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# Record of three specimens of megamouth sharks – *Megachasma pelagios* – in tropical tuna purse seine fisheries in the Atlantic and Indian Oceans

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## Abstract

The observer programme onboard the Spanish tropical tuna purse seine fleet recorded the incidental catch of one adult megamouth shark *Megachasma pelagios* in December 2005 and two juvenile megamouth sharks in the eastern Atlantic in July 2016 and August 2018, respectively. The same fleet also bycaught an adult individual in December 2005 in the western Indian Ocean. The juveniles were caught relatively near to the coast, while the adult was caught in oceanic waters. The companion species in the fishing sets were elasmobranchs, tuna and billfish.

## Introduction

The megamouth shark *Megachasma pelagios* Taylor *et al.*, 1983 (Lamniformes: Megachasmidae) is the only extant representative in both its genus and family. This species was first described based on a specimen caught in 1976, off Hawaii (Taylor *et al.*, 1983). It can be easily identified by its characteristic short, but broadly rounded, snout, very large and long head, numerous small, hooked teeth, and a huge terminal mouth that extends behind the eyes. Although the behavioural ecology of this species remains largely unknown, this species is described as an epi- and meso-pelagic slow swimming shark with a flaccid body and fins, which feeds by filtering plankton (e.g. euphausiids, copepods and jellyfish) in a similar way of engulfment feeding that is typically seen in the rorqual and humpback whales (Compagno, 2001; Nakaya *et al.*, 2008; Nakaya, 2010; Watanabe & Papastamatiou, 2019). According to the results published in an acoustic tracking study, this species shows vertical movements to depths near 200 m during the day with a shallower night phase (Nelson *et al.*, 1997).

Currently the species is assessed as ‘Least Concern’ on the IUCN Red List (Kyne *et al.*, 2019). The level of threat is primarily related to the increasing number of catches in the north-west and central western Pacific and is largely explained by the development of a driftnet fishery targeting sharptail mola *Masturus lanceolatus* in the deeper waters off eastern Taiwan since 2000 (Kyne *et al.*, 2019).

Since the holotype was described in 1983, a number of bycaught and stranded individuals have been documented from around much of the world. According to Rodriguez-Ferrer *et al.* (2017), about 100 confirmed specimens of this rare shark had been caught until 2017, and 65 reported with documented positions, whilst the Florida Museum of Natural History reported on 65 documented records from 1976–2016 (Weichao *et al.*, 2016). Other sources (Yu *et al.*, 2021) inform from 236–250 records until 2020 and 2021, respectively, most of which were associated with the Kuroshio Current, including from the Philippines, Japan, and especially near Taiwan’s waters (146 catches), which seems to be a hotspot for the species (Liu *et al.*, 2018). By contrast, until now only four catches from the Atlantic Ocean have been documented in scientific publications; one from Senegal in 1995, two from Brazil in 1995 and 2009, and one stranded on a beach in Puerto Rico in 2017 (Séret, 1995; Amorim *et al.*, 2000; Lima *et al.*, 2009; Rodriguez-Ferrer *et al.*, 2017), and only seven specimens from the Indian Ocean, including from off Western Australia (Berra & Hutchins, 1990), South Africa (Smale *et al.*, 2002), north of Sumatra (White *et al.*, 2004) and Sri Lanka (Fernando *et al.*, 2015) from the coast of Komodo Island (2017), and three specimens in the eastern Indian Ocean near Manado (1998) and the south of the Bay of Bengal (2002).

Most of the juveniles of this species have been recorded off the Pacific coast of Mexico, but immature individuals have also been caught in Atlantic waters (Amorim *et al.*, 2000; Castillo-Géniz *et al.*, 2012; Hsu *et al.*, 2015) and in the Indian Ocean (White *et al.*, 2004). This work aims to provide new data on fishing events with the presence of *M. pelagios* obtained through the observer programme in the Spanish tuna purse seine fleet operating in the tropical area of the Atlantic and Indian oceans.

## Materials and methods

The observer programme onboard the Spanish (and associated flags) tropical tuna purse seine fleet started in 2003. This programme focuses on discards and bycatch, and its observation

coverage has progressively increased from around 10%, in its initial stage, up to nearly 100% in recent times, mainly thanks to the implementation of a volunteer programme by the fleet.

This observation coverage means that 23,903 and 16,146 fishing operations have been monitored in the Atlantic and Indian Oceans, respectively, during the period 2003–2020, in which observers recorded all species caught and their fate, in addition to other bridge and environmental data such as position, date and time, set type (free school set (FSC) or Fish Aggregating Device (FAD) set), sea surface temperature (SST) and wind speed.

## Results

Two *M. pelagios* were caught by the tropical tuna purse seine fleet in the tropical eastern Atlantic fishing grounds, near the Gabonese and Mauritanian coasts, in July 2016 and August 2018, respectively. A third individual was also caught in December 2005 by this fleet in the western Indian Ocean, between the Maldives and Chagos archipelagos (Figure 1). Both specimens caught in the Atlantic Ocean were recorded as being female, but no information on the sex was available for the other.

The megamouth sharks caught in the Indian Ocean and off the Gabon coast were released alive, but the individual bycaught in Mauritania was discarded dead.

Detailed information by set was obtained from the reports provided by the observers onboard the vessels (Table 1). There are only pictures available for the specimen caught on the Mauritanian coast; according to its length it was presumed to be a juvenile (Compagno, 2001) (Figure 2).

## Discussion

Of the only four previously reported catches of megamouth sharks in the Atlantic Ocean, two were juveniles measuring 184–190 cm total length (Séret, 1995; Amorim *et al.*, 2000), and the other two were a 529 cm male and a 457 cm total length female (Lima *et al.*, 2009; Rodríguez-Ferrer *et al.*, 2017).

The megamouths caught near the Gabon and Mauritania coasts were females of around 180 cm while the one caught in the Indian Ocean was a specimen of 300 cm in total length. According to the life-history parameters males become mature

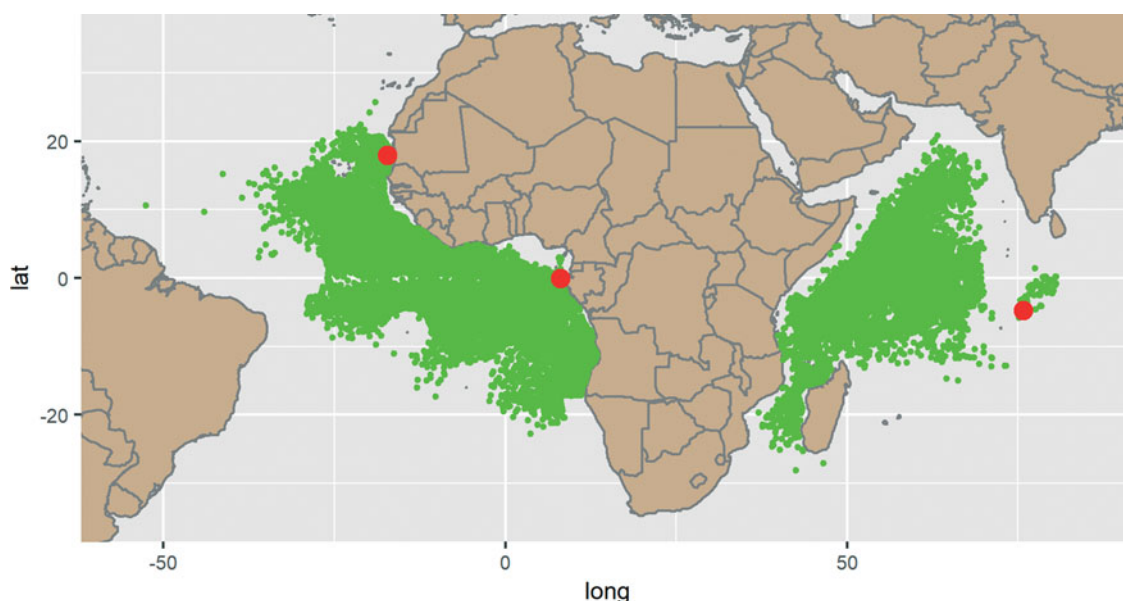
at about 400 cm total length and females at about 500 cm, therefore these three individuals can all be considered as juveniles (Compagno, 2001; Nakaya, 2010). Both sharks in the Atlantic, although in different years, were caught at similar times of the year (July and August). Noteworthy are the few reported catches or stranded individuals of megamouth in the Atlantic Ocean. There are not many mentions of juveniles of this species, but it is important to point out that they have been found in the three oceans and it is also remarkable that four of the six records reported until now in Atlantic waters have been juveniles. In this sense, the juveniles caught by Séret (1995) and Amorim *et al.* (2000), and the two reported in this paper were all caught by commercial vessels targeting pelagic fish, operating in areas relatively near the coast, while the shark reported by Lima *et al.* (2009) was an adult stranded on a beach on the south-western coast of Puerto Rico.

On the other hand, of the seven records in the Indian Ocean, four were juveniles of less than 350 cm, two adults of around 500 cm and the last one could not be estimated in length.

According to a recent revision of the habitat distribution of this species, megamouth shark can be found in all oceans at latitudes from 40°N to 40°S (Watanabe & Papastamatiou, 2019). Using records reported until 2010, Nakaya (2010) found that specimens smaller than 2.5 m were seemingly confined to lower latitudes between 27°39'N and 27°08'S that are in the latitudinal range of the individuals reported in this paper.

The interaction of the purse seine fleet with this species has been documented in various sources, with confirmed specimens caught by purse seiners in the Atlantic and Japanese waters (Séret, 1995; Yano *et al.*, 1999; Sawamoto & Matsumoto, 2012).

However, other studies related to the bycatch of the tropical tuna purse seine fleet did not record *M. pelagios*. In this sense, Amandé *et al.* (2010) studied the bycatch for the European (i.e. Spanish and French fleets) purse seine tuna fishery operating in the Atlantic Ocean during the period 2003–2007, and Hall & Roman (2013) reviewed the information available in published papers, or documents presented at the tuna regional fishery management organizations (RFMOs) related to bycatches in the tropical tuna purse seine fisheries of the world. Two of the specimens were caught in free school sets, while the third was caught associated with a floating object (FOB) set. In general, higher shark



**Fig. 1.** Observed fishing operations, showing the areas fished by the tropical tuna purse seine fleet (green dots), and location of the three megamouth sharks (red dots) bycaught by these fleets.

**Table 1.** Summary of the set characteristics of the three *M. pelagios* bycaught by the purse seiner fleet

Set	Species	No	Catch Weight (ton)	Total Length (cm)	Sex	Catch status	Date	Lat	Long	Location	Set Type	Observed sets/total sets (%)	SST (°C)	Time (GMT)	Wind speed (Beaufort Scale)	
1	<i>Carcharhiniformes</i>	1	0.05	127		Discarded dead	11/12/2005	-4.80 S	75.83 E	Indian Ocean (Maldives and Chagos)	FSC	2%	28.1	10:30	1	
	<i>Thunnus albacares</i>	NA	5	NA		Retained										
	<i>Pteroplatytrygon violacea</i>	2	0.006	39		Released alive										
	<i>Megachasma pelagios</i>	1	0.205	300	N.A.	Released alive										
2	<i>Carcharhinus falciformis</i>	2	0.032	106		Released alive	31/07/2016	-0.13 S	8.15 E	East Atlantic (Gabon)	FAD	62%	25.7	06:51	4	
	<i>Megachasma pelagios</i>	1	0.0473	184	F	Released alive										
	<i>Thunnus albacares</i>	NA	2	NA		Retained										
	<i>Katsuwonus pelamis</i>	NA	21	NA		Retained										
	<i>Makaira nigricans</i>	2	0.172	219		Retained										
3	<i>Isurus oxyrinchus</i>	1	0.0883	200		Released alive	01/08/2018	17.9 N	-17.20 W	East Atlantic (Mauritania)	FSC	68%	25.2	12:08	3	
	<i>Megachasma pelagios</i>	1	0.0443	180	F	Discarded dead										
	<i>Mobula</i> sp.	2	0.3	280		Released alive										
	<i>Katsuwonus pelamis</i>	NA	3	NA		Retained										

**Fig. 2.** Photos of the 180 cm juvenile female megamouth shark caught in 2018 near the coast of Mauritania.

bycatches are found associated with FOB sets than free school sets although this can vary depending on the species (Clavareau *et al.*, 2020). Regarding the rest of the companion species in the fishing sets, we found other elasmobranchs and tuna, and/or billfishes in all cases. Among the elasmobranchs and manta rays (*Mobula* spp.), shortfin mako *Isurus oxyrinchus* and silky shark *Carcharhinus falciformis* were the species identified, in addition to two pelagic stingrays *Pteroplatytrygon violacea*, and one unidentified carcharhiniform shark, which were caught in the Indian Ocean. These species are among the most common bycatch elasmobranch species in the tropical purse seine fleet (Amandé *et al.*, 2010; Hall & Roman, 2013; Clavareau *et al.*, 2020). The catches of elasmobranch and billfishes were limited in all instances presented here, no more than two individuals/set, while the catches of the target species *Thunnus albacares* and *Katsuwonus pelamis* were between 2 and 21 tons.

Several international organizations (Institut de Recherche pour le Développement (IRD), Instituto Español de Oceanografía (IEO), Seychelles Fishing Authority (SFA), Arranzuarekiko Zientzia eta Teknologia Iraskundea (AZTI)) work in a coordinated programme that aims to monitor the fishing activity of the European (and associated flags) tropical purse seine fleet operating in the Atlantic and Indian Oceans. This joint work could be very helpful in the future for the identification and bycatch reporting of *M. pelagios* by the commercial purse seine fleet.

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