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Potentially unsustainable fisheries of a critically-endangered pelagic shark species: the case of the blue shark (*Prionace glauca*) in the Western Mediterranean Sea

by

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Résumé. – La pêche potentielle non-durable d'un requin pélagique en danger critique : le cas du requin peau-bleue (*Prionace glauca*) en mer Méditerranée occidentale.

Le requin peau-bleue (*Prionace glauca*) est un requin pélagique, hautement migrateur, qui est classé depuis 2016 en "danger critique" par l'UICN en mer Méditerranée, mais les autorités n'ont à ce jour adopté aucune mesure pour contrôler son exploitation. Il est communément considéré comme capture accessoire des pêcheries palangrières artisanales. Notre étude analyse les tendances au sein de cette pêcherie durant ces dernières années dans les eaux Méditerranéennes espagnoles. Les résultats montrent que le requin peau-bleue subit une forte pression des flottes palangrières, particulièrement de la flotte industrielle andalouse. Les résultats suggèrent que le requin peau-bleue ne peut plus être considéré comme une espèce accessoire mais qu'il est délibérément ciblé par les pêcheurs. Cela impliquerait la prise de mesures urgentes pour réguler la pêche, de même que de nouvelles études pour savoir si, oui ou non, la pêche au requin peau-bleue peut se poursuivre dans cette zone du globe.

Key words. – Blue shark – Small-scale fisheries – Critically endangered – Mediterranean Sea.

The blue shark, *Prionace glauca* (Linnaeus, 1758) is an elasmobranch species with a wide geographic distribution. Females are sexually mature at 220 cm TL (total length) at 5-6 years old and males at 180 cm TL at 4-5 years old (Nakano and Stevens, 2008). So far in the Mediterranean Sea, the blue shark has been considered to be a bycatch species of surface longline fisheries targeting swordfish (*Xiphias gladius* Linnaeus, 1758) (Megalofonou *et al.*, 2005; Peristeraki *et al.*, 2008; Agencia Estatal Boletín Oficial del Estado, 2014). During the last century, however, the abundance and biomass of blue sharks decreased by around 98% throughout the Mediterranean Sea, a decline that was mainly attributed to fishing activities (Ferretti *et al.*, 2008). The blue shark was considered as "vulnerable" in the Mediterranean in 2007 and "near threatened" in 2009 by the IUCN (International Union for Conservation of Nature) (Cavanagh and Gibson, 2007; Stevens, 2009). In 2016, its status was updated to "critically endangered" (Dulvy *et al.*, 2016), which is one level lower than the category "extinct in the wild". Nevertheless, no limitation whatsoever has been imposed by fishery management authorities to regulate the blue shark fishery in the Mediterranean Sea. Taking the Spanish fishery as our case study, we analyse the trends in the exploitation of the blue shark between 2012 and 2016 in the western Mediterranean Sea. The variables

analysed include landings and catch per unit effort (CPUE) as proxies of abundance and the number of active longline vessels as a proxy of fishing effort.

MATERIALS AND METHODS

We studied the Spanish longline fleets from the communities of Andalusia, the Balearic Islands, Valencia, Murcia, and Catalonia in the Mediterranean Sea. Data on landings and number of longline boats between 2012 and 2016, as well as certain characteristics of the fleet, including motor engine, length of the vessel and number of fishermen, were provided by the regional fisheries management organizations from these regions (Comunidad Valenciana, 2012, 2013, 2014, 2015, 2016; Junta de Andalucía, 2012, 2013, 2014, 2015, 2016; Generalitat Valenciana, 2015; Region de Murcia, 2017a, b).

The catch per unit effort (CPUE) was calculated by dividing the landings by the number of longline fishing boats – following the indications given in Marchal (2008): *i.e.* the boats included in the analyses used the same *métiers*, fished the same species (same population) in the same area and during the same period, were of similar length and power and there were no structural differences regarding fishing methods. However, because the fishing vessels in different Spanish regions differ in length (Fig. 1), the CPUE values were calculated separately for each fleet.

RESULTS AND DISCUSSION

Between 2012 and 2016, landings of blue shark in the Spanish Mediterranean ports were, on average, more than 58 tons per year. There was a clear upward trend with total landings per year almost doubling (> 98%) during that period (Fig. 2).

There are, however, important regional differences. In 2016, for example, blue shark landings from long-line vessels reached 64 tons across all Spanish Mediterranean ports (Fig. 2). In that year, as was the case in the previous four years, the Andalusian fleet exerted by far the strongest pressure, accounting for more than 84% (54 tons) of the total; the Catalan fleet comes second with 4.5% (7 tons) followed by Murcia, with 1.6% (2.5 tons), whereas landings in Valencia and Balearic Islands were negligible. Meanwhile, the size of the fishing fleet involved in the blue shark fishery in the Spanish Mediterranean has remained stable (74 boats in 2012 and 73 in 2016; Fig. 3). Andalusia has the largest number of longliners (52 units in 2016), with vessels that often surpass 20 m in length and that usually have 10 fishermen on board; therefore, this fleet can-

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Figure 1. – **A:** Artisanal pelagic longliner from Torredembarra (Catalonia), Sep. 2012. **B:** Industrial pelagic longliner from Carboneras (Andalusia), Nov. 2014.

not be considered as “artisanal” (Fig. 1A). Catalonia had 14 long-line boats and the region of Murcia only 7 in 2016, in both cases measuring less than 12 m in length and usually with 3 fishermen on board (Fig. 3). The Catalan and Murcia fleet can therefore be considered artisanal. Between 2012 and 2016, the CPUE of the Andalusian fleet doubled from 528 kg/boat to 1005 kg/boat, while in the

same period it almost quadrupled in Catalonia (from 130 kg/boat in 2012 to 501 kg/boat in 2016). However, in Murcia, the increase has been much lower, from 262 kg/boat in 2012 to 352 kg/boat in 2016 (Fig. 4). The upward trend in landings and CPUEs of blue shark in the Spanish Mediterranean ports, particularly in regions where the species is the most fished (Catalonia and more so in Andalusia), suggests that this species can no longer be considered as a by-catch species and has now become a target species for fishermen, confirming the indications provided by Biton-Porsmoguer (2017).

In the European Union (EU), only fisheries of deep-sea sharks are regulated – by means of TACs and a ban on using gillnets at depths below 200 m (European Union, 2002) – although the EU considers that even limited fishing activity could result in a serious risk to their conservation. Fishing opportunities for deep-sea sharks should therefore be fully restricted through a general ban on catching them. In contrast, no restrictive measure has been approved so far for pelagic sharks (except for the ban on shark finning which applies to all species of shark; European Union, 2003). A similar situation occurs in other parts of the world, where stocks of pelagic sharks, especially the blue shark and the shortfin mako, are not well managed owing to the incomplete nature of catch and fishing effort declarations (Yokoi *et al.*, 2017).

The results of this paper clearly show that the blue shark can now be considered as a target species, in particular in Mediterranean regions where it faces a direct fishing pressure that might be threatening its local conservation with potential effects on the whole Mediterranean Sea. This confirms the fears concerning the poor status of elasmobranch populations worldwide (Ferretti *et al.*, 2008; Guisande *et al.*, 2013; Dulvy *et al.*, 2014), particularly those of pelagic species (Yokoi *et al.*, 2017). Furthermore, the blue shark long-line fisheries in certain areas of the Spanish Mediterranean, such as the Andalusian and Catalanian regions, can no longer be considered as ‘by-catch fisheries’. Even in those regions where blue shark is still being caught by small-scale fisheries – which are usually considered to have a smaller ecological impact than industrial fisheries (Lloret *et al.*, 2016) – blue sharks are facing increasing fishing pressure. Our results suggest that these fisheries may be contributing to the overall threat to the sustainability of

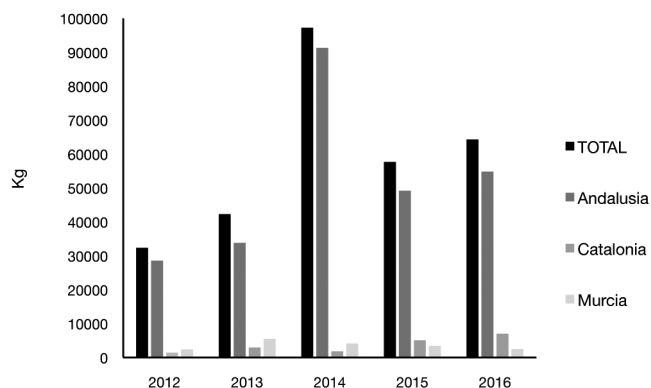


Figure 2. – Landings (kg) of blue shark (*Prionace glauca*) in different regions of the Spanish Western Mediterranean Sea, 2012-2016.

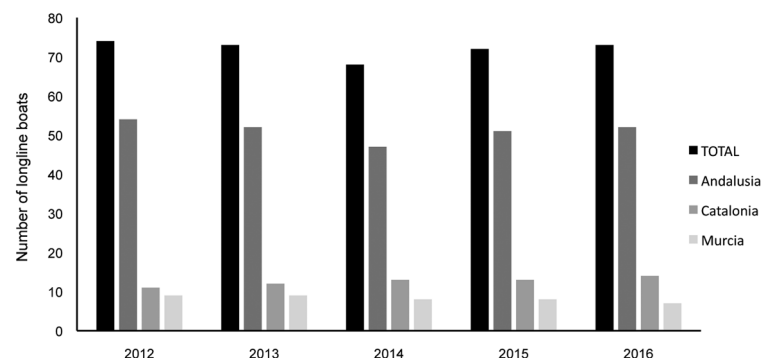


Figure 3. – Number of pelagic longline boats in the three main Spanish fishing fleets involved in the blue shark fishery in the Mediterranean Sea, 2012-2016.

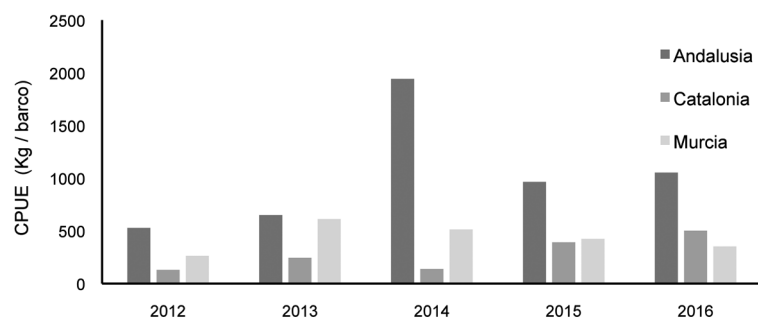


Figure 4. – Catch Per Unit Effort (CPUE, kg/boat) of blue shark (*Prionace glauca*) for each regional fleet, 2012–2016.

vulnerable pelagic sharks, such as the blue shark, in the Mediterranean Sea. Therefore, we believe that studies are urgently needed to assess the current status of the blue shark and provide the critical data required to better manage the stock of this species within the framework of the ICCAT (International Commission for the Conservation of Atlantic Tunas), the STECF (Scientific, Technical and Economic Committee for Fisheries) or the GFCM (General Fisheries Commission for the Mediterranean). In the short term, and as a precautionary measure, European, national, and regional administrations should impose precautionary management restrictions (e.g. TAC and/or size limit) before such studies determine whether or not catches of blue shark should still be permitted in the Mediterranean Sea.

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