Diversity and abundance of pelagic shark bycatch in the tuna fishery of the Indian waters

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ABSTRACT

Pelagic sharks are the most important component of the bycatch in the tuna longline fishery. Results of fishery resource survey conducted by the Fishery Survey of India in the Exclusive Economic Zone (EEZ) revealed that sharks constitute 39.81% by weight to the total catch in the longline fishery. Significant variations in the diversity and abundance of pelagic sharks were observed among three regions of seas around India, i.e., eastern Arabian Sea, western Bay of Bengal and Andaman and Nicobar waters. Exploratory surveys revealed that abundance of pelagic sharks are prominent in Andaman and Nicobar region followed by the eastern Arabian Sea and western Bay of Bengal. In the drift gillnet fishery for large pelagics, elasmobranchs constituted 4-12% of the catch. The pelagic sharks constituted 93%, rays 6% and skates the rest of the elasmobranchs exploited by this gear. Measures adopted by India for the conservation and management of these ecologically and economically important resources are presented and discussed.

Introduction

Sharks are important components of marine ecosystem, functioning as apex predators, playing a vital role to keep the ecosystem balanced and regulate the populations of components of marine life to maintain healthy levels. In India, sharks forms an important part of the fishery, mainly recorded as bycatch in trawl, gillnet and hook and line fishery and the landings reported during 2012 was 22537 t. Shark bycatch in the large pelagic fishery in the Indian seas are fairly well studied (Sudarsan *et al*., 1988; John and Somvanshi, 2000; Bhargava *et al*., 2002; Jayaprakash *et al*. 2002; Varghese *et al*., 2007; John and Varghese, 2009; Varghese *et al*., 2013). Present paper is an overview of the pelagic shark bycatch in the longline and drift gillnet fishery of Indian seas.

Table 1. Summary of longline survey conducted in the Indian EEZ

Vessel	Area	Gear Used
Yellowfin Overall Length (OAL): 36.0; Gross Registered Tonnes (GRT): 290	Arabian Sea	MultifilamentLL: 75,120 (5 hooks/basket)
Matsya Vrushti OAL: 37.5; GRT: 465	Arabian sea	Monofilament LL : 112,155 (7 hooks/basket)
Blue Marlin OAL: 36.0; GRT: 290	Bay of Bengal (Andaman and Nicobar Islands and East Coast of India)	Multifilament LL : 116,349 (5 hooks/basket; 9 hooks/basket)
Matsy Drushti OAL: 37.5; GRT: 465	Bay of Bengal (BoB)	Monofilament LL: 105,877 (7 hooks/basket)

(Source: Varghese et al., 2007)

Species composition

Varghese *et al*. (2007) reported 18 species of pelagic sharks in the exploratory longline survey in the Indian seas, whereas, John and Varghese (2009) reported 23 species of sharks belonging to five families. The species recorded were: survey: Pelagic thresher shark (*Alopias pelagicus*), bigeye thresher shark (*A. superciliosus*), thresher shark (*A. vulpinus*), blacktip shark (*Carcharhinus limbatus*), hard-nose shark (*C. macloti*), spottail shark (*C. sorrah*), whitecheek shark (*C. dussumieri*), black reef shark (*C. melanopterus*), silky shark (*C. falciformis*), dusky shark (*C.obscurus*), silvertip shark (*C. albimarginatus*), oceanic whitetip shark (*C. longimanus*), Pondicherry shark (*C. hemiodon*), tiger shark (*Galeocerdo cuvieri*), shortfin mako shark (*Isurus oxyrinchus*), hammerhad sharks (*Sphyrna lewini, S. zygaena, S. mokarran*), blue shark (*Prionace glauca),* milk shark (*Rhizoprionodon acutus*), broadfin shark (*Lamiopsis temmincki*), spadenose shark (*Scoliodon laticaudus*) and zebra shark (*Stegostoma fasciatum*). The species diversity was more pronounced in Bay of Bengal than in the Arabian Sea. Sharks of the Family Alopiidae (Thresher sharks) and Fam. Carcharhinidae (Requiem sharks) were prominent in the catch. The pelagic thresher shark (*Alopias pelagicus*) formed 37.17% of the total shark catch by weight followed by bigeye thresher shark (*A.superciliosus*)-14.09%, blacktip shark (*Carcharhinus limbatus*) - 16.17%, silky shark (*C.falciformis)* – 6.84% and tiger shark (*Galeocerdo cuvieri*) – 5%.

While analysing the catch in the driftgillnet fishery for large pelagics, concentrated mainly in Cochin (southwest India), Jayaprakash *et al*. (2002) reported the following species (in

the order of abundance) contributing the landings - *Carcharhinus melanopterus*, *Rhizoprionodon acutus*, *Sphyma lewini*, *Scoliodon laticaudus*, *R.oligolinx*, *C. macloti*, *C. brevipinna* and *C. limbatus*. Except the last four species, others significantly contribute to the drift gillnet fishery at Cochin (Jayaprakash *et al*., 2002).

Table 2. Species caught, thier hooking rate and percentage composition from Arabian Sea

Shark Species	Total Shark by		HR	Species % by	
	Nos.	Wt (Kg)		Nos.	Wt (Kg)
Pelagic thresher shark (*Alopias pelagicus*)	15	399	0.008	7.389	12.360
Bigeye thresher shark (*A. superciliosus*)	3	101	0.002	1.478	3.129
Thresher shark (*A. vulpinus*)	1	10	0.001	0.493	0.310
Silvertip shark (*C. albimarginatus*)	2	13	0.001	0.985	0.403
Whitecheek shark (*C. dussumieri*)	14	221	0.007	6.897	6.846
Silky shark (*C. falciformis*)	2	9.2	0.001	0.985	0.285
Blacktip shark (*Carcharhinus limbatus*)	88	864.5	0.047	43.350	26.780
Hard-nose shark (*C. macloti*)	4	57	0.002	1.970	1.766
Blacktip reef shark (*C. melanopterus*)	24	243.5	0.013	11.823	7.543
Carcharhinus sp.	8	90	0.004	3.941	2.788
Tiger shark (*Galeocerdo cuvieri*)	2	151	0.001	0.985	4.678
Shortfin mako shark (*Isurus oxyrinchus*)	5	94	0.003	2.463	2.912
Smooth Hammerhad sharks (*Sphyrna zygaena)*	4	266	0.002	1.970	8.240
Other Sharks	31	709	0.017	15.271	21.963
Total	203	3228.2	0.18		

(Source: Varghese et al., 2007)

Table 3. Shark species caught, thier hooking rate and percentage composition from Bay of Bengal

Shark Species	Total Shark by		HR	Species % by	
	Nos.	Wt (Kg)		Nos.	Wt (Kg)
Pelagic thresher shark (*Alopias pelagicus*)	162	604.5	0.073	37.587	43.152
Bigeye thresher shark (*A. superciliosus*)	49	2,342	0.022	11.369	16.714
Thresher shark (*A. vulpinus*)	25	989	0.011	5.800	7.058

Silvertip shark (*C. albimarginatus*)	1	20	0.00	0.282	0.143
Oceanic whitetip shark (*C. longimanus*)	1	35	0.00	0.232	0.250
Dusky shark (*C. obscurus*)	2	125	0.001	0.464	0.892
Spot tailed shark (*C. sorrah*)	3	78	0.001	0.696	0.557
Blacktip shark (*Carcharhinus limbatus*)	87	1,940	0.039	20.186	13.845
Blacktip reef shark (*C. melanopterus*)	72	943	0.032	16.705	6.730
Spadenose shark (*Scoliodon laticaudus*)	6	171	0.003	1.392	1.220
Tiger shark (*Galeocerdo cuvieri*)	6	717	0.003	1.392	5.117
Scalloped hammerhead shark (*Sphyrna lewini*)	6	219	0.003	1.392	1.563
Great hammerhead shark (*S. mokarran*)	1	150	0.00	0.232	1.071
Smooth Hammerhad sharks (*Sphyrna zygaena)*	2	67	0.001	0.464	0.478
Shortfin mako shark (*Isurus oxyrinchus*)	2	97	0.001	0.462	0.688
Other Sharks	8	169	0.004	1.856	1.206
Total	433	14,108.5	0.195		

(Source: Varghese et al., 2007)

Table 4. Shark species caught, their hooking rate and species complosition from the Indian EEZ

Shark Species	**Total Shark by**		**HR**	**Species % by**	
	Nos.	**Wt (Kg)**		**Nos.**	**Wt (Kg)**
Pelagic thresher shark (*Alopias pelagicus*)	177	6,445.5	0.043	27.830	37.178
Bigeye thresher shark (*A. superciliosus*)	52	2,443	0.013	8.176	14.091
Thresher shark (*A. vulpinus*)	26	999	0.006	4.088	5.762
Silvertip shark (*C. albimarginatus*)	3	33	0.001	0.472	0.190
Oceanic whitetip shark (*C. longimanus*)	1	35	0.00	0.157	0.202
Blacktip reef shark (*C. melanopterus*)	96	1,186.5	0.023	15.094	6.844
Dusky shark	2	125	0.00	0.314	0.721

(*C. obscurus*)					
Spot tailed shark (*C. sorrah*)	3	78	0.001	0.472	0.450
White cheek shark (*C. dussumieri*)	14	221	0.003	2.201	1.275
Silky shark (*C. calciformis*)	2	9.2	0.00	0.314	0.053
Blacktip shark (*Carcharhinus limbatus*)	175	2,804.5	0.043	27.516	16.176
Hardnose shark (*C. mahloti*)	4	57	0.001	0.629	0.329
Carcharhinus spp.	8	90	0.002	1.258	0.519
Shortfin mako shark (*Isurus oxyrinchus*)	7	191	0.002	1.101	1.102
Scalloped hammerhead shark (*Sphyrna lewini*)	6	219	0.001	0.943	1.263
Great hammerhead shark (*S. mokarran*)	1	150	0.00	0.157	0.865
Smooth Hammerhad sharks (*Sphyrna zygaena)*	6	333	0.001	0.943	1.921
Spadenose shark (*Scoliodon laticaudus*)	6	171	0.001	0.943	0.986
Tiger shark (*Galeocerdo cuvieri*)	8	868	0.002	1.258	5.007
Other Sharks	39	878	0.010	6.132	5.064
Total	636	17,336.7	0.155	100	100

(Source: Varghese et al., 2007)

Table 5. Species composition of sharks in Indian waters as observed in Tuna longline survey

Shark Species	**Mean Wt (Kg)**	**Species % by**	
		Nos.	**Wt (Kg)**
Pelagic thresher shark (*Alopias pelagicus*)	36.415	27.830	37.178
Bigeye thresher shark (*A. superciliosus*)	46.981	8.176	14.091
Thresher shark (*A. vulpinus*)	38.423	4.08	5.762
Silvertip shark (*C. albimarginatus*)	11.00	0.472	0.190
Oceanic whitetip shark (*C. longimanus*)	35.00	0.157	0.202
Blacktip reef shark (*C. melanopterus*)	12.359	15.094	6.844
Dusky shark	62.500	0.314	0.721

(*C. obscurus*)			
Spot tailed shark (*C. sorrah*)	26.00	0.472	0.450
White cheek shark (*C. dussumieri*)	15.786	2.201	1.275
Silky shark (*C. calciformis*)	4.600	0.314	0.053
Blacktip shark (*Carcharhinus limbatus*)	16.026	27.516	16.176
Hardnose shark (*C. mahloti*)	14.250	0.629	0.329
Carcharhinus spp.	11.250	1.258	0.519
Shortfin mako shark (*Isurus oxyrinchus*)	27.286	1.101	1.102
Hammerhead shark (*Sphyrna lewini*)	36.500	0.943	1.263
Great hammerhead shark (*S. mokarran*)	150.00	0.157	0.865
Smooth Hammerhad sharks (*Sphyrna zygaena)*	55.50	0.943	1.921
Spadenose shark (*Scoliodon laticaudus*)	28.50	0.943	0.986
Tiger shark (*Galeocerdo cuvieri*)	108.500	1.258	5.007
Other Sharks	22.513	6.132	5.064
Total	27.259	100	100

(Source: Varghese et al., 2007)

Abundance

In India ‘J’ hooks are commonly used. In the exploratory survey, sharks were caught at a hooking rate of 0.16 numbers in 100 hooks operated from the Indian EEZ. The contribution of sharks to the total catch was 20.83% by number and 23.36% by weight (Varghese *et al*., 2007). Abundance was more pronounced in the Andaman and Nicobar waters (HR- 0.23) than the Arabian Sea (0.09) and western Bay of Bengal (0.08). Analysis of trends in the abundance indices of sharks in the exploratory survey revealed sharp decline was in the relative abundance indices from the different regions (John and Varghese, 2009). Varghese *et al*. (2011) while analysing the abundance indices of exploratory survey conducted by the Fishery Survey of India longline vessels in the Indian EEZ during 1984 to 2008 reported that, in the eastern Arabian Sea, the trends in the abundance indices revealed gradual loss of shark abundance in the survey area over the years. The abundance indices recorded during the 80’s and early 90’s were impressive, and hereafter there was drastic reduction in the abundance indices. Drastic decline of shark were noticed in the Bay of Bengal over the years. The highest hooking rate was recorded during 1985,

while the recent years (2005-2008) recorded the lowest. In the Andaman and Nicobar waters, there were wide fluctuations in the abundance indices of sharks over the years with no clear indication of reduction in abundance over the years.

The elasmobranchs constituted 4-12% of the catch by drift longline fishery based at Cochin (Jayaprakash *et al*., 2002). The pelagic sharks constituted 93%, rays 6% and skates the rest of the elasmobranchs exploited by this gear. As in the case of longline fishery, shark abundance indices recorded decline in the drift gillnet fishery also. The production of the elasmobranchs by the gear varied from 1,238 t in 1979 to 42 t in 1994 indicating a gradual decline in the catch. The effort came down from 39,389 units in 1979 to 6,152 in 1995. The catch per effort also showed a similar downfall from 31.4 kg in 1979 to 6.1 kg in 1994.

Table 6. Hooking rate and percentage of sharks obtained in Tuna Longline survey from Arabian Sea and Bay of Bengal

Area	Hooks Operated	Shark			Sharks Weight	
		No	HR%	% by No.	Kg	%
Arabian Sea (Area 51)	18,275	203	0.11	16.09	3,228.20	12.00
Bay of Bengal (Area 57)	2,22,226	433	0.20	24.17	14,109.00	29.82
Total	4,09,501	636	0.31	40.26	17,337.20	41.82

(Source: Varghese et al., 2007)

Table 7. Total catch of sharks by monofilament and multifilament gear

Gear	Total Catch		HR	% of Shark catch	
	No.	Wt.		No	Wt.
Monofilament LL	287	4,513	0.13	15.38	11.14
Multifilament LL	349	12,824	0.18	29.4	38.04

(Source: Varghese et al., 2007)

Figure 1. Abundance in Total Shark Catch by weight

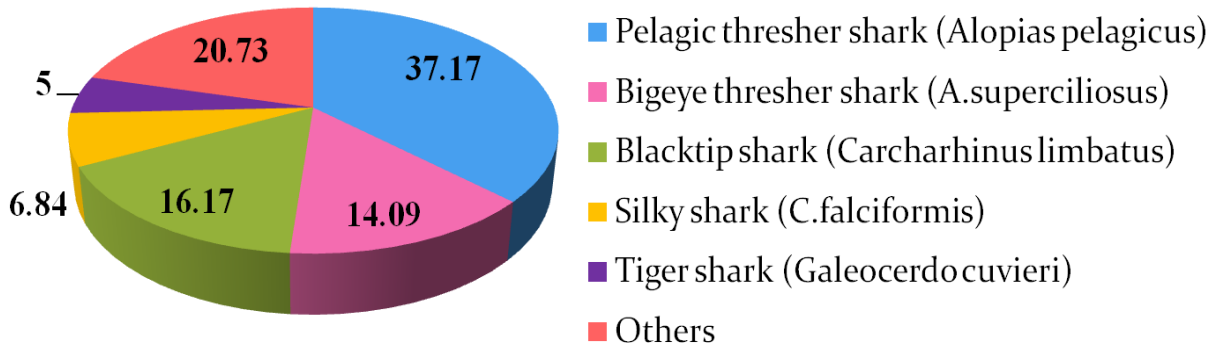
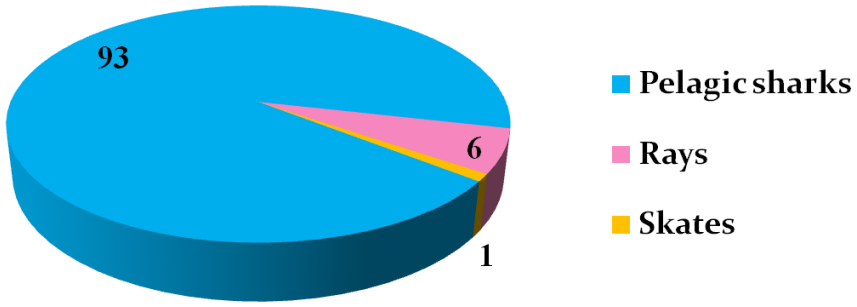


Figure 2. Elasmobranchs Catch by drift longline fishery based at Cochin



Management measures

India, being keen on the conservation of marine resources adopts a precautionary approach and has been practicing fishing ban for a period of 46 days coinciding the monsoon season. This ban is applicable to all mechanised/motorised fishing crafts in the Indian EEZ. Being a responsible member of the IOTC, India issues permits for high sea oceanic fishery under the condition that the vessels operating in the high seas complies to all the IOTC resolutions. Specifically on the management of sharks, the following condrichthyans are protected under the revised 2001 Schedule I of the Indian Wildlife (Protection) Act, 1972 - the knifetooth sawfish (*Anoxypristis cuspidate*), the Pondicherry shark (*Carcharhinus hemiodon*), the Ganges shark (*Glyphis gangeticus*), the speartoothed shark (*Glyphius glyphius*), the Ganges stingray

(*Himantura fluviatilis*), the freshwater sawfish (*Pristis microdon*), the green sawfish (*Pristis zijsron*), the giant guitarfish (*Rhynchobatus djiddensis*), the porcupine ray (*Urogymnus asperrimus*) and whale sharks (*Rhincodon typus*) (moef 2001). India experimented the effects of hook design on longline catches in Lakhsadwwp waters and found positive effects of circle hooks in minimising impact of bycatch on the fish favouring post-release survival of the species (Aneesh Kumar et al., 2013). Further, India has banned the wasteful practice of shark finning in its waters.

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