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Analysis of swordfish surface longline fishery in Andalusia, Spain

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The Spanish surface longline fleet has been historically targeting swordfish (*Xiphias gladius*) but large pelagic sharks are also caught as by-catch. The most frequent by-catch species are the blue shark (*Prionace glauca*) and the shortfin mako (*Isurus oxyrinchus*), both in the Atlantic Ocean and the Mediterranean Sea. These three species represent more than 90% of the total landings (Mejuto *et al.*, 2009). By-catch species may eventually turn into the target species, as has happened with *P. glauca*. The increase in the demand of sharks either for their meat consumption or fin trade, associated with lower profit from *X. gladius* fisheries, have provided a strong incentive for longliners to switch the target species when and where possible.

Andalusia is the southernmost region of Spain. Andalusian longline fleet comprises a total of 52 vessels (register published on February 2016), most of them operating in the Atlantic Ocean and the Mediterranean Sea. Vessels have an average of 15 m in maximum length, with a fish storage capacity that does not exceed 33 t (MAPAMA, 2014). In most cases, storage is limited to fresh fish (not frozen), what makes fishing trips short (i.e. not exceeding three weeks at sea) and limited to Spanish territorial waters or EEZs. Declared catches of swordfish, blue and shortfin mako sharks in Andalusia account for 2.82% of the total landings in 2015 and were worth 9,300,563.35 € (5.8%), according to the statistics provided by Andalusia fisheries administrations. These rates are way higher in the ports of Carboneras and Roquetas de Mar, home to most of the vessels that make up the Andalusian longline fleet. Here, catches of these three species account for 68% and 78% respectively of the total landings and 89% and 71% respectively of the total income. However, these values are in fact larger, since vessels often

land and sell their catches in locations outside Andalusia, and thus sales are not included in the above percentages.

The aim of this study is to analyze the seasonal variation of the catches of swordfish, blue shark and shortfin mako by the Andalusian surface longline fleet in the Atlantic and the Mediterranean fishing areas. Catch data were compiled from sales notes submitted to Andalusian fisheries administrations by fish market operators nationwide, issued at locations where the fish was landed and sold, in accordance with Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy. Catch data were analysed for the period 2013-2015. The final dataset resulted from the combination of the sales information from the Andalusian fish markets and that from the fish markets located elsewhere in Spain. Unlike data from sales made in Andalusia, data from sales made in the rest of the territory did not include information about the landing port. Thus, we assumed that the port where the sale occurred is also the landing port and the fishing area is the one closest to the landing port. Only sales notes referring to the surface longline vessels members of the two Producers Organizations established in Andalusia (OPP 66 and OPP 70) were included in this study. Both OPPs account for 64% of surface longline vessels registered in Andalusia in 2014. Catch Per Unit of Effort (CPUE, in kg) was calculated monthly to analyze catch seasonality as the ratio between the weight of the total catches made by the average number of vessels operating each month (i.e. fishing effort).

The total catch for the analyzed period was 4103.2 t, of which *X. gladius* represented 94.6%, followed by *P. glauca* and *I. oxyrinchus* with 4.6% and 0.74% respectively. *Xiphias gladius* is the dominant species in both fishing areas, and the catches of *P. glauca* and *I. oxyrinchus* were significantly higher in the Atlantic than in the Mediterranean (Fig. 1D).

The three species showed a pattern of seasonality in CPUE, with steep increases and declines throughout the year. *Xiphias gladius* (Fig. 1A) showed opposing trends in the two fishing areas, with maximum catch rates in the Atlantic between June and September, and in the Mediterranean from October to April. *Prionace glauca* (Fig. 1B) had the highest CPUE values in the winter and autumn and the lowest during late spring and summer in the Atlantic. In the Mediterranean, seasonality was not as marked, with CPUE being virtually constant from April to December with a slight increase in spring and autumn. Finally, seasonality in CPUE of *I. oxyrinchus* (Fig.1C) was similar in both areas, being highest in the autumn, decreasing thereafter and being lowest during summer.

The biological characteristics of *I. oxyrinchus* and *P. glauca* are responsible their high vulnerability to fisheries exploitation (Porsmoguer *et al.*, 2015), which has led in recent years to the protection of some species of sharks. Such is the case of *I. oxyrinchus*, whose catch has been forbidden as of August 2015 in the Mediterranean waters after adoption of measures aimed at ensuring that threatened sharks and rays are afforded a high level of protection from fishing activities (Regulation (EU) 2015/2102 of the European Parliament and of the Council of 28 October 2015 amending Regulation (EU) No 1343/2011 on certain provisions for fishing in the GFCM (General Fisheries Commission for the Mediterranean Agreement area).

The present study constitutes a first approach to the analysis of swordfish, blue and shortfin mako sharks landed by the Andalusian surface longline fleet. Data suggest that catches are strongly seasonal, with obvious changes in the landings recorded throughout the year. The importance of this fishery not only to the Andalusian fleet but also the Spanish fleet targeting swordfish would highly recommend a further study to carry out more detailed analyses. Positioning data would be needed to have more accurate information on the fishing grounds and better understand the seasonal patterns described here within more limited geographical areas. The results obtained would of great importance for a better understanding of this fishery in the Atlantic and the Mediterranean. This is valuable information for stock assessment and

fisheries regulation. A combination of season and area closures according to the results of this study could be established to better manage the species.

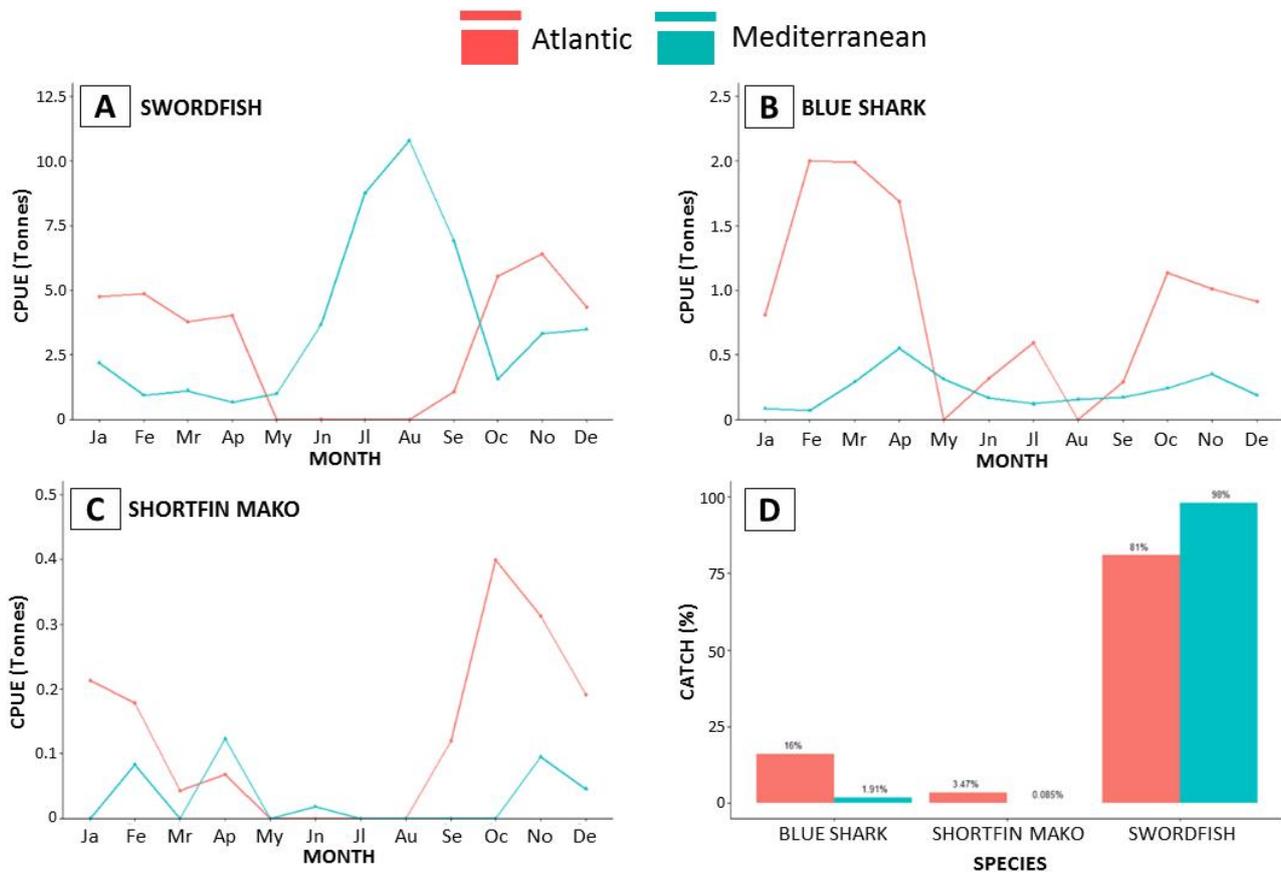


FIGURE 1. A, B and C, monthly variation of CPUE (tonnes) by fishing area (Atlantic and Mediterranean) for swordfish (*Xiphias gladius*), blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrinchus*), respectively. D, percentage of the total catch for the above species by fishing area.

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