish is unknown. Edwards *et al*. (1989) found in a study on mortality and short term survival of released fish that, depending on the fishing techniques used, 54% of all blue marlin caught and released would exhibit short-term survival.

In Puerto Rico, even during all-release tournaments, fishermen seeking trophy size individuals would practice longer fishing, sometimes releasing exhausted fish. In 1985, Wells and Davie examined the effects of stressed on blood-oxygen binding capacity of stressed (by capture) striped marlin and found that most causes of death was intercellular acidosis (Wood *et al*. 1983) and ph mediated reduction of blood oxygen binding capacity to levels that do not allow oxygenation of blood in the gills. In the case of blue marlin fish would die within two hours of release. More information is needed to fully evaluate, predict, and understand survival of released fish.

CONCLUSIONS

Long-term data collection provides a good tool to determine stock health over several years. The data presented here represents a wide scenario of billfish fishing in Puerto Rico. Cooperation from fishermen and marinas is still a crucial part in this endeavor. There was some data missing from 1988 - 1998; some clubs still have the data, but it was not available for review for the authors.

Billfish fishing since 1946 has been developing in Puerto Rico, and it continues to be an important activity for tourism in the Island. The prohibition of sale for these species has granted exclusive use for recreational fisherman.

Several studies have indicated the preference of Puerto Rico fisherman to land fish (Graefe and Ditton 1997). In recent years, more tournaments organizers have encouraged the all release mode in their activities; however, fish are landed regardless of being unacceptable for tournament purposes (awards). Some clubs have even increased minimum size requirements from 99 inches to 101 inches (LJFL) for the fish to be worth points in the competitions. This created some misunderstandings among fisherman that thought that federal minimum size requirements have changed, and most landed fish in the 99 - 100 inches range (LJFL).

Since minimum size requirements have been established, most billfish weighed at fishing tournaments comply with these measurements. Blue marlin exhibit sexual dimorphism in weight, where females are typically heavier than males (Nakamura 1985). Due to its size, most landed fish from fishing tournaments are considered to be females. The peak of spawning season is in the summer months (Erdman 1968) which coincides with the peak of billfish tournaments. This situation should be taken into consideration when managing the species.

Standardizing data collection for all projects and fishing activities for billfish in the Caribbean would provide a better knowledge of the species. Continuous surveys of spawning activities and analysis of the biology of billfish are necessary to accurately predict and understand the status of the stock in our waters.

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