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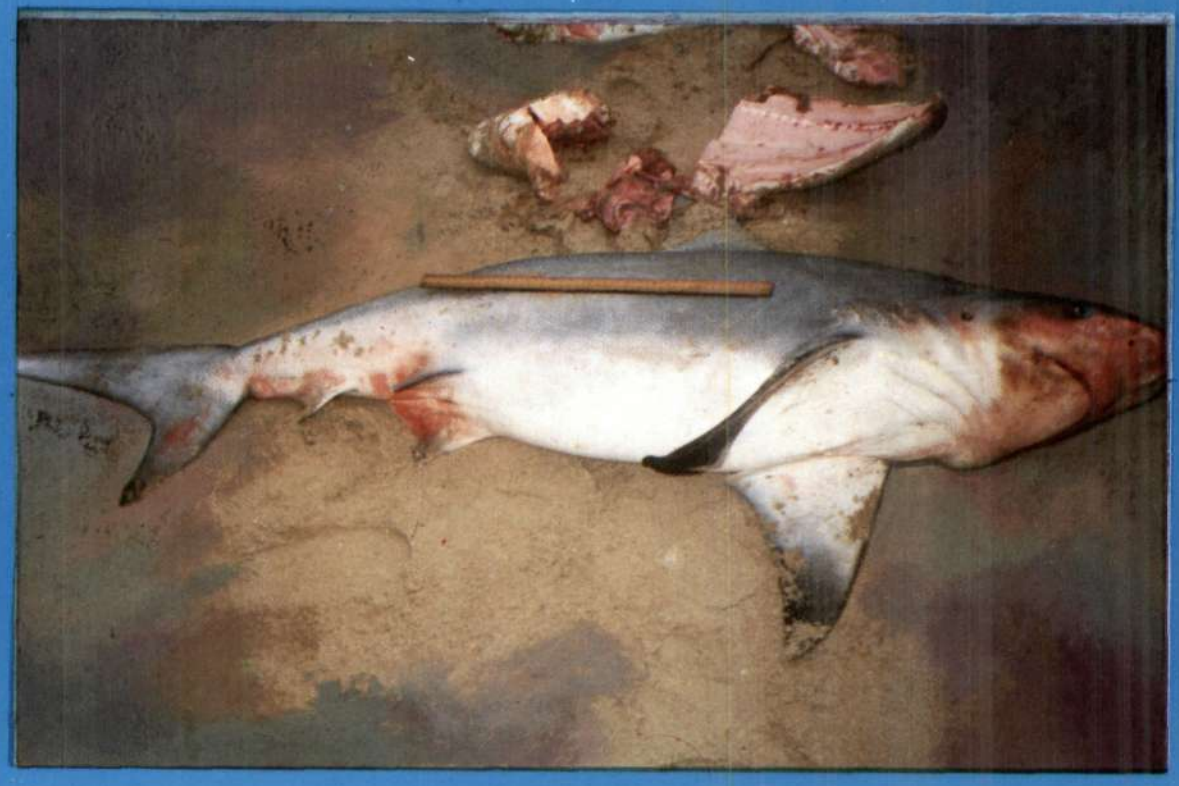
Pelagic Sharks in the Indian Seas – Their Exploitation, Trade, Management and Conservation



By: P.P. Pillai and Biju Parakal

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
P.B. No. 1603, Tatapuram P.O.
Cochin - 682 014, India

AUGUST, 2000

Pelagic Sharks in the Indian Seas— their Exploitation, Trade, Management and Conservation

P.P.PILLAI
BIJU PARAKAL*

Central Marine Fisheries Research Institute
Kochi-682 014
** Present Address:*
Fishery survey of India, Mumbai - 400 001

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PREFACE

Sharks play a crucial role in the marine ecosystem as highly efficient predators which keep ecosystem population in check. However, the low reproductive potential of shark species make them vulnerable to overfishing thus making it imperative to take a more conservative approach concerning their commercial fishery. Further, the Convention on International Trade in Endangered Species (CITES) through a resolution in 1994 requested the FAO and other organizations to collect and collate biological and trade data on shark species. During 1980s the shark fisheries were growing at a rapid pace fuelled by the demand for shark fin and shark meat, and currently shark fisheries cover the entire world oceans.

Though a harvestable potential of 168,000 t of elasmobranchs has been estimated from the EEZ of India (MOA, GOI, 1991), they are not fully exploited as evident from the average production of elasmobranchs (61,591 t) and that of sharks (41,483 t). Pelagic sharks constitute about 68% of the total shark landings in India indicating therein scope for expanding the commercial exploitation of this group of fishes which has to be implemented in a planned manner without affecting their population.

Except for some isolated studies on the taxonomy, fishery, biology, population characteristics and biochemistry on pelagic sharks in the Indian seas, a concerted effort to describe their taxonomy, biological parameters, status of exploitation, trade and

management and conservation aspects from the India seas is wanting. This special publication ecompasses available information on the above lines till date.

I compliment the effrots taken by Dr.P.P. Pillai and Mr. Biju Parakkal for preparing this publication which would help a wide spectrum of the scientific community and marine fishing industry.

Cochin-682 014
August, 2000

V.N. PILLAI
Director
Central Marine fisheries Research Institute

Pelagic Sharks in the Indian Seas— their Exploitation, Trade, Management and Conservation

CONTENTS

CHAPTER I

INTRODUCTION

Sharks are generally large, cold blooded, cartilaginous fishes, which are fast swimming, known for their numerous sharp teeth, distinctive dorsal fin and skill in locating underwater prey. They are members of elasmobranchs that live the same way they did more than 200 million years ago. Sharks belong to the class **Chondrichthys** and the subclass **Elasmobranchii**. The estimated 375 species are divided into 8 Orders and 30 families. They range in size from the dwarf dog-fish (Family: **Squalidae**), (less than 20 cm in length) to the massive whale shark (Family: **Rhiniodontidae**), which reaches a length of more than 12m. Most sharks inhabit tropical or temperate marine waters, but some species have been found in freshwater lakes and polar seas. Depending on the species, sharks inhabit either shallow or coastal waters or the open ocean and some species, such as sixgill shark (*Hexanchus griseus*) live at depths of more than 1800 m. Pelagic sharks are characterised by the absence of spiracles when compared to the bottom-dwelling sharks, which may posess them to breath easier while in the benthic realms.

Sharks play a crucial role in the marine ecosystem. As highly efficient predators, sharks keep ecosystem populations in check. However, slow growth, delayed maturation, long reproduction cycles, low fecundity and long life spans are the major factors which determine the low reproductive potential of many shark species and make them vulnerable to overfishing. This suggests that a new and more conservative approach needs to be taken concerning the commercial fishery for sharks.

The Convention on International Trade in Endangered Species (CITES) through a resolution in 1994 requested the FAO and other International Or-

ganizations to establish programmes to collect and collate necessary information on biological and trade data on sharks. A preliminary evaluation of the status of shark species covering all species that are reported in both commercial and recreational fisheries throughout the world has recently been published by FAO (Castro *et al.* 1999). According to them, problems encountered in assessing shark populations are:

* A general lack of biological and fisheries data;
* Lack of suitable population models to assess the impact of fishing and trade on sharks, and
* Lack of validated age estimates.

The political and economic changes throughout the world in early 1980's affected fishing markets and operations. Shark fins were no longer considered as a luxury product and declining fish catches and rising price of traditional food fishes made under-utilized sharks as inexpensive protein. During the late 1980's shark fisheries were growing at a rapid pace fuelled by demand and the high shark fin prices. By the end of 1990's, ex-vessel price for dry shark fins had reached US $ 50 per kg, which provided incentive to commercially exploit sharks. Further, while **shark fisheries** were growing in the early 1980's, the **tuna longline fisheries** were also growing dramatically. The high price of fins during the late 1980's caused previously discarded sharks to be retained as bycatch. In the past, most shark fisheries were small artisanal fisheries that caught whatever species of sharks that were locally or seasonally abundant or the intensive regional fisheries that targeted individual shark species for specific products such as liver oil and meat. Currently shark fisheries encompass the entire world and catch mostly large species of coastal and oceanic species.

Information on taxonomy, fishery, biology, population characteristics, biochemistry and trade of pelagic sharks exploited by the small scale fishery sector and longline fishery sectors in the EEZ of India and Indian Ocean are contained in the limited studies published earlier (vide: **BIBLOGRAPHY**). Recently, case studies on the topics such as resources, development of the fishery and current status of the means of prosecuting in the fishery and harvesting process, economics of the fishery etc. from India and Indian ocean

bordering countries have been published by FAO (Lesatang, 1999: Seychelles; Hanfee, 1999: Tamil Nadu and Kerala, India; Joseph, 1999: Sri Lanka; Anderson and Waheed, 1999: Maldives; Ali *et al.* 1999: Malaysia; Simpfendorfer, 1999: Western Australia).

As the trade in the shark products is fast multiplying and shark populations are attracting major concerns, it is imperative that efforts be made to regulate the harvest without upsetting the ecological balance at present. The average annual production of sharks in India is about 41, 480 t (1987-1999) and the fishery by small scale sector is limited to 50 to 80m depth zone, where the sharks are fished as a bycatch by many multispecies gears such as drift gillnets, hook and lines, trawls and seines all along the coast of India. However, during the 1950's and 1960's the shark fishery was more or less neglected for the reason that the shark flesh was less preferred as edible meat owing to its pungent odour due to the presence of **trymethylamine**. It was a common practice to remove the fins and discard the maimed shark caught by different fishing gears. In latter years the shark has gained popularity, both in domestic and export markets, partly due to the increase in the demand for seafood in general. The high value fetched by the fins, liver oil, cartilage and skin boosted the demand for sharks (Hanfee, 1999). The trend was accelerated with the entry of well equipped fishing trawlers into the fishery and increasing export demand for shark products. In the Indian seas, the sharks exhibit diversity in the geographical distribution and catch composition. While the elasmobranch fishery in India has increased over the years, the steady decrease in the length of the sharks in the landings is a clear indication that over exploitation is beginning to leave a telling effect (Hanfee, 1999).

As opined by Castro *et al.* (1999), a species approach is the only meaningful and tactical one for the management and conservation of sharks. Further, according to Sivasubramaniam (1992) pelagic sharks have certain specialised qualities that enable them to survive the present fishing effort, such as:

* Being apex predator, they are not preyed on significantly;
* Their bio-chemical properties make them incapable of developing tumours and allows them, if injured, to heal rapidly, and

* The wide distribution of the oceanic pelagic species over such large areas of oceanic province will necessitate intensive fishing effort over the entire area if their population is adversely affected. However, pelagic shark species in localized coastal or insular habitat may be vulnerable to intensive fishing.

Pelagic sharks are frequently exploited as NTADS in the drift gillnet fishery, seine fishery and tuna longline fishery. Studies on this group of fishes were initiated by one of us (P.P.P) since 1980's during the course of investigations on tuna fishery of the Indian seas. The present study was undertaken to evaluate the species characteristics of pelagic sharks, distribution of their landings both by the small-scale sector and exploratory fishery sector and recent trend in the trade of sharks and shark products. Attempts to manage and conserve the sharks have been few and are usually engendered by economic concerns. The present account deals with the future prospects, management and conservation measures concerning the fishery for pelagic sharks in this area. A bibliography on sharks in the Indian seas is also provided to facilitate future investigations on pelagic sharks.

CHAPTER II

TAXONOMY AND BIOLOGICAL NOTES ON PELAGIC SHARKS FROM INDIAN SEAS

A preliminary evaluation of the status of species of sharks recently made based on the historical data on sharks, their reproductive potential and level of exploitation has resulted in the discussion on 347 species of sharks belonging to 30 families from the world oceans (Castro *et al.* 1999). Despite baseline information on the taxonomy, distribution and biological aspects of sharks of Maldives (Anderson & Ahmed, 1993) and Sri Lanka (Moron *et al.* 1998; Joseph, 1999) are available, our information on shark species and their biology is scanty and is limited to scattered studies chiefly by the *Central Marine Fisheries Research Institute* and *BOBP* in the past.

Hanfee (1999) opined that out of the 70 species of sharks occurring in the Indian seas only 22 sspecies have only limited occurrence, 12 species are moderately abundant though not frequently caught and the six major species are: ***Carcharhinus limbatus, Carcharhinus melanopterus, Carcharhinus sorrah, Rhizoprionodon acutus, Scoliodon lacticaudus*** and ***Sphyrna lewini***. This account encompass a **checklist of pelagic sharks** from the Indian seas, their habitat (distribution), size and biological notes on 49 species belonging to 13 families recorded both in the small-scale fishery and longline fishery sectors in the depth area 50 to 70m and in the oceanic regions respectively. Baseline information follow the taxonomical characteristics described by Fisher & Bianchi (1984), Compagno (1984), Sivasubramaniam (1992) and Anderson and Ahmed (1993). (Table 1, Figures 1-49).

TABLE 1. **A CHECKLIST OF PELAGIC SHARKS IN THE INDIAN SEAS**

Sl.No	Scientific Name	Common Name	Distribution	Max. TL(cm)	Common size(cm)
	Family LAMNIDAE				
1	*Isurus oxyrinchus* Rafinesque, 1810 * *	Shortfin Mako Shark	C, O, P	400	270
	Family CARCHARHINIDAE				
2	*Carcharhinus albimarginatus* (Ruppell, 1837) *	Silvertip Shark	C, P	300	160-199
3	*C. altimus* (Springer, 1950) *	Bignose Shark	O, P	300	240
4	*C. amblyrhynchoides* (Whitley, 1934) *	Graceful Shark	C, P	167	140
5	*C. amblyrhynchos* (Bleeker, 1856) *	Grey Reef Shark	C, P	255	140
6	*C. amboinensis* ((Muller & Henle, 1839) *	Pigeye Shark	C, O, P	280	200
7	*C. brevipinna* (Muller & Henle, 1839) *	Spinner Shark	C, O, P	280	250
8	*C. dussumieri* (Valenciennes, in Muller & Henle,1839) * *	White Cheek Shark	C, O, P	100	65
9	*C. falciformis* (Bibron, in Muller & Henle,1839) *	Silky Shark	C, O, P	350	250
10	*C. hemiodon* (Valenciennes, in Muller & Henle, 1839) * *	Pondicherry Shark	C, P	150	-
11	*C. leucas* (Valenciennes, in Muller & Henle, 1839) *	Bull Shark	C, P	350	260
12	*C. limbatus* (Valenciennes, in Muller & Henle, 1839) * * *	Blacktip Shark	C, O, P	247	150
13	*C. longimanus* (Poey, 1861) *	Oceanic White tip Shark	O, P	350	270
14	*C. macloti* (Muller & Henle, 1839) * *	Hardnose Shark	C, P	below 100	76
15	*C. melanopterus* (Quoy & Gaimard, 1824) * * *	Blacktip Reef Shark	C, P	200	100
16	*C. sealei* (Pietschmann, 1916) *	Black Spot Shark	C, P	95	68
17	*C. sorrah* (Valenciennes, in Muller & Henle, 1839) * * *	Spottail Shark	C, P	160	106-150
18	*Galeocerdo cuvieri* (Peron & LeSueur, in LeSueur,1822) *	Tiger Shark	C, O, P	900	250
19	*Glyphis gangeticus* (Muller & Henle, 1839) *	Ganges Shark	C, P	200	170
20	*Loxodon macrorhinus* Muller & Henle, 1839 * *	Sliteye Shark	C, P	91	79
21	*Prionace glauca* (Linnaeus, 1758) *	Blue Shark	O, P	383	below 335
22	*Rhizoprionodon acutus* (Ruppell, 1837) * * *	Milk Shark	C, P	170	76
23	*R. oligolinx* Springer, 1964 * *	Grey Sharpnose Shark	C, P	70	32
24	*Scoliodon laticaudus* Muller & Henle, 1838 * * *	Spadenose Shark	C, P	74	35
25	*Triaenodon obesus* (Ruppell, 1837) *	Whitetip Reef Shark	C, P	213	105
26	*Lamiopsis temmincki* (Muller & Henle, 1839) * *	Broadfin Shark	C, P	168	130
27	*Negaprion acutidens* (Ruppell, 1837) * *	Sicklefin lemon shark	C, O, P	310	214
	Family SQUALIDAE				
28	*Centroscymnus crepidater* (Bocage & Capello, 1864) *	Longnose velvet dog fish	O, DW	90	60
29	*Squalus mitsukurii* Jordan & Snyder, 1903 *	Shortspine spurdog	O, P	95	60-80

Sl.No.	Scientific Name	Common Name	Distribution	Max. TL(cm)	Common size(cm)
	Family SPHYRNIDAE				
30	*Eusphyra blochii* (Cuvier, 1817) * *	Wingehead Shark	C, P	152	104
31	*Sphyrna lewini* (Cuvier, Griffith & Smith, 1834) * * *	Scalloped Hammerhead Shark	C, O, P	420	360
32	*S. mokarran* (Ruppell, 1837) * *	Great Hammerhead Shark	C, O, P	600	240-365
33	*S. zygaena* (Linnaeus, 1758) *	Smooth Hammerhead Shark	C, P	400	275-335
	Family ALOPIIDAE				
34	*Alopias superciliosus* (Lowe, 1839) *	Bigeye thresher shark	O, DW	470	300-400
35	*A. vulpinus* (Bonnaterre, 1788) *	Thresher Shark	C, O, P	609	430-490
36	*A. pelagicus* Nakamura, 1936 *	Pelagic thresher shark	O, P	330	270
	Family RHINIODONTIDAE				
37	*Rhiniodon typus* Smith, 1828 *	Whale Shark	C, O, P	1800	1200
	Family STEGOSTOMATIDAE				
38	*Stegostoma fasciatum* (Hermann, 1783) *	Zebra Shark	C, P	354	below 270
	Family HEMIGALEIDAE				
39	*Hemipristis elongatus* (Klunzinger, 1871) * *	Snaggle tooth shark	C, O, P	240	below 180
40	*Hemigaleus microstoma* Bleeker, 1852 *	Sicklefin weasel shark	C, P	91	-
41	*Chaenogaleus macrostoma* (Bleeker, 1852) *	Hooktooth shark	C, P	100	-
	Family HEXANCHIDAE				
42	*Heptranchias perlo* (Bonnaterre, 1788) *	Sharpnose sevengill shark	O, DW	137	below 110
	Family TRIAKIDAE				
43	*Iago omanensis* (Norman, 1939) *	Bigeye houndshark	O, DW	58	30-40
	Family ECHINORHINIDAE				
44	*Echinorhinus brucus* (Bonnaterre, 1788) *	Bramble shark	C,O,DW	274	150
	Family SCYLIORHINIDAE				
45	*Atelomycterus marmoratus* (Bennett, 1830) *	Coral catshark	O, BD	70	45-60
46	*Halaelurus hispidus* (Alcock, 1891) *	Bristly catshark	O, BD	29	25
47	*H. quagga* (Alcock, 1899) *	Quagga catshark	C, BD	35	25-30
	Family PSEUDOCARCHARIIDAE				
48	*Pseudocarcharias kamoharai* (Matsubara, 1936) *	Crocodile shark	O, P	110	75-100
	Family PROSCYLLIIDAE				
49	*Eridacnis radcliffei* Smith, 1913 *	Pygmy ribbontail catshark	O, BD	24	15-20

C - Coastal, O - Oceanic, P - Pelagic, BD - Bottom dwelling, DW - Deepwater.

* - Rare, * * - Moderte, * * * - Common

FAMILY : LAMNIDAE

Isurus oxyrinchus rafinesque, 1810

Long spindle-shaped body; acutely pointed snout; pectoral fins moderately long and narrowly tipped; dorsal fins unequal, the first is comparatively large; origin of first dorsal fin over the rear tip of the pectorals; second originates well in front of anal fin; teeth strong and blade-like without cusplets; caudal fin cresentic and secondary keel absent on caudal base. (Fig. 1).

This ovoviviparous shark carries 12-20 embryos. The females mature at about 7 years of age. Gestation period is one year. The nursery areas are in deep tropical waters. The life span estimated at 11.5 years (Pratt and Casey, 1983). They feed on fast moving fishes such as mackerel, swordfishes, tunas and other sharks.

Shortfin mako is a common bycatch in tuna fisheries. They are caught on longlines, probably also with gillnets and hook & lines. This is one of the finest sharks for human consumption and fins are widely marketed.

Source of Fig.1-49 : **FAO Species Identification Sheets for Fishery Purposes (Fisher and Bianchi** 1984)

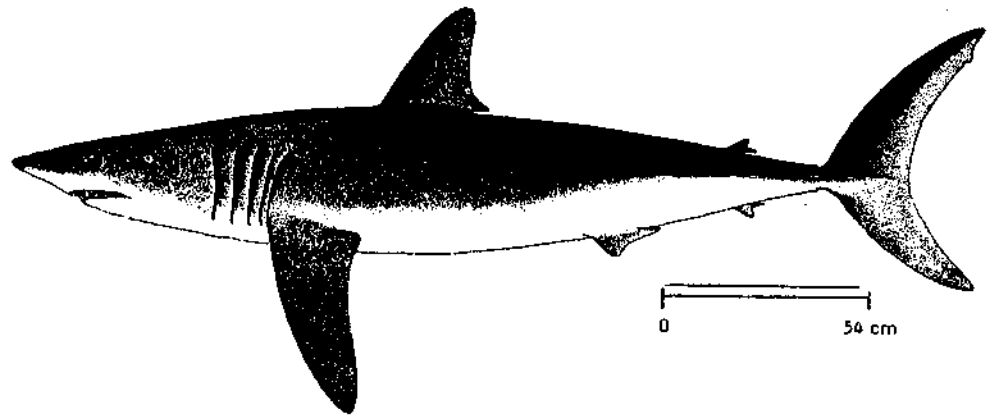


Figure 1. ***Isurus oxyrinchus*** Rafinesque, 1810

FAMILY : CARCHARHINIDAE

Carcharhinus albimarginatus (Ruppell, 1837)

Body large and slender; snout moderately long and broadly parabolic; conspicuous white tips at posterior margins on all fins; black saddles absent on the caudal peduncle; pectoral fin narrow tipped; first dorsal apex narrowly rounded or pointed; dermal ridge present between dorsal fins; teeth with serrated edges, upper teeth broadly triangular and erect in front of mouth. (Fig.2).

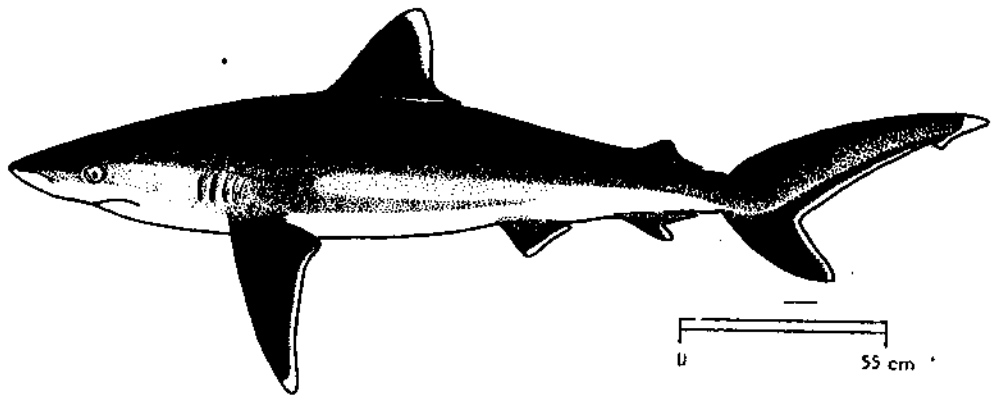


Figure 2. ***Carcharhinus albimarginatus*** (Ruppell, 1837)

Males mature at about 180 cm TL and female at 199cm TL. This viviparous shark carries 1 to 10 embryos; size at birth is about 63-80cm TL. Feed on both bottom and pelagic fishes including rays and octopus.

Usually caught with longlines and gillnets. Widely used for human consumption.

Carcharhinus altimus (Springer, 1950)

Body slender; snout rounded and rather long; anterior nasal flaps expanded as low, with broadly triangular lobes; first dorsal fin moderately high with a narrow rounded apex, its origin over inner margins of pectoral fins; pectoral fins long and not strongly falcate; a high dermal

ridge present between dorsal fins (Fig. 3).

Viviparous; males mature at about 213cm TL and females at about 221cm TL. The number of embryos ranges from 7 to 8 and size at birth probably between 70 and 90cm. They feed mainly on fishes and cephalopods.

These sharks are caught on longlines and with floating gillnets. Their flesh and fins are useful.

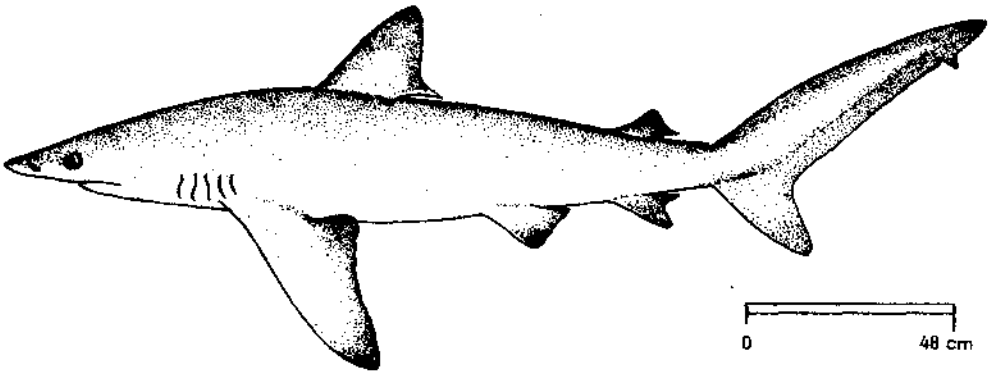


Figure 3. ***Carcharhinus altimus*** (Springer, 1950)

Carcharhinus amblyrhynchoides (Whitley, 1934)

A medium sized shark; snout short and pointed and its length is less than r: outh width; pectoral fins moderately long and falcate, with narrow pointed tips; dermal ridge is absent between dorsal fins; pectoral, dorsal, pelvic and ventral lobe of caudal fin is black or dusky tipped (Fig. 4).

Viviparous with 1 to 6 embryos and size at birth is about 52 to 60cm TL. Males mature at about 108cm TL and females mature at 115cm TL. Food is chiefly fishes.

They are taken on longlines and drift gillnets. Flesh, fin and liver are useful.

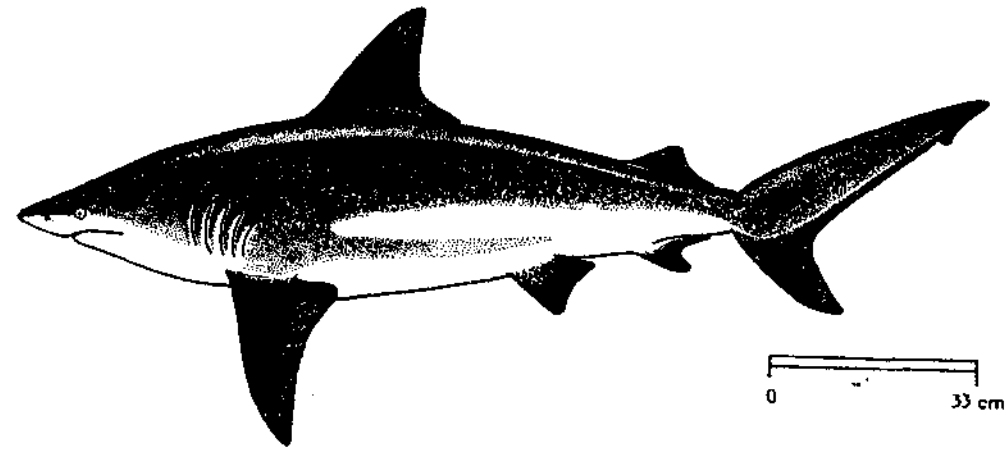


Figure 4. ***Carchrhinus amblyrhynchoides*** (Whitley, 1934)

Carcharhinus amblyrhynchos (Bleeker, 1856)

A medium sized shark; body stout; snout broadly rounded; anterior nasal flaps very low; teeth narrowly triangular, high, moderately narrow and erect-cusped in front of mouth; a weak inter-dorsal ridge present between dorsal fins or no ridge; caudal fin with a conspicuous wide black posterior margin. (Fig. 5).

Viviparous, size at birth about 50 to 60cm, number of young per litter 1 to 6. It is a bottom-feeding shark, eating small reef fishes and octopus.

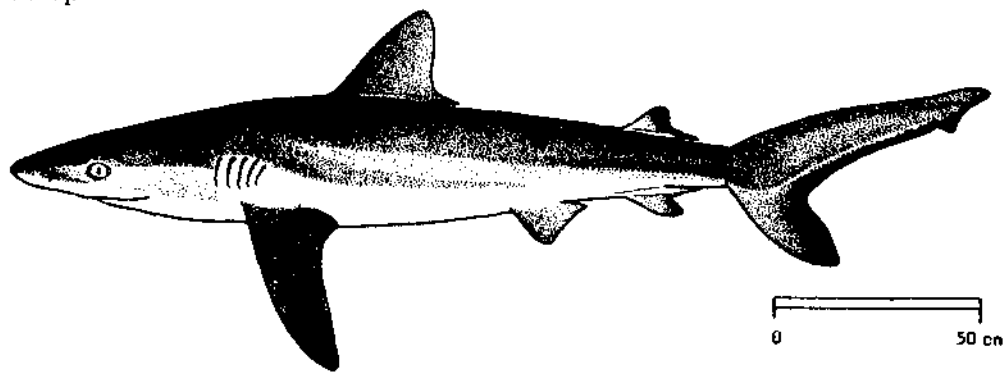


Figure 5. ***Carchrhinus amblyrhynchos*** (Bleeker, 1856)

The grey reef shark forms a major part of catches by bottom set gillnets, bottom set longlines and handlines in the Maldives Islands (Anderson and Ahmed, 1993).

Carcharhinus amboinensis (Muller & Henle, 1839)

A medium sized stout bodied shark with short snout; teeth in upper jaw are triangular with broad serrated cusps; first dorsal fin very high and second dorsal fin very low; large angular pectoral fins; no dermal ridge between dorsal fins. (Fig. 6).

Viviparous, size at birth about 75 cm. Males mature at about 195cm TL and females at about 198 to 223cm. Preys primarily on bottom fishes, small sharks, skates and shrimps.

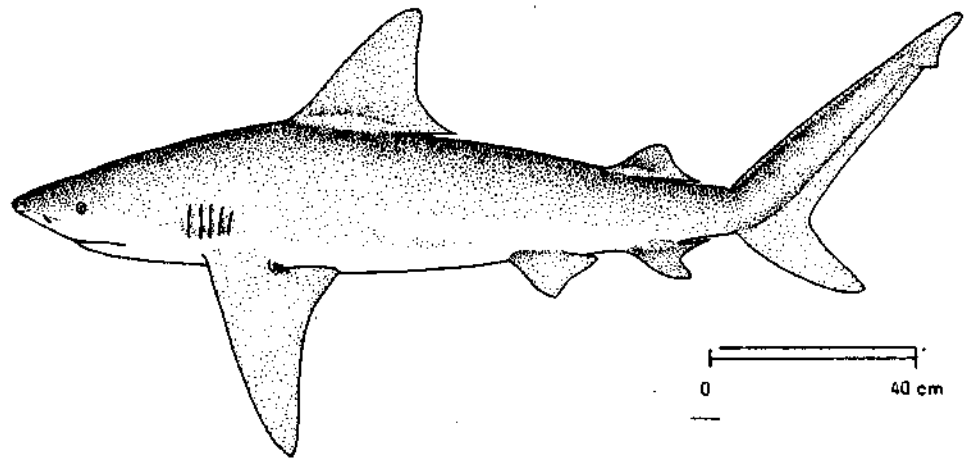


Figure 6. ***Carchrhinus amboinensis*** (Muller & Henle, 1839)

Carcharhinus brevipinna (Muller & Henle, 1839)

A slender bodied medium size shark; snout pointed and long; labial folds short but upper pair longer and more prominent; upper and lower teeth nearly symmetrical and very similar; gill slits relatively long; first dorsal fin with a narrow rounded apex; no dermal ridge between dorsal fins; they are having a conspicuous white band on sides; second dorsal,

anal, undersides of pectorals and lower caudal fin lobe black or dark grey tipped in subadults and adults but not in individuals less than 1m (Fig. 7).

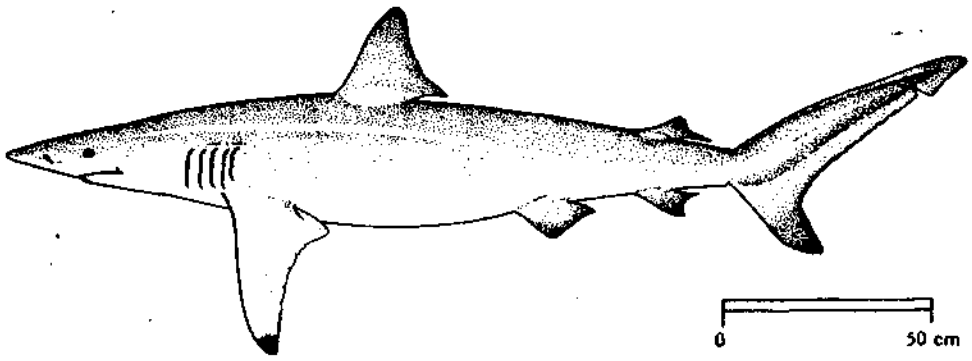


Figure 7. ***Carchrhinus brevipinna*** (Muller & Henle, 1839)

Viviparous, number of embryos is about 6-15. Males mature at 130cm TL or 4 to 5 years, females mature at 150-155cm or 7 to 8 years. The maximum size reported is 280 cm and maximum age may be around 15-20 years. The young are born at 60-75 cm TL (Castro, 1983). It has biennial reproductive cycle and the nursery areas are in shallow coastal waters.

They are migratory species, seen in schools, often leaping out of water while spinning. Feeds on small schooling fishes, squids, small sharks and rays. Flesh is freshly consumed and fins and liver are used in the industry.

Carcharhinus dussumieri (Valenciennes, in Muller & Henle, 1839)

A small grey shark with moderately long, round snout; fairly large eyes; upper teeth with narrow based; strongly oblique cusps and strong serrated cusplets; small semifalcate pectoral fins; small triangular first dorsal with short rear tip; a black spot on the second dorsal fin is the only conspicuous marking. (Fig. 8).

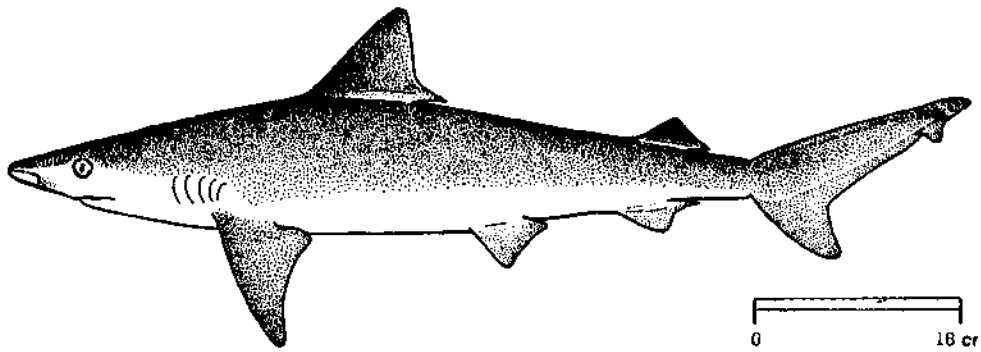


Figure 8. ***Carchrhinus dussumieri*** (Valenciennes, 1839)

Viviparous, number of young 1 to 4, size at birth is about 31 to 40cm. Males mature at 65 to 70cm and females maturing at 70 to 75cm. They eat small fishes and vertebrates.

Caught with drift gillnets and longlines. Utilized fresh for human consumption in India and very common in small-scale fishery.

Carcharhinus falciformis (Bibron, in Muller & Henle, 1839)

A large shark having an elongate and slender body; snout narrowly rounded, moderately long; upper teeth with relatively narrow cusps, well delimited from the heavy, serrated bases, their outer edges notched; the first dorsal origin behind the free rear tips of pectoral fins; latter long and falcate; a dermal ridge present between dorsal fins. (Fig. 9).

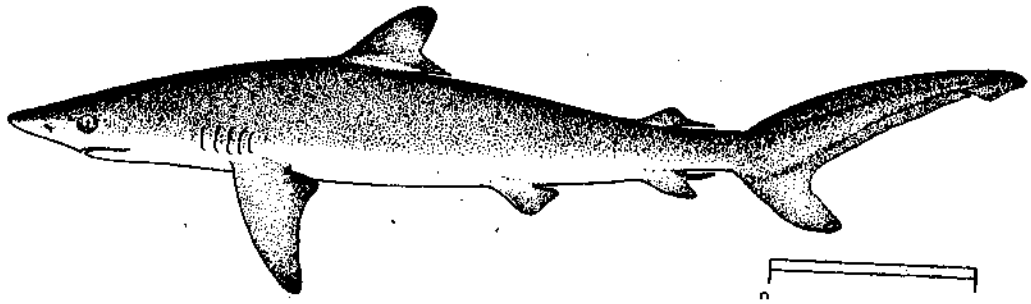


Figure 9. ***Carchrhinus falcifomis*** (Bibron, in Muller & Henle, 1839)

Viviparous, number of young may 6 to 14 per litter, size at birth is 75-80cm TL. Males mature at 225cm (about 10 years) and females mature at 232-245cm TL (more than 12 years). The maximum size is 350cm and life expectancy is about 20-23 years. It feeds on fishes, squids and pelagic octopods.

Caught mainly with floating longlines. This is the most abundant shark caught in tuna fisheries. The life history shows slow growth, late maturation and limited offspring. Hence this species cannot support heavy fishing pressure.

Carcharhinus hemiodon (Valenciennes, in Muller & Henle, 1839)

A small shark, body rather stout; snout moderately pointed and parabolic; anterior nasal flaps with a short, slender, narrow lobe; upper teeth with oblique or semioblique, narrow, unserrated cusps and strong distal cusplets; a dermal ridge present between dorsal fin bases; tips of the pectorals and upper and lower caudal fin lobes black. (Fig. 10).

Presumably viviparous. Diet consists of small fishes, cephalopods and crustaceans.

Caught in bottom-set gillnets. Utilized fresh for human consumption.

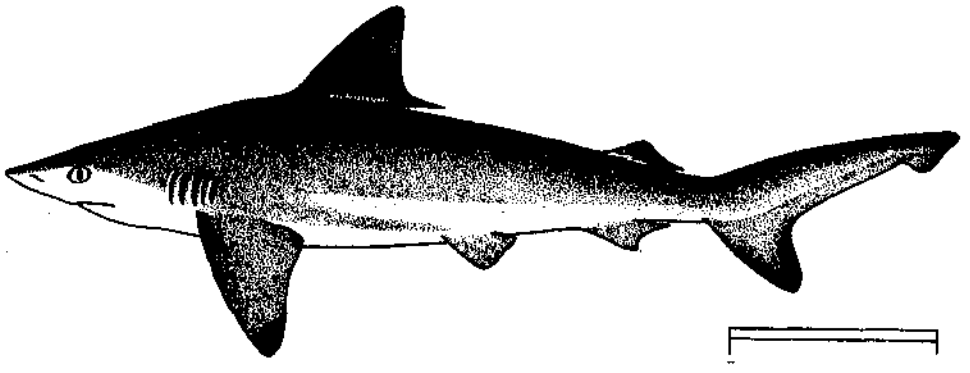


Figure 10. ***Carchrhinus hemiodon*** (Valenciennes 1839)

Carcharhinus leucas (Valenciennes, in Muller & Henle, 1839)

A large stout shark; snout very broadly rounded and extremely short; teeth in upper jaw triangular, with broad heavy serrated cusps; pectoral fin broad, with narrow pointed tips; no dermal ridge between dorsal fins. (Fig. 11).

Oviparous, number of embryos 1-12, size at birth 60-75cm. Males mature at 210-220cm TL (about 14-15 years) and females mature at 225cm TL (18 years). The gestation period is 10-11 months. Feed on fishes including mackerel, tuna, small sharks, rays and invertebrates.

Caught mainly with longliness and gillnets. Dangerous due to its habitat. Flesh and fin useful and liver used for extraction of oil.

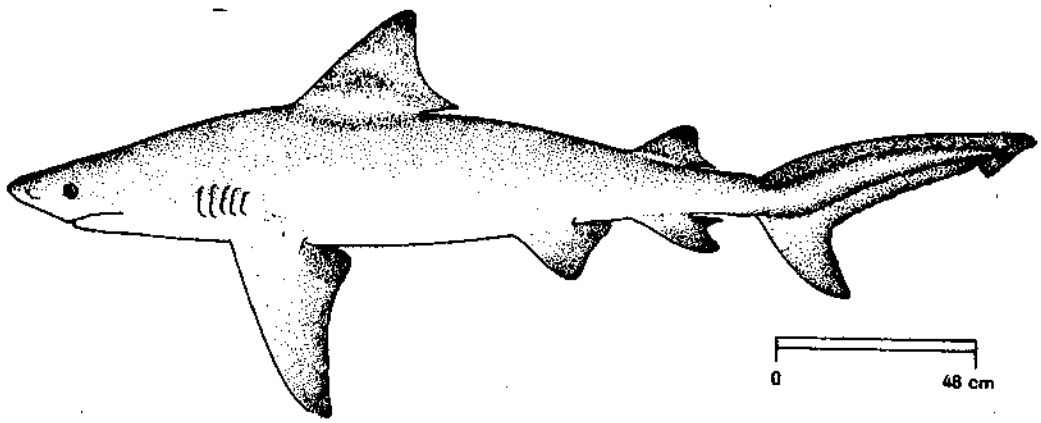


Figure 11. ***Carchrhinus leucas*** (Valenciennes, in Muller & Henle, 1839)

Carcharhinus limbatus (Valenciennes, in Muller & Henle, 1839)

Large fairly stout grey shark with long pointed snout; gill slits moderately long; no inter-dorsal ridge; upper and lower teeth nearly symmetrical and similar, with erect, narrow cusps and serrated edges; moderately large pectoral fins; large first dorsal fins and moderately large second dorsal, both with short rear tips and usually blacktips on most fins (Fig. 12).

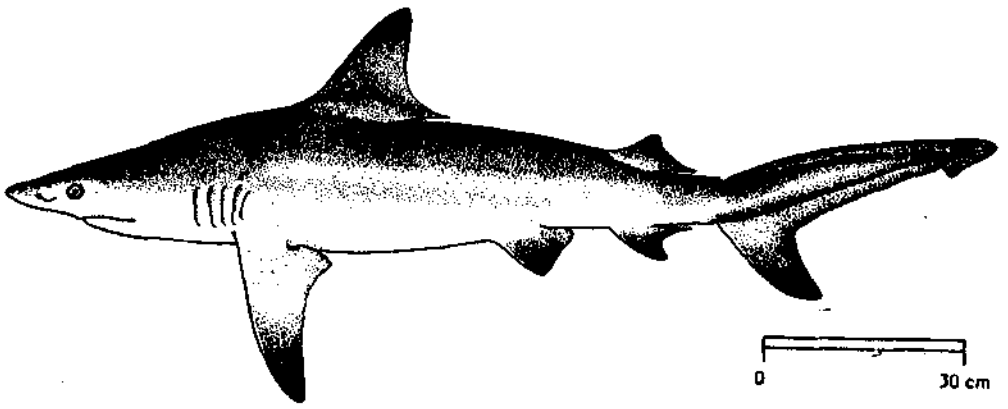


Figure 12. ***Carchrhinus limbatus*** (Valenciennes, inMuller & Henle, 1839)

Males mature between 139-145cm TL and females at about 153-156cm (6-7 years). Estimated maximum age is 10 years. The young are born at 55-60cm TL. Broods range from 1 to 10. The gestation cycle last about one year and the reproductive cycle is biennial. They feed mainly on small schooling fishes and also rays and squids.

They are caught with longlines, floating gillnets and other gears. Flesh, fins and liver are useful.

Carcharhinus longimanus (Poey, 1861)

A large species having short blunt snout; pectoral and first dorsal fins with very broadly rounded apex; pectoral fins very long with broadly rounded, wide tips; fin tips white in adults, also sometimes black markings on fins; a dermal ridge present between dorsal fins (Fig. 13).

Viviparous, number of embryos ranging from 2 to 10, size at birth 65-75 cm. Both males and females mature at about 190cm TL at an age of 4-5 years. The length of gestation period is 10-12 months. The reproductive cycle is believed to be biennial. This shark feeds mainly on fishes and squids, crustaceans, turtles etc.

Oceanic whitetip caught in large numbers as by catch of pelagic

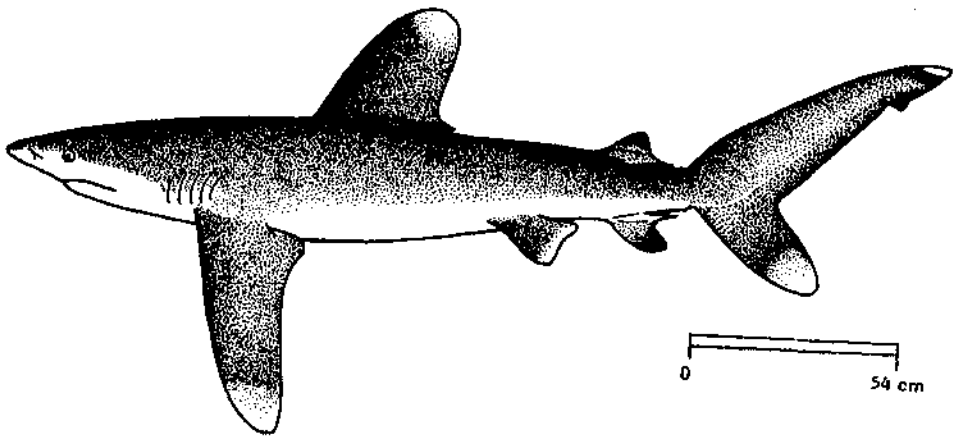


Figure 13. ***Carchrhinus longimanus*** (Poey1861)

tuna fisheries. Caught with floating longliners, also drift gillnets and hand lines. Consumed fresh by human beings, liver processed for oil and fins used in industries.

Carcharhinus macloti (Muller & Henle, 1839)

A shark with relative slender body; snout long and narrowly rounded or pointed; first dorsal fin moderately large with its inner margin greatly elongated; second dorsal fin very low; colour, grayish or grey brown dorsally and white ventrally (Fig. 14).

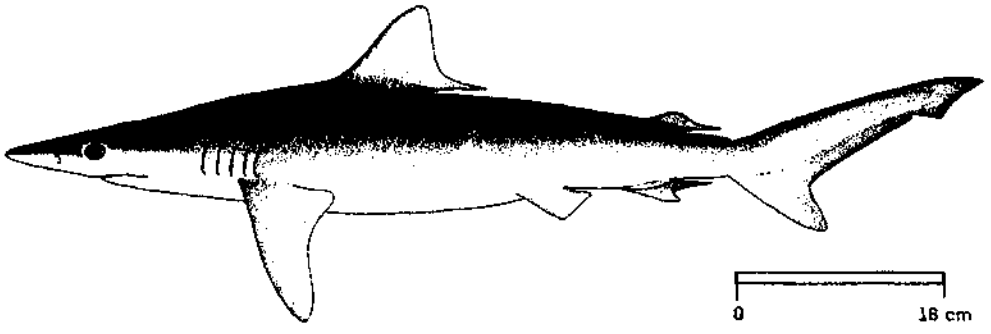


Figure 14. ***Carchrhinus macloti*** (Muller & Henle 1839)

Viviparous, number of embryos 1-2, size at birth 44 to 50cm. Size at maturity for males 69cm TL and the smallest gravid female is 76cm TL. The gestation period lasts 12 months. Feeds on small fishes, cephalopods and crustaceans.

Present in the longline catches. Utilized fresh for human consumption.

Carcharhinus melanopterus (Quoy & Gaimard, 1824)

A small to medium sized shark with bluntly rounded snout; horizontally oval eyes; no inter dorsal ridge; moderately large second dorsal fin; posterior margin of caudal fin with a narrow but obvious black edge; pectoral, second dorsal and caudal fin with clear black tips (Fig. 15).

Viviparous, number of young 2 to 5. Size at birth between 33-52cm. Males mature at 91-100cm TL and females maturing at 96-112cm TL. They eat small bony fishes, octopus and small sharks.

Caught in longlines and gillnets. Their flesh, fins, liver and offal are useful.

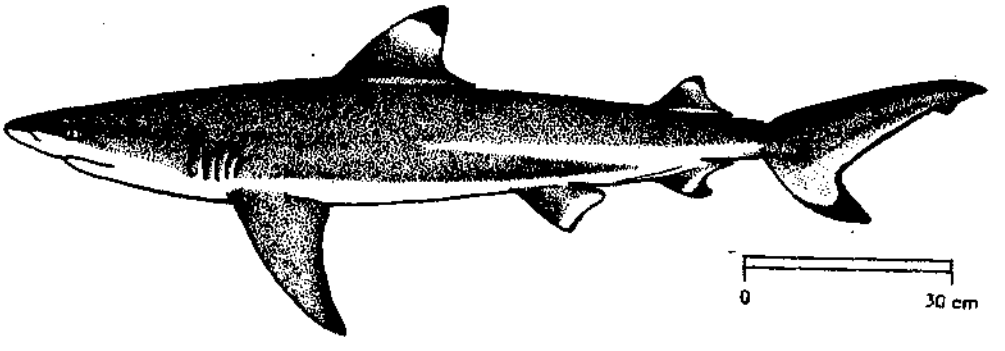


Figure 15. ***Carchrhinus melanoperus*** (Quoy & Gaimard 1824)

Carcharhinus sealei (Pietschmann, 1916)

A small, stout to slender bodied shark; snout rather long and narrowly parabolic or wedge shaped; anterior nasal flaps expanded; teeth

with serrated edges, upper teeth with narrow based, strong oblique serrated cusps and strong cusplets; first dorsal fin moderately high with an angular apex, notched posterior margin and short inner margin strongly falcate; second dorsal fin high; a black spot on the second dorsal fin (Fig. 16).

Viviparous. Maturity reaches at 65 to 75cm TL. Broods consists of 1-2 young, size at birth 33-45cm. Females seems to have a continuous breeding cycle. Feed on small fishes, prawn and squids.

Taken by drift gillnets and hook and line fishery.

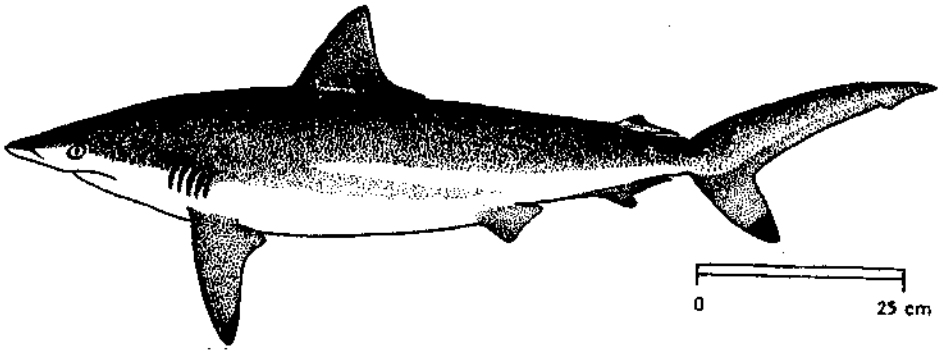


Figure 16. ***Carchrhinus Sealei*** (Pietschmann, 1916)

Carcharhinus sorrah (Valenciennes, in Muller & Henle, 1839)

Spindle shaped shark; moderately long rounded snout; fairly large eyes; oblique-cusped, serrated teeth; with an interdorsal ridge; small pectoral fins; moderately sized first dorsal and small second dorsal, both with long rear tips; conspicuous large tips on the ventral caudal lobe; second dorsal and pectoral fins; a dermal ridge present between dorsal fin bases (Fig. 17).

Viviparous. Males mature at 90cm TL and female mature at about 95cm TL (2-3 years). Broods range from 1 to 8 young and are born at 50-60cm TL. The gestation period is 10 months and reproductive cycle is annual (Stevens and Wiley, 1986). The maximum age recorded is 5 years

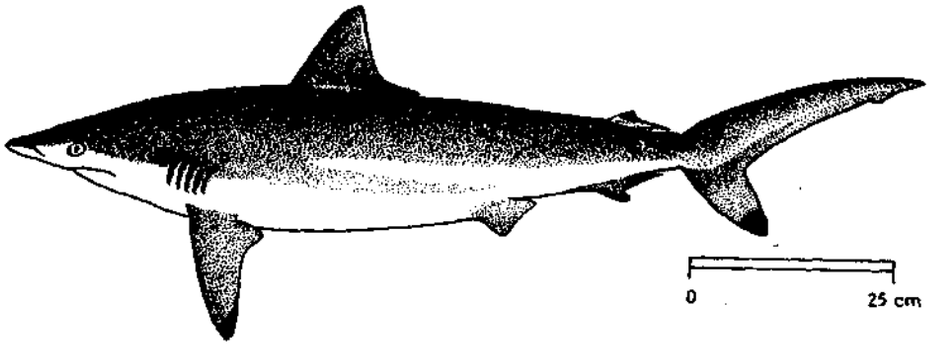


Figure 17. ***Carchrhinus sorrah*** (Valenciennes, 1839)

for males and 7 years for females. They feed on small bony fishes and *Octopus*.

Caught on floating gillnets and longlines. They are preferred in the markets of South India. Utilized fresh for human consumption, fins dried for oriental fin trade, liver processed for oil and offal used to prepare fishmeal.

Galeocerdo cuvieri (Peron & LeSueur, in LeSueur, 1822)

Its characteristic tiger like markings and unique teeth make it easy to identify; big headed; short and blunt snouted species with slender body behind pectoral fins; long upper labial furrows reaching the eyes; teeth coarsely serrated, their outer edges deeply notched and the tips directed obliquely outward; caudal fin with pointed tip; a low rounded keel on each side of caudal peduncle (Fig. 18).

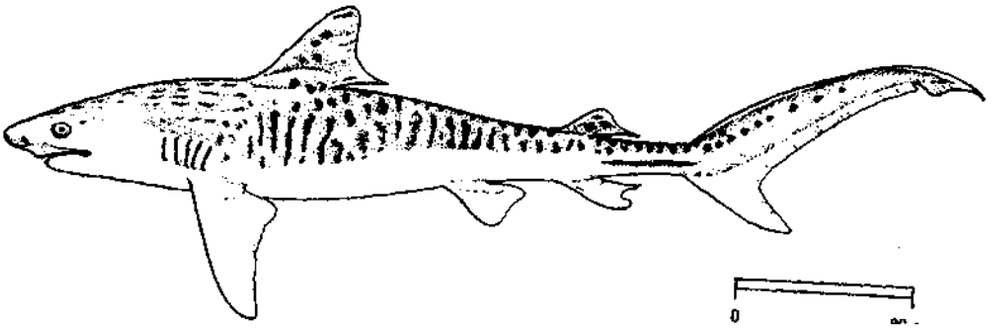


Figure 18. ***Galeocerdo cuvieri*** (Peron & LeSueur, in LeSueur, 1822)

Ovoviviparous and with 10 young in a litter. Size at birth 68-85cm TL. They mature at about 290cm TL (Castro, 1983). Males mature in 7 years and females mature in 8 years. A voracious predator, feeding on all kinds of fish, marine mammals, crabs, squids, sea snakes, sea birds, turtles etc.

Caught in floating and bottom gillnets and with line gear, including pelagic longlines. Utilized fresh and dried-salted for human consumption, liver and offal are taken for oil and fishmeal.

Glyphis gangeticus (Muller & Henle, 1839)

Body moderately stout; snout short; its length about equal to distance between nostrils and less then mouth width; teeth in upper jaw triangular, with broad high serrated cusps; cusps of lower teeth narrow, tall and errect and strongly hooked, conspicuously protruding when mouth closed; upper pre-caudal pit in the form of a shallow, longitudinal depression on the dorsal surface of the caudal peduncle (Fig. 19).

They are viviparous, size at birth probably about 60cm with a prominent umbilical scal.

Gear and forms of utilization is little known.

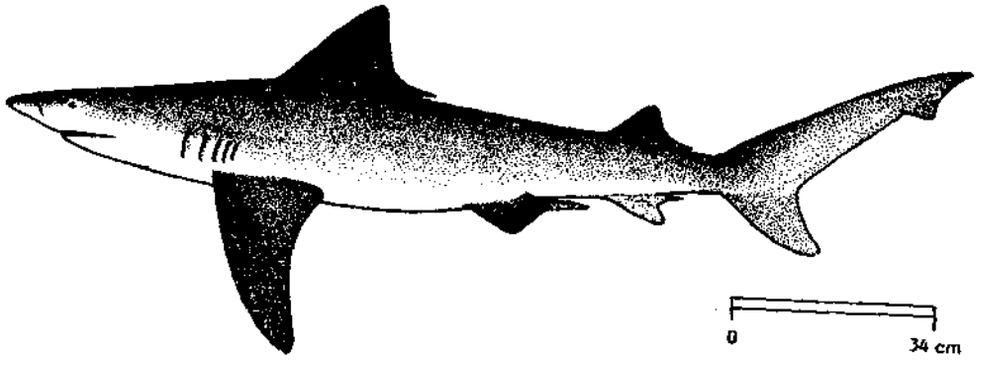


Figure 19. ***Glyphis gangeticus*** (Muller & Henle, 1839)

Loxodon macrorhinus Muller & Henle, 1839

A small, very slender shark; snout very long, parabolic in shape; its length greater than mouth width; labial furrows very short; eyes large with a posterior notch; teeth in both jaws with low cusps and no cusplets; first dorsal fin and pectoral fin are small; anal fin with a slightly concave posterior margin and long preanal ridges (Fig. 20).

They mature at 73-85cm. Viviparous, broods usually having two young and size at birth is 42-43cm TL. This harmless shark feeds on small fishes and crustaceans.

Caught in floating and bottom set gillnets and with line gear including pelagic longlines. Consumed by human beings as fresh.

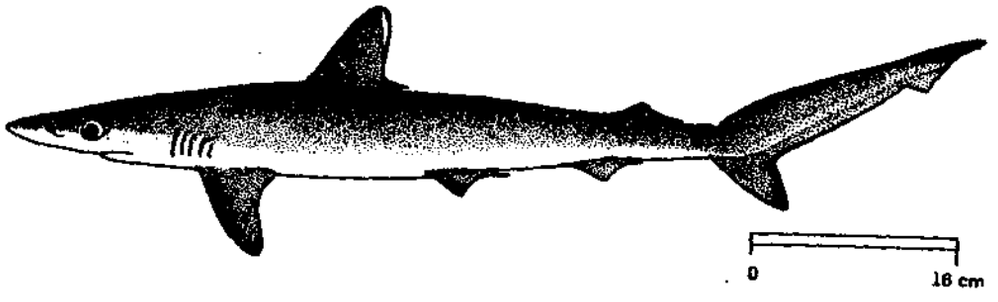


Figure 20. ***Loxodon macrorhinus*** (Muller & Henle, 1839)

Prionace glauca (Linnaeus, 1758)

A slender fusiform shark; snout long; large eyes; long narrow pointed pectoral fins; first dorsal fin close to pelvic base than pectorals; weak keel is present on sides of caudal peduncle; a narrow lobed caudal fin with long ventral lobe. Dark blue color on dorsal side, bright blue on sides and white on the undersides (Fig. 21).

Viviparous, number of embryos range from 1-63 and size at birth at 34-48cm TL. Females mature between 166 and 191cm TL and males at 160-191cm TL. The gestation period last for a year. They feed on bony fishes, small sharks, squids, pelagic crustaceans etc.

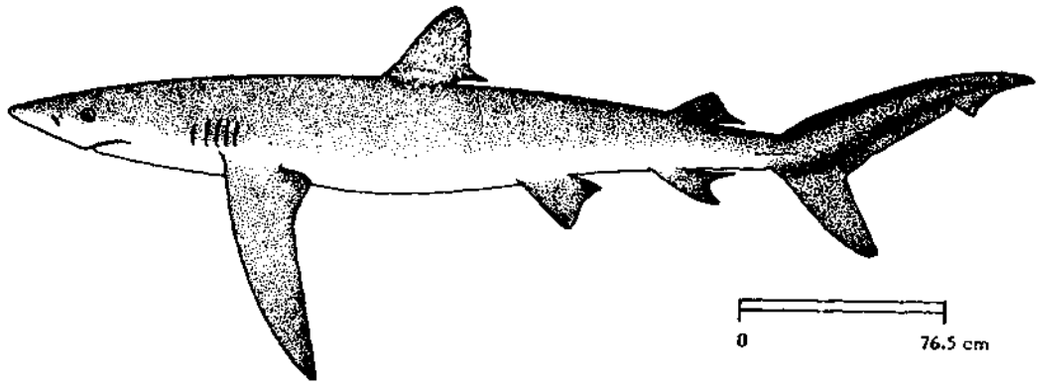


Figure 21. ***Prionace glauca*** (Linnaeus, 1758)

They are caught mainly with pelagic longlines.

Rhizoprionodon acutus (Ruppell, 1837)

A small slender shark; long upper and lower labial furrows; prenarial snout, 4 to 5% of total length; first dorsal origin usually over or slightly in front of pectoral rear tips.; grey-brown or purplish brown colour above, pale below; pectoral fins with a light margin. (Fig.22).

Viviparous, with 2 to 8 fetuses in a litter. Mature at 68 to 72cm TL. Gestation period is about a year. Size at birth is about 30-35cm.

Taken by drift gillnets and longline.

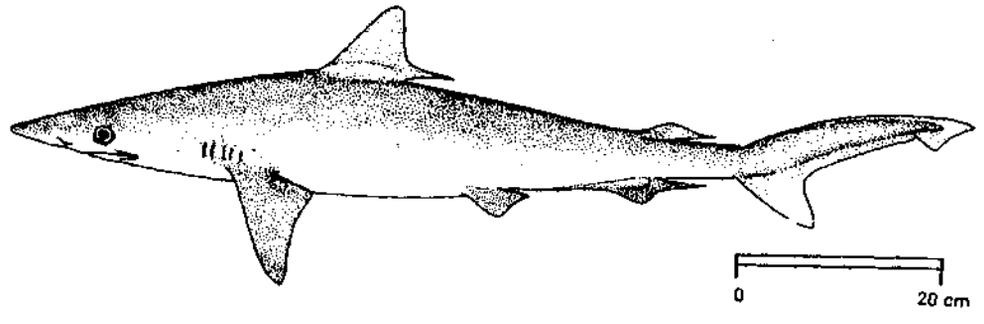


Figure 22. ***Rhizoprionodon acutus*** (Ruppell, 1837)

Rhizoprionodon oligolinx Springer, 1964

A small slender shark; snout long and depressed; eyes without a posterior notch, no spiracles; teeth similar in both jaws and narrow cusped without cusplets; second dorsal fin smaller than anal fin; anal fin with slightly concave posterior margin and a pair of long preanal ridges (Fig. 23)..

Male mature at 38cm TL. Viviparous, size at birth is about 21-26cm. Feeds on small fishes and vertebrates.

Caught with floating and bottom gillnets and line gear.

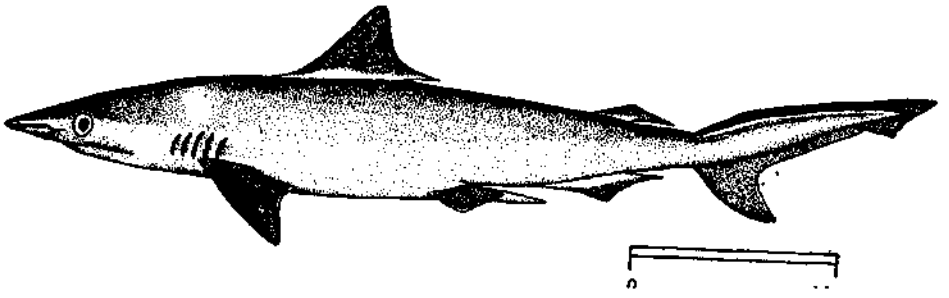


Figure 23. ***Rhizoprionodon oligolinx*** (Springer, 1964)

Scoliodon laticaudus Muller & Henle, 1838

Body small moderately stout; very long flat laterally expanded spade like snout; small eyes; short and broad triangular pectoral fins; the first dorsal origin well behind the anal origin; anal fin larger than second dorsal; caudal fin not deeply notched. Bronzy grey color above and white below (Fig. 24).

Viviparous, number of young 5 to 14, size at birth is about 13 to 15 cm. They feed on shrimps, cuttlefishes and small schooling fishes.

Spade nose sharks are caught with line gear, including floating longlines and surface and bottom gillnets. Utilized for human consumption and offal for fishmeal.

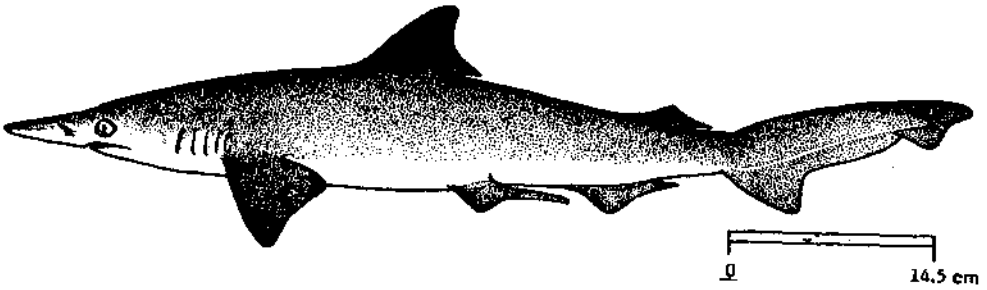


Figure 24. ***Scoliodon laticaudus*** (Muller & Henle, 1838)

Triaenodon obesus (Ruppell, 1837)

Small to medium sized shark; snout very short, broadly rounded, its length much less than mouth width; anterior nasal flaps with a short, truncate, prominent lobe formed into a partial tube; teeth with cusps and cusplets without serrations; first dorsal and dorsal caudal lobe with conspicuous white tip. (Fig. 25).

Viviparous, number of young 1 to 5 in a litter. Size at birth about 52-60cm. This common shark feeds on reef fishes, octopus, lobsters and crabs.

Caught in gillnets and line gear. Utilized fresh.

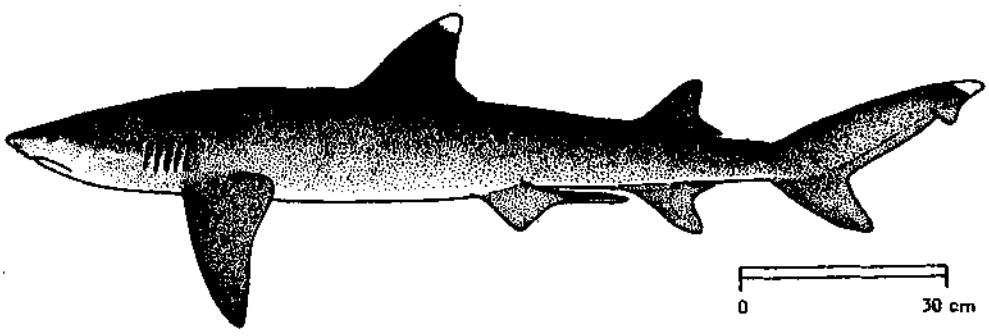


Figure 25. ***Triaendon obesus*** (Ruppell, 1837)

Lamiopsis temmincki (Muller Henle, 1839)

Body moderately stout; snout moderately long, parabolic in shape; anterior nasal flaps with a short, broad lobe; pectoral moderately long, basally very broad; anal fin with posterior margin slightly concave; dermal ridge between two dorsal fins; keel on caudal peduncle absent (Fig. 26).

Viviparous, grow upto 168cm TL.

Caught in bottom and floating gillnets and line gear. Flesh and liver are useful.

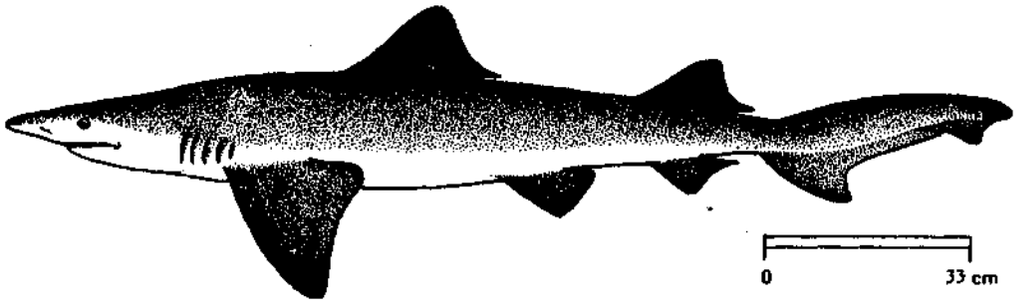


Figure 26. ***Lamiopsis temmincki*** (Muller & Henle, 1839)

Negaprion acutidens (Ruppell, 1837)

A large stout shark; snout short and broad, rounded or obtusely wedge shaped; teeth narrow, their cusps smooth edged; second dorsal fin nearly as large as the first; no dermal ridge between dorsal fins (Fig. 27).

Viviparous, having 12 or 13 young in a litter. Size at birth is about 70 to 80cm. Maturing at about 214cm TL.

Caught in floating and bottom gillnets and in line gear. Fins of this species are considered the best for soup. Flesh is used fresh or dried salted and liver and offal are also used.

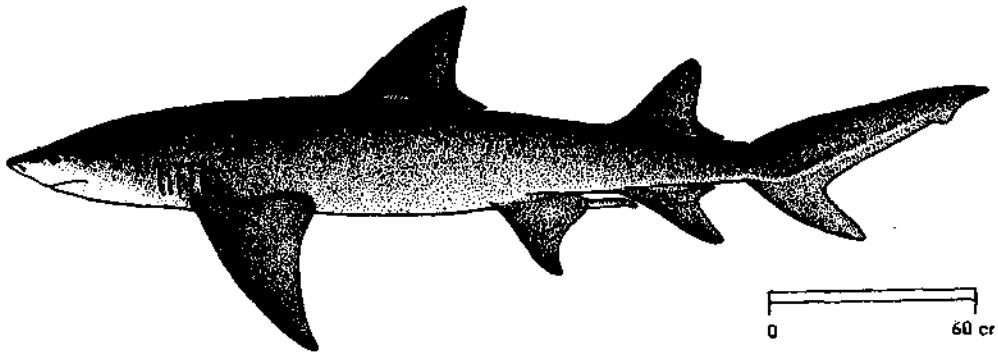


Figure 27. ***Negaprion acutidens*** (Ruppel 1837)

FAMILY : SQUALIDAE

Centroscymnus crepidater (Bocage & Capello, 1864)

Ovoviviparous, number of fetuses four. Females mature at 82cm. Other characters are largely unknown (Fig. 28).

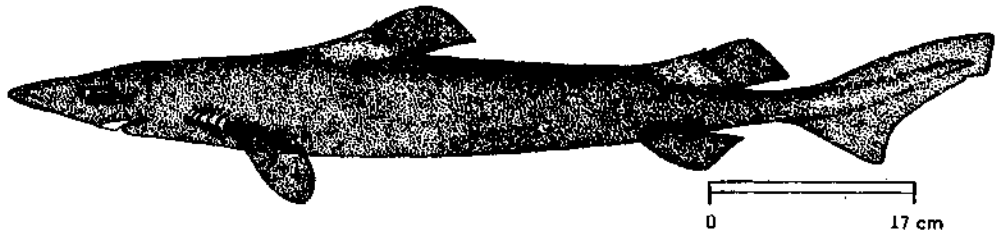


Figure 28. ***Centroscymnus crepidater*** (Bocage & Capello, 1864)

Squalus mitsukurii Jordan & Snyder, 1903

Body moderately elongated and fusiform; denticles of back with broad crown and 3 cusps in adults; nostrils with elongated anterior flaps having short accessory lobes on their medial edges; a strong, moderately long ungrooved spine on both dorsal fins; pectoral fins rather broad, their inner corners narrowly rounded and their posterior margins nearly straight; caudal peduncle with a low lateral keel on each side. (Fig. 29).

Ovoviviparous, number of fetuses 4 to 9, size at birth 22 to 26cm.

Feed on bony fishes, cephalopods and crustaceans.

Caught in bottom trawls.

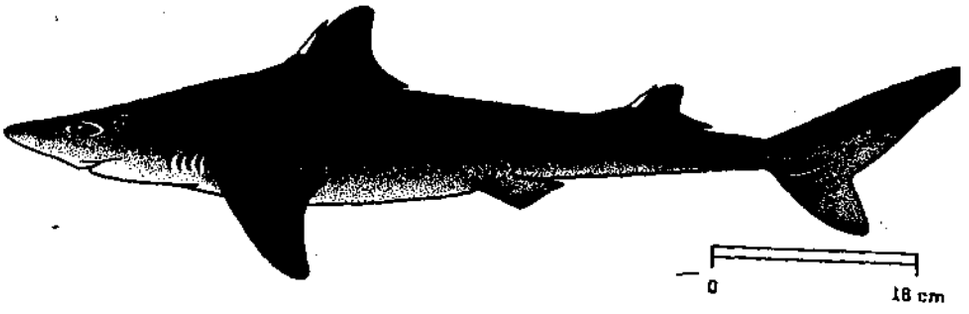


Figure 29. ***Squalus mitsukurii*** Jordan & Snyder, 1903

FAMILY : SPHYRNIDAE

Eusphyra blochii (Cuvier, 1817)

Body elongate and compressed; head shaped like a broad arrowhead or a pair of aircraft wings in dorsal and ventral view; a shallow, but distinct indentation at the midline of head and very broad, shallow indentation opposite to each nostril; nostrils are greatly elongated, wider than mouth; first dorsal fin very high, strongly falcate (Fig. 30).

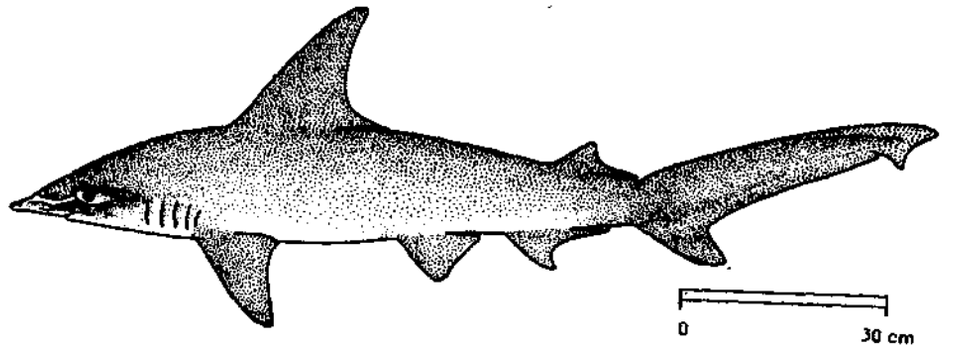


Figure 30. ***Eusphyra blochii*** (Cuvier, 1817)

Viviparous, litter from 6 to 25 size at birth about 35-50cm TL. Gestation period is about 10-11 months and the reproductive cycle is annual. Feed on small fishes, crustaceans and cephalopods.

Caught in gillnets, longlines and hook & lines. Utilized fresh for human consumption, liver yield high protein, vitamin, oil and offal used for fishmeal.

Sphyrna lewini (Cuvier, Griffith & Smith, 1834)

Body elongate and laterally compressed; head 'hammer shaped', its anterior contour broadly arched in young, but moderately in adults, with a shallow but distinct indentation at the midline; nostrils with strong prenarial grooves anteromedial to their incurrent aperture; pelvic with a nearly straight posterior margin. (Fig. 31).

Viviparous, and broods consist of 15-31 young; size at birth is 38-50cm TL. Males mature at 140-165cm TL and females at 2000cm TL. The reproductive cycle is annual and gestation period is 9-10 months. The nurseries are in shallow coastal waters. Feeds on pelagic fishes, other sharks, rays, squids, shrimps, crabs etc.

Caught in floating and bottom gillnets, floating longlines and hook and lines. Utilized fresh and dried-salted for human consumption. Fins and livers are also useful.

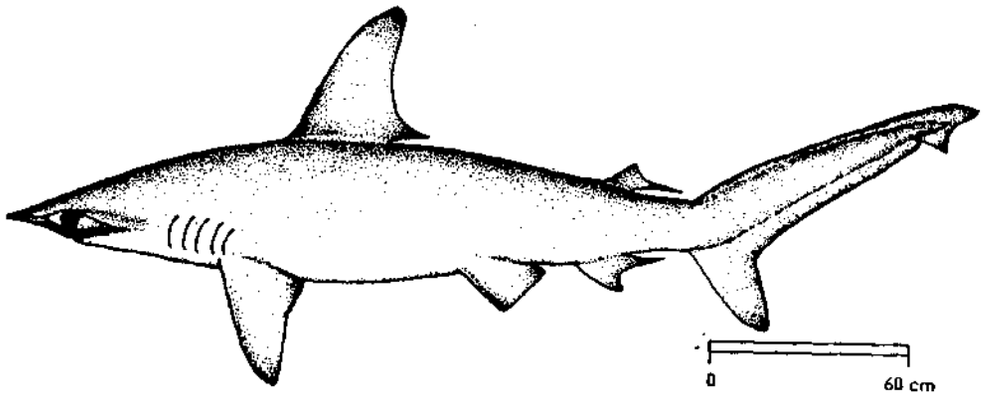


Figure 31. ***Sphyrna lewini*** (Cuvier, Griffith & Smith, 1834)

Sphyrna mokarran (Ruppell, 1837)

Body elongated and laterally compressed; head hammer shaped, its anterior contour moderately arched in young but nearly straight in adults; nostrils with weak prenarial grooves; posterior margins of eyes well anterior to mouth; teeth triangular with strongly serrated edges; pelvic with a deeply concave posterior margin (Fig. 32).

Viviparous with yolk-sac placenta. Number of young 20-40 and size at birth is 60-70cm TL. The gestation period last about 11 months. Reproductive cycle is biennial. Its fin has very high demand in the market.

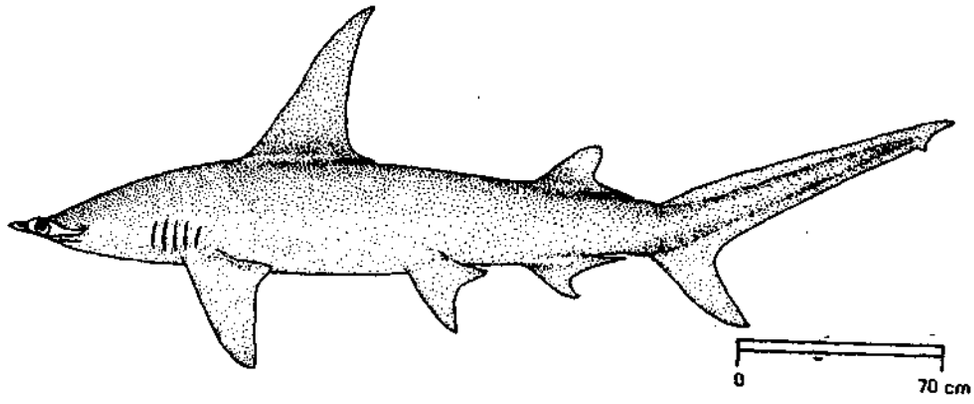


Figure 32. ***Sphyrna mokarran*** (Ruppel, 1837)

Sphyrna zygaena (Linnaeus, 1758)

Body elongated and laterally compressed; head hammer shaped, its anterior contour strongly arched in young and moderately rounded in adults; nostrils with strong prenarial grooves; teeth with smooth edges; first dorsal fin high and moderately falcate, second small with a very long inner margin (Fig. 33).

Viviparous, litter from 29-37 fetuses, size at birth about 50-60cm. Feed on bony fishes, other sharks, rays and cephalopods.

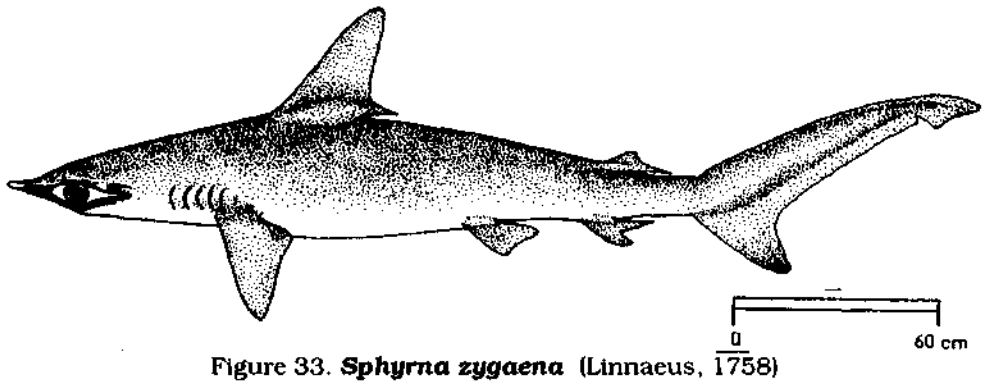


Figure 33. ***Sphyrna zygaena*** (Linnaeus, 1758)

Caught with pelagic longliness and gillnets. Utilized fresh and dried-salted for consumption, liver oil for vitamin extraction, fins for oriental fin trade and offal for fishmeal.

FAMILY : ALOPIIDAE

Alopias superciliosus (Lowe, 1839)

A large shark; head with 5 medium sized gill slits, the last two above pectoral fin bases; a deep horizontal groove on nape on each side; snout moderately long and conical; eyes large, expanding on to dorsal surface of head; long curving asymmetrical caudal fin; first dorsal locate just in front of the pelvic fin origins (Fig. 34).

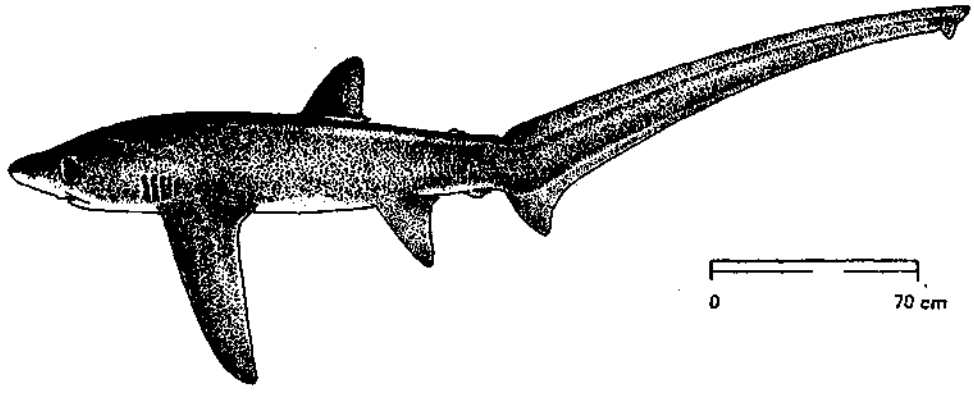


Figure 34. ***Alopias superciliosus*** (Lowe, 1839)

Ovoviviparous, usually with only two youngs, size at birth 100-140cm TL. Males mature at 270-288cm TL and female at 332-341cm TL. It feeds on squids and small schooling fishes, which it stuns with blows from its tail.

Taken by pelagic longlines.

Alopias vulpinus (Bonnaterre, 1788)

A large shark, which grow between 500 to 600cm TL; head with five medium sized gill slits and last two above pectoral fin bases; grooves absent on nape, without gill rackers; snout short and conical; eyes moderate, not expanding unto the dorsal surface of head; pectoral fins very long and about larger than rest of the shark; a white area extends from the abdomen over pectoral fin bases (Fig. 35).

Ovoviviparous, broods consist of 4 to 6 youngs, which measure 137-155 cm TL at birth. Gestation lasts for 9 months. Feed mostly on small schooling fishes.

Taken by pelagic longlines.

Figure 35. ***Alopias vulpinus*** (Bonnaterre, 1788)

Alopias pelagicus Nakamura, 1936

A large shark; head with 5 medium sized gill slits, the last two above pectoral fin bases; forehead nearly straight in lateral view, broadly arched between eyes; snout moderately long and conical; pectoral fins narrow, long and nearly straight broad tipped and not falcate; upper lobe of caudal fin very long and strap like, about as long as rest of the shark; lower lobe short and strong; a white colour from belly not expanded over pectoral fin bases (Fig. 36).

Ovoviviparous, with two youngs born at a length greater than 96cm. They feed on small fishes and pelagic invertebrates.

Pelagic threshers are caught in tuna longlines.

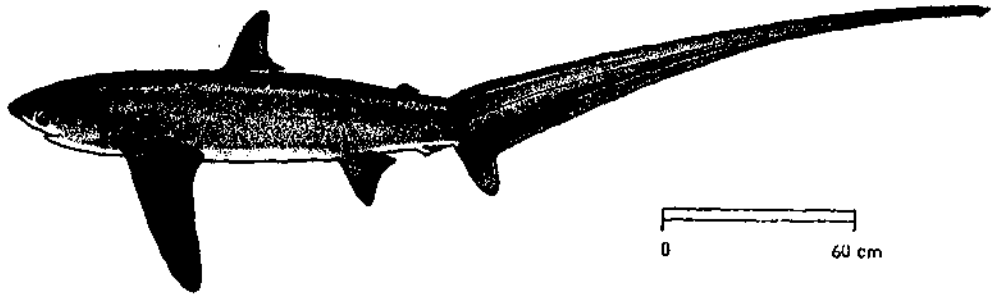


Figure 36. ***Alopias pelagicus*** (Nakamura, 1936)

FAMILY : RHINIODONTIDAE

Rhiniodon typus Smith, 1828

One of the largest sharks; head with five large gill silts, posterior three over the pectoral fin bases; snout extremely short, truncated; nostrils with short quadrate anterior nasal flaps, minute barbles and shallow nasoral grooves; teeth very small and numerous; caudal fin asymmetrical and cresentic with a strong lower lobe; caudal peduncle depressed with a strong keel on each side; having white or yellow spots and transverse stripes on body (Fig. 37).

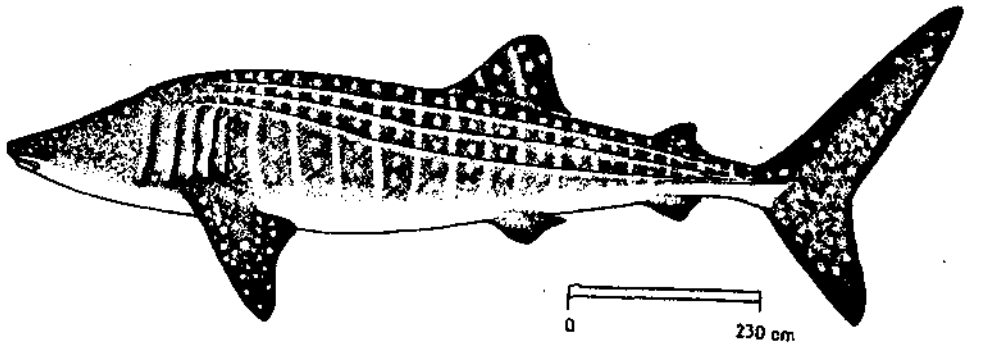


Figure 37. ***Rhiniodon typus*** Smith, 1828

Oviparous, deposit huge eggs in large football sized cases, eggs hatch when the young are over 35cm long. They feed on small pelagic crustaceans, schooling fishes and squids.

They are captured in floating gillnets and sometimes in trawls. Whale shark are utilized dried-salted for human consumption, fins are valuable and oil is also extracted.

FAMILY : STEGOSTOMATIDAE

Stegostoma fasciatum (Hermann, 1783)

A large shark,; body cylindrical with prominent ridges on sides; broad low caudal fin as long as the rest of the shark; nasoral grooves and barbels present; small transverse mouth in front of the lateral eyes; two spineless dorsal fins and an anal fin, banded or spotted colour pattern (Fig. 38).

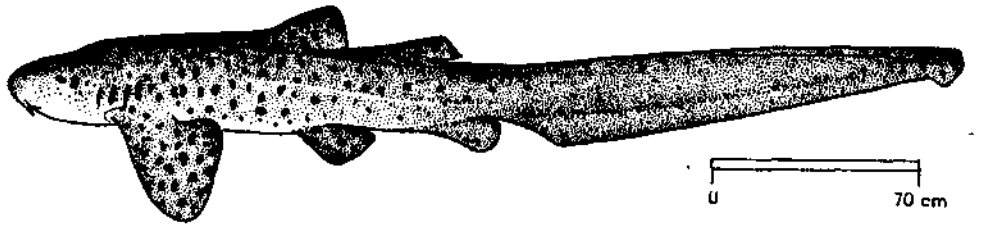


Figure 38. ***Stegostoma fasciatum*** (Hermann, 1783)

Oviparous, depositing eggs in rounded, oblong egg cases 10 to 17cm long. Size at hatching is between 20 and 36cm. Feeds on molluscs and small fishes.

Caught by longliners.

FAMILY : HEMIGALEIDAE

Hemipristis elongatus (Klunzinger, 1871)

A medium sized shark; body moderately slender; snout long, bluntly rounded at tip; labial furrows moderately long and easily seen; mouth long and semiparabolic, with a truncated lower symphysis; teeth distally curved, broad and oblique cusps, prominent distal cusplets serrations; pectoral and pelvic fins strongly falcate. Grey or grey brown colour above, lighter below, without prominent markings (Fig. 39).

Viviparous, number of young 6 to 8 per litter. Size at birth about 45cm. Feeds on inshore pelagics and bottom fishes, other sharks, rays.

Caught with floating and fixed bottom gillnets and floating longlines. Flesh, fin, liver and offal are taken from this snaggletooth shark for commercial use.

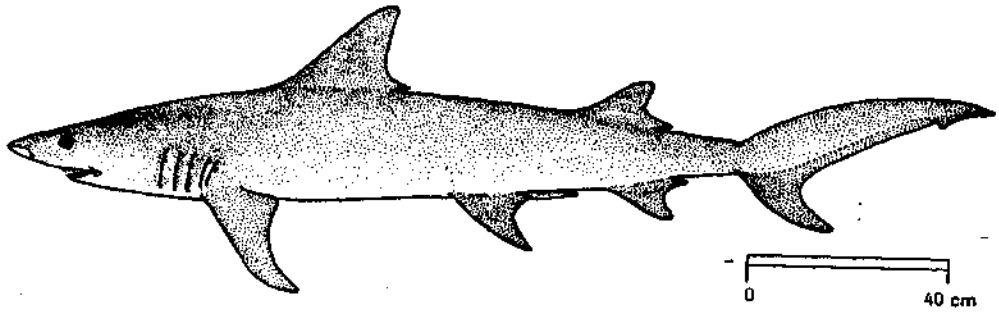


Figure 39. ***Hemipristis elongatus*** (Klunzinger, 1871)

Hemigaleus microstoma Bleeker, 1852

Long snout, its length somewhat greater than mouth width; labial furrows moderately long and easily seen; mouth very short and broadly arched; spiracles present and small; gill openings short; pectoral and pelvic fins strongly falcate; anal fin slightly smaller than second dorsal fin, without long preanal ridges (Fig. 40).

Viviparous, two foetuses in a litter, grow to a maximum length of at least 91cm. Feed on small fishes and cephalopods.

Caught with floating and bottom gillnets, longlines and hook and lines. Utilized fresh for human consumption and offal used for fishmeal.

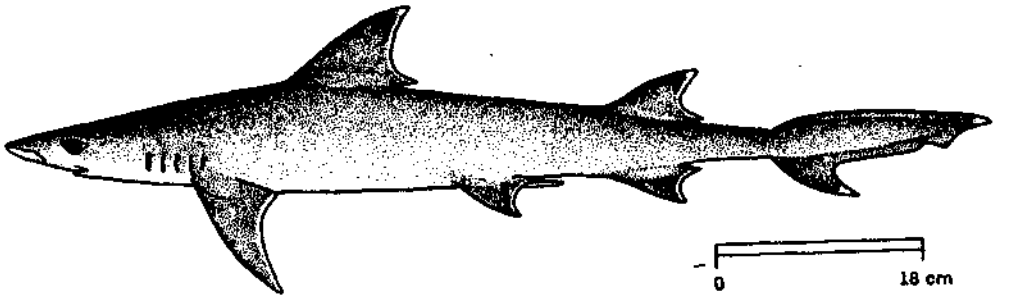


Figure 40. ***Hemigaleus microstoma*** (Bleeker, 1852)

Chaenogaleus macrostoma (Bleeker, 1852)

Body moderately slender; snout long, its length slightly greater than mouth's width, obtusely wedge-shaped towards tip; labial furrows moderately long; mouth long and parabolic, spiracles small; gill slits very long, the longest over twice the eye length; teeth in lower jaw with arched roots and long, hooked, slender, mostly erect cusps that prominently protrude when mouth is closed; anal fin slightly smaller than second dorsal fin without long preanal ridges (Fig. 41).

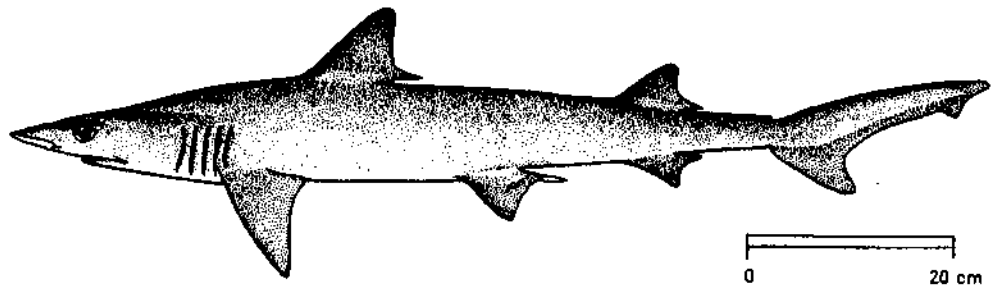


Figure 41. ***Chaenogaleus macrostoma*** (Bleeker, 1852)

Viviparous, number of young 4, size at birth 20cm. They eat small fishes and vertebrates.

Caught in drift and bottom gillnets and on longlines. Flesh and offal are useful.

FAMILY : HEXANCHIDAE

Heptranchias perlo (Bonnaterre, 1788)

A small slender shark with 7 gill slits; head and snout very narrow; eyes very large; single dorsal fin, separated from origin of caudal fin by over twice its base length; a shorter caudal fin lobe in adults (Fig. 42).

Ovoviviparous, number of youngs 9 to 20, size at birth 25cm TL. Maturity is reached at about 85-90cm TL.

They are usually caught in bottom trawls.

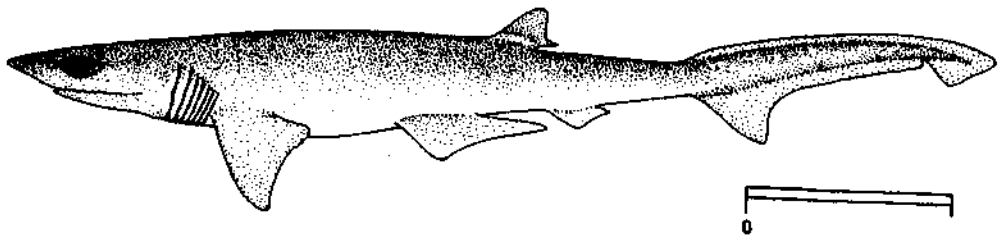


Figure 42. ***Heptranchias perlo*** (Bonnaterre, 1788)

FAMILY : TRIAKIDAE

Iago omanensis (Norman, 1939)

A small, slender shark with a stout, humpbacked trunk; nostrils with small nasal flaps; nasal grooves absent; eyes horizontally oval on sides of the head; teeth small, compressed, blade like, lateral teeth with short oblique cusps but without cusplets; caudal fin with lower lobe hardly indicated (Fig. 43).

They are viviparous, with a yolk-sac placenta. Males mature between 30 to 36cm, females mature at 40 to 45cm. They feed on small fishes and crustaceans.

They are caught on floating gillnets from Indian Ocean.

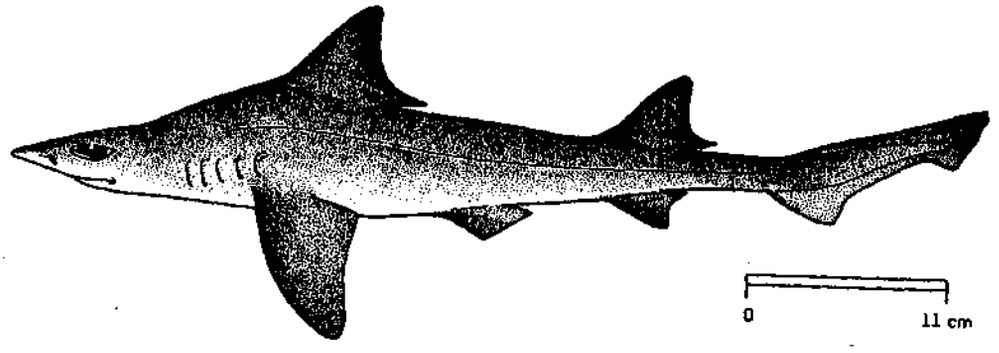


Figure 43.**Iago *omanensis*** (Norman, 1939)

FAMILY : ECHINORHINIDAE

Echinorhinus brucus (Bonnaterre, 1788)

A medium sized, heavy bodied shark with very large plate—like denticles scattered sparsely over the body and armed with one or more thorn like cusps; first dorsal fin originating over or posterior to pelvic fin origins; pelvic much larger than second dorsal; anal fin absent; caudal

fin strongly asymmetrical without well developed lower lobe (Fig. 44).

Ovoviviparous usually produces 52 embryos. Size at birth 40cm. Feeds on small fishes, other sharks and crabs.

They are usually caught in bottom trawls. Flesh used for medicinal purpose in South Africa. Offal and liver are useful.

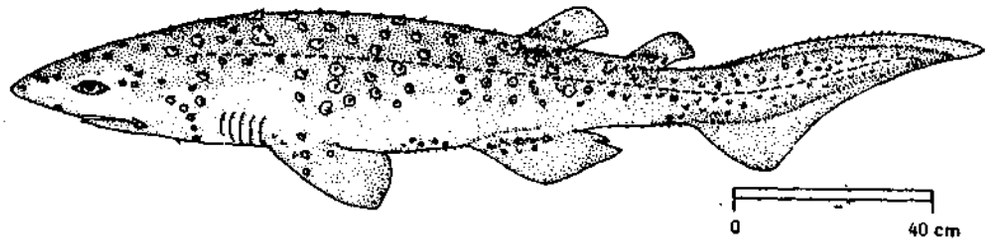


Figure 44. ***Echinorhinus brucus*** (Bonnaterre, 1788)

FAMILY : SCYLIORHINIDAE

Atelomycterus marmoratus (Bennett, 1830)

A small shark; body slender; head narrow; nostrils without barbels, with greatly enlarged anterior nasal flaps; shallow nasal grooves between nostrils and mouth but no prenasal grooves; labial furrows present on both jaws; first dorsal fin about as large as second, originating over pelvic fin mid-bases; caudal fin short, asymmetrical with a sub-terminal notch but with no lower lobe (Fig. 45).

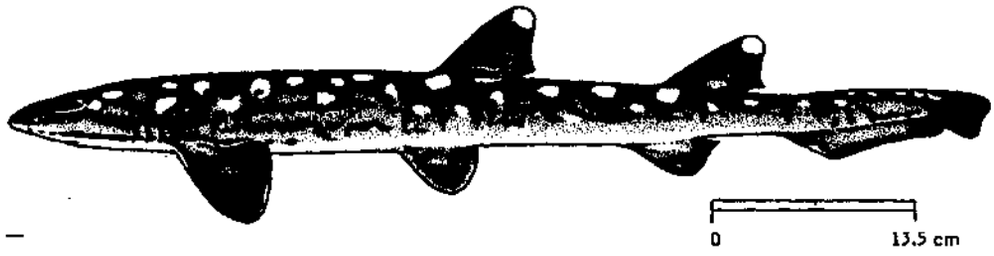


Figure 45. ***Atelomycterus marmoratus*** (Bennett, 1830)

Oviparous, grow about 70cm.

Caught with line gear and gillnets. Utilized fresh and dried salted and processed for oil and fishmeal.

Halaelurus hispidus (Alcock, 1891)

A small species with rounded snout; long abdomen and short anal base; snout-tip knoblike, broadly parabolic; anterior nasal flaps subtriangular; labial furrows rather short; mouth moderately large; first dorsal origin over last third of pelvic bases, second dorsal slightly smaller than first, its origin over or slightly in front of anal midbase. Colour pale brown or whitish (Fig. 46).

Adult males 24-26cm, adult females about 22 to 29cm. Other reproductive characters are unknown.

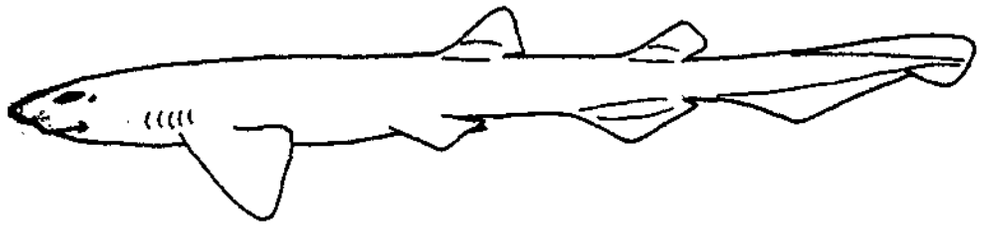


Figure 46. ***Halaelurus hispidus*** (Alcock, 1891)

Halaelurus quagga (Alcock, 1899)

Snout tip pointed; eyes in adults 12 to 13 times in distances from snout to first dorsal origin; anterior nasal flaps subtriangular; labial furrows rather short; mouth moderately large; first dorsal origin about opposite or slightly behind anal insertion; abdomen short in adults; colour light brown above, lighter below, with over 20 dark brown narrow vertical bars (Fig. 47).

Adult males 28-35cm and size at hatching about 8 cm.

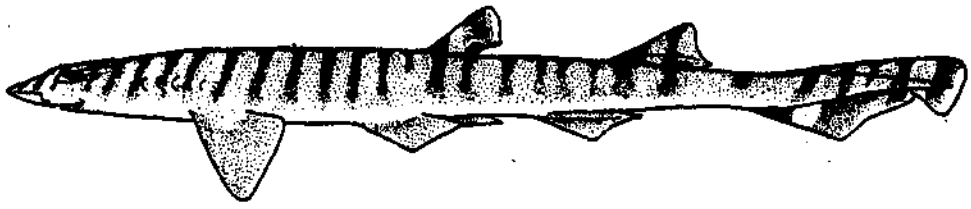


Figure 47. ***Halaelurus quagga*** (Alcock, 1899)

FAMILY : PSEUDOCARCHARIIDAE

Pseudocarcharias kamoharai (Matsubara, 1936)

Small and relatively slender shark; head with 5 large gill slits all in front of pectoral fin bases; no gill rackers; eyes very large without nictitating eyelids; mouth very long and angular, extending well behind eyes; caudal fin short, strongly asymmetrical with a pronounced subterminal notch and a short ventral lobe (Fig. 48).

Ovoviviparous, with litters of 4 young, size at birth between 41 and 51cm. Feed on small oceanic fishes and squids. Jaws can be protruded to a considerable distance forward from mouth.

Caught in pelagic longlines.

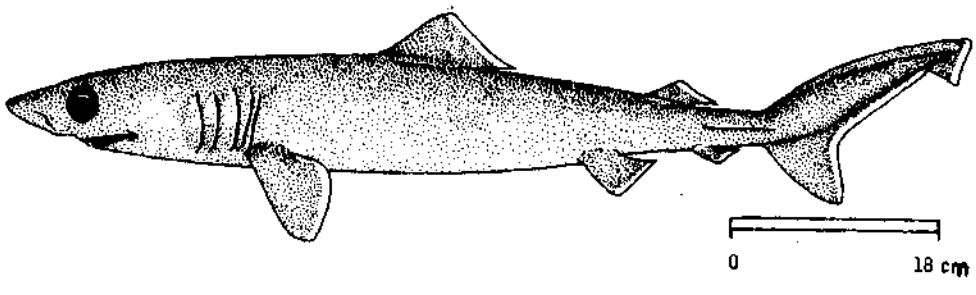


Figure48. ***Pseudocarcharias kamoharai*** (Matsubara, 1936)

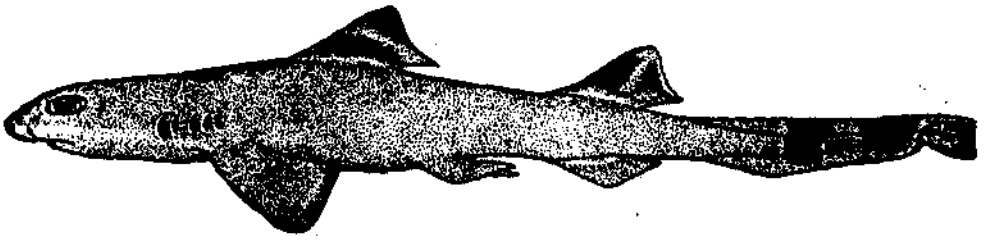
FAMILY : PROSCYLLIIDAE

Eridacnis radcliffei Smith, 1913

Shark having two equal-sized spineless dorsal fins, first dorsal fin over abdomen and slightly closer to pelvic fins than pectorals; nictitating eyelids; a triangular mouth; a narrow ribbon like caudal fin with prominent dark bandings; dark markings on dorsal fins and brown colouration (Fig. 49).

Ovoviparous, number of young 1 or 2 in a litter. Size at birth is about 10 to 11cm length. Females mature at small size of 16.6cm TL and males at 18 to 19cm TL. Feed on small bony fishes and crustaceans.

Caught usually by bottom trawls.



CHAPTER III

STATUS OF EXPLOITATION OF PELAGIC SHARKS IN THE EEZ OF INDIA

A. Artisanal Fishery Sector And Mechanised Fishery Sector

The annual average landing of elasmobranchs (sharks, skates and rays) during 1987-1999 was 61,591 t, which constitute about 2.7% of the total marine fish landings in India. The share of sharks in the total elasmobranch landings during this period are presented in Figs. 50 &51. The composition of sharks fluctuated between 49.2% (1990) to 71.5% (1992) and in 1999, 62.9% of the elasmobranchs landed was constituted by sharks.

The average catch of sharks during the period 1987-1999 in the small-scale fisheries sector was 41, 483 t and ranged between 24, 920 t (1990) and 47, 279 t (1998). Though a harvestable potential of 1,68,000 t of elasmobranchs has been estimated from the EEZ of India (**Ministry of Agriculture, Government of India, 1991**), they are not fully exploited as evident from the average production of elasmobranches (61, 591 t) and that of sharks (41,483 t). However the production indicated an increasing trend, and sharks constitute about 1.8% of the total marine fish landings in India during recent years Fig.52.

A study of the distribution of fishery for pelagic sharks indicate that about 69% of the sharks landed are from the west coast of India. Zonewise percentage composition of landings of sharks during 1987-1999 indicates that the NW coast contributed 54.3%, SW coast 11.7%, SE coast 25.2% NE coast 7.1%, A & N 1.3% and Lakshadweep 0.5% of the total catch (Fig. 53). *Scoliodon laticaudatus* is the dominant species along the Gujarat and Maharashtra coasts followed by *Carcharhinus* spp.,

Rhizoprionodon spp. and the tiger shark along with other minor groups forming the rest of the catch (Hanfee, 1999). Along the SW coast (Kerala, Karnataka and Goa) the grey shark (*Carcharhinus* spp.) formed the major catch followed by the hammerhead sharks (*Sphyrna lewini* and *S. mokarran*) and other *Carcharhinus* spp. On the east coast the grey sharks contribute about 58.9% of the shark landings followed by the hammerheads, *Rhizoprionodon* spp., tiger shark and other species.

On an average, Gujarat contributed 16,589 t (40%) followed by Maharashtra 7,302 t (17.6%), Tamil Nadu 5,120 t (12.3 %), Andra Pradesh 4,708 t (11.3 %), Kerala 2,852 t (6.9 %), Orissa 1,487 t (3.6%), West Bengal 1,279 t (3.1%), Karnataka 1,082 t (2.6%), Andamans 622 t (1.5%), Goa 186 t (0.4%), Lakshadweep 189 t (0.5%) and Pondicherry 68 t (0.2%) (Figs. 54, 55).

The fishing gears and crafts discussed below are general for all fisheries. Prior to 1960's, the shore seines, boat seines, gill nets etc. were employed in the exploitation of sharks, which landed mostly small sharks such as *S. lacticaudus* and *C. indicus* and young of hammerhead sharks. Troll, longline fishing and drift gillnets landed mostly larger sharks such as *Carcharhinus* spp., *Galeocerdo cuvieri* and seasonally the whale shark. With the introduction of motorisation of the country crafts and mechanised trawlers during the 60's and 70's the fishing pattern for sharks changed and the trawlers landed more small sized shark. Presently the sharks are caught with hook and line, gill nets and trawls. An improved version of hooks on longliners using mechanised gears has proved effective in capturing larger fishes including sharks. Gillnets with large mesh size more than 45 mm and upto 500 mm and a total length range between 500 m and 2500 m with a depth of 3 to 15 m are used to capture large pelagics including sharks.

Average gear-wise landing of pelagic shark during the period 1991-1995 (Devaraj *et al.* 1997) is depicted in Figure 56. The trawl net contributed 65.25%, drift gillnet 32.17%, purse seine 2.20% and ring seine 0.37% of the total shark landings. However from 1985, the catch by different gears used for shark landings where drift gill nets (48.5%), mechanised trawlers 31.5%, hook and line 2.1%, dol net 2.5% and the remaining by shore seines, purse seine and boat seines.

Shark fishery in different states is multispecies, and no species is dominant throughout the coasts of India, neither a single species, nor a group of species synoptically dominates in different states. Some regions are excessively exploited and some are totally unexploited. *Scoliodon* spp. dominates the fishery in the Gujarat and Bombay regions and grey sharks and hammerhead sharks dominate the catch in Kerala and Karnataka states. The whale shark (*Rhiniodon typus*) has become the target fishery at Veraval on the Gujarat coast and *Carcharhinus* spp. are targeted and fished for their liver and fins. As stated earlier Gujarat contributed over 50% of the total elasmobranch catch from the west coast and Maharashtra and Gujarat share about 78% of the pelagic shark catch on the west coast and 53% of the all India landings of the sharks. The east coast contributed about 36% in the total sharks caught, Tamil Nadu and Andra Pradesh together accounted for 76% of the total pelagic sharks landed along the east coast and 26% of the total pelagic sharks caught in the Indian coastal waters.

Seasonality in the availability of pelagic sharks indicates that along the Gujarat and Maharashtra coasts, large concentrations of the adults and juveniles of *S. lacticaudus* are recorded in the benthic area during the period when forage items are abundant in the bottom waters. Adults of *Scoliodon* spp. feed on pelagics while juveniles prefer crabs, squilla and small prawns as forage. The adults of these species are taken by drift gillnets and juveniles by bottom trawlers. Along the SW Coast (Kerala and Karnataka), pelagic shark fishery is at its peak when shoals of oil sardine and mackerel occur at the surface.

The trend of landings of sharks presented in Figs. 57,58,59,60&61 indicate that the same in Gujarat, Tamil Nadu and Andra Pradesh are on the increase from 1987 to 1999 whereas a decreasing trend was noticed in Maharashtra and Kerala.

B. Exploratory Fishing

There has been no organised industrial fishing for pelagic sharks till today although the catches of tuna longline vessels from the offshore and oceanic waters include *Carcharhinus melanopterus, C. limbatus, C. plumbeus, Alopias vulpinus, A. pelagicus, Isurus glaucus, Isurus oxyrhincus*

and *Sphyrna zygaena* (Hanfee, 1999).

Study of the results of the exploratory surveys by the Government of India tuna longlines indicate that the pelagic sharks constitute 42% of the total longline catch in the Arabian sea, 32% in Bay of Bengal, 43% in the Andaman sea and 31% in equatorial areas. An atlas of tunas, billfishes and sharks in the Indian EEZ and adjacent oceanic regions based on the results of tuna longline surveys by FSI during October 1983 to March 1988 in the area lat. 0°-16°N and long. 67°-96°E was published by Sudarsan *et al.* (1998). According to them, the species that occurred in the longline catches are *Carcharhinus albimarginatus, Carcharhinus dussumieri, Carcharhinus limbatus, Carcharhinus longimanus, Carcharhinus malcoti, Carcharhinus melanopterus, Carcharhinus sorrah, Galeocerdo cuvieri, Prionace glauca, Rhizoprionodon acutus, Scoliodon lacticaudus, Stegostoma fasciatum, Alopias spp. Isurus oxyrhincus* and *Sphyrna spp.* The shark catch (Hook Rate %) during the above surveys is presented in Fig.62. Relatively high areas of concentration of pelagic shark were recorded by them in the offshore regions of the west coast and Lakshadweep area, southern oceanic region, middle part of SE coast and in the A & N sea. The quarterly distributions of hooking rate in the long line fishery during the surveys conducted during 1983-88 are presented in figures 63, 64, 65 and 66 (Sudarsan *et al.* 1988).

The shark catches (HR %) during the exploratory surveys by the FSI vessels employing tuna longline and shark long line in the NW coast, SE coast, A & N waters and NE coast during the period 1993-1999 are presented in Table 2. Along the NW Coast (15°N-23°N) the productive months were January, June, September and December. Along the SE Coast (10°N-16°N) November and February were the periods of maximum catch. In the A & N area (5°N-15°N) April-August and November were productive for shark fishing and in the NE coast (15°N-20°N) December and January were the months when high hooking rates were observed. However a critical analyses and evaluation of the results of the exploratory surveys and operations of chartered longline vessels would provide a clear picture regarding the productive areas, seasons and species composition of pelagic sharks in the EEZ of India and contiguous high seas.

Table 2: Shark Catch (HR%) by FSI vessels during 1993-99

Vessel	Area	Month	Effort (No.of Hooks	Shark Catch (HR %)	Percentage
YELLOWFIN (Tuna longline)	NW Coast (15°N - 23°N)	4/93	7350	0.41	
		9/3	3250	0.15	
		10/93	3680	0.46	
		3/94	8405	0.26	
		4/94	7875	0.39	
		5/94	8325	0.42	
		8/94	6300	0.06	
		9/94	6300	0.48	
		10/94	7905	0.43	
		1/95	2400	0.67	
		2/95	7550	0.85	
		3/95	7500	0.12	
		4/96	5625	0.23	
		8/96	6250	0.30	
		9/96	9375	0.79	
		10/96	7500	0.19	
		11/96	6125	0.10	31.4%
		12/96	8750	0.60	
		1/97	9750	1.01	
		2/97	4250	0.05	
		3/97	10000	0.17	
		4/97	3000	0.47	
		5/97	5500	0.14	
		6/97	3250	0.58	
		7/97	5200	0.10	
		8/97	7875	0.29	
		9/97	9375	0.48	34.40%
		10/97	8625	0.21	
		11/97	8125	0.21	
		12/97	9375	0.26	
		1/98	6910	0.74	
		2/98	8750	0.44	
		3/98	9250	0.25	
MATSYA HARINI (Shark Longline)	SE Coast (10°N-16°N)	4/93	3500	0.23	
		10/94	4000	0.13	
		4/96	2010	0.10	
		5/96	2255	0.04	
		6/96	880	Nil	15.80%
		8/96	1020	Nil	
		11/96	350	0.86	
		6/97	1600	0.13	
		8/97	3400	0.15	
		2/98	1530	0.46	
		4/98	2140	0.05	
		7/98	1805	0.11	
		9/98	3035	0.43	
		11/98	200	-	
		1/99	4430	0.18	
		3/99	2455	0.08	

Vessel	Area		Month	Effort (No.of Hooks	Shark Catch (HR %)	Percentage
BLUE MARLIN (Tuna Longline)	A & N Waters	(5°N-15°N)	4/93	6875	1.21	
			10/93	9375	0.20	
			11/93	9250	2.64	
			12/93	9450	1.75	
			1/94	9375	1.30	
			2/94	9375	1.50	
			3/94	8820	2.16	
			5/94	7710	0.88	
			6/94	9185	1.33	
			7/94	7595	1.04	
			8/94	9375	1.22	
			9/94	5625	0.52	
			10/94	9375	2.95	
			11/94	9375	2.92	
			12/94	8000	1.51	
			2/95	625	1.76	
			3/95	8750	1.61	
			4/96	7375	0.52	
			5/96	8125	0.23	
			6/96	8125	0.26	
			8/96	9375	0.28	
			9/96	3500	0.30	
			10/96	4875	0.33	
			11/96	8625	0.65	
			3/97	5625	0.23	
			4/97	1250	0.24	
			5/97	7275	0.32	
			6/97	4700	0.34	
			7/97	1200	1.08	
			8/97	5550	0.47	
			11/97	2945	0.13	
			2/98	8125	0.17	
			3/98	7500	0.18	
	NE Coast	(15°N-20°N	12/96	6250	0.14	
			1/97	5000	0.44	
			12/97	6975	0.40	
			1/98	6875	0.20	
		(5°N-15°N)	4/98	5000	0.20	
			5/98	3750	0.29	
			6/98	3375	0.18	
			7/98	7375	0.66	
			8/98	7500	0.19	
			9/98	6450	0.14	
			10/98	2275	0.22	
			11/98	4675	0.84	
			12/98	6875	0.39	
			3/99	8750	0.34	

Source: FSI Annual Reports (1993-1999)

Figure 50. **Share of sharks in total elasmobranch**

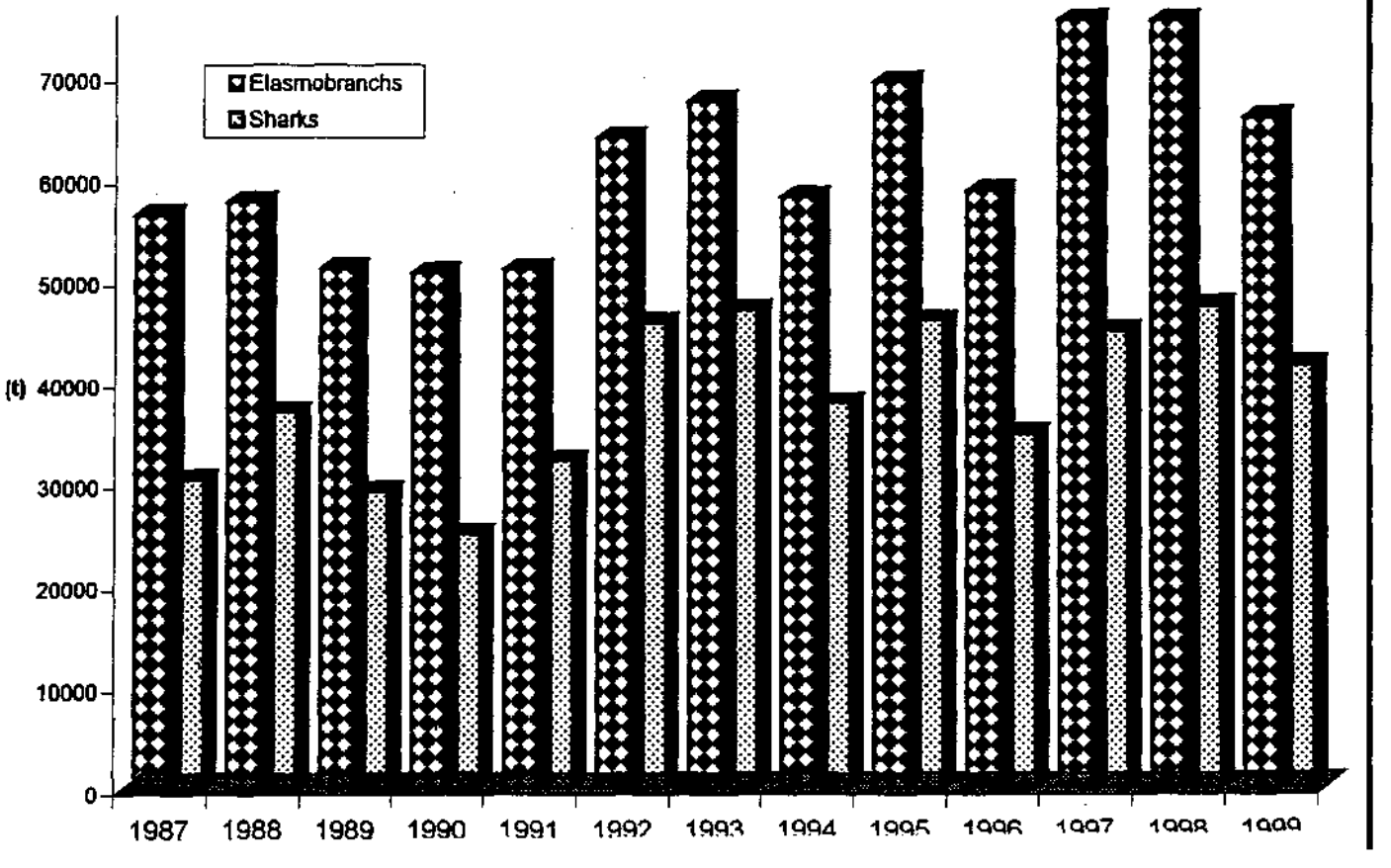
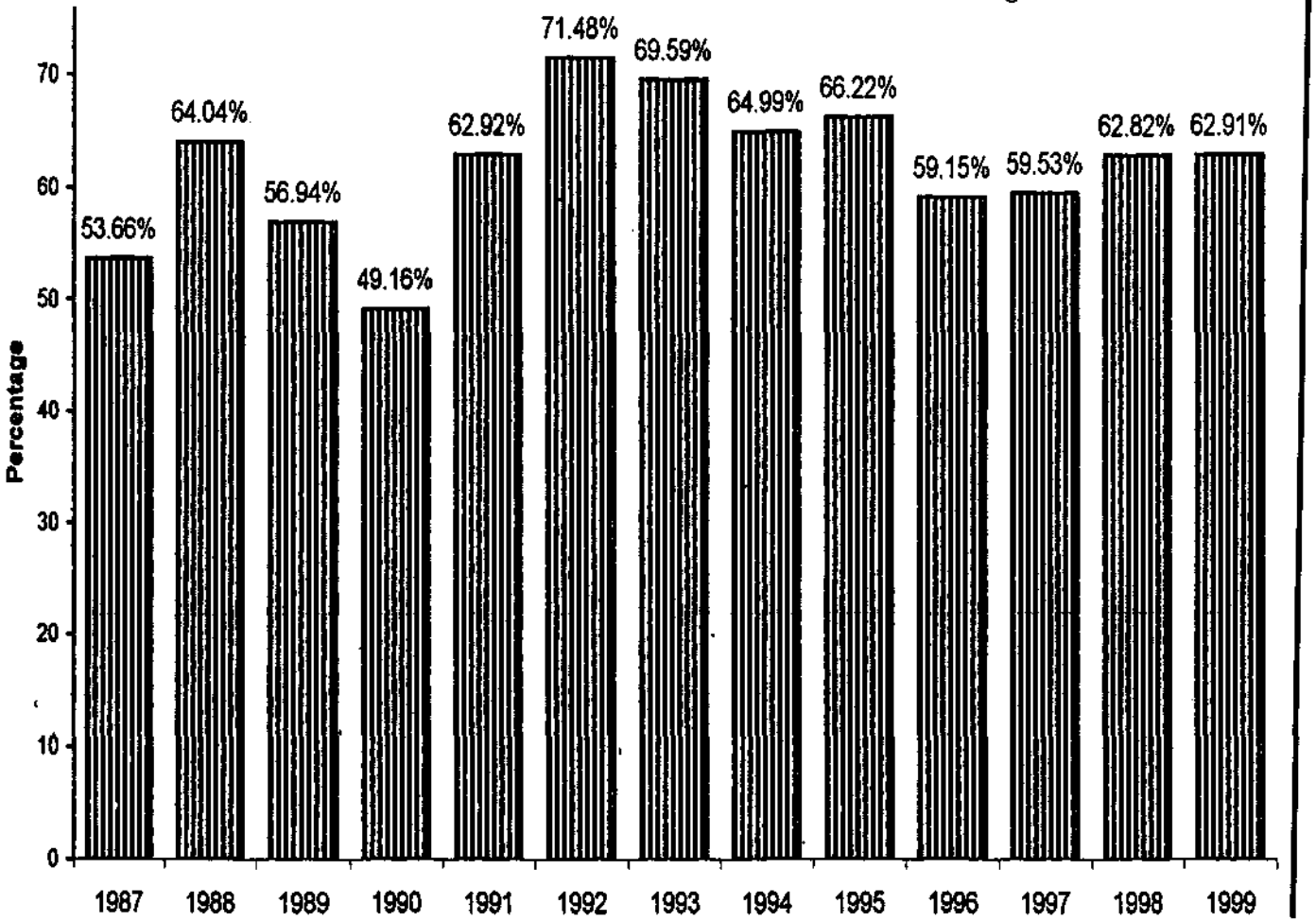


Figure 5.1.**Percentage of Sharks in total elasmobranch landing**



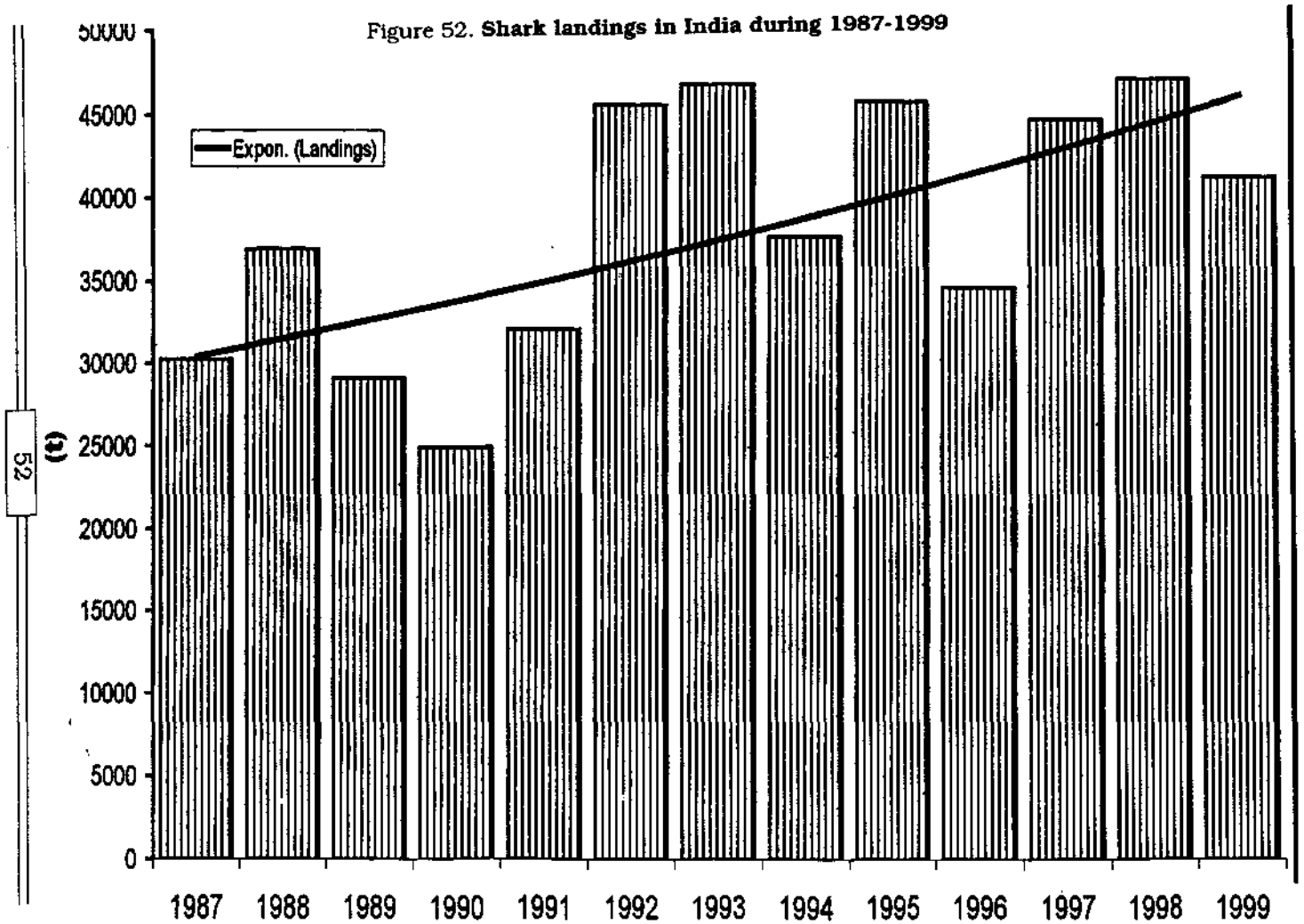
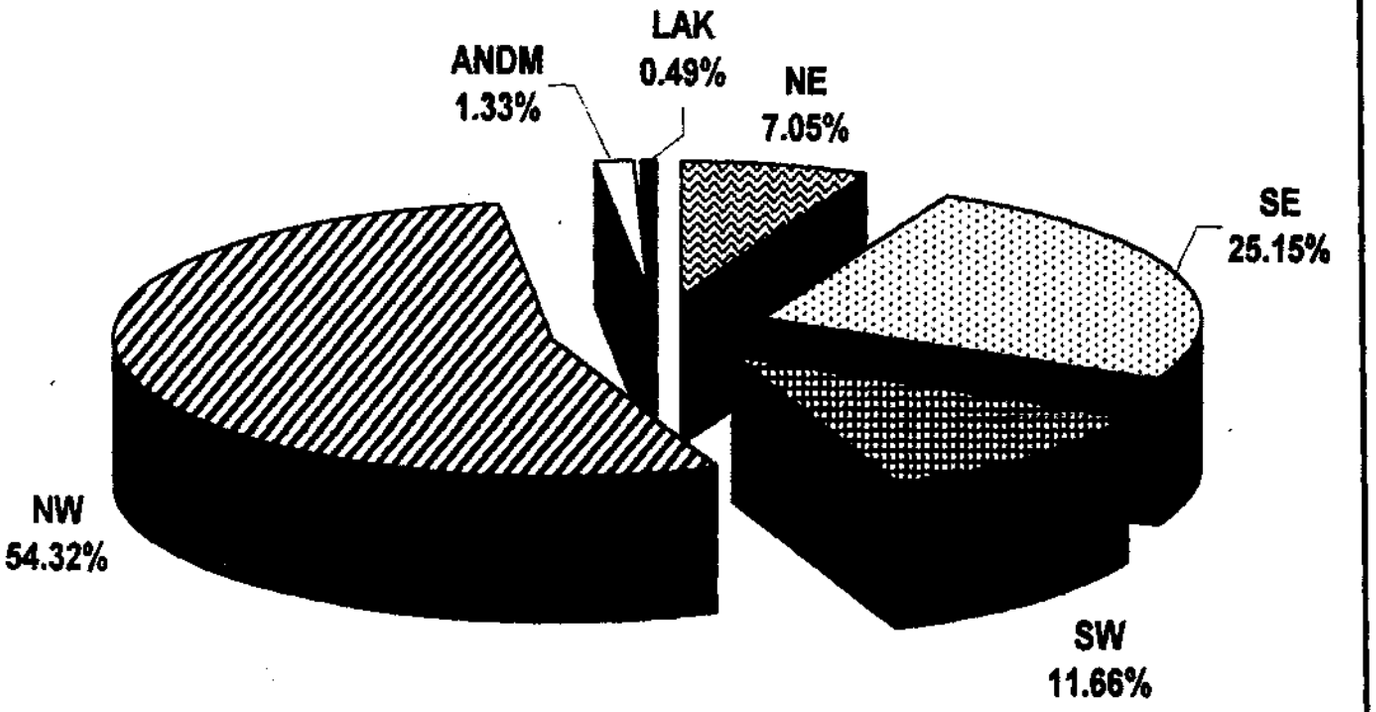


Figure 52. **Shark landings in India during 1987-1999**

Figure 53. **Percentage composition of sharks in different zones**



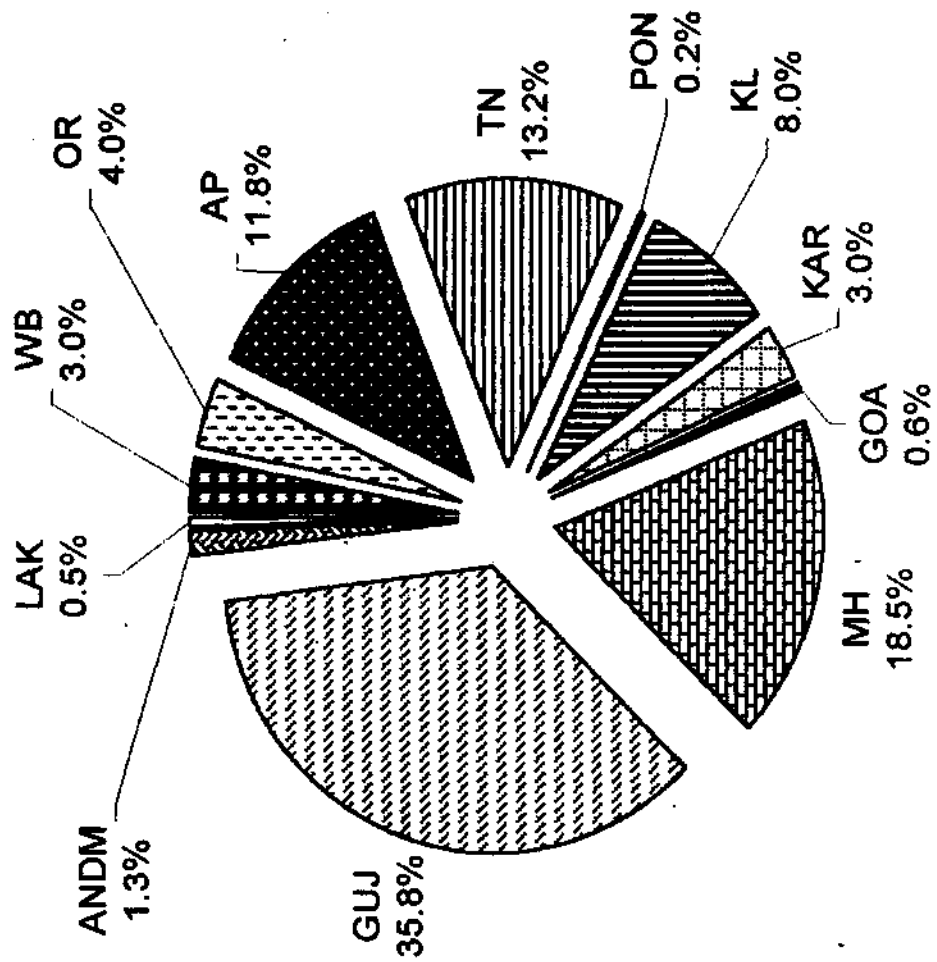
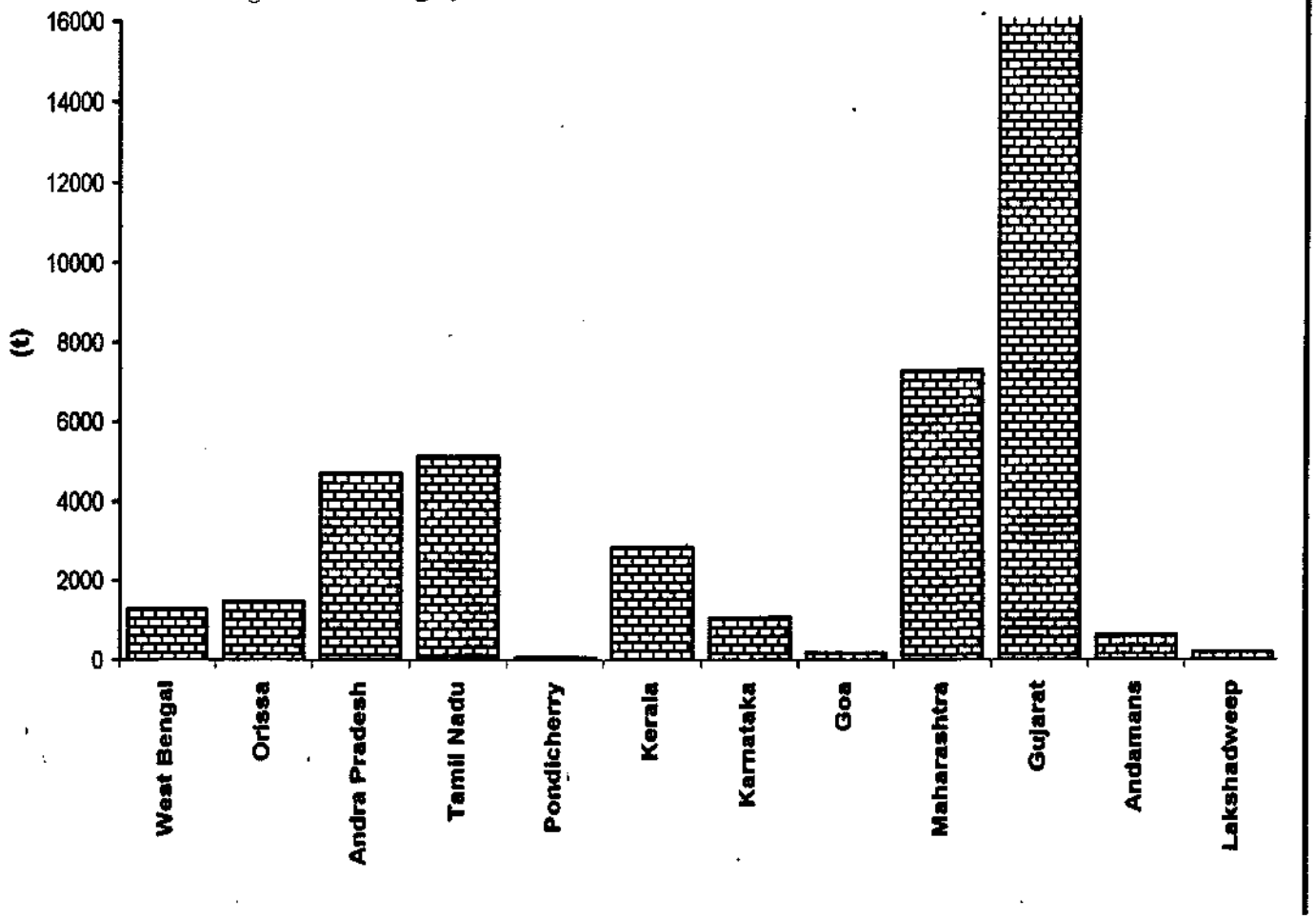


Figure 54. **Percentage composition of sharks in different states**

Figure 55. **Average yield of sharks in different states during 1987-1999**



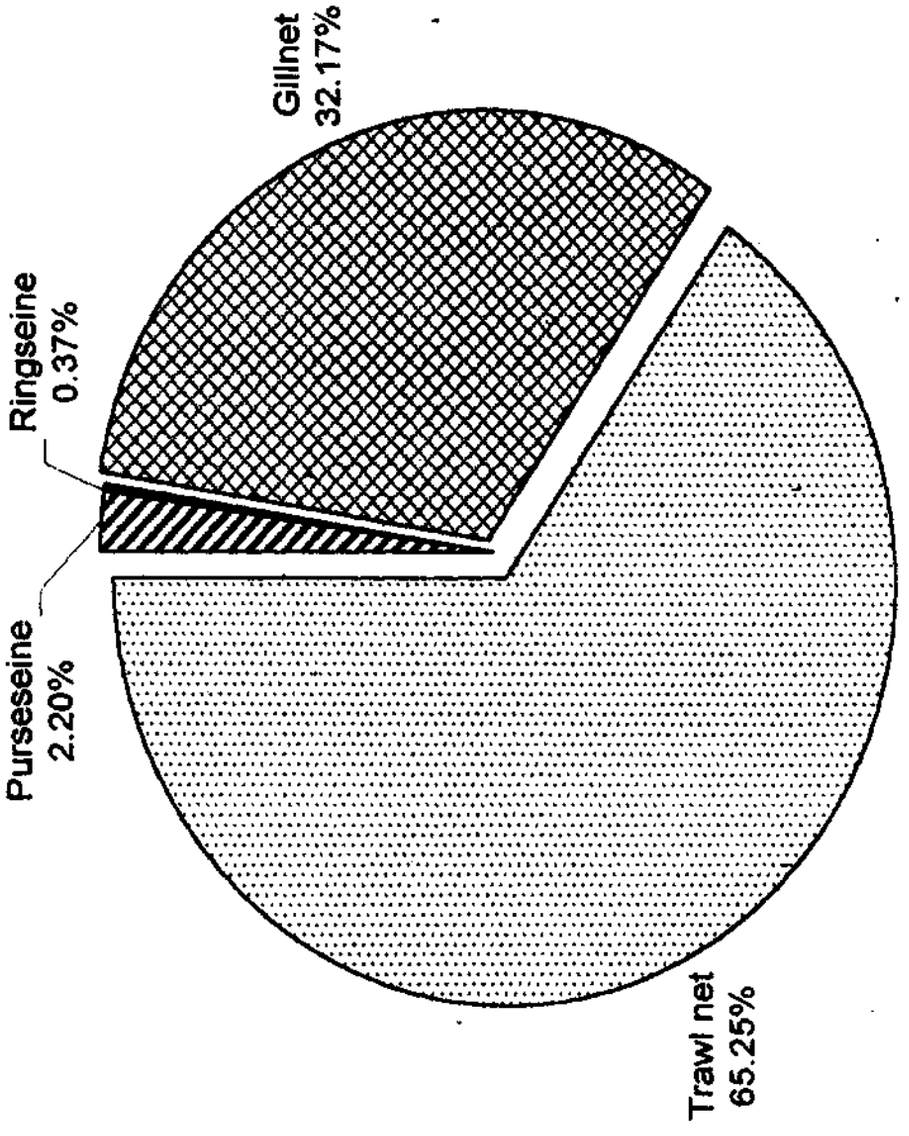


Figure 56. **Average gearwise landings of Pelagic Sharks during 1991-95**

Figure 57.**Shark landings in Gujarat during 1987-1999**

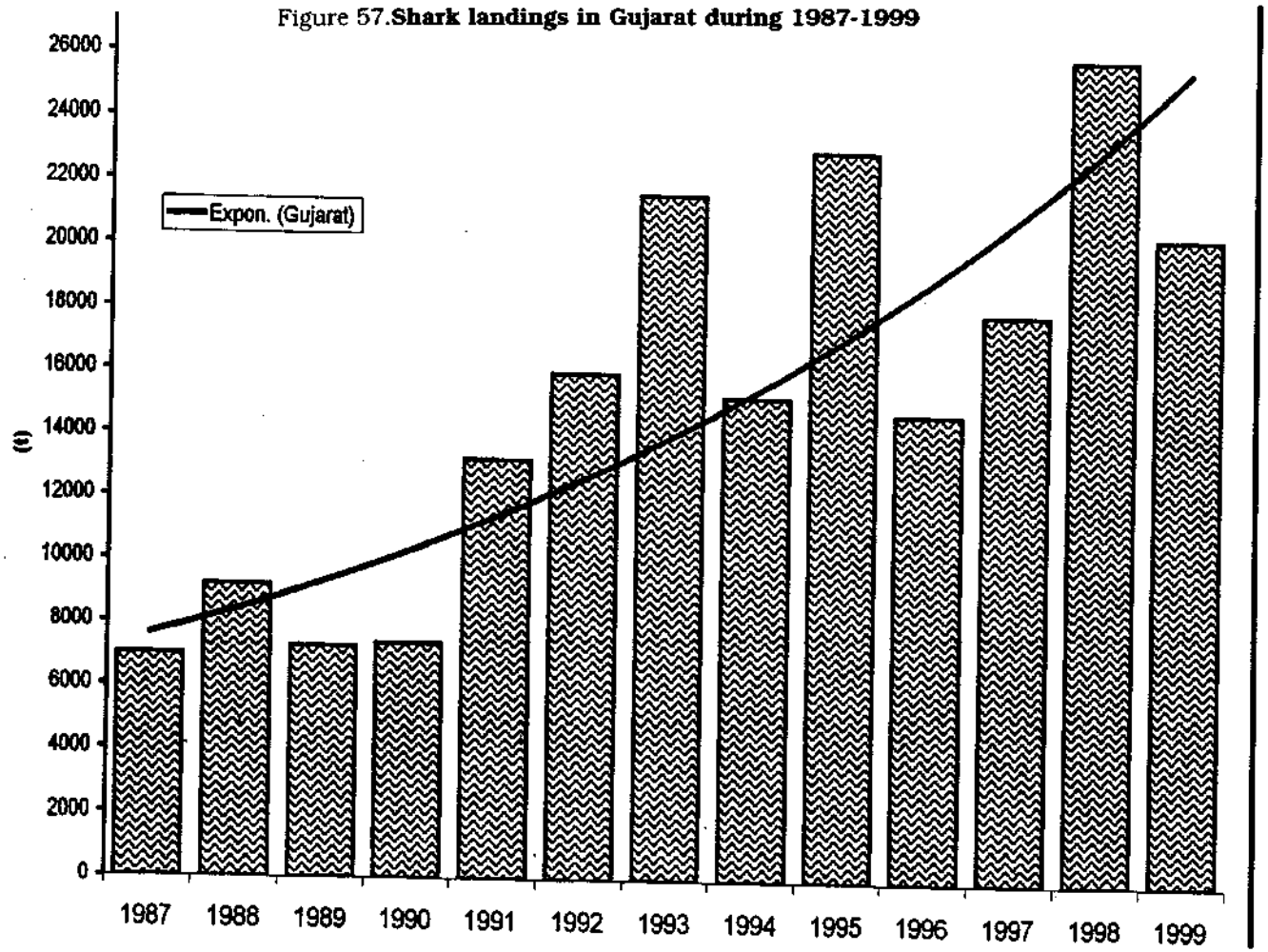


Figure 58. **Shark landings in Maharashtra during 1987-1999**

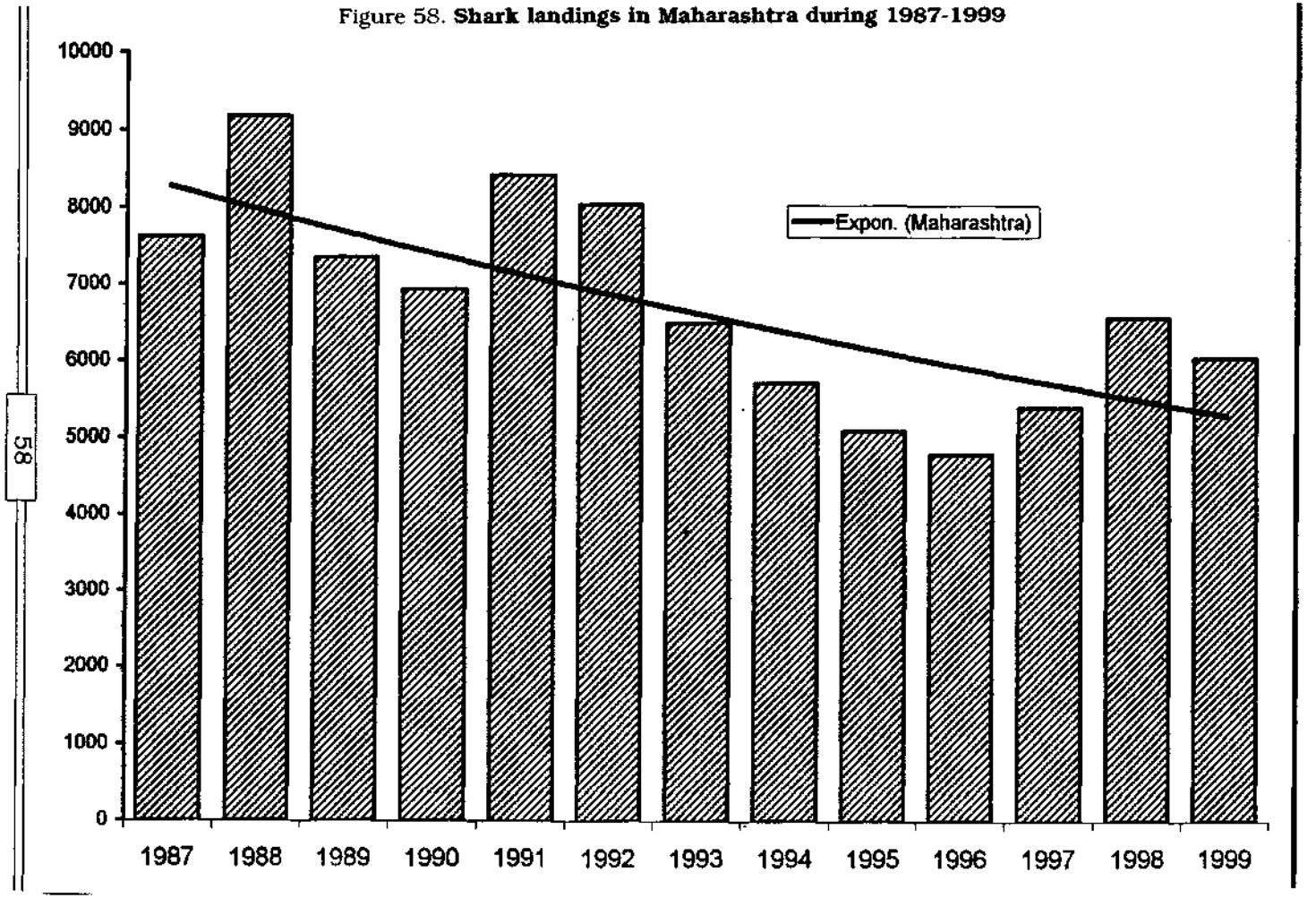


Figure 59. **Shark landings in Kerala during 1987-1999**

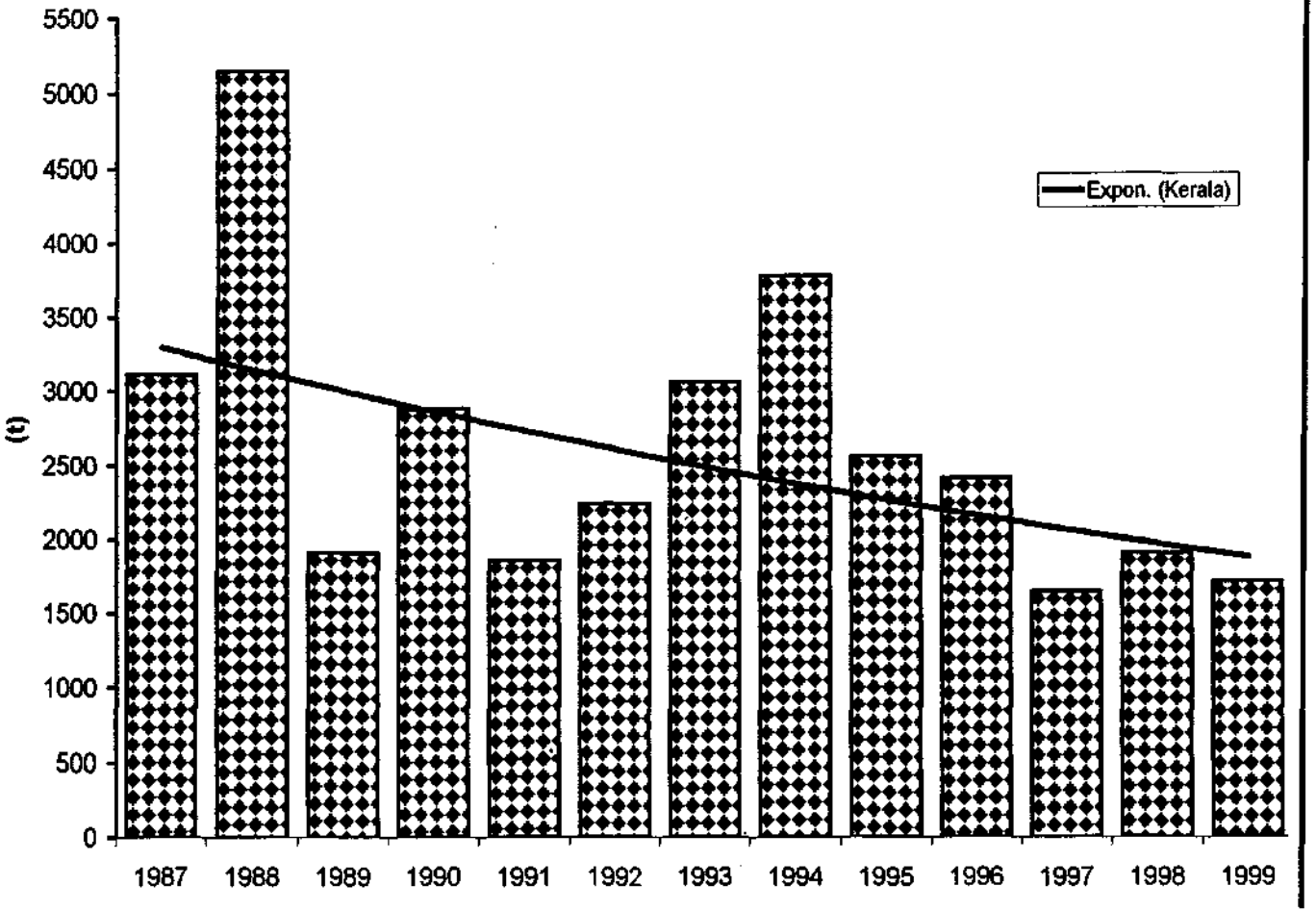


Figure 60. **Shark landings in Tamil Nadu during 1987-1999**

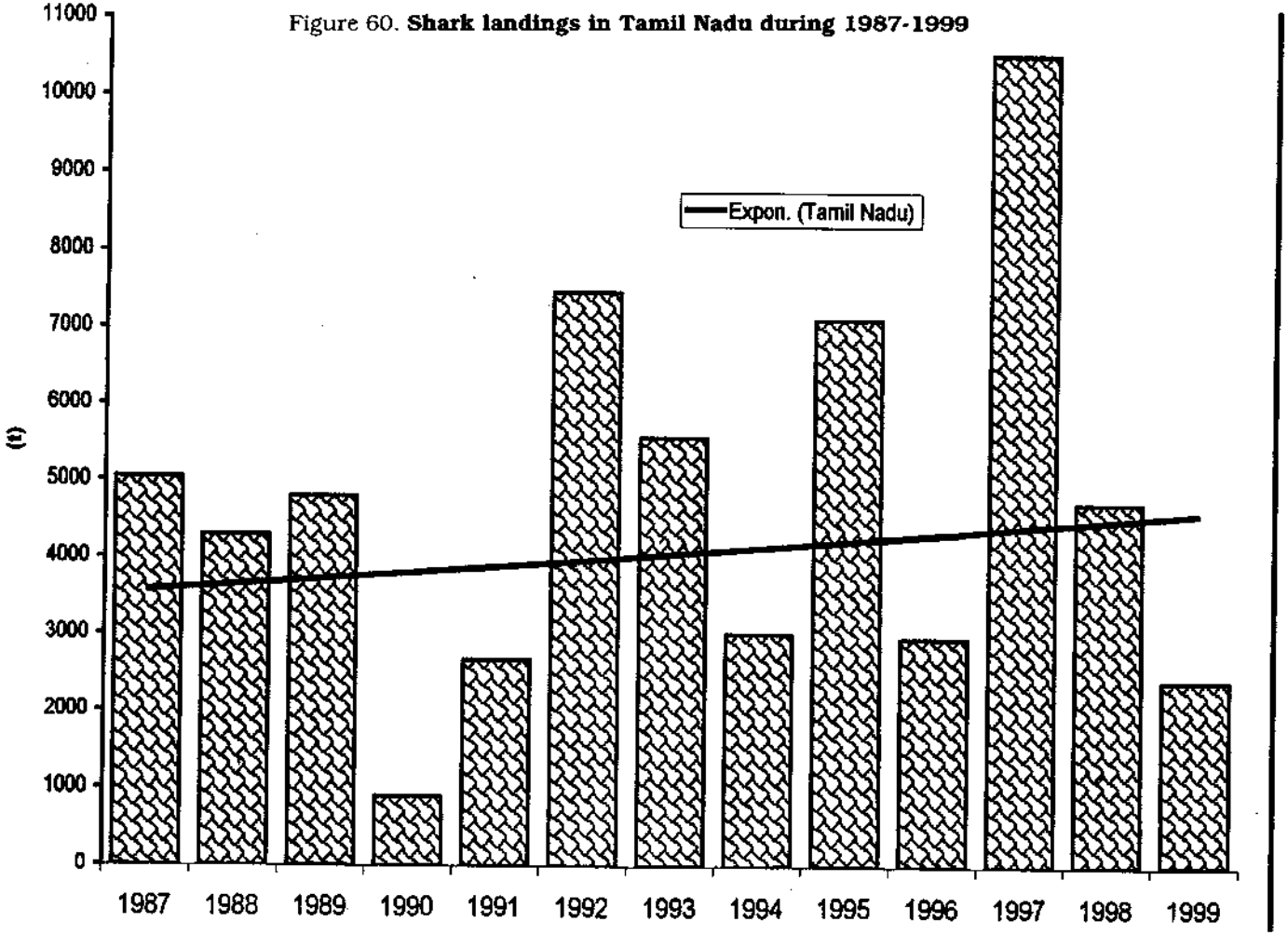


Figure 60. **Shark landings in Andra Pradesh during 1987-1999**

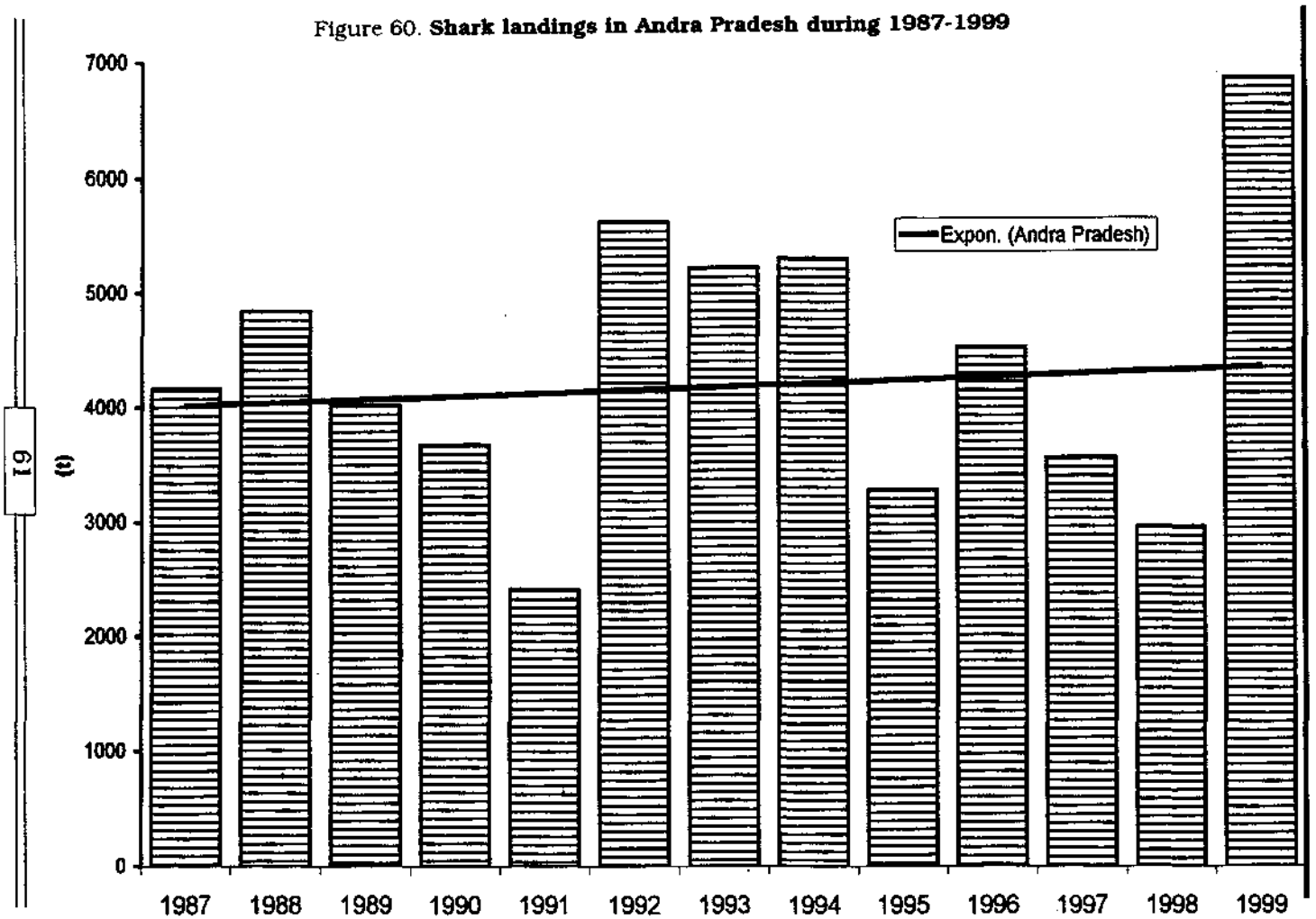
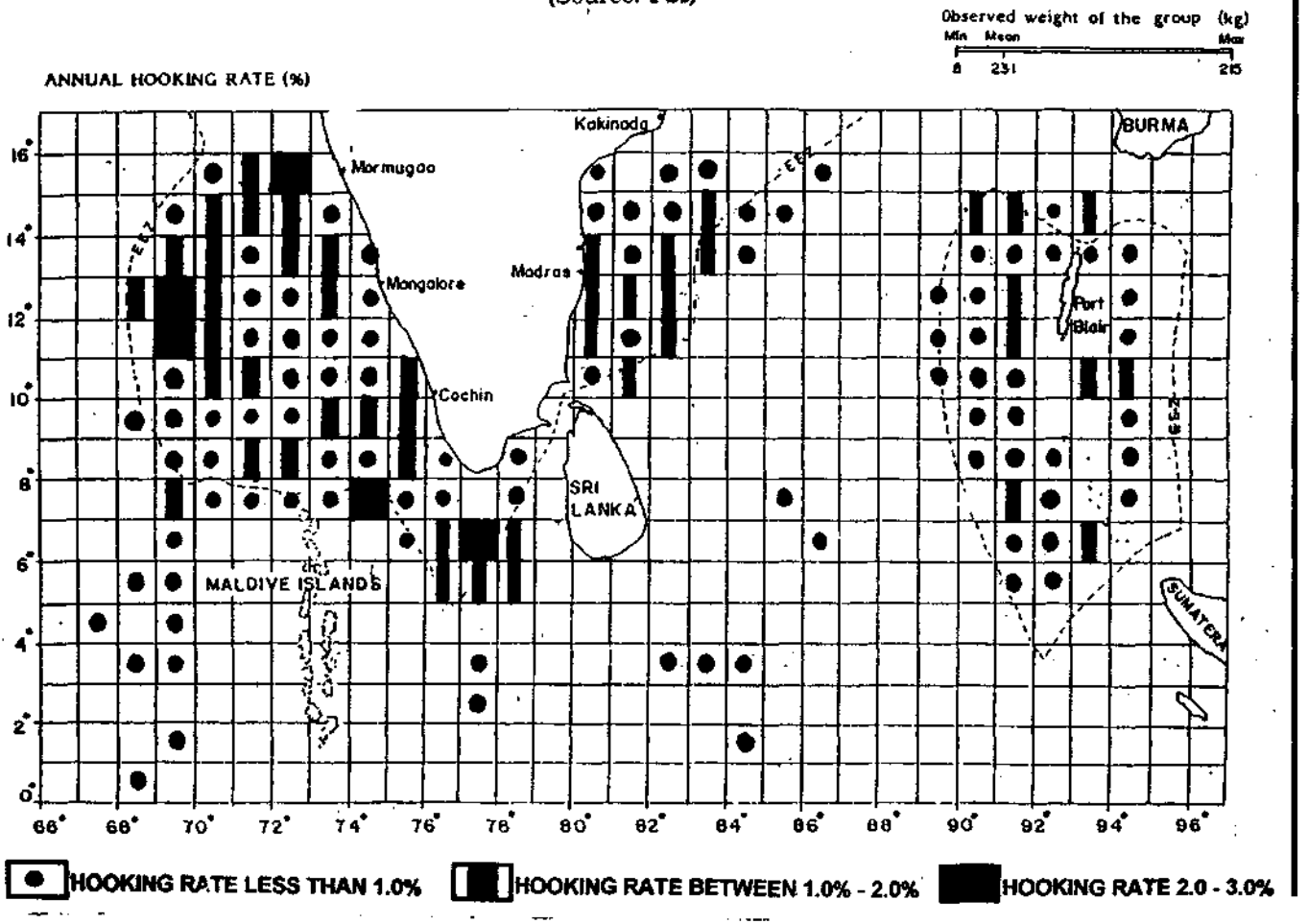


Figure 62 : **Distribution atlas of Sharks**
(Source: **FSI**)



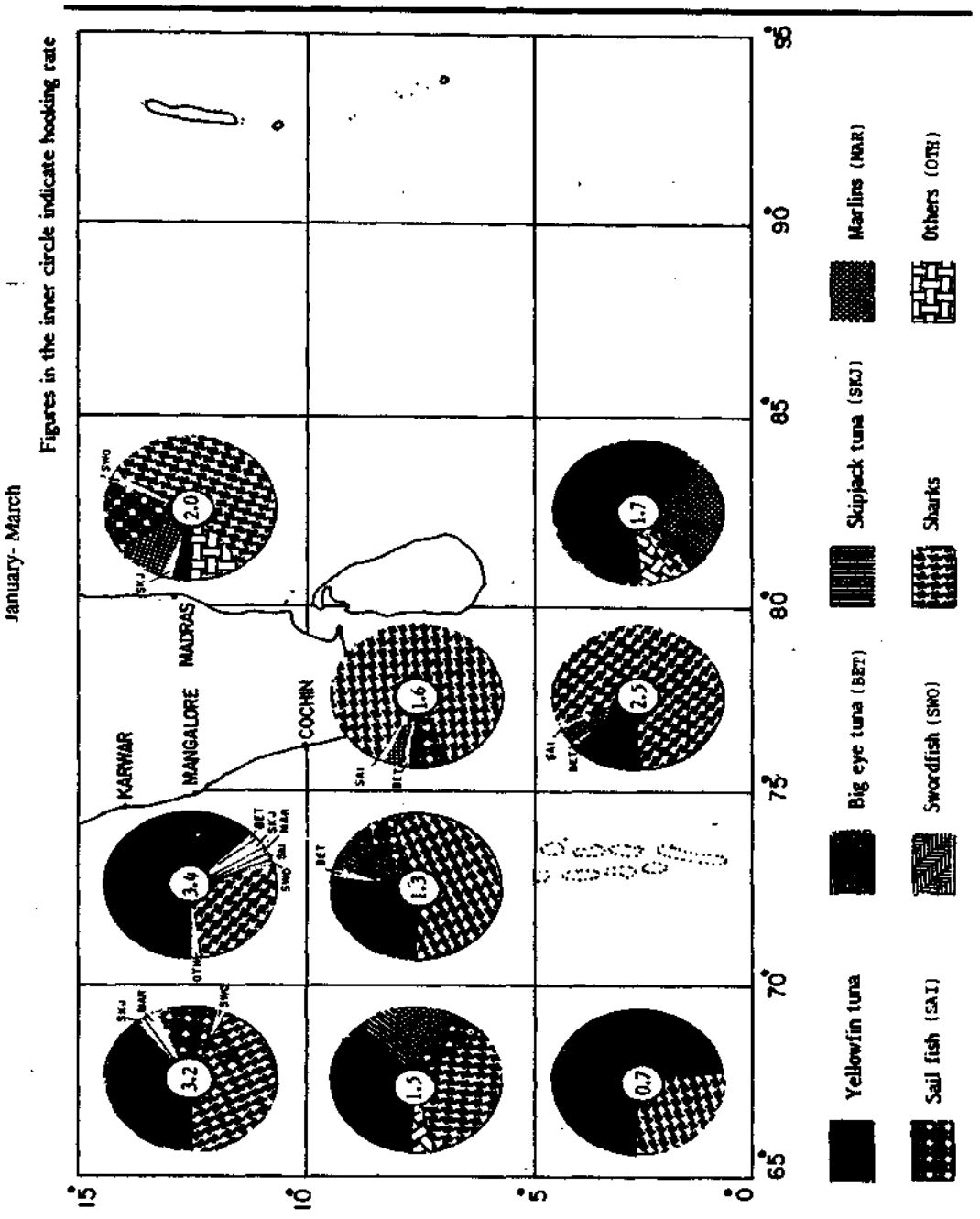


Figure 63. **Catch composition of Tunas, Billfishes and Sharks in The Tuna Long Line Fishery (1983-1988) — FSI**

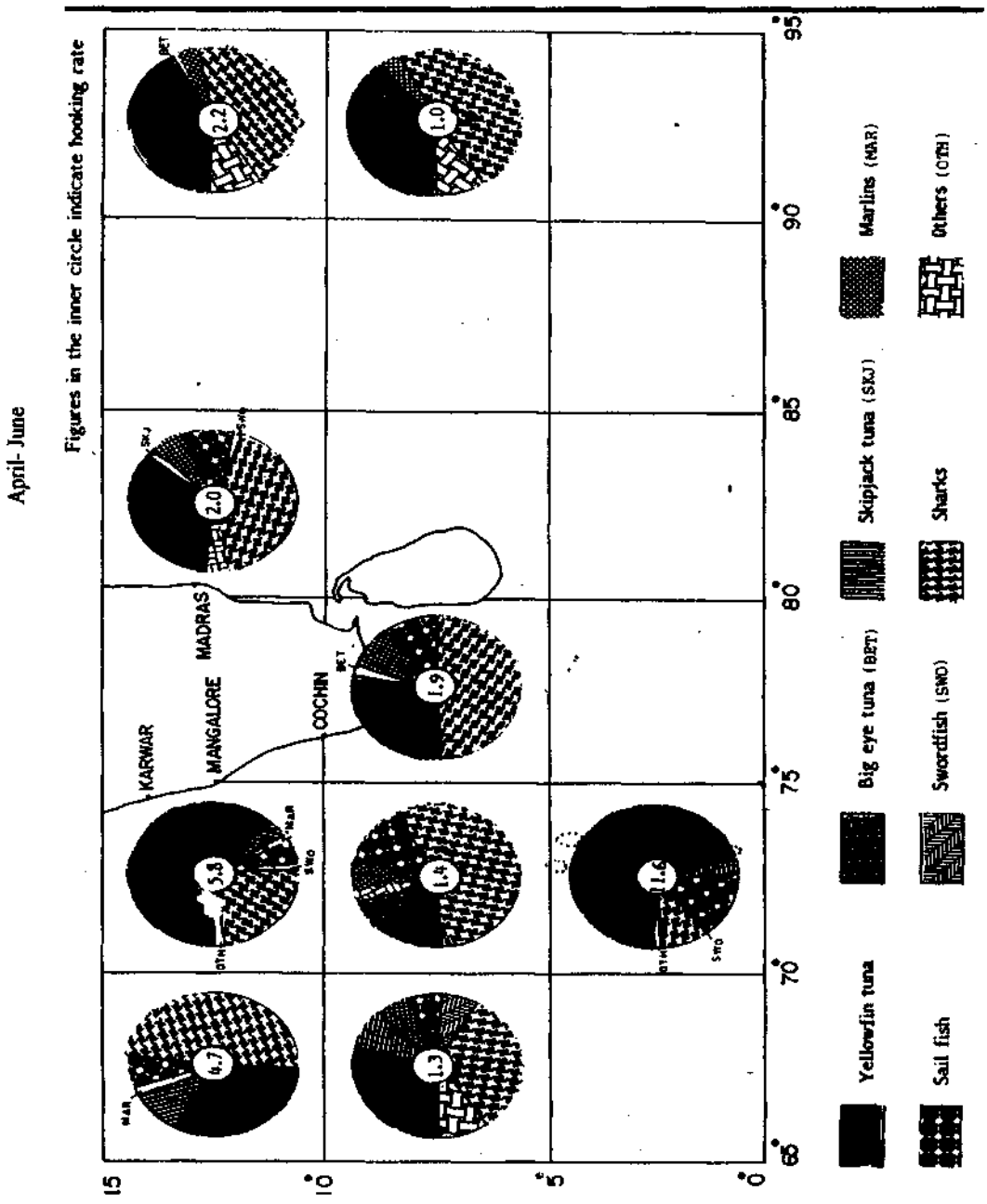


Figure 64. **Catch composition of Tunas, Billfishes and Sharks in The Tuna Long Line Fishery (1983--1988)-FSI**

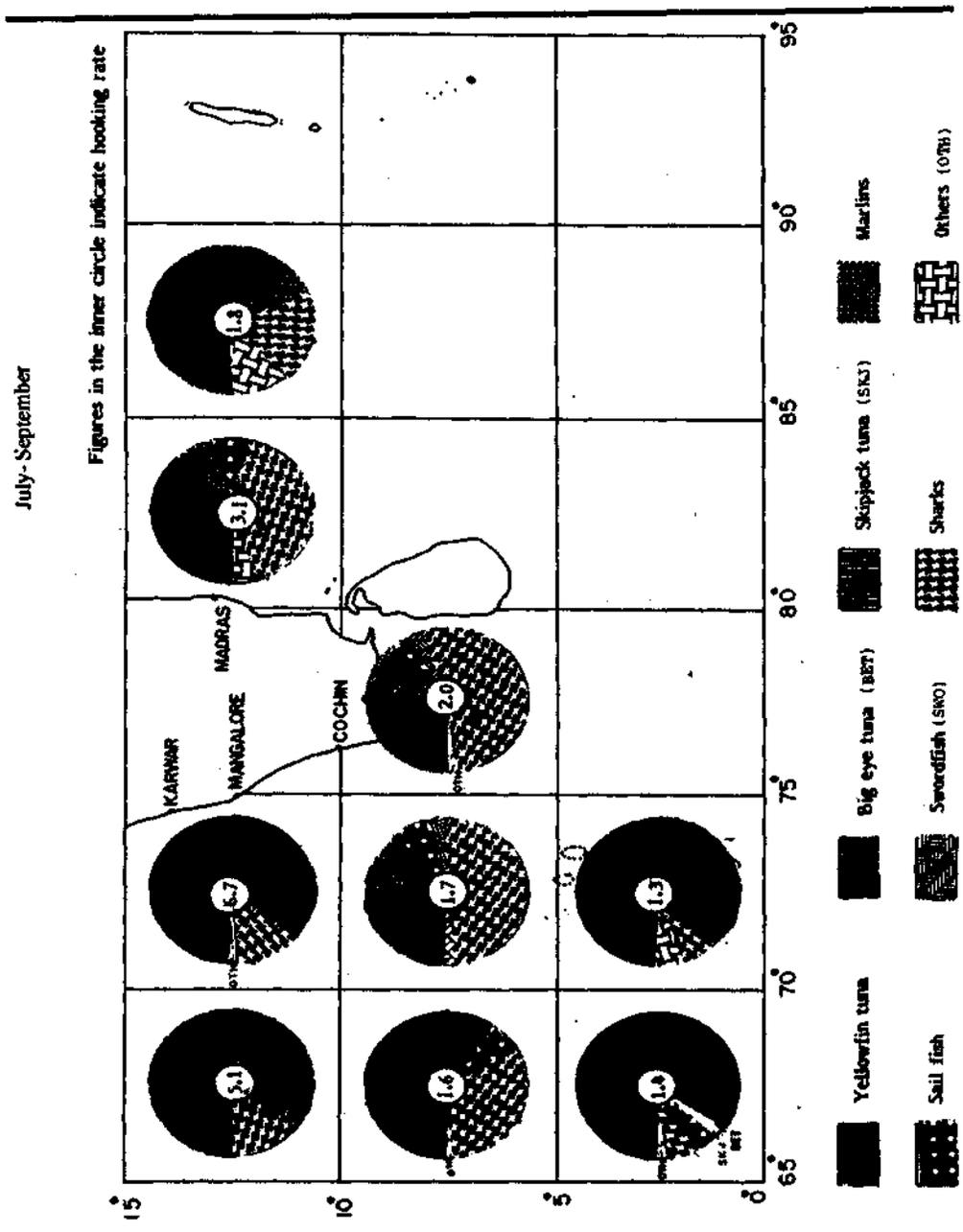


Figure 65. **Catch composition of Tunas, Billfishes and Sharks in The Tuna Long Line Fishery (1983--1988)-FSI**

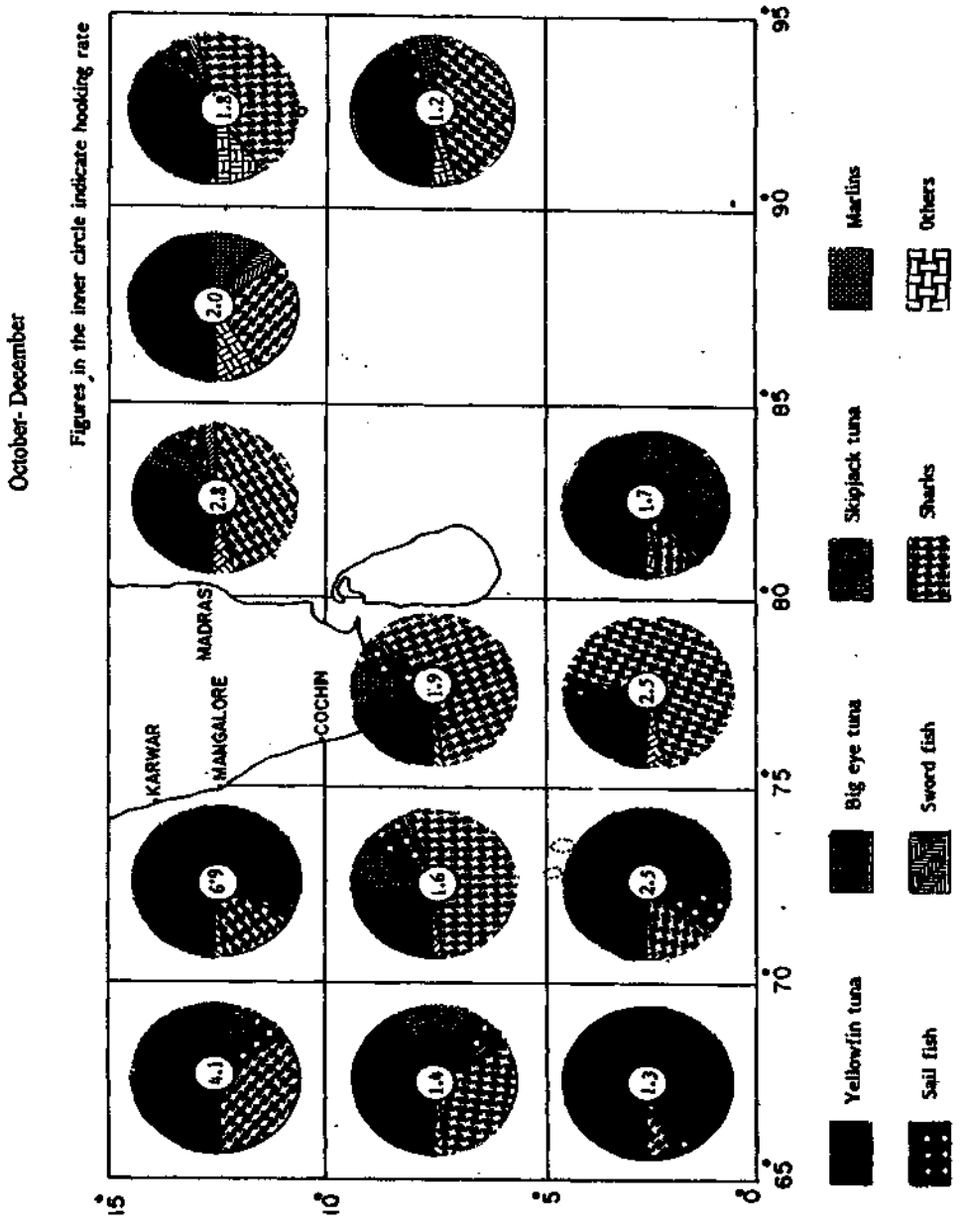


Figure 66. **Catch composition of Tunas, Billfishes and Sharks in The Tuna Long Line Fishery (1983--1988)-FSI**

CHAPTER IV

TRADE IN SHARKS AND SHARK PRODUCTS

Trade of sharks and shark products evinced an increase since 1980's due mainly to the increased utilization of shark meat for domestic consumption along with the reduction of tariff rates on the import of shark fins etc. by countries such as China. Further, the escalating cost of traditional food fishes made the under utilized sharks as a relatively cheap sources of protein.

The shark fishery assumed a lucrative one in view of the great demand for their fins and flesh. The major products for trade from sharks are:

* Fins and fin rays
* Meat
* Liver oil, liver and fish meal
* Cartilage
* Skin and jaws.

Shark fin is a highly valued commodity in the overseas markets such as Hong Kong, Singapore and other Southeast Asian countries, USA, UAE, Sri Lanka and Europe where the sharkfin soup is considered as a great table delicacy. In India, the fins of the following species are being collected and exported (*Source:* MPEDA):

1. *Sphyrna zygaena* (Hammerhead/Round headed shark)
2. *Rhizoprionodon acutus* (Grey dog shark/Milk shark)
3. *Scoliodon laticaudatus* (Shadenose shark/Yellow dog shark)
4. *Carcharhinus melanopterus* (Black finned/Black tip reef shark)
5. *Rhincobatus djeddensis* (Whitespotted shovel nose/Guitar fish)
6. *Negaprion acutidans* (Sicklefin lemon shark)
7. *Rhiniodon typus* (Whale shark)

Dorsal, ventral, pectoral and lower caudal fins of edible and large sized sharks are processed and exported. The IInd dorsal, pelvic and anal fins of large species (eg. *Negaprion acutidans*) are utilized. The processing of shark fins/fin rays for export are published by MPEDA. The trend of export of sharkfins to overseas markets during the period 1985 - 1999 are shown in Figures 67 & 68 and Tables 3 & 4. The quantity of fins exported fluctuated between 96 t in 1985 and 303 t in 1995. The value increased from Rs.13 million (1985) to Rs. 105 million (1996) and the export value evinced a decreasing trend during 1997 -99. This trend in the sharkfin export can be attributed to the undeclared transportation of dried sharkfin in bulk in personal baggages to foreign countries especially to Singapore (via) Chennai Port (*source:* MPEDA). A perusal of the figures indicate that the increase in quantity was not substantial (Table 3 & Figure 67). Average share in the quantity (t) of the shark fin export from countries of destination during 1985-99 indicate that of the total quantity exported, about 34.4% was to Singapore, 41.2% to Hong Kong, 6.9% to Sri Lanka, 3.5% to China, 2.9% to USA, 1.2% to Taiwan and the rest to other countries. (Table 4 & Figure 67). The major portion of the sharkfin export during 1995-99 was from Chennai followed by from Mumbai, Kandla, Trivandrum, Cochin, Porbandar and Tuticorin ports (Table 5).

Shark meat is consumed locally, either in fresh or dried (salt-cured) form. With the change in consumer taste, fresh shark meat has gained popularity in recent years in most of the cosmopolitan cities in India. Large sharks such as *C. melanopterus* of more than 2m. fetch from Rs.

1500-5000/piece at the major Fisheries Harbours such as Cochin (Kerala) and Puri (Orissa). Most of the small sized species (*Scoliodon* spp.) are marketed fresh and can fetch Rs. 75-150/piece in local markets in Kerala, Goa and Gujarat. Dried salted shark meat is popular in Kerala, Goa and interior markets. Relatively high urea content and the odour of ammonia in the flesh of sharks is an inhibiting factor encountered in the commercial utilization of the shark flesh in fresh form or processed products. As opined by Anderson and Ahmed (1993) if the urea is removed immediately after catching by bleeding the shark it prevents the formation of ammonia and eliminates the strong ammonia odour and taste. However, a successful method has been developed for removal of urea from shark by CIFT.

Shark liver is a rich source of vitamins A & D and was in great demand during second world war. Large sharks (Tiger sharks, Hammerhead sharks and Black fin sharks) are the commercially important species, which yield liver oil with high vitamin content. The shark liver oil factory was functioning in 1854 at Calicut (Kerala), but the industry faced with the problems with the introduction of synthetic vitamin A. At present there is only one shark liver oil factory at Kakkinada. This factory converts refined oil into capsules of vitamin A and D. One kg of refined oil produces 10,000 capsules, which sell at a retail price of Rs. 50-70 per 1000 capsules. Oil is extracted crudely at some places in an unorganized manner and are used as a preservative for boats (Hanfee, 1997).

The largest market for shark liver oil is Japan where it is used by the cosmetic industry. Germany is also employing shark liver oil in the textile, leather, paints and varnish industries. Stearin and liver meal are the byproducts from liver oil. Stearin is used in the manufacture of candles, soaps and paints, where as liver meal is used in the poultry feed.

Cartilage: There is an occasional demand for 'shark bone' which is powdered and made into tablets (*source:* CIFT), the price of which ranges from US$ 15-20/kg. It is reported to have anti-cancer properties.

Skin of the sharks are processed into good quality leather.

Jaws: In India, there is an unorganized trade for shark jaws as curios. The teeth are also used as beads in artificial jewellary.

Figure. 67 : **Export of shark fins during 1985-1999**

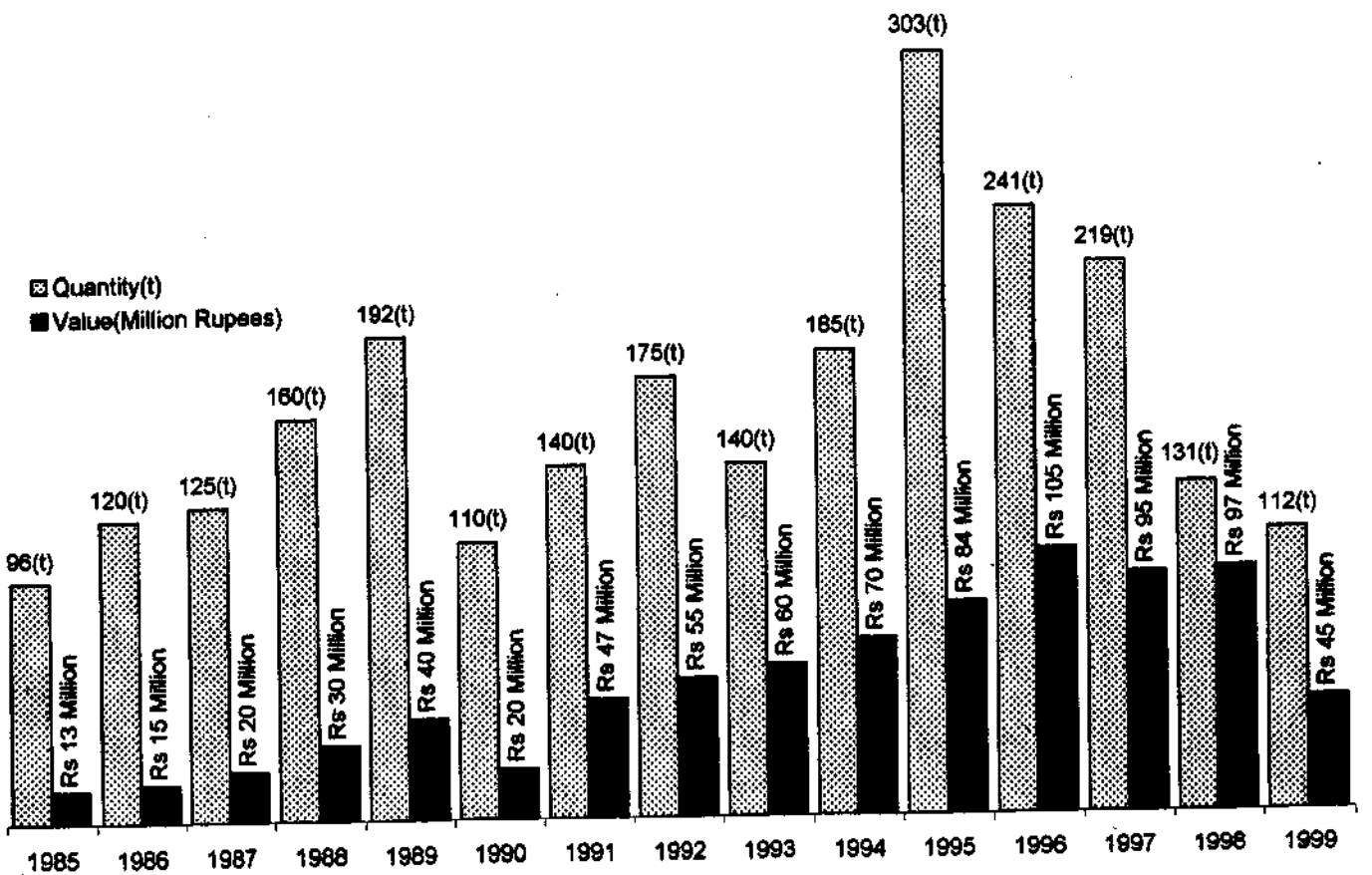


Table 3. Export of shark fins by reported country of destination

Q: Quantity in Kgs. V: Value in Rs.)

	1995		1996		1997		1998		1999		Total qty.	Avg.qty.
Country	Q	V	Q	V	Q	V	Q	V	Q	V	(95-99)	(95-99)
China	.	.	.	.	.	.	.	.	3195	4706906	31195	6239
Germany	.	.	999	17143	.	.	.	.	.	.	999	200
HongKong	199252	27307170	103525	18916410	125149	26766124	77250	36704886	38298	13729819	364147	72829
Japan	.	.	.	.	.	.	.	.	617	845000	617	123
Malaysia	.	.	95	78286	.	.	.	.	.	.	95	19
Singapore	102807	56098268	125161	85035677	90922	6827675	48267	58694107	16595	20867493	383752	76750
Sri Lanka	.	.	.	.	2300	58360			192	343504	60660	12132
Taiwan	.	.	11000	354123	.	.	.	.	.	.	11000	2200
UAE	.	.	5	2875	.	.	.	.	6750	1872907	6755	1351
USA	450	428064	35	107477	800	275147	5500	1885979	18720	3204986	25505	5101
Total	302509	83833502	240820	104511991	219171	95376386	131017	97284972	112367	45570615	884725	176945

Source: MPEDA (1999).

Figure 68 : Average share in quantity (t) of shark fin export from India to countries of destination during 1995-1999

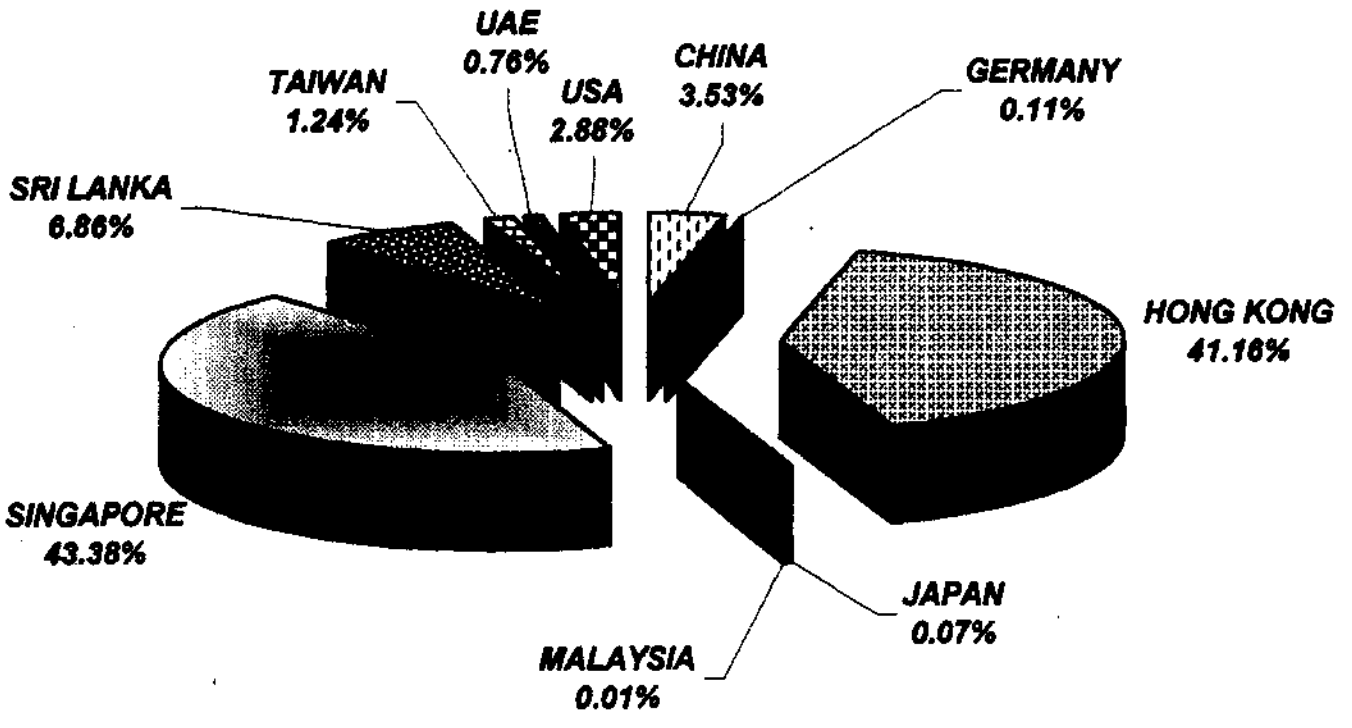


Table 4. Export of shark fins by port

Q: Quantity in Kgs. V: Value in Rs.)

	1995		1996		1997		1998		1999	
Port	Q	V	Q	V	Q	V	Q	V	Q	V
Cochin	240	77051	.	.	800	275147	.	.	.	.
Calcutta	.	.	.	.	.	.	.	.	.342	955536
Chennai	179403	64482362	133483	89807517	125018	85798248	69936	87626614	47563	34378162
JNP					30441	3175681				
Kandla					26662	3109029	32645	3829068	42325	6241102
Mumbai	122818	1864089	95338	14333209	35650	3006980	22936	3943311	21943	3459512
Porbandar	.	.	.11000	354123						
Trivandrum	48	310000	999	17143			5500	1885979	194	536303
Tuticorin					600	11301				
Total	302509	83833502	240820	104511992	219171	95376386	131017	97284972	112367	45570615

Source: MPEDA (1999)

CHAPTER : V

PELAGIC SHARKS - A PERSPECTIVE, MANAGEMENT AND CONSERVATION

The marine fisheries resources potential of the EEZ of India is variedly estimated at 3.921mt. (Sudarsan et al., 1990) and 3.900mt. (MOA, 1991). According to Sudarsan et al., (1990) 58% of the potential marine fisheries resources in the EEZ of India lies within the 50 m isobath, around 35% in the depth zone 50-200m and 7% beyond 200m depth. The productive potential of elasmobranchs from the 0-50m depth zone is estimated at 11, 177 tonnes from the NE Coast, 18,722 tonnes from the SE Coast, 10,735 tonnes from the SW Coast and 24,300 tonnes from the NW Coast, thus totaling to 64,934 tonnes (MOA, 1991). The state-wise estimated annual catchable potential of elasmobranchs in the depth zone 0-50m is presented below (MOA, 1991):

States	WB	OR	AP	TN	PON	KER	KAR	GOA	MH	GUJ	Total
Pot.(t)	505	2515	8097	18357	365	7579	2704	452	12046	12254	64,934

Though a harvestable potential of **65,000** t of elasmobranchs in the depth zone 0-50m and **103,000** t from beyond 50m have beeen estimated for the EEZ of India (MOA,1991), they are not fully exploited as evident from the average production of elasmobranchs (61,591 t). However, the annual average landings of elasmobranchs during1987-1999 was 61,591 tonnes which constituted about 2.7% of the total marine fish landings in India.

The average catch of sharks during the period 1987-99 in the small scale fishery sector was 41,483 t and ranged between 24,920 t (1990) and 47,279 t(1998). The productive potential of **Pelagic sharks** from the

depth zone 0-200 m has been assessed by Sudarsan *et al.* as: 16,000 t from the NW Coast, 31,000 t from the SW Coast, 5,000 t from the lower east coast, 6,000 t from the upper east coast and 5,000 t from the A&N islands. According to them, 92.1% of the potential of pelagic sharks lies in the depth zone 50-200 m and 7.9% in 0-50m. While dealing with the potential estimates of **pelagic sharks** in the EEZ of India, Sudarsan *et al.*(1990) opined that "as the distribution range of sharks extends from surface to sub-surface layers, it is assumed that the yield from the surface fishery would be about the same from the sub-surface fishery. They have given the potential estimated of pelagic sharks from surface fishery as 15,800 t and from the sub-surface fishery 15,800 t, thus totaling to **31,600 t**. As opined earlier, the average catch of sharks was 41,483 t (1987-1999) and assuming that about 68% of the total sharks landings are constituted by **Pelagic sharks**, the present catch of pelagic sharks would be **28,210 t.** All the above facts indicate that there is scope for expanding the commercial exploitation of **pelagic sharks** which has to be implemented in a planned manner.

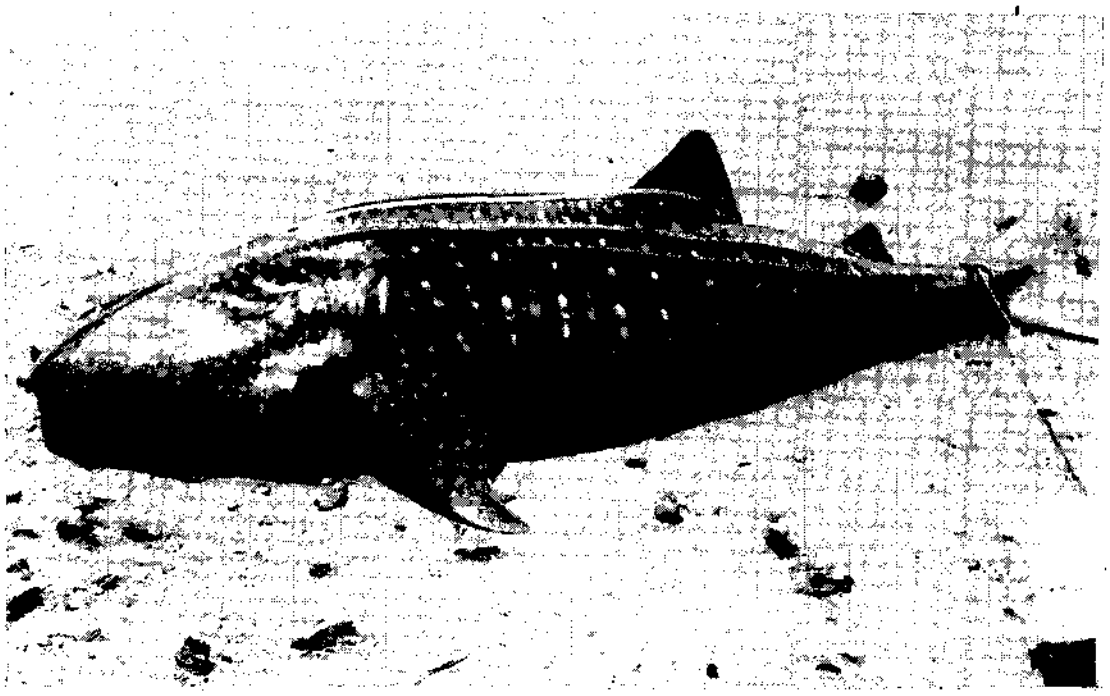
The marine fishery fleet has increased from **0.146million** in 1992-93 to about **0.238million** in recent years which include about **35,730** motorised traditional crafts and **47,000** mechanised boats. In addition, there are about 170 large fishing vessels above 20m in OAL. Evolution of the fleet and fishing effort along the Indian coast indicates that the bigger boat as well as trawlers (25`-35`) were introduced in the 1960's and 70's, and were slowly replaced by larger boats of 45` OAL fitted with 120 HP engines. Motorization of traditional boats and catamarans and improvement in the design of trawl nets and drift gillnets encouraged fishermen to increase their fishing efforts. Major fishing activities has still concentrated in the area within the 0-80m depth zone. Large trawling vessels are confined to northeast coast and concentration of traditional crafts is greater on the east coast (about 63% on the total) than the west coast. With regard to motorised and mechanized vessels the reverse is the case. Sharks form bycatch in almost all the gears employed by different types of crafts along the Indian coasts as no gear is exclusiely employed

to exploit sharks except large meshed gillnets and hook and line gears. The **Jadajal** (large meshed drift gill net) employed off Gujarat and Maharashtra coasts, sharks gillnets employed along Kerala coast and large meshed gillnets and hook and line gears along Tamil Nadu coast are responsible for a major percentage of shark landings in India. A sizeable portion of the juvenile sharks are landed by trawlers, which are engaged in the fishing for shrimp and fish.

Maintenance of the catch at optimum level and avoid overeexploitation of the stock are the major fishery management objectives. In view of the fact that the **National Fisheries Policies** centre around the mechanized trawl fisheries while sharks are mainly taken by gears such as gillnets and hook and lines no specific objectives have been set for the management of shark fisheries in India at the National level, even though concern has been raised due to the fact that sharks are a highly vulnerable group for overfishing due to their limited fecundity. The main management measure adopted in the **Marine Fishing Act (1981)** that the restriction of trawling during monsoon period may be beneficial to juvenile sharks landed by trawlers. However, the banning of the fishing by mechanized trawlers during the SW monsoon period has only limited application to shark fishery, as Scoliodon are taken as bycatch in the trawl fishery. There is no regulation, prohibiting catch of immature sharks or minimum sized sharks in the dol net and trawls. It is felt imperative that the regulation are required for the fishery of juvenile sharks especially those of whale shark.

Ramachandran and Sankar (1990) and Vivekanandan and Zala (1994) reported that there is a regular fishery for whale shark(*Rhiniodon typus)* at Veraval (Gujarat) during Feb. to May. Every year more than 500 whale sharks are caught during the four months fishing season. Since the whale sharks are naturally less abundant and few in numbers, it is necessary that this resources is managed by restricting the exploitation in the northwest coast. Hanfee (1999) reported that at Veraval and Okha the target fishing for huge whale sharks (4-12m) which are hooked mainly for

fins and liver and occasionally for meat when the demand arises is in the rampant. It has been reported that the whale sharks meat is exported in fresh and frozen form to countries such as Taiwan, Korea and Singapore.



A study of records of whale sharks landings in India indicates that their occurrence and incidence along the west and east coasts of India are from **Veraval** (Asok kumar *et al.*, 1996 & Sudhakar Rao, 1986), **Mumbai** (Karabhari *et al. 1986*, Shriram, 1986 & Shriram *et al.*, 1994), **Malwan** (Jayadev, 1992), **Karwar** (Pai *et al.* 1983), **Magalore** (Kulkarni, *et al.*, 1959), **Calicut** (Sehappa *et al.*1972), **Trivandrum-Kanyakumari Area** (Lazarus *et al.* 1988; Lazurus et al., 1988; Krishna Pillai 1993), **Kanyakumari** (Joel *et al.* 1994 & Krishna Pillai, 1996), **Kilakkari, Gulf of Mannar** (Nammalwar, 1986), **Athankarai, Palk Bay** (Kasinathan *et al. 1995)*, **Tuticorin** (Mhadevan Pillai, 1973 & Silas *et al.* 1963), **Madras** (James *et al.* 1986 & Subramani, 1988), **Kakinada** (Ramalingam *et al.* 1993 & Seshagiri *et al.*, 1992) and **Visakapatnam** (Ramalingam *et al.*, 1993 & Seshagiri *et al.*, 1993). However, the whale shark is one of the species, which require urgent conservation measures, in spite of the lack of data

on the populations or the effects of present levels of fishing on the entire population.

Efforts should be made to collect species-specific data on shark fisheries and it has to be managed to ensure their long term conservation and sustainable utility. Complete and reliable statistics on catch and fishing effort should be maintained and disseminated so that species wise conservation measure can be taken. Levels of fishing effort should commensurate with low reproductive capacity of shark species. Measures should be taken to minimize shark discards. There is a large gap between the potential yield of sharks and the present rate of exploitation and with the increase in effort in the inshore waters, sustainability of resourse in this area appears to be threatened. However there is scope for developing the fishing in the offshore waters. It is thus difficult to provide a perspective of the shark fishery and management as there are no extant regulatory measures in India, even though Acts and Polices such as **MPEDA Act (1972), Indian Fisheries Act (1897), The wild life (Protection) Act (1972), Marine fishing regulation Act (1981)** and **Environment Protection Act (1986) (Coastal Regulation Zone)** are in existence and in vogue.

The concern for conservation of pelagic sharks assumes importance in view of the fact that about 50% of the world catch of this group is reported to be taken as bycatch. It is concluded that the management policies should consider the effect of fishery regulation for the shark fishery on the fishery of other resources. In view of the trawlers landings small sized sharks and juvenile of the large pelagic sharks in sizeable quantity, the regulatory measures for passive and static gears which exploit sharks is not suitable for trawlers. The whale sharks *(Rhiniodon typus)* is one of the species used by the conservation movement as a symbol of threatened and endangered shark, in spite of the lack of data on populations or the effects of present level of exploitation on the entire population. Further, *S.lacticaudus* and *R. acutus* are considered over fished by trawlers and gillnetters due to their low fecundity but are able to withstand the fishing pressure because of their faster growth rate. Further exploitation of the pelagic shark resources is possible by tapping the larger shark resources, which are oceanic in distribution.

CHAPTER VI

BIBLIOGRAPHY ON SHARKS

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