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# SCIENTIFIC CATCH ESTIMATIONS OF BYCATCH SPECIES LANDED BY THE SPANISH SURFACE LONGLINE FLEET TARGETING SWORDFISH (*Xiphias gladius*) IN THE INDIAN OCEAN WITH SPECIAL REFERENCE TO THE YEARS 2007 AND 2008.

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***SUMMARY***

This document provides an overview of the bycatch levels by species landed by the Spanish surface longline fleet targeting swordfish (*Xiphias gladius*) in the Indian Ocean during the years 2007 and 2008. The three most prevalent species in the catch, swordfish, blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrinchus*) represented 84.3% and 88.5% of the total Indian Ocean landings in weight during the last two years, respectively. During the years 2007-2008 the bycatch species accounted for 56.0% of the total landings in weight from the Indian Ocean –large pelagic sharks, 43.6%; tunas, 6.9%; billfish, 1.7% and other species, 3.7%–. As far as only the bycatch species are concerned, large pelagic sharks were the most prevalent, comprising an average of 78.0% of the total bycatch in weight, whereas tunas accounted for 12.3%; billfish, 3.1% and other species, 6.6%. The blue shark and the shortfin mako were the most important species within the group of large pelagic sharks, reaching prevalences of 86.0% and 10.8%, respectively.

*Key words: surface longline, bycatch, sharks, statistics.*

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## 1. INTRODUCTION

The Spanish surface longline fleet has been historically targeting swordfish *Xiphias gladius* (SWO) in Indian Ocean areas since 1993. Other epipelagic species are also caught simultaneously, consisting mostly of large pelagic sharks – mostly blue shark- and, to a lesser extent temperate and tropical tunas, billfish, etc., as was also reported for other oceans (García-Cortés and Mejuto 2000, 2002; Mejuto *et al*. 2000, 2002a, 2002b, 2003, 2006, 2007, in press).

The fishing gear used historically by Spanish surface longline vessels from the beginning of their activity in the Atlantic until the late 1990s was mostly the 'traditional Spanish longline', equipped with a multifilament main line and clips. However since then, the monofilament or 'American style' –Florida style modified– longline gear has been introduced in most of the surface longline vessels of the Spanish fleet fishing in the different oceans, with a mean deployment of around 1 100-1 500 hooks per set.

The methods used by the national administrations of many countries generally allow estimates of the landing levels of the so-called bycatch species to be obtained. However, these data are often grouped together according to commercial criteria and/or taxonomic similarity. Oftentimes the species are either misidentified by the fleets or they fail to reach the precise taxonomic level required for scientific purposes. An example of these historical obstacles in the Atlantic is the problematic situation of the breakdown of the Istiophorid group, despite the long history of the ICCAT (García-Cortés *et al*. in press). Moreover, in many cases the breakdown of bycatch species has not been detailed enough to provide data with the same resolution as the target species. In such situations, it is of utmost importance to develop research efforts that will able to determine, with a sufficient level of confidence and on a global level, the annual catches of the different bycatch species and their respective prevalence levels within these species as a whole to be used in quantitative analyses of the different stocks, where possible, as well as in performing qualitative analyses on the vulnerability of these species to the fishery activity. The apparent increase in the spatial and temporal resolution of the data does not necessarily imply improved accuracy in the data available for scientific purposes or the availability of sufficiently detailed taxonomic levels to be ably to carry out these types of analyses. In these situations the essential preliminary steps that must be taken to pursue a diagnosis of the pelagic ecosystem and achieve greater resolution and reliability in the data are to obtain scientific estimates of the annual landings of the so-called bycatch species at the most detailed taxonomic level possible along with the implementation of sustained training strategies directed at the fleets as a whole.

The objective of this paper is to update the scientific estimations of Spanish longline bycatch landings in the Indian Ocean for the most recent years 2007 and 2008, at the most detailed taxonomic level possible, and to define the relative global prevalence among these species. This information updates the historical series of the surface longline fleet targeting swordfish which is already available to determine the consistency of the estimations across years.

## 2. MATERIAL AND METHODS

The information provided in this paper is based on scientific information obtained from a research project. The information used was taken from interviews on landings per trip, interviews with skippers at the ports, information filled out voluntarily by the fleet as well as other sources. The paper also made use of data provided by the scientific observers on board commercial vessels during regular fishing activities targeting swordfish. The breakdown into species of the most prevalent bycatch landed, such as *Prionace glauca* (BSH) and *Isurus oxyrinchus* (SMA), was generally carried out using the information provided by each individual boat in their voluntary scientific reports, sampling at the ports and other sources, since the routine taxonomic identification of these species is usually reliable. However, identification at the level of species belonging to some of the much less prevalent groups such as SHK (other pelagic sharks), BIL (billfish species), TUN (tuna species) and OTH (other species) was fundamentally based on the information provided by more detailed information and on-board observers who have a limited spatial-temporal coverage and on the basis of sampling upon arrival at the port. Due to the wide geographic areas covered by Spanish vessels in the Indian Ocean, in certain cases a satisfactory breakdown of the landings was not reliable. Consequently, the reported landings of combined species with a low prevalence could, in some cases, being assigned or allocated to a single species observed.

The records that were originally based on gutted or dressed weight were converted, where necessary, to units of round weight (RW) by applying different conversion factors according to the species or group of species, depending on the manipulation process applied to the fish on board. Conversion factors were defined for different species and presentations: *Prionace glauca* (BSH): Round weight (RW) = Dressed weight (DW) * 2.4074. *Isurus oxyrinchus* (SMA): Round weight (RW) = Dressed weight (DW) * 1.4541. The other pelagic sharks (other SHK): Round weight

(RW) = Dressed weight (DW) * 1.4 (except for species of Carcharhinidae: Round weight (RW) = Dressed weight (DW) * 2.0). All species included in the group of billfish (BIL): Round weight (RW) = Dressed weight (DW) * 1.2. The conversion factors applied to each species within the group of tuna (TUN) were: Round weight (RW) = Gutted weight (GW) * 1.1 and Round weight (RW) = Dressed weight (DW) * 1.25.

## 3. RESULTS AND DISCUSSION

Table **1** shows the total landings in weight per species for years 2007 and 2008. The three most prevalent species in the catch, which are also those of highest commercial interest for human consumption (SWO+BSH+SMA), represented 86.3% of the total landings in the Indian Ocean, similar levels (85.2%) to those observed during the 2004-2006 period (Ramos-Cartelle *et al.* 2008).

Table **2** shows the scientific estimations of landings of the target species and combined bycatch obtained by the Spanish surface longline fishery in 2007 and 2008. The group of species considered to be bycatch of the swordfish surface longline fishery from the total catch landed in weight during 2007 and 2008, accounted for 54.1% and 58.1% respectively. This percentage was similar to those previously obtained in the Indian Ocean (53.8%) (Ramos-Cartelle *et al.* 2008) and the Pacific Ocean (42.6%) (Mejuto *et al*. 2007). Nevertheless it is lower than the value observed for the Atlantic Ocean which reached 71.7% for years 2005-2006 (Mejuto e*t al*. in press).

During years 2007 and 2008 the bycatch in the Indian Ocean consisted mainly of large pelagic sharks (SHK) accounting for 43.6% in weight of the total catch landed. The landing of the tuna group (TUN) had a mean value in weight of 6.8% of the total catch landed. The volume of billfish (BIL) amounted to 1.7% of the total landed catch and finally, the group of species with the lowest economic value (OTH) represented around 3.7% of the total yearly landings (figure **1**).

The volume of landings in weight per group of species in relation to those assumed to be bycatch, as a whole (excluding the swordfish) during 2007 and 2008, amounted to 78.0% for the SHK group, 12.3% for the TUN group, 3.1% for the BIL group and 6.6% for the OTH group in the Indian Ocean (table **3**, figure **2).** As expected, the amount of SHK was much more prevalent as compared to the other groups.

The bycatch analyzed during this period was made up fundamentally of BSH, with an average prevalence of 67.1% of the total bycatch species followed by the SMA with 8.4%. The other SHK group accounted for 2.5% of the total bycatch species. As far as the species of the TUN group are concerned, the species *Thunnus alalunga*, *Thunnus obesus* and *Thunnus albacares* represented 8.2%, 2.2% and 1.8%, respectively. In the OTH group, the species *Lepidocibium flavobrunneun* was the most prevalent and represented 4.8% of the total bycatch landed.

Considering only the SHK group, the BSH species accounted for most of the average catches (86.0%), followed by SMA (10.8%). These rates or prevalence between the two species are almost identical to those observed by the Spanish surface longliners in previous years in the Indian Ocean as well as in other oceans. The prevalence of BSH is clearly predominant and remarkably higher as compared to the group of other bycatch species and, of course, within the SHK group. Considering the TUN group only, the species *Thunnus alalunga* and *Thunnus obesus* represented 66.7% and 17.5%, respectively. Within the BIL group, 68.8% was identified as *Istiophorus platypterus*, 14.7% as *Tetrapturus audax* and 9.1% as *Makaira mazara*. Within the OTH group, 72.7% was represented by the species *Lepidocibium flavobrunneun*, which was very frequent in all the oceans observed. *Thunnus alalunga* and *Istiophorus platypterus* are more easily identified by the skippers than other species of tuna or billfish, respectively, so both are frequently recorded specifically. This praxis could result in larger catch estimations within the respective groups after the raising and substitution procedures. The data provided for years 2007 and 2008 update previous reports (García-Cortés and Mejuto 2001, García-Cortés and Mejuto 2005, Ramos-Cartelle *et al.* 2008). By combining these sources of information, it is possible to obtain a complete overview of the bycatch historically taken by this fleet in the Indian Ocean.

As previously indicated, the classification of the catch on board in most fleets usually follows commercial criteria rather than scientific norms. The taxonomic identifications are often inaccurately recorded especially in the case of less prevalent or less valuable by-catch species. Species with a similar price or morphology could be included in the same commercial category or even categorized with different common names. This problem was not restricted to by-catch species. For instance, the purse seine activity targeting valuable tropical tunas has similar difficulties obtaining catch estimations at the species level. For this reason, scientific procedures have been applied in order to obtain, as a first step, annual catch estimates at the species level that would be considered more reliable than those directly

obtained from commercial records. However, the scientific procedures used in the case of bycatch species only provide an approximation to the species breakdown on an annual global level, and they would not be adviseable for application by small spatial and temporal strata, unless a great number of assumptions and susbtitutions were used. For this reason, we consider it essential to give top priority to annual landing estimations for the different species that may be captured in the broad fishing areas of the Indian Ocean during the recent 2007 and 2008 period (figure **3**). To try and put together data that are geographically and temporally more desegregated would amount to nothing more than a simulated data set mostly affected by the substitution criteria used. As has been recommended in other oceans, it is of utmost priority to actively develop training programs to improve the precision and accuracy of bycatch identification and data transmission in the different fleets of the Indian Ocean.

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Table 1. Scientific estimation of by-catch landings (kg of round weight –RW–) by species and the target species swordfish of the Spanish surface longline fishery in the Indian Ocean in the years 2007 and 2008.

| Group | SPECIES | 2007 | 2008 |
|---|---|---|---|
| BIL | *Makaira indica / M. Nigricans* | 2666 | 6610 |
| BIL | *Makaira mazara* | 11617 | 19401 |
| BIL | *Tetrapturus audax* | 21214 | 28807 |
| BIL | *Istiphorus platypterus* | 128068 | 106746 |
| BIL | *Tetrapturus angustirostris* | 9543 | 6401 |
| OTH | *Acantocibium solandri* | 1557 | 662 |
| OTH | *Coriphaena spp.* | 40659 | 27834 |
| OTH | *Lepidocibium flavobunneum* | 367347 | 166990 |
| OTH | *Lampris guttatus* | 107 | 177 |
| OTH | *Other spp.* | 44166 | 24435 |
| OTH | *Rubetus pretiosus* | 12212 | 17356 |
| OTH | *Sphyraena spp.* | 18955 | 12972 |
| SHK | *Alopias superciliosus* | 317 | 849 |
| SHK | *Alopias vulpinus* | 199 | 0 |
| SHK | *Carcharhinus falciformis* | 17195 | 39304 |
| SHK | *Carcharhinus longimanus* | 13955 | 36551 |
| SHK | *Carcharhinus obscurus* | 838 | 2856 |
| SHK | *Carcharhinus plumbeus* | 53835 | 0 |
| SHK | *Carcharhinus brachyurus* | 15186 | 0 |
| SHK | *Galeocerdo cuvieri* | 767 | 600 |
| SHK | *Isurus oxyrinchus* | 456793 | 474305 |
| SHK | *Isurus paucus* | 6520 | 3944 |
| SHK | *Lamna nasus* | 4449 | 1263 |
| SHK | *Prionace glauca* | 3554479 | 3880295 |
| SHK | *Sphyrna lewini* | 123 | 1166 |
| SHK | *Sphyrna spp.* | 36282 | 36621 |
| SHK | *Sphyrna zygaena* | 1350 | 1360 |
| TUN | *Thunnus alalunga* | 623832 | 285612 |
| TUN | *Thunnus obesus* | 101651 | 136636 |
| TUN | *Gasterochisma melampus* | 8227 | 0 |
| TUN | *Katsuwonus pelamis* | 9008 | 3062 |
| TUN | *Thunnus albacares* | 85485 | 109540 |
| **SWO** | ***Xiphias gladius*** | **4796458** | **3924743** |

Table 2. Scientific estimation of landings (kg of round weight –RW–) of the target species SWO (*Xiphias gladius*) *vs.* combined bycatch species and prevalence of the bycatch obtained by the Spanish surface longline fishery in the Indian Ocean during the years 2007 and 2008.

| sp/yr | **2007** | **2008** |
|---|---|---|
| SWO | 4796458 | 3924743 |
| BY-CATCH | 5648602 | 5432355 |
| **TOTAL** | **10445060** | **9357098** |
| *%BY-CATCH* | *54.1* | *58.1* |

Table 3. Scientific estimation of prevalence of the total bycatch and bycatch landings (kg of round weight –RW–) by group of bycatch species, made by the Spanish surface longline fishery in the Indian Ocean during the years 2007 and 2008.

| yr/sp | **BIL** | **OTH** | **SHK** | **TUN** |
|---|---|---|---|---|
| **2007** | 173108 | 485003 | 4162288 | 828203 |
| **2008** | 167965 | 250426 | 4479114 | 534850 |
| **TOTAL** | **341073** | **735429** | **8641402** | **1363053** |
| ***%*** | *3.1* | *6.6* | *78.0* | *12.3* |

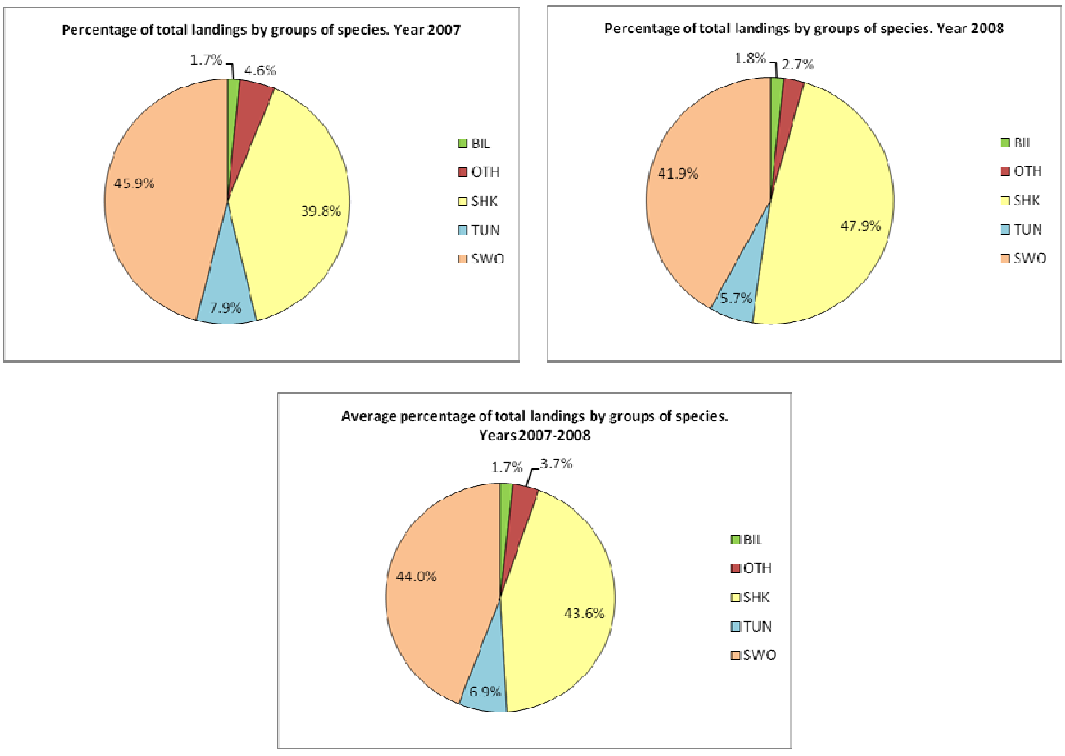


Figure 1. Scientific estimation of the percentage of landings by group (target and by-catch species) in the Spanish surface longline fishery in the Indian Ocean, during the years 2007 and 2008 and average percentage for the 2007-2008 period.

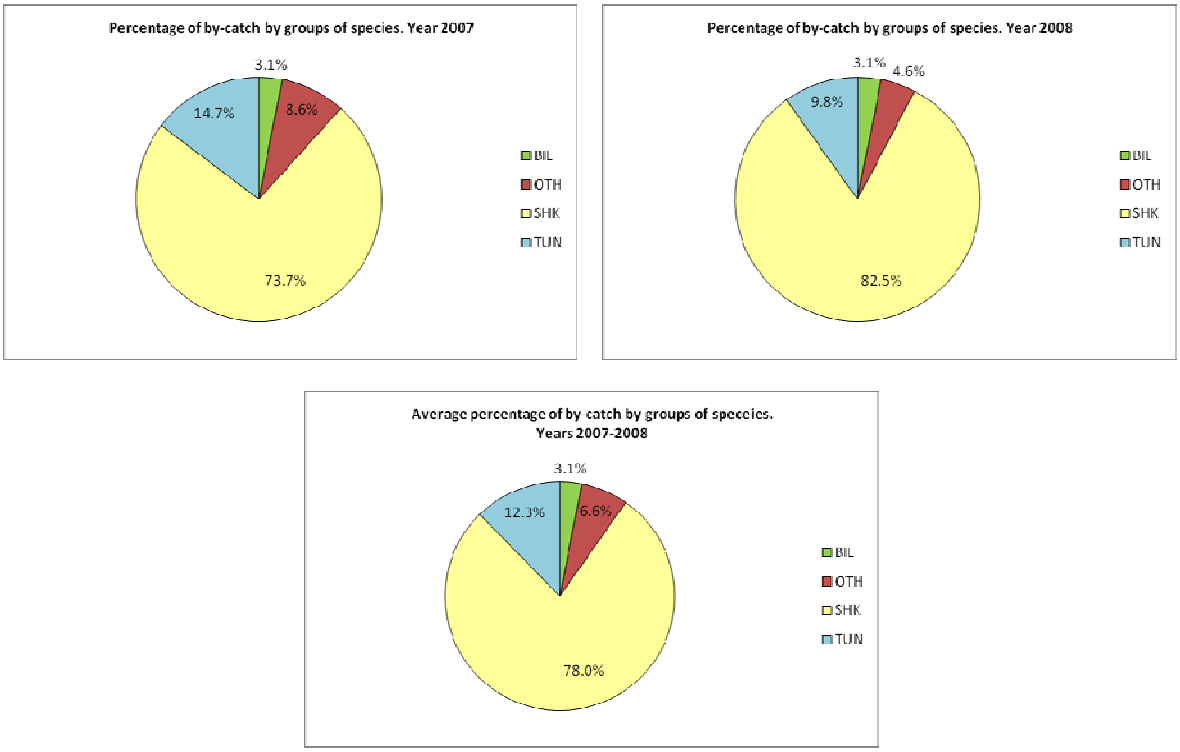


Figure 2. Scientific estimation of the percentage of landings by group (by-catch species) of the Spanish surface longline fishery in the Indian Ocean, during the years 2007 and 2008 average percentage for the 2007-2008 period.

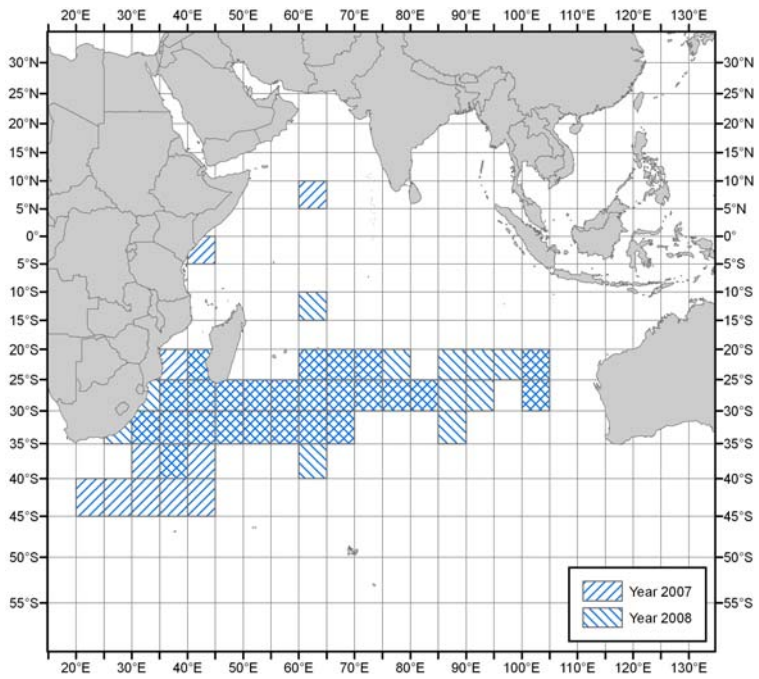


Figure 3. Fishing areas of the Spanish surface longline fleet during the years 2007 and 2008, in the Indian Ocean.