

A HISTORICAL REVIEW OF THE BY-CATCH FROM THE PORTUGUESE SURFACE LONG-LINE SWORDFISH FISHERY: OBSERVATIONS ON BLUE SHARK (*PRIONACE GLAUCA*) AND SHORT-FIN MAKO (*ISURUS OXYRINCHUS*)

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SUMMARY

*This paper review historical data on the by-catch from the Portuguese long-line swordfish fishery, namely on the blue shark (*Prionace glauca*) and the short-fin mako (*Isurus oxyrinchus*). This was done by analysing logbooks both for the North (ICCAT area 94B) and South Atlantic (ICCAT areas 96 and 97) areas, in order to detect any relationship on the ratio between the catches of swordfish and non-target species. Based on these analyses the Portuguese catches of sharks associated to the swordfish fishery were estimated. The seasonal nature of the catch rate was investigated. Catch rates for blue shark and swordfish, in the North Atlantic area, exhibit a pronounced seasonal and asynchronous nature. The highest catch levels of the blue shark are obtained during the 1st semester, while those of swordfish occur in September/October. No clear trend for the short-fin mako catch rate was observed, but they are slightly higher during the second semester.*

RÉSUMÉ

*Le présent document examine les données historiques sur la prise accessoire des palangriers portugais qui pêchent l'espadon, plus précisément sur celle de requin peau bleue (*Prionace glauca*) et de requin-taupe commun (*Isurus oxyrinchus*). Ceci a été fait en analysant les extraits de livres de bord pour les zones nord (zone ICCAT 94B) et sud (zones ICCAT 96 et 97) de l'Atlantique dans le but de détecter toute relation concernant la proportion des prises d'espadon et de celle des espèces non ciblées. Les prises portugaises de requins associées à la pêche d'espadon ont été estimées d'après ces analyses. Le caractère saisonnier du taux de capture a été examiné. Le taux de capture du requin peau bleue et de l'espadon dans la zone nord-atlantique montre un caractère saisonnier et asynchrone prononcé. Le niveau de capture le plus élevé du requin peau bleue est atteint pendant le premier semestre, et celui de l'espadon en septembre/octobre. Aucune tendance claire du taux de capture du requin-taupe commun n'a été observé, mais il est légèrement plus élevé pendant le deuxième semestre.*

RESUMEN

*En este documento se revisan los datos históricos de la captura fortuita de la pesquería de palangre portuguesa dirigida al pez espada, a saber, captura fortuita de tiburón azul (*Prionace glauca*) y marrajo dientuso (*Isurus oxyrinchus*). Esta revisión se realizó mediante el análisis de los cuadernos de pesca del Atlántico norte (zona ICCAT 94B) y Sur (Zonas ICCAT 96 y 97), con el fin de detectar una relación entre la tasa de capturas de pez espada y especies no objetivo de la pesca. Se estimaron las capturas de tiburones asociadas a la pesquería de pez espada basándose en dichos análisis. Se investigó el carácter estacional de la tasa de captura. Las tasas de captura para el tiburón azul y el pez espada, en la zona del Atlántico Norte, presentan un pronunciado carácter estacional y asincrónico. Los niveles más altos de captura de tiburón azul se obtuvieron durante el 1^{er} semestre, mientras que los de pez*

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espada se produjeron en septiembre y octubre. Para el marrajo dientuso no se observó una tendencia clara, pero las capturas parecen presentar unos niveles ligeramente más elevados en el segundo semestre.

KEYWORDS

Swordfish fishery, By-catch, Blue shark (Prionace glauca), Short-fin mako (Isurus oxyrinchus)

INTRODUCTION

The Portuguese swordfish long-line fishery developed after 1986 when this type of fishery started to have a special importance in the North Atlantic, while the fishery in South Atlantic area gained importance in 1989. Nowadays, it plays an important role on the Portuguese fisheries due to the amount of people involved and the high market value of this species.

The swordfish (*Xiphias gladius*) is mainly caught by surface long-line. Although the fishing effort is primarily targeting swordfish, this is a multi-specific fishery, where some species of pelagic sharks may be targeted during some seasons or areas, especially when the swordfish is less abundant. Several other species like billfishes, coastal and pelagic sharks and tunas are caught as by-catch. Among these, the most important are the blue shark (*Prionace glauca*) and the short-fin mako (*Isurus oxyrinchus*). Blue shark was always had more importance than short-fin mako in the catches, but in the first years of the fishery was discarded at sea without being discriminated in the logbooks or in the catch statistics. However, during last decade the landings and the reports in the logbooks of pelagic sharks have increased, reflecting a change in marketing of these species and the increasing interest of the international markets by shark products.

The aim of this report is to review historical data on the by-catch from the Portuguese long-line swordfish fishery, namely on the blue shark and the short-fin mako. To the authors' best knowledge, limited attention has been given to these species, by Portuguese researchers. The available studies concern short studies on the biology and aspects of the blue shark fishery in the Azores area (Silva & Pereira, 1998; Simões, 1998; Silva *et al.*, 2000).

DATA SOURCES AND METHODS

Data concerning the Portuguese long-liners targeting swordfish was collected from the DGPA (Fisheries and Aquaculture General Directorate) database and logbooks. The available data covered the period 1990-2000 and 1995-2000, for the North (ICCAT area 94B) and South Atlantic (ICCAT areas 96 and 97), respectively. A total of 22764 logbooks records were analysed, of which 19855 corresponded to fishing area 94B, 2194 in area 97 and the remaining 715 in area 96. This was done in order to investigate any possible relationship on the annual ratio between the catches of swordfish and the above mentioned non-target species. Based on these observed annual ratios, estimations of the annual catch of the blue shark and the short-fin mako were made.

A comparative description of the total annual landings (MT) of swordfish, blue shark and short-fin mako was made. Additionally, the monthly variation of the catches was analysed to identify possible trends on the fishery. For this purpose, the proportion of monthly landings was estimated for swordfish, blue shark and short-fin mako. This was made for the period 1996-2000 and for the North Atlantic only.

RESULTS AND DISCUSSION

Annual catch ratios between swordfish and non-target species

Figures 1 to 3 show the observed annual ratio between the swordfish and the two no-target shark species catches from the Portuguese long-liners.

In the North Atlantic area, as far as the ratio between the blue shark and swordfish is concerned, it was observed a constant ratio (1.1-1.2) between 1990 and 1994, followed by a important increase from 1994 to 1997, reaching some stability from 1997 forward (2.8-3.1). A similar trend was observed for the ratio between the short-fin mako and swordfish. However, in this case the ratio has a much lower value. The sharp increase observed between 1994 and 1997, is probably a consequence of a strong demand for shark products in European markets as noted by Fleming & Papageorgiou (1997), rather than a shift on the natural occurrence of these species on the fishery. This idea is reinforced by the fact that before and after this period constant ratios were observed. On the other hand, the lower ratio values observed during the beginning of the 90's was due to non-reporting, as a consequence of a minor interest of the fishermen on these pelagic sharks, namely for the blue shark. Due to these facts, we used the average ratio values obtained during the "stable" period (1996/7-2000), to estimate the total shark catches between 1990 and 1995/6. The used values were 2.920 and 0.406 for the blue shark and the short-fin mako, respectively.

In the South-eastern Atlantic a positive trends was observed on the evolution of the annual ratios (Figure 2). However, this was more evident in the case of the blue shark. The difference between the two ratios is of the same magnitude of that observed on the North Atlantic, but their values are lower than those observed on the Northern latitudes. In order to estimate shark catches during the first 2 or 3 years of the fishery, the following ratio values were used: 2.229 and 0.241 for the blue shark and the short-fin mako, respectively.

The pattern observed on the evolution of the annual ratios in the South-western Atlantic is similar to that of the South-eastern (Figure 3). However, a slight decrease was observed for the year 2000. On the other hand, the ratio values are lower than those observed on the eastern part of the Atlantic for the some period.

Total annual estimated landings

The total Portuguese landings of swordfish, and the estimated catch of the two most important by-catch species in the North and South Atlantic are reported in Tables 1 and 2, respectively.

The annual catches for the 3 species in the North-eastern Atlantic (ICCAT area 94B) reached a peak in 1993, with catches of the blue shark and the short-fin mako reaching 4843 MT and 691 MT, respectively. Between 1993 and 1996 the catches remained stable, around 2500 MT and 330 MT until 1996 (*vidé* Figure 4 and Table 1). After 1997, the observed decreases on the catches were due to the ICCAT swordfish TAC.

In the South-eastern Atlantic (ICCAT area 97) the annual catches for the 2 pelagic sharks remained constant until 1997, around 830 MT and 90 MT for the blue shark and the short-fin mako, respectively. They decreased during 1998, showing a slight increase thereafter (*vidé* Figure 5 and Table 2). On the other side of the Atlantic (ICCAT area 96) an increase was observed from 1997 to 1998 on the catches of the short-fin mako, decreasing thereafter. While the blue shark showed a peak on the catches in 1999 (270 MT) decreasing in the year 2000 to 159 MT (*vidé* Figure 6 and Table 2).

Seasonal trends on the fishery

The monthly variation of the catch proportions by species in the North Atlantic is shown in Figure 7. The swordfish dominates the catches between September (when the peak is reached) and November. However, an increase trend was observed from May to September and a decrease thereafter. In contrast, the blue shark dominates the catches for most of the time (from December to August), showing an increase from September to May and a sharp decrease during the Summer months. The existence of two asynchronous fishing seasons for swordfish and blue shark in the North Atlantic has been previously observed in the Azorean waters by Silva *et al.* (1998, 2000). In fact, a shift on fishing effort towards pelagic sharks possibly occurs during times of low abundance of swordfish, particularly during the 1st semester.

The short-fin mako did not show a clear trend, as those observed for the swordfish and the blue shark. The catch levels were all year round less than 9 % of the total catches. However, they were slightly higher during the 2nd semester.

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Table 1 – Total annual landings (MT) of swordfish and estimated catches of blue shark and the short-fin mako, from Portuguese surface long-liners in North Atlantic (ICCAT area 94B), between 1990 and 2000.

Year	Swordfish	Blue shark	Short-fin mako
1990	475	1387	193
1991	773	2257	314
1992	542	1583	220
1993	1961	5726	796
1994	1599	4669	649
1995	1617	4722	657
1996	1703	4843	691
1997	903	2630	354
1998	773	2440	307
1999	777	2209	324
2000	732	2081	305

Table 2 – Total annual landings (MT) of swordfish and estimated catches of blue shark and the short-fin mako, from Portuguese surface long-liners in South Atlantic (ICCAT areas 96 and 97), between 1995 and 2000.

Year	ICCAT area 96			ICCAT area 97		
	Swordfish	Blue shark	Short-fin mako	Swordfish	Blue shark	Short-fin mako
1995				380	847	92
1996				389	867	94
1997	81	86	10	360	802	87
1998	200	238	34	184	400	48
1999	136	270	31	242	552	53
2000	94	159	17	298	665	71

Table 3 – Relative proportion (%) of swordfish, blue shark and short-fin mako caught by Portuguese surface long-line fleet, in the North Atlantic (ICCAT area 94B), between 1996 and 2000.

Month	Swordfish	Blue shark	Short-fin mako
January	41	53	6
February	37	56	7
March	31	61	8
April	28	65	5
May	20	74	6
June	24	70	7
July	34	58	8
August	41	53	6
September	61	30	8
October	59	32	9
November	49	43	9
December	42	49	9

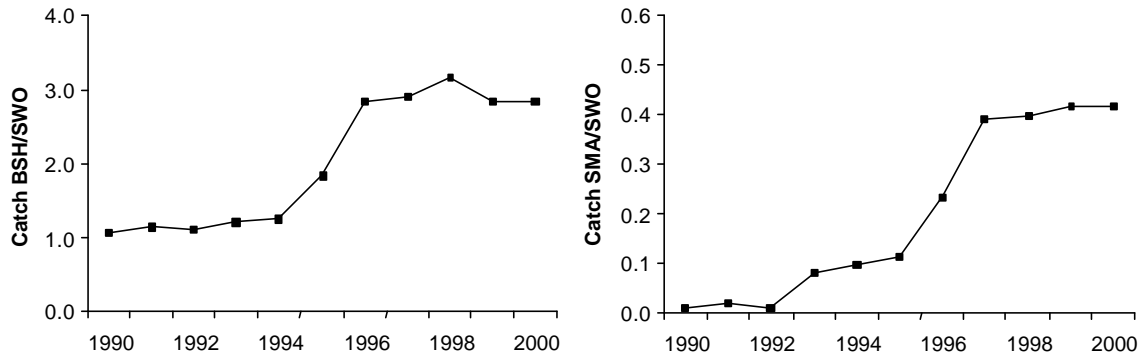


Figure 1 – Observed annual ratio between swordfish and blue shark catches (left) and between swordfish and short-fin mako catches (right) on the North-eastern Atlantic (ICCAT area 94B). Based on Portuguese logbook records during the period 1990-2000.

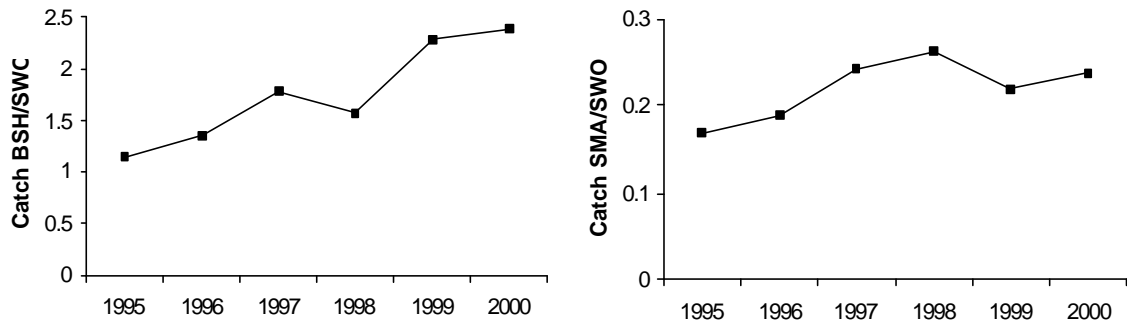


Figure 2 – Observed annual ratio between swordfish and blue shark catches (left) and between swordfish and short-fin mako catches (right) on the South-eastern Atlantic (ICCAT area 97). Based on Portuguese logbook records during the period 1995-2000.

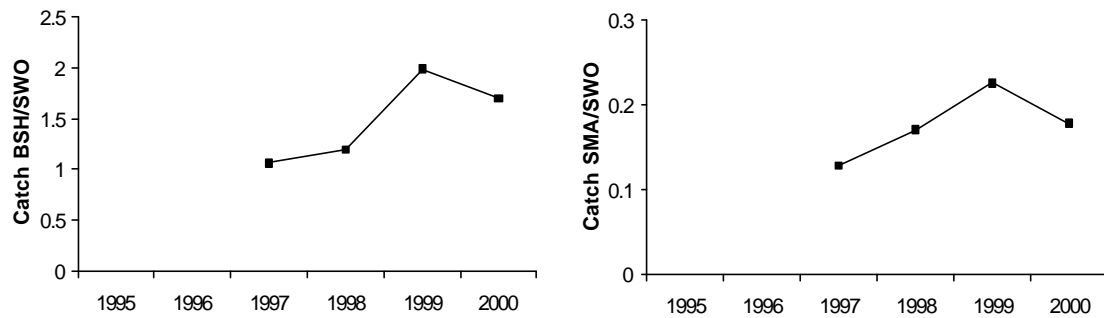


Figure 3 – Observed annual ratio between swordfish and blue shark catches (left) and between swordfish and short-fin mako catches (right) on the South-western Atlantic (ICCAT area 96). Based on Portuguese logbook records during the period 1997-2000.

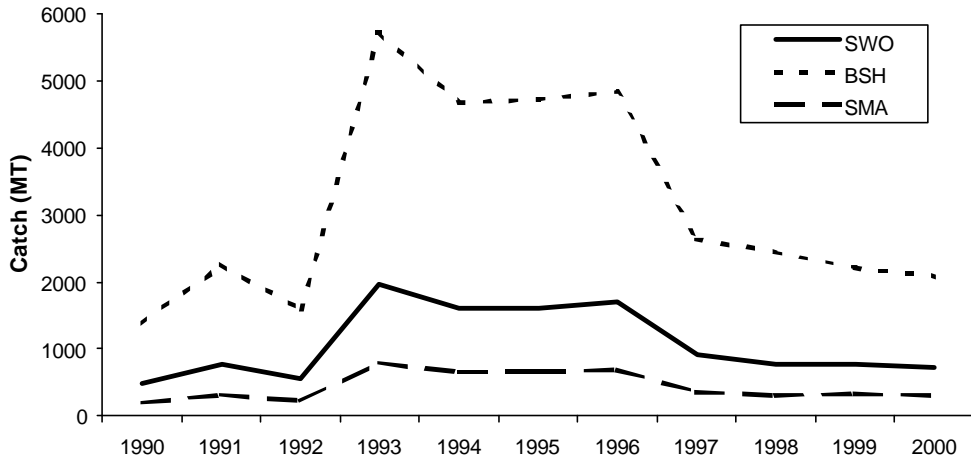


Figure 4 – Portuguese total annual landings (MT) of swordfish (SWO) and estimated catches of the blue shark (BSH) and short-fin mako (SMA) in the North Atlantic (ICCAT area 94B), between 1990 and 2000.

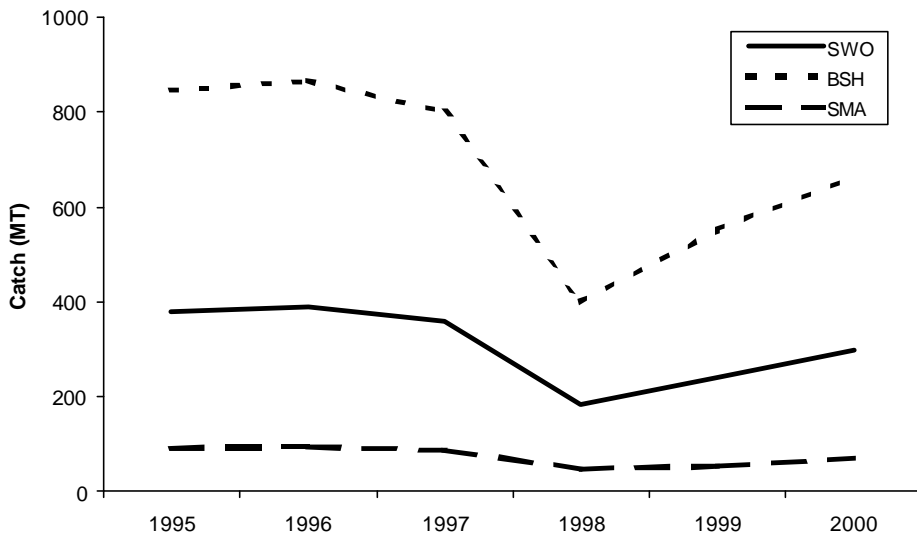


Figure 5 – Portuguese total annual landings (MT) of swordfish (SWO) and estimated catches of the blue shark (BSH) and short-fin mako (SMA) in the South-eastern Atlantic area (ICCAT area 97), between 1995 and 2000.

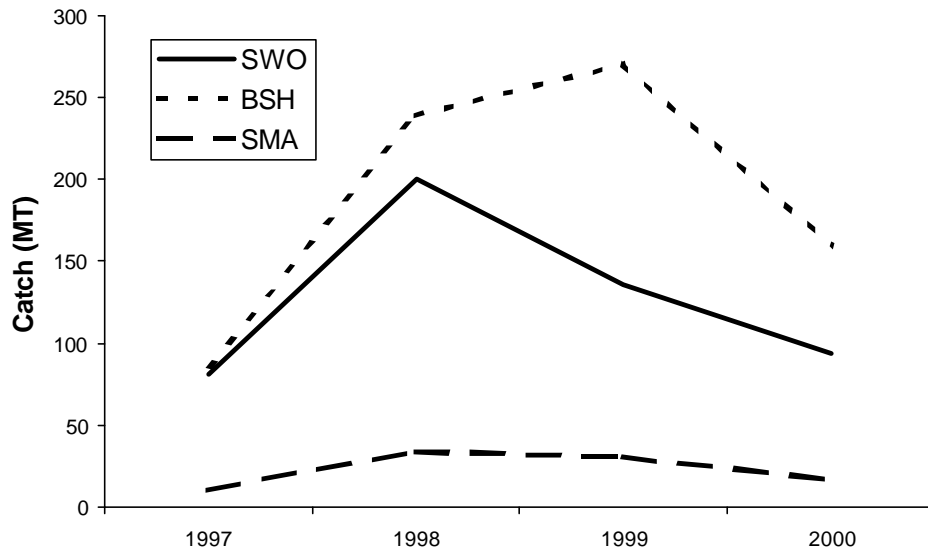


Figure 6 – Portuguese total annual landings (MT) of swordfish (SWO) and estimated catches of the blue shark (BSH) and short-fin mako (SMA) in the South-western Atlantic area (ICCAT area 96), between 1997 and 2000.

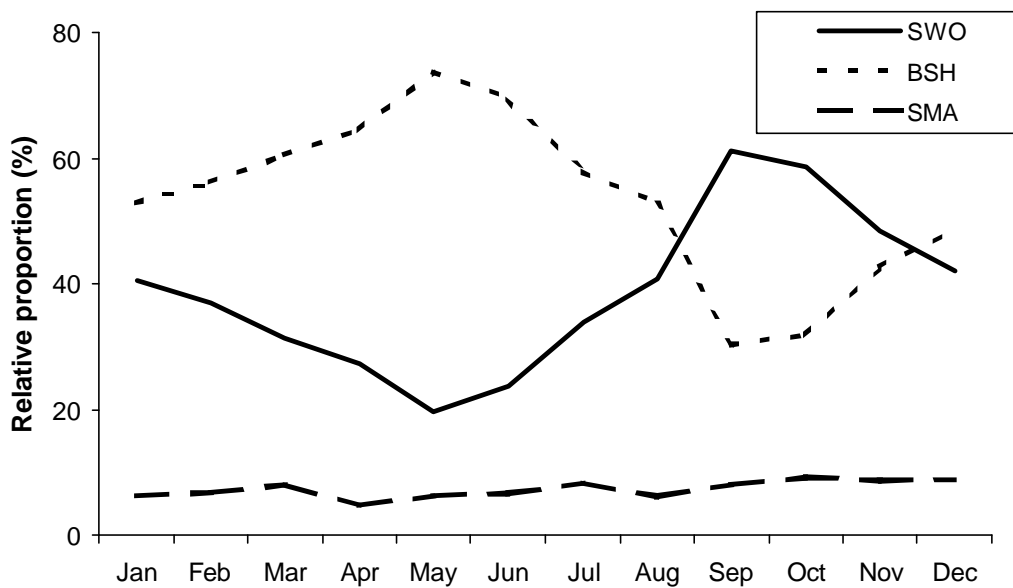


Figure 7 – Monthly mean catch proportions (%) of swordfish (SWO), blue shark (BSH) and short-fin mako (SMA) from Portuguese surface long-line fishery in the North Atlantic area (ICCAT area 94B), during the period 1996-2000.