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Indian Freshwater Elasmobranchs: Ongoing Threats along with IUCN Current Status and Conservation of Protecting Hidden Treasures: A Review

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ABSTRACT

We always thought that elasmobranchs inhabit marine environments, but this is only partially true. About 5% of known elasmobranch species are the freshwater compared to 40% of teleost species. A systematic checklist is available for Indian freshwater elasmobranches with names and IUCN status. A total of 13 species belonging to 3 orders, 3 families and 10 genera were enlisted from secondary data. Euryhaline and obligate species include sharks as *Carcharhinus, Glyphis* (Carcharhinidae), *Chiloscyllium* (Hemiscylliidae), sawfishes or *Pristis* (Pristidae), stingrays or *Himantura* (whiprays) and *Pastinachus* (cowtailed rays) (Dasyatidae). We focus on distribution, feeding habits, threats and conservation. Freshwater excursions are relatively rare in extant elasmobranchs than other groups of fish. The low growth rate is probably due to late age at maturity and low fecundity, long gestation periods, slow growth and productivity (small, infrequent litters), high natural survivorship for all age classes and long life. Despite this, some species of freshwater elasmobranchs can tolerate and even thrive in freshwater.

Key words: Chondrichthyans, Conservation, Gangetic shark, IUCN, Management, Rays, Skates.

Elasmobranchs, also known as chondrichthyans, are marine vertebrate with a cartilagenous skeleton (Nair *et al.,* 2015). It is one of the largest marine fish resources consisting sharks, skates, sawfishes and rays (Kumar *et al*., 2022). Importantly, compared with other marine vertebrates, elasmobranchs are highly evolutionary distinct and are greatly threatened by human activities (for uses of various body parts such as the meat, fins, liver and teeth), especially by overfishing (Pimiento *et al*., 2023). These fishes are distinguished from their sister group of bony fishes (teleost) by traits such as a cartilaginous skeleton, the lack of swim bladders and the presence of 5 to 7 pairs of gill slits not covered by an operculum (Compagno, 2002). However, elasmobranchs occur regularly in low-salinity water, often beyond the tidal region. These comprise about 5% of all live elasmobranchs (approximately 60 out of 1154 described species). Although the reasons are unknown, marine elasmobranchs maintain a high requirement for urea in their bodies (Ballantyne and Robinson, 2010). They have two groups: 1. Euryhaline elasmobranch 2. Obligate freshwater elasmobranch.

1. Euryhaline elasmobranch

Those fishes that can tolerate a wide range of salinities, from freshwater to brackish, are termed 'euryhaline elasmobranch'. Euryhaline chondrichthyans include sawfishes (Pristidae), several whaler sharks (Carcharhinidae), one skate (Rajidae) and several stingrays (Dasyatidae), which are primarily marine fishes that can enter and stay in freshwater (Lucifora *et al*., 2015).

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2. Obligate freshwater elasmobranch

These fishes confine to freshwater and comprise all the freshwater stingrays (family-Potamotrygonidae) and several stingrays (Dasyatidae), which complete their whole life, cycle exclusively in freshwater (Lucifora *et al*., 2015).

According to the IUCN, freshwater elasmobranchs are typically at high risk of extinction but least evaluated. The IUCN Red List of Threatened Species is increasingly used to reveal the health of ocean biodiversity. Dulvy *et al*. (2021) assessed 1,199 chondrichthyans and demonstrated the need for fishing limits on target and incidental catch and spatial protection to avoid further extinctions and allow for food security and ecosystem functions.

Highlights

1. More than one-third of chondrichthyan fish species are threatened by overfishing.
2. A disproportionate threat in the tropics risks the loss of ecosystem functions and services.
3. Three species not seen in >80 years are Critically Endangered (Possibly Extinct).
4. The depletion of these species has a continuous demand for human food.

Diversity distribution of freshwater elasmobranches in the world

According to IUCN, 1,199 species were reported in Class Chondrichthyes-sharks, rays and chimeras (Dulvy *et al*., 2021). The first global assessment (2014) concluded that one-quarter (24%) of species were threatened. Now, 391 (32.6%) species are threatened with extinction.

The seven freshwater obligate chondrichthyans comprised a single West African species (Smooth Stingray- *Fontitry gongaurouensis*) and six Southeast Asian species (Roughback-Whipray *Fluvitry gonkittipongi*, Marbled Whipray- *F. oxyrhynchus*, White-edge Whipray- *F. signifer*, Mekong Stingray- *Hemitry gonlaosensis*, Chindwin Cowtail Ray- *Makararaja chindwinensis* and Giant Freshwater-Whipray (*Urogymn uspolylepis*).

Distribution and freshwater elasmobranches in India

Indian waters support a diverse chondrichthyan group consisting of more than 110 species of elasmobranch, which comprises 66 species of sharks and 44 species of batoides (Raje *et al*., 2002). Later description of new records and new species may bring to this sum to about 150-170 species from the Indian coast only, of which 3% are Critically Endangered (CR), 5% are Endangered (EN), 26% are Vulnerable (VU), 21% are Near Threatened (NT), 8% are of Least Concern (LC), 27% are Data Deficient (DD) and 10% are Not Evaluated (NE) (Joshi, 2022; IUCN, 2024). However, there is no correct information on freshwater elasmobranchs.

In the present report, we have listed 13 species belonging to 3 orders, 3 families and 10 genera from secondary data. We assessed the IUCN status also (Table 1) and provide a systematic checklist of Indian freshwater elasmobranches with their taxonomic position, distribution and IUCN Red List status (Table 2).

Habit and habitats

The freshwater elasmobranches occupy a wide range of habitats, including freshwater riverine (but not land-locked water systems) and lake systems, inshore estuaries and lagoons, coastal waters, the open sea and the deep ocean. Most elasmobranchs are mid-level or top predators and play a key role in trophic food webs (Yeldan, 2018).

Socio-economic significance of elasmobranch

Chondrichthyans groups are one of the most versatile/ valuable fisheries resources, providing meat and shark fins for human consumption (Shark fin soup); gills (as a tonic), leather (Purse, belt); shark liver oil used to produce lubricants, for medicine, fuel, cosmetics and vitamin A; live specimens for aquaria; and shark teeth (Ornamental) and jaws sold as tourist curios (Fig 1) (Dent and Clarke, 2015). More recently, shark cartilage has been exploited to treat cancer and other ailments and sharks and rays have become an attraction to scuba divers.

Major emerging threats to elasmobranches

Threats posed to elasmobranchs habitats by humans are directly proportional to the habitat's proximity to land. Elasmobranch fishes (sharks, rays and skates) face several major emerging threats to their survival and well-being (Fig 2) (Bornatowski *et al.,* 2014). These threats contribute to declining populations and endanger many species. Some of the emerging threats to elasmobranchs are:

Overfishing

It is one of the threats to elasmobranchs driven by the demand for shark fins, meat and other products. They are caught by bottom trawls, longlines and gillnet fishing gears (Dulvy *et al.,* 2021). Many species have slow growth rates and reproduce infrequently, making them particularly vulnerable to overexploitation.

By-catch

Elasmobranchs are often caught unintentionally as by catch in commercial fishing operations targeting other species. It can lead to high mortality rates for elasmobranchs, especially when discarded at sea.

Habitat loss

Habitat degradation and loss, primarily caused by coastal development, pollution and climate change, impact elasmobranchs' breeding and feeding grounds. Mangroves, estuaries and coral reefs are crucial habitats for many species.

Climate change

Climate change poses several threats to elasmobranchs. Rising ocean temperatures can alter their distribution and

Table 1: Current IUCN red list status.

IUCN categories	Contribution (%)
Critically endangered	23.08%
Endangered (EN)	15.38%
Vulnerable (VU)	23.08%
Near threatened (NT)	23.08%
Not evaluated (NE).	15.38%

Table 2: Systematic Checklist of Indian freshwater elasmobranches, their taxonomic position, common, Distribution along with IUCN Red List status.

Scientific name	Common name	Distribution	Reproduction mode	IUCN status	CITES	CMS	National protection WPA
Sharks							
Order: Carcharhiniformes							
Family: Carcharhinidae							
Glyphis gangeticus (Müller and Henle, 1839)	Ganges shark	Indo-West Pacific region, Ganga, Hooghly, Mahanadi and Brahmaputra rivers.	Viviparpous	CR	NE	Not listed	Sch I (Part IIA)
Carcharhinus leucas (Müller and Henle, 1839)	Bull shark, Zambezi shark in Africa	Cosmopolitan in tropical and subtropical waters, Ganga River, Bangladesh.	Viviparpous	VU	NE	Not listed	Not protected
Carcharhinus hemiodon (Valenciennes, 1839)	Pondicherry Shark, or Long-Nosed shark	Very rare Indo-West pacific species; Gulf of Oman to Pakistan, India and possibly Sri Lanka.	Viviparous	CR	NE	Not listed	Schedule I
Scoliodon laticaudus (Müller and Henle 1838)	Spadenose shark	Indo-West pacific region; Bangladesh; India; Iran, Islamic Republic of; Myanmar [Myanmar (mainland)]; Pakistan; Sri Lanka; Thailand	Viviparous	NT	NE	Not evaluated	Not protected
Order: Orectolobiformes							
Family: Hemiscylliidae							
Chiloscyllium indicum (Gmelin, 1789)	Slender bambooshark, Ridgebacked bamboo shark	Bangladesh; China; India; Indonesia; Malaysia; Myanmar; Singapore; Sri Lanka; Thailand; Vietnam.	Oviparous	VU	NE	Not listed	Not protected
Rays							
Order: Myliobatiformes							
Family: Dasyatidae							
Himantura luviatilis (Hamilton, 1822)	Ganges stingray	Asia: Gangetic river system. Possibly in the Bay of Bengal and the Fly river system in New Guinea.	Ovoviparity	NE	NE	Not listed	Not protected
Pastinachus ater (Macleay, 1883)	Broad cowtail stingray, banana-tail ray, drab stingray, fantail ray, feathertail stingray and frill tailed sting ray.	Indo-West pacific: Madagascar, Western Australia, Philippines, Indonesia and Malaysia and Papua New Guinea	Ovoviparity	VU	NE	Not listed	Not protected

Table 2: Continue...

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Pastinachus sephen (Forsskål, 1775)	Cowtail stingray	Indo-West pacific, found only in Northwestern Indian Ocean	Ovoviparity	NT	NE	Not listed	Not protected
Brevitrygon walga (Müller and Henle, 1841)	Dwarf whipray, Scaly whipray or mangrove whipray	Northern Indian Ocean: From the Red Sea to western India, including the Persian Gulf.	Ovoviparity	NT	NE	Not listed	Not protected
Skates Order: Rajiformes/ Rhinopristiformes Family: Pristidae							
Pristis pristis (Linnaeus, 1758)	Largetooth Sawfish, Common sawfish	Western Pacific: Northern Australia, from Western Australia to Queensland. Eastern pacific: Gulf of California to Ecuador. Western Atlantic: Florida and Louisiana, USA to Brazil. Eastern Atlantic: Portugal to Angola, including the western Mediterranean. Pakistan and India.	Ovoviparity	NE	Appendix I	App. I and II	Sch I
Pristis microdon (Latham, 1794)	Freshwater or largetooth sawfish	Indo-West Pacific: East Africa to New Guinea, north to the Philippines and Viet Nam, south to Australia.	Ovoviparity	NE	Appendix I		Sch I (Part IIA)
Pristis pectinata (Latham, 1794)	Smalltooth sawfish	Indo-West Pacific: Red Sea and East Africa to the Philippines.	Ovoviparity	CR	Appendix I	Appendix I and II	Not protected
Anoxypristis cuspidata (Latham, 1794)	Narrow Sawfish, Knifetooth sawfish, Pointed sawfish	Indo-West Pacific: Red Sea and the Persian Gulf to New Guinea, north to southern Japan, south to northern Australia	Ovoviparity	NE	Appendix I	Appendix I and II	Not protected

CR: Critical endangered; NE: Not evaluated; NT: Near threatened; VU: Vulnerable; WPA: Wildlife (Protection) Act, 1972; CMS: Convention on migratory species.

affect prey availability. Ocean acidification can harm their calcium-based skeletons and eggs and changing currents can impact migration patterns.

Illegal fishing

Illegal, unreported and unregulated (IUU) fishing operations often target elasmobranchs for their valuable fins and meat. These activities can undermine conservation efforts and exacerbate population declines.

Trade and shark finning

The global trade in shark fins for use in shark fin soup and traditional medicines is a cause of elasmobranch exploitation. Shark finning, the practice of removing fins and discarding the rest of the carcass at sea, is wasteful and unsustainable.

Shark mislabeling

Shark mislabeling refers to the fraudulent practice of misidentifying or misrepresenting shark species in the



Fig 1: Sharks and rays landed at cochin fisheries harbour, Kochi, Kerala (Photo credit: Ashish Sahu).



Fig 2: Major emerging threats to elasmobranches (Illustration by Ashish Sahu).

Table 3: Freshwater elasmobranchs protected under schedule I of (Indian) Wildlife (Protection) Act, 1972.

Scientific name	Common name	Family/Order
Sharks		
Carcharhinus hemiodon	Pondicherry shark	Carcharhinidae/Carcharhiniformes
Glyphis gangeticus	Ganges river shark	Carcharhinidae/Carcharhiniformes
Rays		
Himantura fluviatilis	Ganges sting ray	Dasyatidae/Rajiformes
Sawfishes		
Anoxypritis cuspidata	Pointed sawfish	Pristidae/Pristiformes
Pristis microdon	Largetooth sawfish	Pristidae/Pristiformes

seafood supply chain. It can occur at various stages, including fishing, processing and distribution. The mislabeling of shark products has consequences for consumers and the marine environment (Bornatowski *et al.,* 2013).

Pollution

Pollution from plastic debris, chemical pollutants and heavy metals can harm elasmobranchs directly or indirectly by contaminating their prey and habitats.

Invasive species

Invasive species introduction in freshwater habitats can disrupt elasmobranchs' ecosystems and reduce prey availability.

Lack of conservation measures

Many elasmobranch species lack adequate protection under national and international conservation agreements. Stronger regulations and enforcement are needed to safeguard these animals (Fischer *et al.,* 2012).

Scientific knowledge gaps

Limited scientific understanding of elasmobranch biology, population dynamics and behavior can hinder conservation efforts. More research is needed to fill these knowledge gaps.

Conservation status of Indian freshwater elasmobranches

International conservation and management initiatives for elasmobranches fish

- United Nations Convention on the Law of the Sea (UNCLOS), 1982.
- UN Fish Stocks Agreement, 1995.
- FAO Code of Conduct for Responsible Fisheries (CCRF), 1995.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973.
- Convention on Migratory Species (Bonn Convention), 1979.
- Convention on Biological Diversity, 1992.
- The International Union for Conservation of Nature.

In 2013, the Ministry of Environment and Forests, Government of India implemented shark finning. The Indian Wildlife (Protection) Act, 1972 lists ten elasmobranchs in Schedule I part 2(A) in MoEF, 2001, which are identified accurately in the field to ensure their protection (Table 3).

CONCLUSION

Approximately 5% of all chondrichthyans are found in the freshwater ecosystem far beyond tidal influences, inhabiting the tropical and subtropical freshwater environment (river and lakes) where prolonged isolation has led to speciation and specialization to freshwater habitats. There are gaps in knowledge of the biology and status of obligate freshwater and euryhaline elasmobranchs. The total diversity of elasmobranchs utilizing reduced salinity habitats is not known. Compagno and Cook (1995) documented 44 species in the river mouths and an additional 25 species penetrate estuarine waters.

This 21st century has been called the century of extinction. Over-exploitation and habitat degradation/ alteration are major concerns causing loss of biodiversity. There is an urgent need to catalog biodiversity before several species become extinct without humans knowing their existence. This study suggests awareness to conserve these valuable species among all levels of people involved in the fishery and trade of elasmobranchs. We suggest that a systematic review of fishery trades, importance, distribution, biology and the migration pattern of this group in Indian waters, with regional sampling and molecular investigations would identify a greater diversity of this group. We recommend conservation and management, as well as priorities for future work.

Conflict of interest

All authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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