Pelagic sharks by-catch in Indian tuna fishery in 2018

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Abstract

Barring the Government owned research vessels conducting exploratory surveys, India has negligible fishing fleet exclusively targeting tunas round the year. However, small-scale and artisanal sectors deploying both mechanized and motorized boats (all <24 m OAL) using a variety of gear largely contribute to the tuna fishery. This fishery, fishing exclusively within the Exclusive Economic Zone (EEZ), occasionally records pelagic sharks as bycatch. The total catch of pelagic sharks by this fishery during 2018 was 959.27 t. Drift longline was the main gear contributing the pelagic shark bycatch (96.11%), followed by gillnet (2.92), handline (0.65). The status of pelagic shark stocks in the Indian seas are constantly monitored employing four research vessels of Fishery Survey of India (FSI). Detailed studies on the biological aspects of major species including silky shark (*Carcharhinus falciformis*), pelagic thresher (*Alopias pelagicus*), bigeye thresher (*A. superciliosus*), oceanic whitetip shark (*Carcharhinus longimanus*), tiger shark (*Galeocerdo cuvier*), shortfin mako (*Isurus oxyrinchus*), longfin mako (*I. paucus*) and blue shark (*Prionace glauca*) resulted in gathering valuable information on size structure, diet and reproduction of these species.

Introduction

In India, the small-scale and artisanal sectors largely contribute to the tuna fishery. This fishery operates exclusively within the Exclusive Economic Zone (EEZ) deploying both mechanized and motorized boats using a variety of gears. Pelagic sharks constitute a major proportion of the bycatch of Indian tuna fishery.

Pelagic sharks are important components of the oceanic pelagic ecosystem, functioning as apex predators and scavengers, exerting significant impact on other species of the marine food web (Varghese et al., 2017). They are long-lived animals, having slow growth rate, maturing late and have low reproductive output. Most of the pelagic sharks are highly migratory, travelling long distances and thus encounter many fishing operations, making them vulnerable to overexploitation and fishing mortality. Due to increasing demands for shark flesh for human consumption, fins for shark fin

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soup, liver oil for vitamin extraction and hides for leather (Compagno, 2002), sharks are increasingly exploited both by targeted fisheries and as by-catch. Scientists have documented growing concern over the widespread decline of shark populations due to this increased fishing mortality (Stevens et al., 2000). Identifying and quantifying pelagic shark bycatch is essential to evaluate the impact of fisheries on this group of fishes, and to evolve suitable management measures or fishing policies that protect these species. With this perspective, the present paper aims to update the pelagic shark bycatch by the Indian tuna fishery during the year 2018. Information on the pelagic sharks bycatch in the tuna longline survey conducted by the research/survey vessels of Fisher Survey of India vessels (FSI) are presented and new information on the biology of pelagic sharks of Indian seas gathered from the recent literature also is furnished.

Materials and Methods

The marine fishery data collection in India is done by two methods a). Land-based sampling (by Fisheries Departments of State Governments/Union Territories (UT) and the Central Marine Fisheries Research Institute) and b) sea-based exploratory surveys (by Fishery Survey of India, FSI). The CMFRI along with the Fisheries Departments of the coastal States/UTs undertakes regular sampling and estimation of the fish landings from designated landing points throughout the coastline. Besides estimating the fishery landings, studies on biological and socio-economic attributes of fisheries are also carried out by the institute on a regular basis. The Fishery Survey of India operates eleven research/survey vessels for collecting the sea truth data on the fish abundance, biology, oceanographic parameters etc. The pelagic shark landing data collected by CMFRI and States/UTs are analysed in the present paper. Further, the survey results of four dedicated longliners of FSI, two based on the east coast and two on the west coast are also analysed. These modern longliners undertake exploratory surveys on a regular basis through pre-determined sampling programmes. The exploratory surveys provide information on pelagic shark resource distribution in the Indian EEZ, effort, and also various environmental parameters to correlate with the exploitation of shark resources.

Results and Discussion

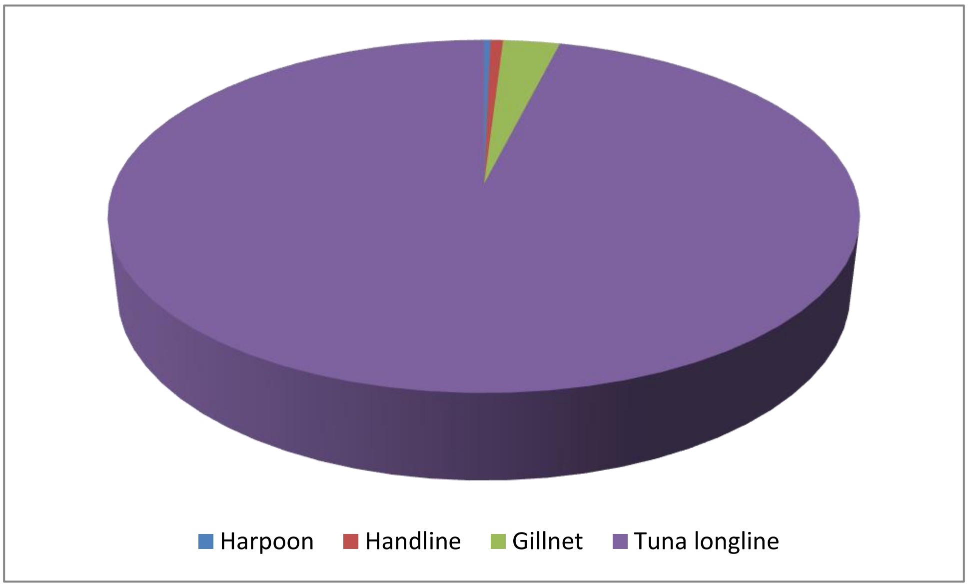

Figure 1. Pelagic sharks landings by Indian tuna fishery (2018)

The total pelagic sharks landings by the Indian tuna fishery during the year 2018 was 959.27 t. Drift longline was the main gear contributing the pelagic shark bycatch (96.11%), followed by gillnet (2.92), handline (0.65) and harpoons (0.32) (Fig. 1).

Similar to many of the coastal nations of the Indian Ocean, drift gillnets remained one of the most popular gear (after longline) among the fishermen targeting large pelagic in India, mainly due to the economy in the operation of craft due to low fuel consumption, easy maintenance and though not high, steady returns (Jayaprakash et al., 2002). The drift gill net fishery operating from Cochin fisheries harbor (south-west india) is studied in details and it is estimated that pelagic sharks constitutes 12-20% of the total landings by this fishery (Jayaprakash et al., 2002; Varghese et al., 2015). This fishery deploys about 210 mechanized boats of 10–20 m overall length (LOA), operating drift gillnets of maximum 2000 m length and 11 m hung depth with mesh size 100–350 mm. Shooting of the net is done in the evening hours and after allowing immersion time of about 10 h the hauling is done in morning. Shooting and hauling are done manually (Varghese et al., 2015). This fishery operates throughout the year. However, the peak catch is during April/May to September (jayaprakash et al., 2002). Many of these crafts occasionally operate longlines also. Mean annual catch of each boat is estimated to be 32.83 t (Boopendranath & Hameed, 2007) of which about 20% is pelagic sharks (Varghese et al., 2015).

The status of stocks of large pelagics including pelagic sharks of the Indian EEZ is constantly monitored by the Government of India research/survey vessels operated by the Fishery Survey of India. The results show that sharks constitute 19.5% of the total catch by longliners (Varghese et al., 2015). The relative abundance index (Hooking rate,

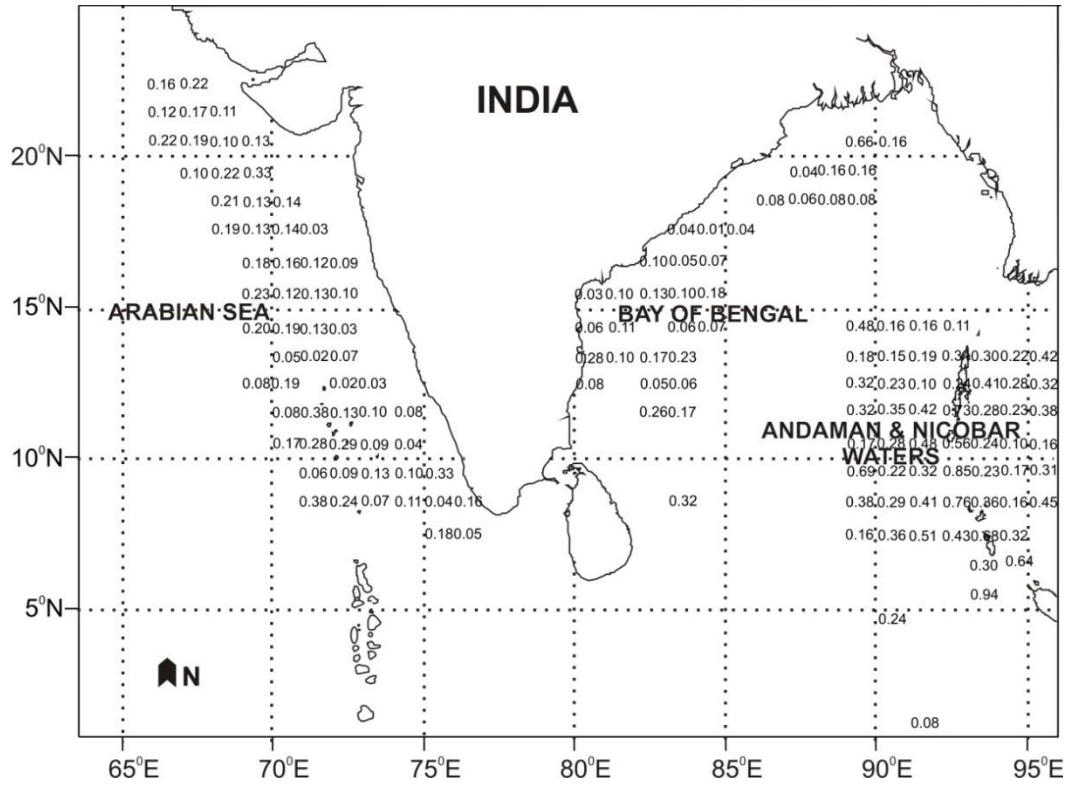

Figure 2 Grid-wise (1 x 1) average hooking rate (number in 100 hooks) of pelagic sharks bycatch in the tuna longline survey in Indian seas during 2004-2010 (source: Varghese et al., 2015)

number of specimen in 100 hooks) recorded in this fishery during 2004-2010 was 0.13 ± 0.42 (average ± standard deviation) (figure 2). Catches of sharks are prominent in Andaman and Nicobar region contributing 35.15% of the catch of exploratory longlines by number and 51.46% by weight. In the eastern Arabian Sea, sharks constituted 15.49% and 14.89% of the total catch by number and weight respectively, in the western Bay of Bengal, this group contributed 7.74% by number and 9.33% by weight to the total catch. Eighteen species of pelagic sharks were recorded in the tuna longline survey conducted in the Indian seas. Diversity of shark species was more in Andaman and Nicobar waters (16 species), followed by Arabian Sea (14 species) and from Bay of Bengal (11 species).

Time series analysis of the pelagic shark hooking rates indicated noticeable decline in the abundance indices in the eastern Arabian sea and western Baby of Bengal, whereas in the Andaman and Nicobar waters, no such reductions in abundance was discernible (John and Varghese, 2009; Varghese et al., 2015).

The length structure, length-weight relationship and diet of pelagic sharks caught in longline survey are studied in details (Varghese et al., 2013; 2015). Highest average total length was recorded for *Alopias suerciliosus.* Predominance of males was reported in the *A pelagicus* and *A. suerciliosus,* whereas male to female ratios were near to unity in requiem sharks (*Carcharhinus* sp.). *A. pelagicus* feeds mainly during night, but occasionally during day in epi- and mesopelagic waters (Varghese et al. 2014). Silky sharks (*C. falciformis*) of the eastern Arabian Sea feed primarily on swimming crab, *C. smithii,* while purpleback flying squid, kawakawa and purple-spotted bigeye were the other dominant prey identified.

Seasonality in reproduction of the Arabian Sea silky sharks was not evident and in males, sexual maturity was attained at 201–223 cm total length with the size at maturity occurring at 217.0 cm, whereas in females sexual maturity was attained at 224–231 cm and size at maturity occurs at 226.5 cm. Numbers of embryos in females were in the range of 3–13, averaging 7.6 (Varghese et al., 2015).

Size structure, sex and maturity of pelagic thresher (*Alopias pelagicus*), bigeye thresher (*A. superciliosus*), oceanic whitetip shark (*Carcharhinus longimanus*), tiger shark (*Galeocerdo cuvier*), shortfin mako (*Isurus oxyrinchus*), longfin mako (*I. paucus*) and blue shark (*Prionace glauca*) in the eastern Arabian Sea were studied in detail by Varghese et al (2016) based on 1449 specimens collected from gillnet-cum-longline landings at the Cochin fisheries harbour during 2013–2014. Sex ratios of sampled specimens were biased to males in pelagic thresher, bigeye thresher, tiger shark and blue shark, while females dominated in the specimens of oceanic whitetip shark. Females matured at greater lengths than males in all species except oceanic whitetip shark. Lengths at maturity for males were in the range of 189.05–286.56 cm, whereas those of females were in the range of 187.74–310.69 cm (Table 1). Litter sizes of both the thresher shark species were always two, while in oceanic whitetip shark, litter size was 3–9 and 22–51 in tiger shark. Seasonal reproduction was noticed in oceanic whitetip shark and tiger shark. Pregnant females were not found in the blue shark, shortfin and longfin makos sampled during the study period.

Table 1. Length, sex ratio, maturity and litter size of pelagic sharks in the eastern Arabian Sea (TL, Total length; SD, standard deviation) (Source: Varghese et al., 2017)

Species	Sex ratio (F:M)	TL (cm)	TL Mean +SD (cm)	Size at birth (cm)	Litter size
A. pelagicus	01:01.6	142–319	248.16 +31.92	137.8–142	2
A. superciliosus	01:01.4	135–361	254.35 +38.92	118–135	2
C. longimanus	01:00.9	65–265	155.43 +38.32	64.2–65.0	3–9 (5.8+2.39)
G. cuvier	01:01.1	85–398	198.23 +59.54	79.6–85.2	22–51 (35.25 +8.94)
I. oxyrinchus	01:01.0	97–269	168.73 +37.56		
I. paucus	01:01.3	140–258	167.57+35.05		
P. glauca	01:05.5	186–280	218.93+20.30		

India, being a responsible nation, adopts a number of regulatory measures to conserve its marine living resources. India observes an annual uniform ban on fishing by all mechanized fishing from 15 June to 31 July (along the west coast) and 15 April to 31 May (along the east coast) for the conservation and sustainable management of its marine resources. Further, ten elasmobranch species are included in Schedule I of the Indian Wildlife (Protection) Act, 1972. Four of these species viz., *Rhincodon typus* (whale shark), *Carcharhinus hemiodon* (Pondicherry shark), *Glyphis gangeticus* (Ganges river shark), and *Glyphis glyphis* (speartooth shark) are sharks (Kizhakudan et al., 2015). Exploitation and trade of these species have been banned and declared as punishable offences. Shark finning is banned in India (vide the Ministry of Environment and Forests (Wildlife Division) policy F. No4-36/2013WL dated and 21 August 2013) and export and import of shark fins are also banned (Department of Commerce of the Ministry of Commerce and Industry, Govt of India, Notification No.110/(RE-2013)/2009-2014 and Notification No.111/(RE-2013)/2009-2014). In addition to these specific measures, India is also regulating fishing practices through demarcation of about 31 Marine Protected Areas, fixing Minimum Legal Size (MLS) for capture of common species, gear-specific mesh size regulations, restrictions on operation of certain gears like ring seines, purse seines and pair trawling, introduction of by-catch reduction devices (Kizhakudan et al., 2015).

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