DISTRIBUTION, ABUNDANCE AND BIOLOGY OF PELAGIC STINGRAY *PTEROPLATYTRYGON VIOLACEA* (BONAPARTE, 1832) (MYLIOBATIFORMES, DASYATIDAE) IN THE INDIAN EEZ

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Data on the bycatch species of the Tuna longline survey voyages undertaken by the four survey vessels of Fishery Survey of India (FSI) from January 2005 to December 2007 was analysed to study the distribution, abundance and biology of the Pelagic stingray, *Pteroplatytrygon violacea* (Bonaparte 1832) in the Indian Exclusive Economic Zone (EEZ). A total of 378 specimens of the species were caught from Arabian Sea, Bay of Bengal, and Andaman and Nicobar waters during the study period. From the Arabian Sea, this species was caught at a hooking rate (HR) of 0.42 individuals/1000 hooks while a HR of 0.51 and 0.96 were registered for this species from the Bay of Bengal and Andaman and Nicobar waters respectively. The abundance was maximum in the southern latitudes (6-9° N) of Andaman and Nicobar waters. The disc width of the specimens caught was in the range of 40-62 cm, weighing 2.0-5.6 kg. The individuals belonging to the species were found to feed upon jellyfish, oceanic squids, argonauts, swarming crabs, pelagic shrimps, euphausiids and finfish. Egg bearing females were observed in the catch during December-March of every year of the study period and a single mother carrying three embryos were caught during May 2006. The present study forms the first report of this species from the Indian waters.

Key words: pelagic stingray, bycatch, tuna longline, Arabian Sea, Bay of Bengal, Andaman and Nicobar waters, Indian EEZ

Abbreviations used: OAL – Overall length, GRT – Gross Registered Tonnage, HR – Hooking Rate, TL – Total Length, DW – Disc Width, CPUE – Catch Per Unit Effort, SST- Sea Surface Temperature

INTRODUCTION

Longline fishery targeting tunas and swordfish catches a number of other species as bycatch. The bycatch in marine fisheries is an increasingly prominent international, ecological, social and economic issue (Alverson *et al.* 1994; FAO 1999; Cook 2001; Gilman 2001; Dobrzynski *et al.* 2002; Gilman *et al.* 2005), which necessitates the importance of documentation and quantification of bycatch in different fishing methods. Species composition of the bycatch in the tuna longline fishery in the Indian Exclusive Economic Zone (EEZ) show many interesting species hitherto not reported or poorly documented in Indian EEZ. Since India is establishing itself as a major tuna fishing nation in this part of the globe by converting the loss making shrimp trawlers to tuna longliners (Somvanshi *et al.* 2008), it is the need of the hour to study more about the bycatch in the tuna fishery for effective management of these resources. In the spirit of the Code of Conduct for Responsible Fisheries, an attempt was made by the Fishery Survey of India (FSI) to explore the abundance and distribution pattern of major bycatch species of longline fishery in the Indian EEZ. Distribution and abundance of one such bycatch species, the Pelagic Stingray *Pteroplatytrygon violacea* (Bonaparte 1832) as revealed during the tuna longline survey conducted by the FSI vessels in the Indian EEZ is presented in this paper. Results of preliminary studies on the biology of this species caught from the Arabian Sea are also presented here.

The Pelagic Stingray *P. violacea* is the only currently known pelagic species of the Family Dasyatidae. Until recently, the pelagic stingray was classified under the genus *Dasyatis*, and later moved to *Pteroplatytrygon* by McEachran and Fechhelm (1998). Synonyms of this species appearing in the literature include *Trygon violacea* Bonaparte, 1832, *T. purpurea* Smith, in Muller and Henle 1841, *Dasyatis purpurea* Banard 1934, *D. atratus* Ishiyama and Okada 1955, *D. guileri* Last 1979 and *D. violacea* Bonaparte 1832. Pelagic Stingray is distributed in the tropical to temperate waters of all the major oceans (Wilson and Beckett 1970; Hart 1973; Nakaya 1982; Branstetter and McEachran 1983; Compagno 1987; Lamilla and Melendez 1989; Nishida and Nakaya 1990; Menny *et al.* 1995; Menny and Stechmann 2000; Bañón 2000; Mollet 2002; Letourneur *et al.* 2004; Domingo *et al.* 2005). In the Indian Ocean, the species has been reported from Australia (Last and Stevens 1994), Reunion Island (Letourneur *et al.* 2004) and Indonesia (White *et al.* 2006). A review of the literature shows that the occurrence of *Pteroplatytrygon violacea* is not reported so far from the

Indian EEZ. The longline survey vessels of FSI are regularly hooking this species all along the Indian EEZ. Since humans do not consume this fish, when caught onboard commercial longliners it is killed, as the fishermen fear possible stinging while removing the hook, and thrown out at the sea. Therefore, the catch is not usually reflected in the logbooks of the industrial longline operators.

MATERIAL AND METHODS

Data gathered by the scientists participating onboard four tuna longline survey vessels of FSI during January 2005 to December 2007 are analyzed for studying the distribution, abundance and biology of pelagic stingray. The vessels, *MFV Matsya Vrushti* (OAL 37.5m, GRT 465t), and *MFV Yellow Fin* (OAL 36.0m, GRT 290t) operating from Mumbai surveyed the West coast (Arabian Sea), while the other two vessels, *MFV Matsya Drushti* (OAL 37.5m, GRT 465t) and *MFV Blue Marlin* (OAL 36.0m, GRT 290t), belonging to Chennai and Port Blair Base, surveyed the Bay of Bengal, and Andaman and Nicobar waters of the Indian EEZ, respectively. While conventional Japanese multifilament longline with five hooks per basket was operated from the vessels *MFV Yellow Fin* and *MFV Blue Marlin*, the other two vessels operated monofilament longline gear with seven hooks per basket. The longline gear consists of a series of baited hooks attached to a main line, which is suspended from buoys floating at the sea surface. Every month, these vessels are deployed for voyages of 20 days duration, and about 15 longline operations are conducted in each voyage, operating an average of 9,000 hooks. The general method of operation is: shooting of the line begins before sunrise and is completed in about 2-2.5 hours. On an average 600 hooks are operated per set. Immersion time of 5-6 hours is allowed and hauling is done in the afternoon starting from the initially shot end.

Onboard, the Pelagic Stingray *Pteroplatytrygon violacea* (Bonaparte 1832) was identified following characters described by Smith and Heemstra (1986). After the identification, all the specimens caught during the survey voyages were subjected to morphometric measurements using fish measuring board to the nearest millimetre and weighed using a digital balance with a precision of 0.01 gm. The fishes were dissected to study their sex, maturity stages, and stomach condition. The gonads and guts were preserved in well-labelled polythene bags and kept in frozen condition until they were shifted to the shore laboratory for further investigations. After the conclusion of the voyage, samples were brought ashore for attending the detailed biological studies. Standard protocols were followed for studying the reproduction and food and feeding habits, in the shore laboratory (Stillwell and Kohler 1982; Peres and Vooren 1991).

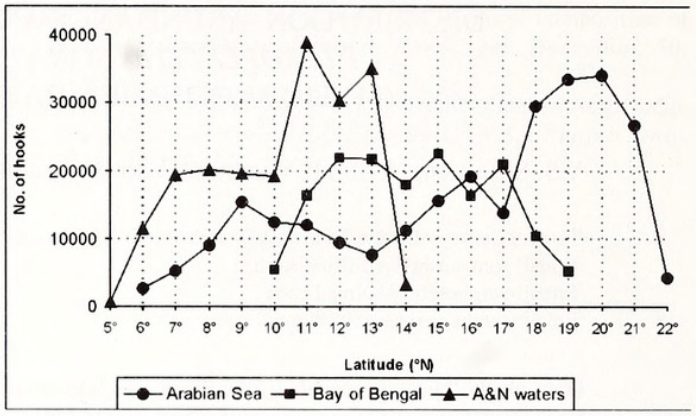

Fig. 1: Latitude-wise number of hooks operated in different regions of the Indian EEZ during the 2006-2007

For data analysis, Indian EEZ was divided into three regions, namely Arabian Sea, Bay of Bengal, and Andaman and Nicobar waters. The data gathered from January 2005 to December 2007 were treated separately for the three regions and analyzed for studying the spatial distribution, abundance and percentage contribution of Pelagic Stingray to the total catch. Abundance index is expressed in terms of Hooking rate (HR), the number of fish caught per 1,000 hooks.

RESULTS

During the study period, the four longliners together operated 6,16,314 hooks in the Indian EEZ. Of this, 2,61,002 hooks were operated in the Arabian Sea (6°-22° N), 1,58,492 in the Bay of Bengal (10-19° N) and 1,96,820 in the Andaman and Nicobar waters (5°-14° N). Latitude-wise number of hooks operated in the three regions (Fig. 1) show that the hooks operated at each latitude ranged between 625 and 38,720.

Morphological characters

The specimens of *P. violacea* hooked during the study were observed to have the following morphological characters. Body diamond-shaped with a broadly rounded snout and angular pectoral disc. Wedge-shaped disc slightly wider than long, convex at the front, with broadly rounded corners, and straight on the sides. Eyes small and do not protrude. Tail about twice body length with a long lower caudal finfold ending far in front of tail tip, but with no upper finfold. Tail with a thick base, tapering to the origin of the single extremely long (13.0-13.5 cm TL) and highly venomous serrated spine. Front margin of the pelvic fin straight, outer corner broadly rounded. No prominent markings on the body. Colour uniformly violet, purple, or dark blue-green dorsally, underside white.

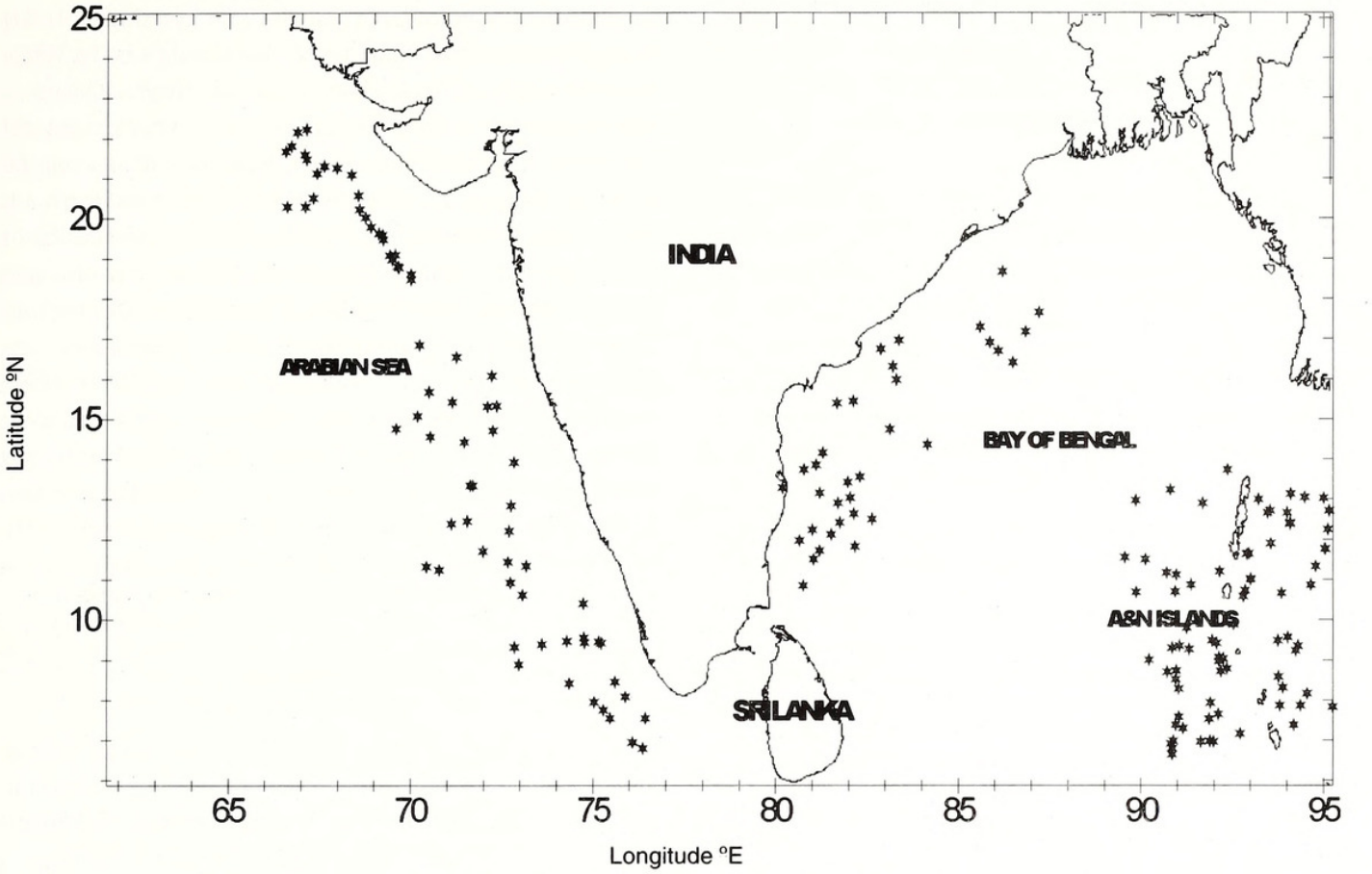

Fig. 2: Map showing the locations of hooking of *P. violacea* during the present study

Distribution and abundance

Total of 378 individuals of *P. violacea* were hooked during the survey period, registering a Hooking Rate (HR) of 0.613 individuals per 1,000 hooks. The Pelagic Stingray was caught from almost all the areas surveyed during the period. Sampling stations from where the species was hooked (Fig. 2) indicate wide distribution of the species. HR recorded from different latitudes and their percentage contribution to the total catch registered from these areas (Figs 3, 4, 5) did not show any remarkable trend in their abundance indices.

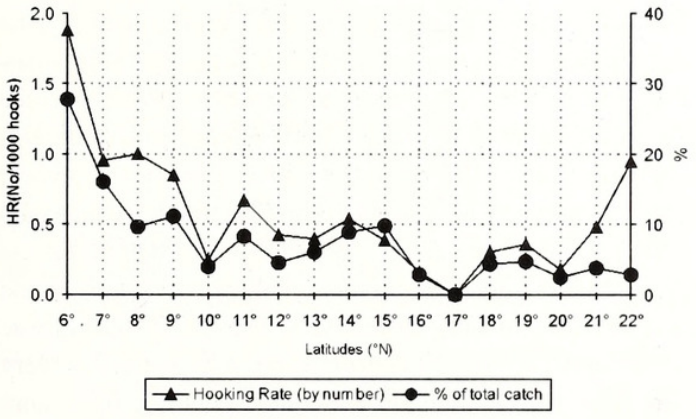

Fig. 3: Hooking rate of *P. violacea* and its percentage contribution to the total catch recorded from the Arabian Sea

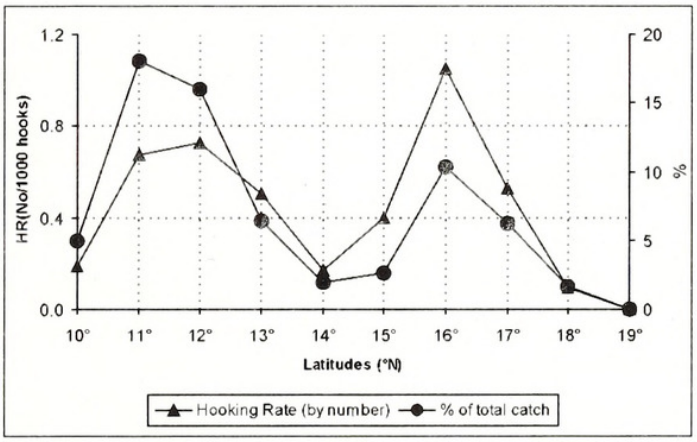

Fig. 4: Hooking rate of *P. violacea* and its percentage contribution to the total catch recorded from the Bay of Bengal

In the Arabian Sea, a total of 109 individuals of this species were hooked registering a hooking rate of 0.42 individual/1000 hooks. The percentage contribution of the species to the total catch from this area was 5.32%. Latitude-wise data shows maximum abundance in the 6° N with a HR of 1.88 followed by and 8° N (1.00) and 7° N (0.95). At 6° N, this species alone constituted 27.78% of the total catch while its contribution to the total catch from 7° N was 16.13% (Fig. 3). In northern Arabian Sea, maximum catch rate was recorded from the 22° N with a HR of 0.94. From

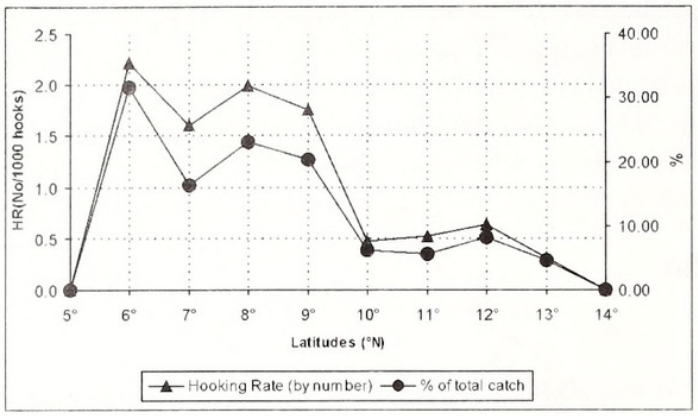

Fig. 5: Hooking rate of *P. violacea* and its percentage contribution to the total catch recorded from the Andaman & Nicobar waters

the Bay of Bengal, 80 specimens of this species were hooked during the study period, registering a HR of 0.51. Hooking rate was maximum in the 16° N (1.05), followed by 12° N (0.73) and 11° N (0.68). In the 11° N, this species constituted 18.03% of the total catch (Fig. 4). In the Andaman and Nicobar waters, *P. violacea* was more abundant in the southern latitudes, 6°-9° N. Maximum HR was recorded from the 6° N (2.21) followed by 8° N (1.99). The species contributed 31.65% to the total catch recorded from the 6° N of Andaman and Nicobar waters. Contribution of this species to the total catch from the 8° N (22.99%), 9° N (20.36%) and 7° N (16.40%) of Andaman and Nicobar waters also were significant (Fig. 5). Although limited survey was conducted in the 5° and 14° N, pelagic stingray were not hooked from these two latitudes.

Biological observations

The disc-width, weight and biological aspects analysed in the present study revealed that disc-width of the specimens caught ranged from 40-62 cm, while weight of the specimens ranged from 2.0 to 5.6 kg. Food and feeding studies conducted showed that this species feeds on Jellyfish, oceanic squids, *Argonauta* spp., crabs, pelagic shrimps, euphausiids and finfish. About 22% of the stomachs examined during the present study were found to be empty. Swarming crab, *Charybdis smithii* was the single dominant prey item observed in the stomach. Oceanic squid species, including *Sthenoteuthis oualaniensis*, *Onychoteuthis banksii* and *Histeoteuthis* sp. also were found to be contributing significantly to the food of Pelagic Stingray of the Indian EEZ. A variety of small pelagic fishes belonging to the families Nomidae, Myctophidae, Gempylidae, Sternoptychidae, and Carangidae were also found among the gut contents.

Reproduction

The sexual development in Pelagic Stingray is ovoviviparous (aplacental viviparity), i.e., producing living young from eggs that hatch within the female's body. While inside the uterus, the embryos are nourished by yolk, later they receive additional nourishment from the mother by indirect absorption of uterine fluid, which is enriched with mucous, fat or protein through specialized structure (Dulvy and Reynolds 1997). In the present study, the sex ratio of the specimens collected was 3:1 (M:F). Egg-bearing females were observed during December-March, while a single mother carrying three embryos was reported during May 2006 from the Arabian Sea. The specimen carrying the embryo had a disc-width of 58 cm weighing 4.3 kg. The colourless embryos extruded out of the mother's body had a disc-width 7.5 to 8.2 cm and the weight of embryos ranged from 16.9 to 18.3 gm. Since the gestation period of this fish is usually four months (Hemida *et al.* 2003), it is inferred that parturition will be during June-September in the Arabian Sea.

DISCUSSION

A review of available literature showed that the Pelagic Stingray *P. violacea* is not reported and investigated, so far, from the Indian EEZ, the present study forms the first report of this species in the Indian EEZ. This fish constitutes a considerable part of the bycatch in the industrial tuna longline fishery, playing a role in the pelagic ecosystem of the world oceans. Although most of the Pelagic Stingrays hooked on longline are taken onboard in live condition, the fishermen, fearing possible stinging, usually kill the ray by banging it on the sides of the vessel before removing the hook and throwing the carcass into the sea. Ward and Myers (2005) reported that industrial fishing had resulted in shifts in open ocean fish communities reducing the abundance (by 21%) and biomass (by a factor of 10) of tunas and sharks in the tropical Pacific Ocean. However, the population of several small and formerly rare species, like Pelagic Stingray had increased. Environmental parameter like Sea Surface Temperature (SST) is reported to have some influence on the distribution of *P. violacea*. Domingo *et al.* (2005) reported increase in the CPUE of *P. violacea* with Sea Surface Temperature in Uruguayan waters. Higher catch rate was registered when SST recorded >20°C. During the present study, no attempts were made to correlate the abundance with SST. Low fecundity (1 to 9 per litter) of this fish makes the species more vulnerable to over exploitation. Based on the mathematical models suggested by Musick (1999), Froese and Pauly (2005) had categorized this fish as having "very low resilience" (minimum population doubling time more than 14 years (K=0.18 (captivity); Fec=1-9), while the species is categorised as with "High to very high vulnerability"

(66 of 100) based on the model suggested by Cheung *et al.* (2007). These peculiar life history traits of the species warrant a cautious approach for the management of this species in the pelagic ecosystem. Mitigation devices for reducing the number of Pelagic Stingray hooked in the longline also need to be developed for avoiding possible stock depletion due to longline fishing. Mitigation devices will help the fishermen, who consider the Pelagic Stingray as a pest consuming the bait aimed for highly valued tunas and swordfish. More studies on bycatch are needed to account the impact of longline fisheries on species associated with or dependent upon harvested species with a view to maintaining or restoring populations of such associated or dependent species above the levels at which their reproduction and recruitment may become seriously threatened.

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