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Recent trends in the mobulid fishery in Indian waters

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Abstract

Mobulidae are zooplanktivorous elasmobranchs, found circumglobally in tropical, subtropical and temperate coastal waters. It comprises of two recognized species of manta rays (Manta spp.) and nine recognized species of devil rays (Mobula spp.). Although the reports of mobulid fishery in India were only from 1960s, however it was commercially exploited only after 2007 for their valuable gillrakers. *Mobula diabolus, M. tarpacana, M. japonica, M. kuhlii, M. thurstoni, Manta birostris* and *M. alfredi* are the seven species which contributes to mobulid fishery. White gilled *Mobula tarpacana* is highly targeted for its high priced gill raker which fetches upto Rs. 8,000 kg^{-1} in dry weight. Few mobulid species has already reached the IUCN Red List status. Thorough monitoring of mobulid fish exploitation level is essential in India. It is necessary to ensure standardized sampling and modelling methodologies to estimate the stock position of these fishes from Indian waters.

Keywords: *Mobulids, fishery, gill rakers, exploited, Indian waters.*

Introduction

Mobulids are large sized zooplanktivorous elasmobranchs which are found circumglobally in tropical, subtropical and temperate coastal waters. Mobulids are harmless to human beings, although earlier literature painted them as 'diabolical creatures' and 'ferocious brutes'[1,2]. Although their existence has been documented since the 17th century[3], information on their biology and ecology is scanty[4].

World over, mobulids are represented by two species of manta rays, *Manta alfredi* (Krefft, 1868) and*M. birostris* (Walbaum, 1792) and nine species of devil rays, *Mobula eregoodootenkee* (Bleeker, 1859), *M. hypostoma* (Bancroft, 1832), *M. japanica* (Muller and Henle, 1841), *M. kuhlii* (Muller and *Henle*, 1841), *M. mobular* (Bonnaterre, 1788), *M. munkiana* (Notarbartolo-di-Sciara, 1987), *M. rochebrunei* (Vaillant, 1879), *M. tarapacana* (Philippi, 1892) and *M. thurstoni* (Lloyd, 1908)[8,9]. Mobulids are highly epipelagic rays that are challenging to observe. Species identification of mobulids is problematic because of the close external resemblance of many species which has lead to taxonomic ambiguities. Till 2009, *Manta* rays were recorded only as *Manta birostris*. With the redescription of *Manta* spp[9], a new species Manta alfredi was recognized. Misidentification of *Mobula* spp is very common even in current literature[4]. This has lead to problems in the IUCN assessment of many mobulid species. The 2011 IUCN Red List reassessment has listed the two *Manta* species *Manta birostris* (Walbaum, 1792) and *M. alfredi* (Krefft, 1868) as globally Vulnerable[10,11]. Data deficiency status has been given for three *Mobula* species (*Mobula hypostoma, M. kuhlii* and *M. tarapacana*), [12-14] Near Threatened for M. eregoodootenkee, *M. japanica, M. munkiana* and *M. thurstoni*, Vulnerable for *M. roachebrunei* and Endangered for *M. mobular*[15-20].

Mobulids were not of much commercial value in fishery till late 2007; however, across the globe, large numbers

are being landed in targeted and bycatch fisheries due to increasing demand for mobulid products in the Asian markets [5,6,7]. Fisheries for mobulids are considered to be unsustainable because of large, directed catches coupled with the very low fecundity, long gestation period [4]. Manta rays bear only one pup on an average every two to three years, which makes them highly vulnerable to overexploitation. They are killed as bycatch and in targeted fisheries throughout the Atlantic, Pacific, and Indian Oceans. In recent years, manta ray fishing has expanded in many places throughout their range, primarily in response to the emerging international market for their gill plates. *Manta* ray gill plates, which are sold in some Asian markets in a tonic with purported health benefits, are the part most valued in international trade, with cartilage and skins of lesser importance. Population depletion for oceanic and reef mantas is high in several regions, with declines by more than 85 percent of the baseline[5].

Although the presence of these mobulids in Indian waters were reported earlier[21,22], with the inclusion of manta rays in CITES Appendix II since May 2013, appropriate record of catch is essential. The present trend for fishing of the mobulids for the highly valuable gill rakers[23] will threaten the status of the mobulids further in the Indian EEZ. In this study we present landing data of mobulids in Indian waters from 1961-2011 to understand trends in fishery and highlight conservation needs.

Material and methods

Literature survey was carried out in detail with majority of the literature available through the Central Marine Fisheries Research Institute (CMFRI) website (www.eprints.cmfri.org.in) and published fishery data of CMFRI for the period 1961 -2013. The published literature was tabulated to get an account of the landings reported from different coasts. Fishery data on rays was also taken from CMFRI website; besides regular weekly field observation was also conducted at Cochin Fisheries Harbour for a one year period to note the ray landing at the Harbour as well as the gill raker trade in practice. Species identification of mobulids and manta rays landed was done using Photo identification guide of Manta Trust using gill rakers and ventral body markings.

The close resemblances in the external characters of *Mobula* and *Manta* species have proven to be a barrier in the field identification. In majority of cases during the study, the fishes were cut up in the harbour itself and gill rakers removed, meat sold in retail markets. Identification was easier for *Mobula* species using the gill raker plates rather than the body markings. The mobulid *Mobulatarpacana* was locally called "white" due to the white naturfe of the gills; the other species *Mobula japonica* and *M. thurstoni* was called "black" due to the black colour of the gill plates. Recently named *Manta alfredi* was easily mistaken for *Manta birostris* except for the black collar like patch around the head. In addition to the species identification,pups of *Mobula japanica, M. tarpacana and Manta alfredi* were collected from pregnant females during the study period.

Results

Fishery

India along with Indonesia, Sri Lanka comprise the top three manta fishing countries and account for an estimated 90 percent of the world's manta catch and target mantas for their gill plates. Commerce in gill plates is not well-documented, although an estimate of the total volume of the gill plate trade has been produced from an analysis of market surveys in the major manta ray gill plate markets- Guangzhou, Hong Kong, and Macau in China, as well as Singapore, with an estimated 99 percent of the market based in Guangzhou. These surveys estimated the annual volume of gill plate sales as about 21,000 kilograms (46,300 pounds) of dried manta ray gill plates and representing an estimated 4,652 manta rays. Virtually no management exists for the international trade in manta products. (http://www.pewenvironment.org/news-room/fact-sheets/cites-2013-manta-rays-).

In India, during the period 2007-12 *Mobula* landings on the west coast of India comprising of the states of Gujarat, Maharashtra, Karnataka and Gujarat have increased tremendously from 790 t to 2694 t. Gujarat contributed to over 50 % of the fishery, followed by Kerala. Landings showed an increase of 86 % in 2011 over 2007 on the west coast. Taking a species wise account, two species namely *Mobula diabolus* and

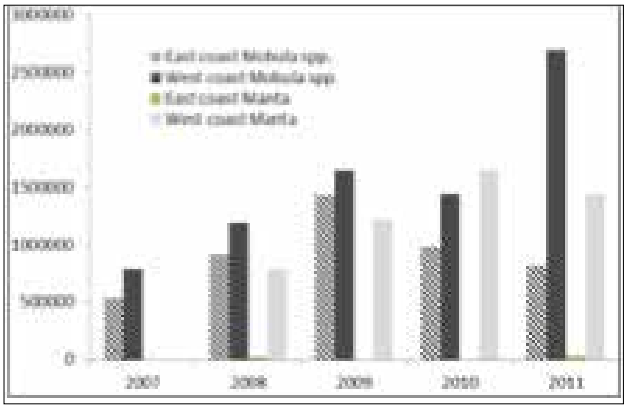

Fig. 1. Landings of *Manta* spp. in west and east coast of India from 2007-2011

Mobula spp was the major contributors. On the east coast, Tamil Nadu was the major contributor with 86 % share; landings have shown a decline after 2009. Landings of *Manta* spp. increased on the west coast upto 2010 and showed a slight decline in 2011 (Fig.I). However, landings on the east coast were scarce. The presence of another unidentified *Mobula* sp. is also reported in the catch data. During the year 2012, 75 % of the mobulid landings in Kerala were constituted by *Mobula japonica*, followed by *M. tarpacana*, *M. diabolus*, *M. birostris* and *M. kuhlii*. (Fig.)

Taking a species breakup of the fishery at Kochi during 2011, seven species contributed to the fishery namely *Mobula diabolus, M. tarpacana, M. japonica, M.kuhlii, M.thurstoni, Manta birostris* and *M. alfredi, Mobula japonica* was the major contributor followed by *M. tarpacana* and contributed to 65 % of the ray fishery. The locations along the Indian coast where *Manta* and *Mobulid* rays landings were reported during the period 1961 - 2013 is shown in Fig.

In all cases, only one pup was collected from the adult. Length at birth of the pups is given in (Table I). The adults of *Mobula japanica* landed had a disc width (WD) of 230 - 238 cm; reports[4] show that females with disc width of 236 cm are mature. Mobula tarpacana landed in the fishery had a disc width of 113-327 cm for female fishes and 226 – 248 cm for male fishes; landings were predominantly females; a female of disc width 320 cm had one pup of disc width 103 cm. WD at maturity for female *M. japonica* is unknown[16], based on the present study,WD could be 320 cm as pups were not recorded in other fishes landed.

Mobula tarpacana landed at Cochin had a disc width of 112-322 cm for females and 310 cm for males. Given the WD for males and females at maturity for *M. tarpacana* as 234-252 cm for males[16], the fishes caught were mature. The WD for females at maturity for *M. tarpacana* is unknown[16]; however, the fish of WD 320 cm had a pup of 103 cm. Therefore the WD for females may be tentatively taken as 320 cm.

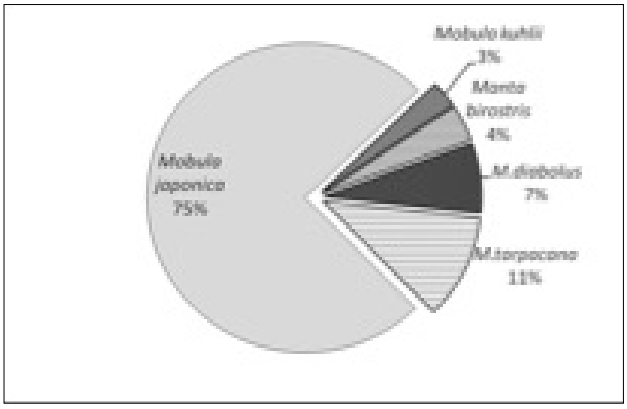

Fig. 2. Percentage contribution of different mobulid species to the fishery in Kerala during 2011-2012

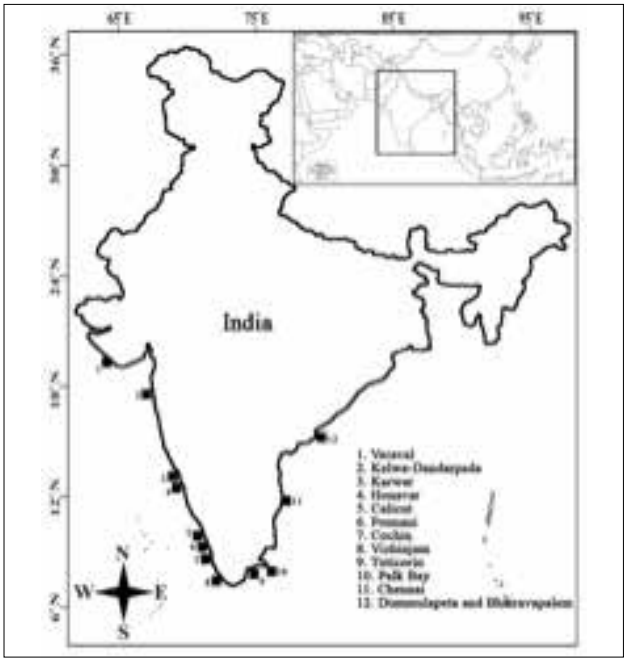

Fig. 3. Localities along the Indian coast where Manta and Mobulid rays landings were reported during the period 1961-2013

Of the mobulids reported landed from Indian waters, dominance was on the east coast compared to west coast of India (Fig.). During the period 1961- 2009, there were 20 reports of *Manta birostris* from Indian waters of which only five were from the west coast. List is not complete as there may be several landings along

Table 1: Length at birth of mobulids collected from Kochi, India.

Species	Disc Width (cm)	Total length (cm)	Weight (Kg)	DW of adult (cm)
Manta alfredi	114	112.5	9.8	1500
Mobula japonica	48.5	115	7.8	226
Mobula tarpacana	103		9	320

the coastline which may be unreported. Largest record was a *M. birostris* of disc width 553 cm and weight 2.4t from Tuticorin waters. The largest *Manta birostris* from west coast was of disc width 594 cm and weight 1.4t from Calicut. (Table 2) Length at first maturity of *Manta birostris* reported is 413 cm[23]; hence most of the fishes caught were sexually mature. With the low fecundity of one pup and a probably long gestation period, heavy exploitation of this species will pose a threat to the fishery of this species. Documented records of *Mobula diabolus* from Indian waters (1961-2013) is given in Table II the list of localities is mentioned[25-48].

Table 2: Mobulids landed at different locations in India.

Locality	Year	Disk width (cm)	Length (cm)	Weight (kg)	Sex
		Manta birostris			
Saurashtra coast, Veraval[25]	28 Dec, 1961	626	359	1000	Female
	15 Mar, 1962	482	248	-	
Veraval[26]	26 March 1980	680		2000	Female
Nochikuppam, Madras[27]	23rd Mar, 1981	427	187	750	Female
Karwar[28]	1st Dec, 1987	447	386	800	Female
Tuticorin[29]	3rd May, 1990	554	217	1200	Female
		525	211	1150	Male
Bhidiya, Veraval[30]	15th Feb, 1993	490	286	1350	Unknown
Tuticorin[31]	29 Mar, 1993	567	302	1375	Female
		570	305	1425	Female
Karwar[32]	16 Sep, 1995	550	300	1200	Female
Honavar[33]	20 Sep, 1995	120	-	-	Female
Tuticorin[34]	28th Apr, 1997	553	224	2400	Female
		542	221		Female
Tuticorin[35]	24th Mar, 2001	576	331	1850	Male
Kelwa-Dandarpada, Maharashtra[36]	24th Sep, 2002	594	417	1500	Female
Tuticorin[37]	31st Mar, 2006	620	370	1550	Female
Chennai[38]	15th Apr, 2006	520	210	1050	Female
	6th Oct, 2006	520	210	1000	Female
	10th Oct, 2006	480	-	850	Male
Palk Bay[39]	9th Mar, 2006	165.5	-	42	Unknown
		154	-	10	
Chennai[40] (Bumper landings)	10th& 20th Feb, 2009	-	-	700-1200	Unknown
Calicut[41]	18 Oct, 2009	594 cm	342		Male
	1400				
		Mobula diabolus			
Gulf of Mannar[42]	20th July, 1993	235	122	90	Female
		260	138	120	Male
		266	141	125	Male
		266	145	130	Female
Vizhinjam[43]	19th June, 1995	442	192	800	Female
	16 Jan, 1997	450	200	850	
	20th Feb, 1997	-	-	700	
		396	150	500	
Chennai[40] (Bumper landings)	10th& 20th Feb, 2009	230-320	-	250-450	Unknown
Ponnani[44]	23rd June 2009	492	221	900 Kg	Unknown
Tuticorin[45] 36 nos	15th July, 2009	141-166	-	2486	Unknown
Dummulapeta and Bhairavapalem, Andhra Pradesh[46] (23 nos)	21 Mar, 2012 to 23 Mar, 2012	97-163 cm	62-105 cm	40 and 110 kg	Unknown
		Mobula japanica			
CFH, Kerala[47]	Aug, 2009	310	-	-	Unknown
Tharuvaikulam, Tuticorin[48] (10 nos)	13th Sep, 2013	108-234 cm	-	-	Unknown

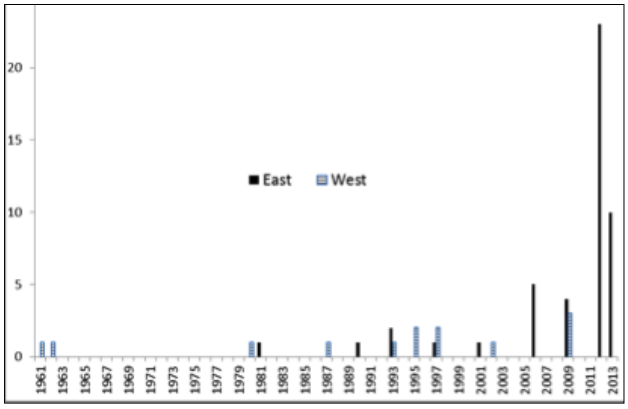

Fig.4. Coastwise occurrence records of mobulids from 1961-2013

In recent years, fishers have been targeting manta and mobula rays with modern fishing gear. The emerging market for dried gill rakers is the primary driver; rays provide a cheap substitute for shark cartilage used in nutritional supplements[48]. Documentation of the gill rakers trade from India is yet to begin. Statistics are not available; however, liver oil extraction from mobulids was popular in the Lakshadweep islands[49]. Meat of manta and mobulid rays is mostly sold in local markets in Central Kerala in fresh form or as salted chunks. Fresh meat fetches only Rs.150 kg^{-1}. Filter plates of mantas are cut in the landing centres and sorted as "white" and "black", based on the colour when dried. White filter plates are from *M. tarpacana* whereas black filter plates are from other manta and mobulids (Fig. V). The filter plates are sun dried and sent to Chennai where they are further processed before export. Dried filter plates of *Mobula diabolus* fetches upto Rs.9,000 kg^{-1}; 'white' filter plates fetch upto Rs.8,000 kg^{-1}dry weight while black fetches upto Rs.2,000 kg^{-1} dry weight.

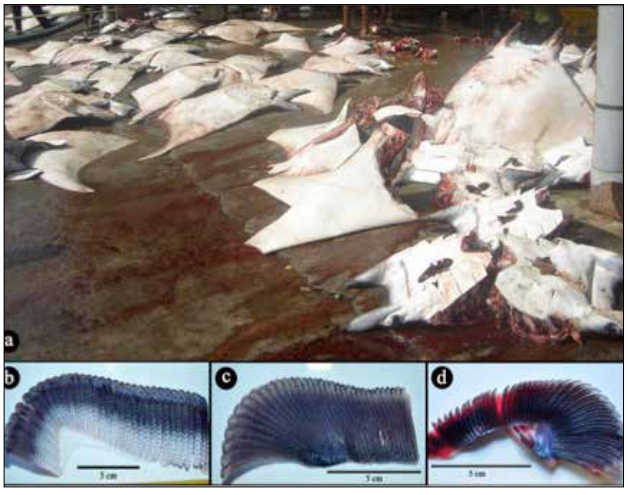

Fig.5. a.Heavy landings of mobulids at Cochin Harbour, Kerala; b. Gill raker of *Mobula tarpacana*; c.Gill raker of *Manta birostris*; d. Gill raker of *Mobula japonica*

Discussion

The recent developments in international market in shark products will only voluminise the trade from India leading to more rampant exploitation of mantas and mobulids. *Mobula japonica*, the highest contributor to the fishery is already under Near Threatened category. *Manta birostris* and *M. alfredi* is under Vulnerable status.[10-20] Recent increase in the landings of *M. japonica* will threaten the resource further. Given the slow growth and very low fecundity for these species, it is imperative that more research is carried out on the biology and population characteristics of these fishes to estimate available fishing stock from Indian waters.

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