Online Available at: https://www.sciplatform.com/index.php/wjb/article/view/869

ISSN (Online) = 2522-6754 ISSN (Print) = 2522-6746

WORLD JOURNAL OF BIOLOGY AND BIOTECHNOLOGY

Research Manuscript www.sciplatform.com

Taxonomic & biological annotations on six endangered shark species found in the landings at Karachi Fish Harbour with reference to some conservation strategy measures

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Authors' Contribution: **Nasir, R.**, conducted field visits, collected and identified samples, and conducted further laboratory procedures. **N. Afsar** prepared the research plan, suggested methodology and checked final version of manuscript.

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Review Process: Peer review

ABSTRACT

Identification based on taxonomy of six (6) shark species that have been occasionally seen in the landings of Karachi Fish Harbour (KFH) was carried out in this study. Between 2014 and 2023, field and laboratory observations were made in five different surveys. These uncommon shark species were identified as *Carcharhinus amblyrhynchus, C. amboinensis, C.hemiodon, C. longimanus, C. macloti* and *Stegostoma fasciatum*. The International Union for Conservation of Nature (IUCN) have described these species of sharks as endangered, data deficient, critically endangered and near threatened species respectively in their Red List 2022. These species are being captured and sold for markets connected to domestic and international commerce or export procedures, despite the fact that they are endangered and on the verge of extinction. Regrettably, the main reasons for this out-of-control situation and the extinction of these protected species are the local fishermen's misunderstanding of the laws and the inadequate monitoring provided by higher authorities.

Keywords: Shark species, taxonomy, critically endangered, identification, export procedures.

INTRODUCTION: About 450 million years ago, two subclasses of cartilaginous fishes (Chondrichthyes), elasmobranchs and chimaeras (Holocephali), broke apart from the other jawed vertebrates (Hara *et al.*, 2018). The elasmobranch species belong to the class Chondrichthyes, which also includes sharks, batoid species which are comprises of guitarfishes, skates, sawfishes and stingrays as well as chimaera species, which comprise around 60 families, 189 genera, and over 1200 extant species (Compagno *et al.*, 2005). The varied range of shark, skate, and ray species found in elasmobranchs may be identified by their morphological attributes and behavioural patterns. The flesh, fins, liver, skin, and other body parts of these animals are utilized for a variety of purposes. The biological aspects in these species, which include late age of development, limited fertility and low rates of growth, are the cause of their risk at extinction because these species are caught brutally and are overfished again and again. The possible explanations of these sharp declines can be the degradation of natural habitat, excessive untargeted fishing and slow rates of recovery, especially in the Mediterranean Sea area where fishing was always seen a part of life and still it is. Some species are already endangered (Bradai *et al.*, 2012). Sharks are important members of the marine ecology in shallow and offshore waters. Because they are inherently dangerous predators, they live at the higher echelons of food webs. Shark behaviour might change based on the circumstances. Changes in a shark's normal habit are quite difficult to achieve since most sharks shun humans, especially open circuit scuba divers. Since many sharks are nocturnal, they enter the darkness of the water (Nelson *et al.*, 1986).

Products from elasmobranch species are generally consumed (as meat), utilized as nutritional supplements (such as liver oil and their cartilaginous bone), whereas the fins of these species are considered as the overprized luxury dish in many areas of the world (often called as Fin Soup). The majority of known species of cartilaginous fishes (99.6%) are subjected to either deliberate (targeted) or accidently (as by catch) fisheries mortality (Dulvy *et al.*, 2021). Shark extinction is becoming more and more likely. Their disappearance poses a hazard to the entire marine biological system since they are essential to sustaining the equilibrium of marine ecosystem in the ocean and controlling the diversity and ecology of these marine species that are beneath them in the food chain. In addition to the regulation of the fishing sector, public opinion is crucial to any conservation endeavour. Sharks, on the other hand, receive little public attention or funding for conservation, in contrast to other famous sea creatures like dolphins (Jorgensen *et al.*, 2022). There is a great number of recent research addressing elasmobranch distribution in the world, species diversity, conservation and their management has doubled during the last ten years (Dulvy *et al.*, 2021). For various reasons, scientists are quite interested in the feeding habits, techniques, and dynamics of sharks. Evolutionary theory states that the sharks (fishes that have jaws within their mouth) and other bony fishes had common ancestors (Schaeffer and Williams, 1977; Carroll, 1988; Long, 1995). Sharks may consume anything from microscopic zooplanktons to giant marine species, despite the fact that they are never herbivorous. Sharks consume less food than other animals do (Pratt, 1982) (Compagno, 1990). From massive, extended fisheries focusing valuable species, or from expansive multispecies fisheries, bycatch accounts for a significant portion of unintentional shark captures (Bonfil, 1994). According to the data, analyzed by United Nations Food and Agriculture Organization (FAO) shark's catches have consistently increased since 1950s, with 240 000 tonnes recorded in 2005. When grouping capture statistics for sharks and batoids, the word "elasmobranchs," which includes both, is commonly used. Generally speaking, shark catches have received less attention than those of other marine animals with greater commercial worth. Furthermore, there are a lot of unreported abandoned bodies since the high cost of shark fins offers both legitimate and illicit finners tremendous incentives (Bonfil, 1994).

Due to the widespread usage of illicit fishing nets, including as wire and trawl nets, along Lasbela Balochistan's coastline, the amount of fish caught has been steadily declining. The use of prohibited nets, such as homemade purse seine nets and wire nets, illegal bottom trawling, overfishing, and an increase in the number of fishermen, are the primary causes of the drop in fish catches. Unregistered trawlers, predominantly from Sindh (70%) engage in illicit fishing inside the waters of Balochistan (Yousuf *et al.*, 2020). This is widely acknowledged that shark's life patterns are characterized by the long lifespans, enormous adult sizes, delayed development as well as delayed maturity, late maturation and reproduction, multiple reproductive cycles over the life time, their prolonged gestation periods, reduced fertility and the offspring which are mobile just after the moment of birth or hatching from their eggs. While most other living things reproduce primarily through viviparity, shark species all employ internal fertilization. Furthermore, it seems that the population size is directly correlated with recruitment because of reproductive constraints. The biological diversity and abundance of sharks attest to their ongoing effectiveness as predators in the marine environment, despite these seemingly restrictive aspects of their life histories (Compagno, 1990). Although there is ample qualitative documentation of the variety of shark life cycle methods (Compagno, 1990). Despite the identification of certain broad trends (Hoenig, 1990), there is a dearth of quantitative data about trait correlations and life history trends, particularly at the individual and group levels.

Globally, increasing habitat loss and degradation as well as increased human exploitation over the past 20 years have put shark populations in urgent danger. The creation of demographic and other population dynamics models, which rely on knowledge of significant life history elements, would greatly benefit from a greater awareness of their life experiences and the manner in which traits over time differ. This would support the management and conservation of this species (Cortés, 2000). Because stock evaluations are necessary and samples from deceased animals may be obtained, life history research have tended to favour commercially significant species. Research priorities are moving from evaluating stock condition to more general conservation, which means that a greater variety of morphological groupings are being examined as well as that harmless techniques for gathering life cycle data are being looked for (Jorgensen *et al.*, 2022).

OBJECTIVES: : Following were the study aims and objectives:

 Digital Object Identifier: https://doi.org/10.33865/wjb.009.01.0869

1. To recognize the kinds and numbers of non-target species that are caught in Karachi Fish Harbour alongside target species in order to observe the consequences on the ecosystem health as well as the marine biodiversity.
2. To examine the taxonomy of the species which are encountered after being endangered.
3. To evaluate the possible ways by which these species can be conserved.

MATERIAL AND METHODS: Sampling procedure: Several elasmobranch species (Sharks, Skates, and Rays) were sighted in the landings at Karachi Fish Harbour, which was selected as the research area between 2014 and 2023. The observed specimen were then measured by using the measuring tape to obtain their lengths and used digital weight machines due to variation in the sizes and weights of different species. Moreover digital images of observed specimen were taken on the study site.

Laboratory work: The specimen which were small in size were brought into the laboratory for further biological, histological and lab analysis. The dead samples of small sized shark species collected from Karachi Fish Harbour (KFH) were carefully preserved and examined in controlled laboratory settings using all the preservation protocols in order to obtain the authentic scientific data. Different chemical facilities and specialized tools were available in laboratory setting to analyze the samples with accuracy and caution. To keep the samples away from decomposing and to maintain the tissues integrity for examination, the sharks were kept in refrigerated units which kept them frozen in the way they were collected. To reduce the contamination in the samples and to obtain reliable results from analysis, strict protocols were followed throughout the sample collection, dissections and lab procedures. Different aspects of biology of sharks, including their genetics, morphology, histology and biochemical tests were studied throughout the research period by using various scientific methods. This study sought to improve the management and general understanding of marine ecosystems by gaining insights into the population dynamics, their ecology and the conservation status of shark species in the area through laboratory investigations.

Identification of samples: Taxonomically the observed specimen were identified by the help of available online identification guides (Compagno, 1990; Compagno and Niem, 1998; Psomadakis, 2015)

RESULTS AND DISCUSSION: A total number of 1157 shark specimen were examined critically on Karachi Fish Harbour (KFH) which is selected as the study site during 2014-2023. On the landing site, these observed specimen showed the variety of different species representing several families like Alopiidae, Carcharhinidae, Hemigaleidae, Hemiscyliidae, Laminidae and Sphyrnidae. From among these reported sharks, six distinct species of sharks were found as endangered shark species. The total number of these uncommon shark species and their contribution to the overall shark catch were discovered in survey 2 throughout the study period of 2014–2023, as shown in table 1.

Table 1: Endangered species contributing the observed catch of sharks landing at Karachi Fish Harbour. (N1= No. of individuals).

Specie Name	Common Name	N1	%age of total catch
Carcharhinus amblyrhynchus	Grey Reef Shark	4	18.18
C. amboinensis	Pigeye Shark	4	18.18
C. hemiodon	Long Nosed Shark	4	18.18
C. longimanus	Ocean White Tip Shark	5	22.73
C. macloti	Blacktip Shark	3	13.64
Stegostoma fasciatum	Zebra Shark	2	9.09

Kingdom Animalia
Phylum Chordata
Subphylum Vertebrata
Super class Gnathostomata
Class Chondrichthyes
Subclass Elasmbranchii
Super order Galeomorphii
Order Carcharhiniformes
Family Carcharhinidae
Genus *Carcharhinus*
Species *Carcharhinus amblyrhynchos* (Bleeker, 1856)

1. ***Carcharhinus amblyrhynchos*** (Bleeker,1856)

Synonyms: *Carcharhinus wheeleri* (Garrick, 1985)
Common name: Grey Reef Shark
Recorded size: 105cm – 124cm
Description: These species are referred to as fishes of medium to big sizes that are often found in the open ocean. Their nose is also substantially rounded, as are their eyes. On their body, the inter-dorsal ridges are completely gone, however they do have extremely small labial furrows (Raje *et al.*, 2007). The ventral side is bright white, but the dorsal side is light grey. Since they are more active during the day, it is typical to see these species creating schools of fish (Compagno and Niem, 1998) (figure 1A).
Distribution: These species are found in coastal pelagic, insular and continental shelves.They can travel from the depth of approximately 280m to the ocean's surface along with the coral reefs. Commonly distributed in Indo Pacific tropical waters as well as Central Pacific Ocean (Ahmad and Lim, 2013).
Biology: the maximum length of male specimen of this species can be up to 185 cm whereas the maximum length of female specimen is recorded as 190 cm. Males reach maturity at the length of 120-140 cm, while females do so around the length of 125 cm (Smale, 2009) and for both sexes at around 7 years old. The size of juvenile at the time of birth varies from 45 to 75 cm. The maximal age is thought to be around 25 years old (Compagno *et al.*, 2005). A viviparous species, the grey reef shark. During the mother's pregnancy, a yolksac placenta provides the embryos with nutrition. An estimated 12-month gestation period is followed by the live delivery of a litter of 1-6 pups (Compagno *et al.*, 2005; Smale, 2009).
Commercial importance: These species are caught by the trawlers, long lines and gillnets (Ahmad and Lim, 2013). Fish meal is made from the offal and fins. Meat that is eaten fresh or salt-dried. Exports of dried fins are made (Raje *et al.*, 2007)
Conservation status: They are marked as endangered in IUCN Red List 2022.

2. ***Carcharhinus amboinensis*** (Mullar & Henle, 1839)

Synonyms: *Triaenodon obtusus* (Day, 1878)
Common name: Pigeye Shark
Recorded size: 87cm –97cm
Description: They are considered as the medium sized sharks, and they have a wide, very short snout. While the first dorsal fin is extremely high, the second dorsal fin is incredibly low, with its inner edge nearly as tall as the fin. From the dorsal perspective, their body is grey, but when viewed from the ventral view, it is light greyish. When young, the fin tips are darker, but this coloration diminishes as they grow (Carpenter and Niem, 2001) (figure 1B).
Distribution: These species are commonly found in Indo-West Pacific: South Africa, Pakistan, Indonesia, Sri Lanka, Madagascar, Australia and Gulf of Aden, also in Easter North Atlantic: Nigeria (Raje *et al.*, 2007). The Indo-West Pacific, which includes the Indo-Malay Archipelago, Southeast Asia, and eastern Africa, has a vast but patchy population of pigeye sharks from Australia to South Africa. In the Eastern Central Atlantic, Nigeria and Guinea-Bissau has also reported finding it, but the region is presumably where it is more common (Ebert *et al.*, 2013).
Biology: They are regarded as viviparous creatures since internal fertilization and embryonic development take place inside the bodies of female individuals. They have a gestation age of around 12 months then after that they are able to produce litters of 3 to 13 pups (Raje *et al.*, 2007). The pup's size at birth might range from 71 to 72 cm (Compagno and Niem, 1998). Males typically attain maturity at a size of 195 cm, whilst females typically do so at a size between 195 and 223 cm (Raje *et al.*, 2007).
Commercial importance: Pigeye sharks are used for their flesh, which has a high value when it comes to adults, as well as their skin, jaws, fins, and cartilage (White *et al.*, 2006). Adults of this species are commonly traded whole, with their meat cut into little cubes, dried, and transported to foreign markets. Juvenile flesh of *C. amboinensis* is often available fresh for human consumption in the Arabian Sea region's local marketplaces (one route is from Dubai to Sri Lanka). This species' fins are used in the fin trade; according to (Fields *et al.*, 2018), this species made up less than 0.4% of trims in Hong Kong fin markets.
Conservation status: These species are data deficient in IUCN Red List 2022.

3. ***Carcharhinus hemiodon*** (Valenciennes, 1839)

Synonyms: *Hypoprion atripinna* (Chu,1960)
Common name: Pondicherry Shark
Recorded size: 131cm
Description: These species are commonly referred to as grey sharks which are small in size and have a rather elongated, sharp snout. They differ from many other species by having a first dorsal fin with a narrow, rounded tip (Raje *et al.*, 2007). This species' body has a white ventral side and a brownish dorsal side. Typically, the fin tips are

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Figure 1: Endangered sharks; *Carcharhinus amblyrhynchus* (A), *C. amboinensis* (B), *C. hemiodon* (C), *C. longimanus* (D), *C. macloti* (E); *Stegostoma fasciatum* (F).

dark in colour or black (Compagno and Niem, 1998) (figure 1 C).

Distribution: In the past, the Pondicherry Shark lived in the Oman region (in Arabian Sea) and in the South China Sea (Garrick, 1985). But only a small number of cases had been reported from people in widely different parts of the Indo-West Pacific which includes Pakistan, Borneo, Java, India and Oman (Garrick, 1985). There are fewer than twenty specimens of the Pondicherry Shark in museum collections, all of which were acquired in 1960 and before it. Past accounts from Sri Lanka region have not been independently demonstrated, and latest accounts (De Silva, 2014) are false.

Biology: These species are classified as elasmobranchs with viviparous species because they produce a litter of, on average, 6 embryos, usually 2 to 4 in each uterine lobe. The embryo within a length range of 30 to 33.5 cm was at the advanced stage when gravid females of this species were taken in March off the east coast of India in the Gulf of Mannar. The females' lengths ranged from 82.5 to 88.7 cm (Raje *et al.*, 2007).

Commercial importance: Fins of Pondicherry shark can be eaten fresh, salted, or dried, and the offal can be used to make fish meal (Raje *et al.*, 2007).

Conservation status: According to the reports of IUCN Red List 2022 *C. hemiodon* is marked as critically endangered

4. *Carcharhinus longimanus* (Poey, 1861)

Synonyms: *Pterolamiops budkeri* (Fourmanoir, 1961)

Common name: Ocean White tip Shark

Recorded size: 163cm–192cm

Description: It has a long, broadly rounded snout and is a massive, hefty shark. Having a wide, rounded tip and rising large, the first dorsal fin (Raje *et al.*, 2007). Their top teeth are sharp and triangular, and their body has an interdorsal ridge. They have a back that is dark grey with a touch of copper, which can occasionally turn bluish or brownish. The hue of the belly is primarily white, occasionally with a hint of yellow. The tips of first dorsal fin and pectoral fins are white in colour. The lower lobe of caudal fin is also promarily white in colour (Compagno and Niem, 1998) (figure 1D).

Distribution: The Oceanic White tip Shark may be found worldwide in arctic and tropical seas (Ebert *et al.*, 2013). Western Atlantic: Caribbean, Gulf of Mexico, and Maine to Argentina. Gulf of Guinea, Madeira, Portugal, Eastern Atlantic. South Africa, Mozambique, Seychelles, Mauritius, India, the Red Sea and the Madagascar are located in the western Indian Ocean. Australia, China, New Caledonia, the Philippines, and the western Pacific region. Hawaii, Tahiti, and the Taumotu Archipelago are in the central Pacific. Eastern Pacific: Clipper ton Island, California, and Peru (Raje *et al.*, 2007).

Biology: in the species, both male and female specimen sexually mature at the approximately same lengths of about 170 – 188 cm, which come after the age of 4-5 years (Baum *et al.*, 2015). Data shows that the oceanic white tip shark mates in different parts of the north western Atlantic and in the southern Indian Ocean in early summers. It is viviparous, this shark. The growing embryos are fed by a placental yolk-sac that is attached to the uterine wall via umbilical cords. 1 to 15 puppies are born after 10 to 12 months of gestation period. A size of litter and the number of puppies in it seem to be connected (Compagno *et al.*, 2005). At birth, each pup measures around 60–65 cm in length (Baum *et al.*, 2015).

Commercial Importance: The animal's meat, fins, liver oil, and skin are all consumed (Ebert *et al.*, 2013). 1.8% of the fins imported into Hong Kong between 1991 and 2001 and 0.6% in 2014 came from the Oceanic White tip Shark (Fields *et al.*, 2018). Fresh meat of Oceanic White tip Shark Juveniles is sold for Human Consumers in Some Areas.

Conservation status: These species are critically endangered in IUCN Red List 2022.

5. *Carcharhinus macloti* (Muller & Henle, 1839)

Synonyms: *Hypoprion macloti* (Muller & Henle, 1839)

Common name: Hard Nose Shark

Recorded size: 58cm –61cm

Description: It is that species of shark which is grey in colour and small in size. It have long, slightly pointed, and narrow hypercalicified snout with, rigid bulk that is simple to feel when pinched. Present labial fold, reasonably large eyes, and absence of the interdorsal ridge. These species have medium sized, long rare tip first dorsal fin whereas the second dorsal fin is small and has a huge rear tip. Compared to the anal fin, the second dorsal fin originates somewhat later. White below and a greyish or grey-brown dorsum. Fins have no obvious marks (Raje *et al.*, 2007) (figure 1E).

Distribution: These species are commonly found in Indo-West Pacific: Mauritius, Mozambique, Kenya, Seychelles, Pakistan, Madagascar, China, South Africa, Tanzania, Andaman Sea, Sumatra, New Guinea, Sri Lanka, Java and Viet Nam (Raje *et al.*, 2007). They can also be found in continental waters among both offshore and inshore waters (Fischer, 1984).

Biology: This is a viviparous animal supposed to have placenta in it (Dulvy and Reynolds, 1997). Only 1-2 pups takes birth (usually 2 pups) per littre (Compagno and Niem, 1998). They have the gestation age of about 11-12 months (Raje *et al.*, 2002). Their males mature at the size of 69 cm whereas their females reaches on their maturity at the size of 70cm (Raje and Joshi, 2003).

Commercial importance: Fins are used for shark fin soup, shark hides are used to make leather which is further used to make jackets, bags, livers for shark liver oil which is used to heal wounds, and the remaining of shark's body is used as the feed for fish and poultry animals. Other parts are used for fresh, frozen, or smoked food. Cartilage and fins are exported (Raje *et al.*, 2007).

Conservation status: According to the data of IUCN Red List 2022 *C. macloti* is marked as near threatened.

Order	Orectolobiformes
Family	Stegostomidae
Genus	*Stegostoma*
Species	*Stegostoma fasciatum* (Hermann, 1783)

6. *Stegostoma fasciatum* (Hermann, 1783)

Synonyms: *Squalus cirrosus* (Gronow, 1854)

Common name: Zebra Shark

Recorded size: 150cm – 157cm

Description: a massive, cylinder-shaped shark having five minute gill holes, the last three of which are behind the beginning of the pectoral fin. Sides with pronounced ridges. A little transverse mouth

 Digital Object Identifier: https://doi.org/10.33865/wjb.009.01.0869

may be seen before the lateral eyes. The spiracles are about the same size as the eyes, there are barbels, and have wide, round and large pectoral fins. The size of the second dorsal fin is approximately half that of the first dorsal fin.The initial dorsal origin is located at the pelvic fin's base. Caudal fin length is approximately or exactly half that of the body. Dermal ridges are present on the sides of the caudal peduncle that extend forward. Animals under 60 cm in height have a blackish or sometimes dark brown dorsal surface with spots, vertical yellow bars, and reticulations; however, in adults, the darker regions disperse into sporadic darker dots on a backdrop of yellow (Raje *et al.*, 2007) (figure 1F).

Distribution: According to Compagno (2001), the Indian Ocean and Western Pacific's insular and continental shelves provide inshore waters where the Zebra Shark can be found.

Biology: The males of this species reaches to its sexual maturity at about150 –180 cm, while the female's specimen matures at 170 cm in length (Compagno, 2001). The life span of zebra shark is considered as 25- 30 years. These are oviparous animals, releasing egg cases into the environment that attach to the substrate's bottom with the help of fibres that resemble hair. Large egg casings, 17x8x5 cm (6.73.12 in.) in size, brownish or sometime blackish in colour and with longitudinal bands. Young one are likely to be measured in between 20 and 36 centimeters long (7.9-10 in.). In captivity, several animals have been seen to deposit eggs sporadically for up to three months per year laying 40–80 eggs annually. It is also known that zebra sharks may reproduce asexually by parthenogenesis, which is the process by which an unfertilized egg develops into a young that is essentially a clone of the mother (Robinson *et al.*, 2011).

Commercial Importance: These types of sharks are sometime caught as the whole fish, and their skin (which is dried), flesh, fins and soft bones are used (White *et al.*, 2006). Around the world, this species are housed as aquarium fishes. They reproduce effectively in aquariums, and for aquaria stock, eggs and adults are also harvested from the wild. They are important for the recreational SCUBA diving sector, especially in the waters off eastern Australia (C. Dudgeon, pers. comm.), in the vicinity of Phuket in Thailand (Anderson, 2002), and elsewhere.

Conservation status: These species are endangered in IUCN Red List 2022.

Approximately one-third of the endangered chondrichthyan species are elasmobranchs, which include sharks, stingrays, and chimaeras. This is because to unsustainable fishing techniques. Large markets which are readily available with shark's meat and luxuries like dried fins might inspire the purposeful capture or retention of high-value export species, which can contribute to overfishing. If this is typical, the risk of extinction for species traded internationally may increase. Here, we looked at the species makeup of the Hong Kong shark fin market from 2014 to 2018, and we discovered that all high value species are threatened, with traded species predominating in threatened categories (70.9%) (Cardeñosa *et al.*, 2022). An in-depth examination of the variety, prevalence, and conservation of sharks in the southern South China Sea may be found in a study paper. The study comprised assessments of shark populations at several areas around the region during a ten-year period, from 2005 to 2015. The 65 shark species that were discovered by the researchers were divided among 18 families and consisted of the brown banded bamboo shark, spot-tail shark, and Indonesian bamboo shark. The study also showed that overfishing and other conservation issues were putting several shark species, including the whale shark and the tiger shark, in danger (Arai and Azri, 2019). From a social, cultural, and economic standpoint, shark fisheries have long been significant at the local, regional, and worldwide levels. Shark goods have primarily been the consequence of accidental capture in fisheries that target other, more lucrative species, despite being often targeted. The United Nations Food and Agriculture Organization (FAO) receives reports on shark landings from at least 135 different countries. Sharks are caught using a wide range of fisheries and fishing equipment by industries ranging from large multinational corporations to small-scale artisanal fishermen. There was a peak in the global shark catch in 2003 which dropped by around 20% till now (Davidson *et al.*, 2016). An essential source of information on the physical characteristics and population dynamics of these endangered shark species is the biometric pooling data. This dataset provides information on the range of sizes and weights found in the population. It includes maximum length (L1), lowest length (L2), average length (L), maximum weight (W1), minimum weight (W2), and average weight (W). Furthermore, the documented numbers of males and females (N2) provide important details for comprehending the demographic makeup and reproductive habits of these sharks. Such thorough information is critical to conservation efforts because it informs tactics meant to prevent these species and their habitats from declining any more (table 2).

Table 2: Biometric pooled data of Max. Length (L1), Min. Length (L2), Average Length (L), Max. Weight (W1), Min. Weight (W2) and Average Weight (W) with no. of male and females N2 recorded.

Species	Sex	N2	L1	L2	L	W1	W2	W
	M	2	132	124	128	9	8	8.5
Carcharhinus amblyrhynchus	F	2	118	105	111.5	10	7.2	8.6
	M	3	97	87	92	9	7	8
C. amboinensis	F	1	92	92	92	7.8	7.8	7.8
	M	2	137	131	134	11	9	10
C. hemiodon	F	2	142	101	121.5	10.3	7	8.65
	M	3	183	163	173	12	8	10
C. longimanus	F	2	192	185	188.5	13	9.5	11.25
	M	1	58	58	58	8	8	8
C. macloti	F	2	73	61	67	11	9	10
	M	1	113	113	113	9	9	9
Stegostoma fasciatum	F	1	150	150	150	12	12	12

Species included in the shark fin trade include large coastal carcharhinids such as Grey reef (*Carcharhinus amblyrhynchos*) and Bull shark, (C*. leucas*), coastal-pelagic species such as Great white (*Carcharodon carcharias*) and Hammerhead sharks (*Sphyrna spp*.), and oceanic species such as Oceanic whitetip (*C. longimanus*) and Thresher sharks (*Alopias spp*.), among others. The International Union for the Conservation of Nature (*www.iucnredlist.org*) has designated several of these species as being globally vulnerable, making their urgent conservation a priority. Figure 2 showed the different categories of species according to their availability and abundance.

Due to the dearth of fundamental biology data for many species, the level of information and understandings about Selachian's life cycle trade-offs remains relatively restricted. This is a disgrace, since a greater understanding of the patterns and trade-offs in the life histories of elamobranchs would be useful for comparing the evolution of creature life histories and for elucidating the relationships that exist within this group between natural selection and life histories. Even though from the coast of Sindh, illegal trawlers and netting procedures are being followed which causes different harmful effects in the habitat in the form of habitat destruction and untargeted species catch.

Shark populations suffer greatly from the use of illicit fishing methods, which puts their existence in jeopardy and causes sharp drops in their abundance. Shark populations are declining globally due to practices like shark finning, in which sharks are captured just for their fins and the remainder of their bodies are thrown away. Because sharks are essential to preserving the stability and health of marine food webs, their indiscriminate destruction upsets the delicate balance of marine ecosystems. Sharks' decrease is further exacerbated by the fact that illicit fishing techniques like longlining and gillnetting frequently lads to the unintended capture of sharks as bycatch. The strain from illicit fishing drives many shark species closer to extinction, since they already face risks from habitat degradation, pollution, and climate change. The wellbeing and resilience of marine ecosystems as a whole, as well as the survival of sharks, depend on keeping them safe from illicit fishing. When compared to all shark species, however, animals involved in the shark fin trade had markedly different patterns of variation (Lucifora *et al.*, 2011).

 Digital Object Identifier: https://doi.org/10.33865/wjb.009.01.0869

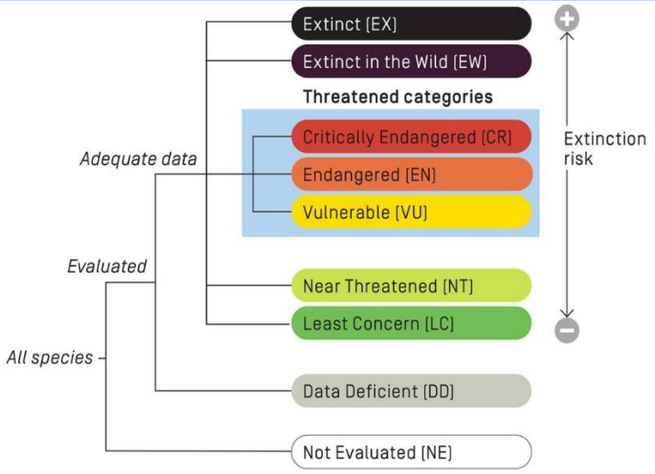

Figure 2: The IUCN Red List Categories for threatened species. (https://www.iucnssg.org/uploads/5/4/1/2/54120303/iucn-red-list-figure-01_orig.jpg)

Figure 3 showed the seasonal occurrence of the endangered species observed in the landings at Karachi Fish Harbour during the study period (2014-2023) which is selected as the observation site. The figure shows that these endangered species were seen in surveys 2, 3 and 4 whereas they were not observed in the landings which were conducted in survey 1 and survey 5.

Figure 4 showed the contribution of endangered sharks which have been observed in the catch landed at Karachi Fish Harbour during the study period 2014-2023. These species have been marked as those species that can be extinct in near future by the IUCN Red List 2022 but still these species can be seen in the landings as bycatch due to unregulated fishing.

Since the public became aware of the practice of switching out high-value fish for low-value fish in markets, restaurants, and processed seafood, mislabeling of fish and fish products has received a lot of attention. Sometimes, mislabeling involves IUU (illegal, unreported, and unregulated) fishing, which contributes to overfishing of replacement species that are undetected when marketed under incorrect names (Agyeman *et al.*, 2021).

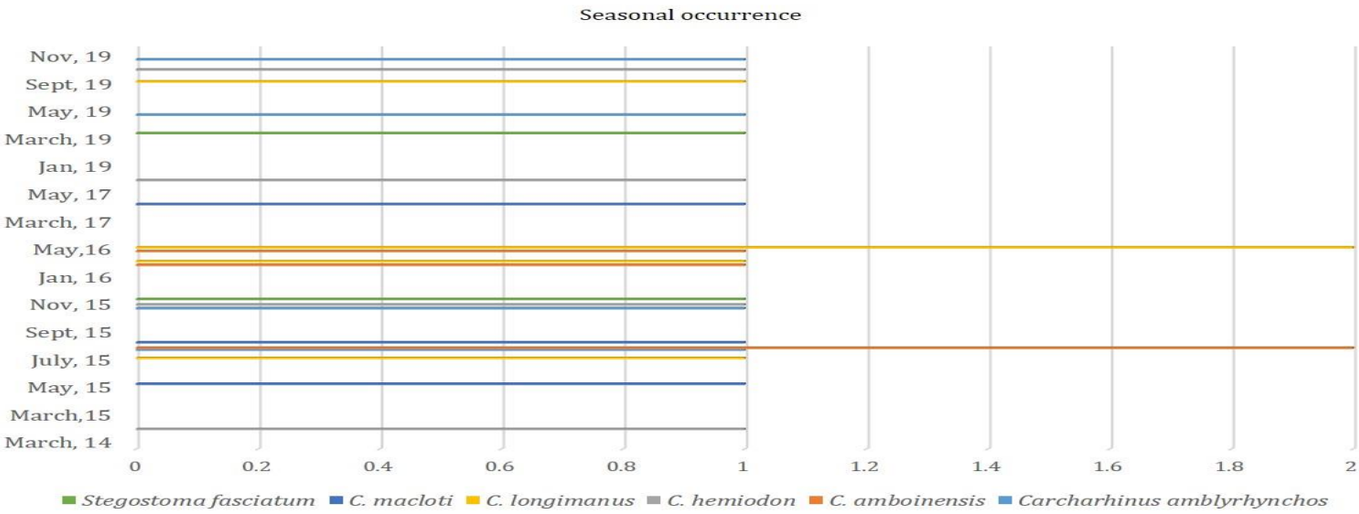

Figure 3: Seasonal occurrence of endangered sharks in the landings at Karachi Fish Harbour.

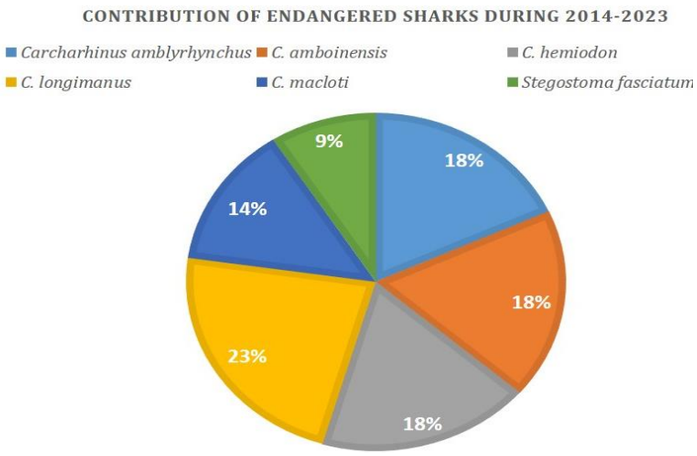

Figure 4: Endangering shark's contribution in the landings observed at Karachi Fish Harbour between 2014 and 2023.

Sharks were formerly revered and respected, despite what current western civilization feels. This is demonstrated by history. The public's image of sharks is badly impacted by sensationalised media coverage, and policymakers' capacity to maintain healthy shark populations is negatively impacted by a lack of knowledge regarding management and conservation choices. It is critical to take into account people's attitudes towards sharks when creating conservation measures since these views will affect how eager people are to find a way to cohabit with sharks (Neves *et al.*, 2022).

CONCLUSION: Few species of sharks in the landings at Karachi Fish Harbour during the study period 2014-2023 were observed as endangered species, which emphasizes the urgent need for conservation measures to protect their populations. Species including *Carcharhinus amblyrhynchus, C. amboinensis, C. hemiodon, C. longimanus, C. macloti, and Stegostoma fasciatum* are among those that are at risk. These species, which represent the delicate balance of marine ecosystems, are threatened by a variety of issues, including pollution, habitat loss, overfishing, and climate change. The dusky shark, *Carcharhinus amblyrhynchus,* is found in coastal seas all around the world. It is susceptible to overexploitation because of its low reproductive rate, late maturity, and sluggish development. Similar population losses are observed in the spot-tail shark, *C. amboinensis,* as a result of heavy fishing for its flesh, fins, and liver oil. Because they typically tangle in fishing gear meant for other species, these species' vulnerability to bycatch exacerbates their decline. The *C. hemiodon* (pondicherry shark) , is unique to the Indo-Pacific region and faces habitat loss as a result of pollution and coastal development, which is made worse by the shark's small range. The overfishing of the oceanic white tip shark (*C. longimanus*), which is highly valued in the lucrative shark fin trade, is the main cause of the shark's dramatic population decreases. It's decrease is harmful to marine biodiversity because it serves as an apex predator in pelagic habitats. The *C. macloti* (hardnose shark), is found in shallow coastal areas. Overfishing, habitat degradation, and accidental catch are some of the dangers it confronts. It's significance for preserving the equilibrium of ecosystems emphasizes how urgent conservation efforts must be. The *Stegostoma fasciatum* (zebra shark), which is valued for both it's flesh and fins, is being overfished and is losing habitat, especially in coral reef environments. The conservation tactics employed for these critically endangered sharks include habitat preservation, sustainable fisheries management, and legislative actions. To stop population decreases, laws restricting bycatch and outlawing shark finning must be put into place and enforced. Marine protected areas (MPAs) are essential for preserving important ecosystems and giving fragile species a place to live. To promote appropriate fishing techniques and raise knowledge of conservation issues, community participation and education programs are essential. For conservation efforts to be successful and guarantee the long-term survival of shark populations and marine ecosystems, cooperation between governments, non-governmental organizations, scientists, and local communities is crucial. Moreover, studying the biology, ecology, and behaviour of these threatened shark species is essential to creating focused conservation plans. Comprehending their reproductive biology, genetic diversity, and migratory patterns can help with the formulation of successful conservation strategies and management choices. It is imperative to tackle the wider problems of pollution, climate change, and habitat loss in order to secure the future of these threatened shark species. The negative effects of climate change on marine biodiversity can be lessened by minimizing human impacts

 Digital Object Identifier: https://doi.org/10.33865/wjb.009.01.0869

on marine ecosystems through sustainable development practices and carbon emission reduction. In summary, it is a difficult but necessary task to conserve endangered shark species like *Carcharhinus amblyrhynchus, C. amboinensis, C. hemiodon, C. longimanus, C. macloti,* and *Stegostoma fasciatum*. We can protect these iconic species and ensure the resilience and health of marine ecosystems for future generations by working together to reduce threats and promote sustainable management practices.

CONFLICT OF INTEREST: The authors declared no conflict of interest.

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