

Elasmobranch conservation, challenges and management strategy in India: recommendations from a national consultative meeting[†]

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Historically, India has been projected as one of the major elasmobranch fishing nations in the world. However, management and conservation efforts are not commensurate with this trend. Along with the Wildlife (Protection) Act, 1972, several generic conservation measures are in place at the regional/local level. But India is still a long way from meeting global conservation commitments. We present here the status of elasmobranch management and conservation in India, with the specific objective of identifying the gaps in the existing set-up. We also present recommendations based on a national consultative workshop held at the Central Marine Fisheries Research Institute, Kochi, in February 2020. We recommend the implementation of a National Plan of Action (NPOA-Sharks) and more inclusive governance and policymaking for elasmobranch conservation in India.

Keywords: Consultative meeting, elasmobranch, fisheries, management and conservation, regulations.

MOST elasmobranchs, including sharks, rays, skates, sawfishes and guitarfishes, by their typical conservative life-history traits, are highly sensitive to overexploitation. The elasmobranch population reductions due to overexploitation¹⁻⁵ can have major ecological impacts⁶, and may forewarn the socio-economic challenges that can result from a fisheries collapse. High international market demand for shark fins is often considered the major driver for exploitation⁷⁻⁹. However, for many countries, including low-income and developing countries, elasmobranchs are an important source of food nutrition, and their high first-sale

returns support the community economically, leading to the continued exploitation of the group as a valuable resource¹⁰⁻¹⁴.

Elasmobranchs are a regular component in India's artisanal, small-scale and semi-industrial marine fisheries, largely as bycatch, but also as targeted fisheries¹⁵, contributing significantly to nutrition and livelihood^{14,15}. They are predominantly used for consumption within the country. The consumption of elasmobranchs varies among communities and regions, with preference among some communities being driven by cultural affinities, while other consumers

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[†]*Disclaimer:* The marine fish landings data used in this study are research data of ICAR-Central Marine Fisheries Research Institute, Kochi collected through diachronic primary surveys following a stratified multi-stage random sampling design across the coastline of India.

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are attracted by the ‘delicacy’ status of shark meat and/or associated health benefits^{14,16,17}.

Historically, India has figured among the top elasmobranch fishing nations in the world^{15,18–20}. They are caught by diverse fleets and multi-gear fisheries operating across the entire exclusive economic zone (EEZ). Despite this, the share of elasmobranchs in the estimated annual marine fish landings in India reduced from 3.4% in 1985 to under 2.0% in 2005, and has remained in the range of 1–2% since then¹⁵; the group formed <1% of the annual landings in 2020 (ref. 21). A peak in elasmobranch landings in India during 1997–98 and subsequent decline raised serious concerns about sustainability¹⁵; the peak was due to increased fishing efforts and targeted fishery for sharks, particularly the whale shark (*Rhincodon typus*), to meet the increasing export demand of shark products, intense mechanization of fishing boats and increased offshore multiday fishing.

The first initiative towards elasmobranch conservation in India began in 2001, when some sharks and rays were declared as protected species under the amended Wildlife (Protection) Act, 1972 (hereafter WPA). Today, nearly two decades later, despite several policies and programmes in place to address elasmobranch conservation globally²², India’s approach to sustainable exploitation, conservation of elasmobranchs and research needs improvement. In recent years, the Government of India (GoI) has put in place several directed measures for marine conservation and fisheries management in general²³, some of which apply to elasmobranchs¹⁵, the most recent being a comprehensive National Policy on Marine Fisheries (NPMF) notified by the Department of Animal Husbandry, Dairying and Fisheries (DAHDF), the Ministry of Agriculture and Farmers Welfare (MoA&FW), GoI, vide Gazette notification F. No. 21001/05/2014-FY (Ind) Vol. V. – Preamble dated 28 April 2017. However, India is yet to achieve its international commitments to regulations/conventions under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on the Conservation of Migratory Species of Wild Animals (CMS) and Convention on Biological Diversity (CBD) specific to elasmobranch conservation.

The Indian Ocean countries, including India, have a set of complex challenges, often masked in generalist threats and management issues^{24,25}. India has been identified as one of the priority countries where improved conservation and management efforts are needed^{26,27}. There are reports of local extinction of three species, i.e. tentacled butterfly ray (*Gymnura tentaculata*), Indian sharpnose ray (*Telatrygon crozieri*) and Ganges shark (*Glyphis gangeticus*)⁴ in their distribution range including the Indian EEZ, in addition to the possible local extinction of sawfishes (Pristidae)^{28,29}.

Recognizing the need for specific action plans for the conservation and management of elasmobranchs in Indian waters, a national expert consultative workshop was conducted from 4 to 6 February 2020 at Central Marine Fisheries Research Institute (ICAR-CMFRI), Kochi, India, involving

scientists, academicians, independent researchers and Government officials with expertise in the area³⁰. Here, we present an overview of (i) the status of elasmobranchs in India, including fisheries, utilization and trade; (ii) their management and conservation, including legislation at the National and State levels; (iii) Regional and International commitments, and (iv) challenges to effective conservation. Finally, we summarize the recommendations of the expert consultative workshop which will be useful in formulating and implementing effective management policies on par with global conservation actions.

Current status of elasmobranchs in India

Fishery of elasmobranchs

In India, elasmobranchs are landed as retained bycatch in a multitude of fishing gears operated along and off the coast¹⁵. A targeted fishery operated by fishermen in Thuthoor, Kanyakumari District, Tamil Nadu, on the south coast has now been diversified to other groups¹⁵. A rapid stock assessment (RSA) comparing the recent three-year average annual landing of elasmobranchs with the historical average using landing data for 29 years (1985–2013) and following specified classification criteria³¹, indicated that elasmobranchs were either ‘declining’ or ‘less abundant’ in most parts of the coast¹⁵. The annual landings of elasmobranchs in India estimated by ICAR-CMFRI showed an overall declining trend from ~33,500 tonnes in 1961 to ~25,900 tonnes in 2020, with intermediate peaks; the general pattern was similar to the reported catch from the Indian Ocean by the Food and Agriculture Organization, Rome (FAO) (Figure 1). The average decadal annual landings declined from 64,732 tonnes in 1991–2000 to 52,031 tonnes in 2001–10 and 47,732 tonnes in 2011–19, showing similarity with the global trends³². The proportion of elasmobranchs in the overall fish landings has also reduced through the period¹⁵.

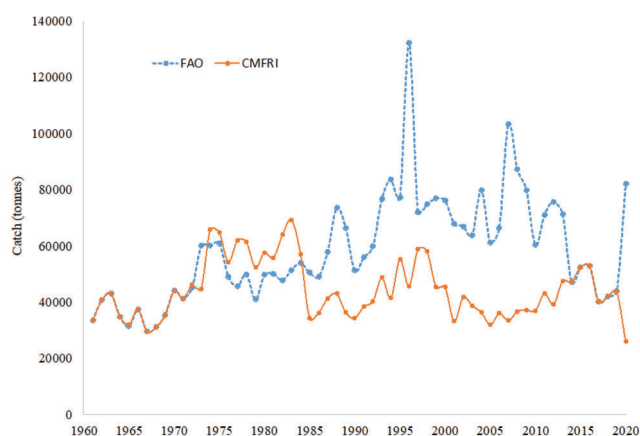


Figure 1. Elasmobranch landing data – India (mainland) estimated by ICAR-CMFRI vis-à-vis FAO-reported catch data for ‘sharks, rays, skates, etc.’ from the Indian Ocean (source: FishStatJ, 1961–2020).

However, the landing estimates by ICAR-CMFRI vary from those provided by the State Fisheries Departments (SFDs). Many coastal species of sharks show signs of being exploited beyond optimum levels^{15,30,33–35} and the disappearance of some elasmobranch species from the fishery has been perceived by the fishing communities¹⁴. A major lacuna in the available elasmobranch landing data for India is the poor representation of the fishery in the islands. Studies have documented the presence of elasmobranch fisheries in the Andaman Islands^{36,37}. Transportation of shark fins from the Island to the mainland has also been reported³⁸. In spite of the vagaries in data, the extent of exploitation and landings of elasmobranchs must be considered a major criterion for recommending regulations and management measures.

The elasmobranch species listed in the WPA do not form a major part of the bycatch or targeted fishery. However, unusual bycatch of whale sharks and its utilization was recorded along the Andhra Pradesh coast in 2015–16. Following these observations, awareness campaigns were conducted by several organizations, and the catch and utilization were stopped^{21,39}. Sawfishes were also considered a good fishery historically, particularly along the northern Arabian Sea coast and the northern Bay of Bengal (before 1960–70), but this gradually declined due to incidental capture and habitat degradation/loss, until the fishes virtually ‘disappeared’ locally^{29,40}.

Trade and utilization

Sharks and their products are in demand in domestic and international markets¹⁴; however, this demand is not uniform across the country. Landed sharks are utilized completely as there is a good domestic market for its meat as well as domestic and export demand for shark liver oil, jaw and skin¹⁵. Previously, international demand for shark fins and oil, and domestic demand for fresh and processed sharks were the drivers for targeted shark fishery in certain parts of India. In recent years, there has been an increasing demand for gill plates of manta and devil rays, even though international trade of the same is regulated under Appendix II of CITES¹⁵. Other than the shark fin export ban, elasmobranch trade is prohibited only for the ten protected species; there are no restrictions on domestic trade of other species or export of non-fin commodities. With little information at the species level on the quantum of trade, products/types, destination, value addition, etc. ensuring transparency and traceability becomes extremely challenging. The Marine Products Export Development Authority under the Ministry of Commerce and Industry, GoI, monitors, promotes and regulates the export of marine products from India. Though export trade data records are mandatory, data are recorded in a broad aggregate category, with non-species-specific or group-level declarations. Thus, there is a need for improved understanding of the elasmobranch trade dynamics in India,

including (species-specific) sources, markets and market-chains as well as the social and economic dependency on elasmobranch trade, which are all necessary for informed management⁴¹. A joint study by ICAR-CMFRI and WWF-India during 2017–18 on the value chain and socio-economics of elasmobranch fishing showed a high level of reluctance on the part of traders and other stakeholders to share trade information about sharks⁴⁰, possibly due to the conservation attention to the group. In 2019, ICAR-CMFRI, in collaboration with FAO initiated a study on shark and ray non-fin commodities in India to map the market chains across the country^{39,42}. The study was the first of its kind in the country, and involved several stakeholder meetings and extensive questionnaire-based surveys of respondents, including fishers, aggregators and sellers across 34 coastal sites in mainland India.

Management and conservation of elasmobranchs in India

Research and monitoring

Elasmobranch research in India is mainly undertaken by Government-funded agencies (Figure 2), namely Fishery Survey of India (FSI) under the Ministry of Fisheries, Animal Husbandry & Dairying (MoFAH&D), GoI and ICAR-CMFRI under MoA&FW, GoI. FSI estimates fish abundance in India’s coastal waters and EEZ through experimental fishery surveys⁴³. ICAR-CMFRI estimates stock status (both multispecies estimates based on catch and effort, and species-specific length-based/age-based assessments) from fishery landing data collected through a statistically designed sampling method, by a large network of trained field survey staff across the maritime states⁴⁴. Several universities, colleges and NGOs are also involved in research on elasmobranchs. Most of the research remains scattered and isolated from each other without adequate consolidation or collaboration. While there is good knowledge on the spatial distribution of species with distributional records, species biology and fisheries from India not withholding limitations, information on species-specific stock status, critical habitats of elasmobranchs, conservation, management and socio-economics, human dimensions of elasmobranch fisheries is limited or non-existent⁴⁵.

MoFAH&D and MoA&FW, GoI, are the nodal agencies overseeing fisheries research, and formulation and implementation of management and conservation advisories. Conservation actions fall under the Ministry of Environment, Forest & Climate Change (MoEF&CC), GoI. The SFDs have the flexibility to chart and implement their own rules and regulations for conservation, such as zonation, closed areas, minimum legal size (MLS) and conservation incentives within the ambit of the Marine Fishing Regulating Acts (MFRAs), which are usually generic and seldom address species-specific needs. Thus, the SFDs

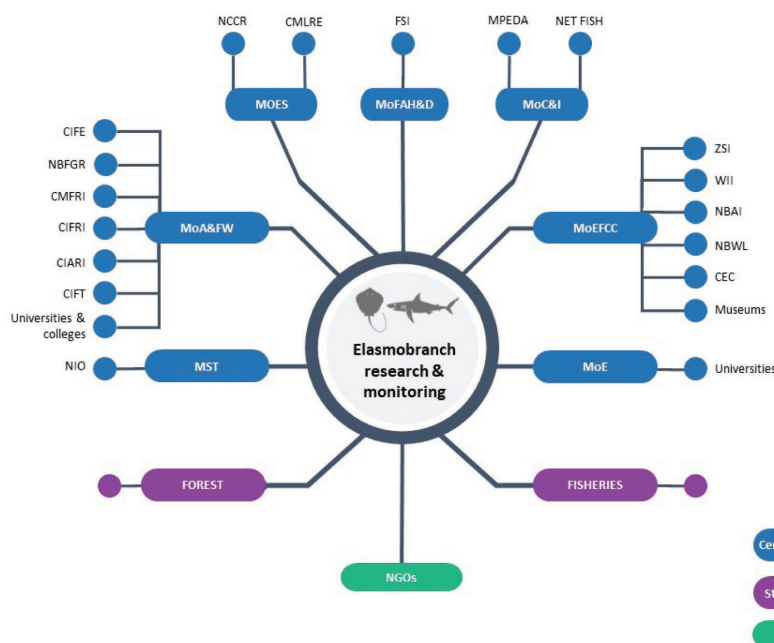


Figure 2. Diversity of organizations/ministries involved in elasmobranch research in India.

play a major role in enforcing conservation and management measures. Government agencies, such as Coastal/Marine Police, Central Board of Excise and Customs, Indian Coast-guard, Wildlife Crime Control Bureau, Indian Navy and the Directorate of Revenue Intelligence also play a role in monitoring and controlling fishing and trading of protected and regulated species.

National legislation for elasmobranch conservation in India

WPA is the major national legislation that directly addresses the conservation of flora and fauna in India, under the MoEF&CC, GoI, to identify and categorize high-risk species/groups or regions that have rich biodiversity or habitats of threatened fauna that require prioritization for conservation and protection.

Wildlife that requires conservation measures is categorized under various schedules of the WPA (such as I, II, III and IV) with varying protection statuses and penalties being assigned. Habitats are protected through declarations of Protected Areas (PAs) on land or sea. There are different categories of PA, viz. Wildlife Sanctuaries, National Parks, Community Reserves and Conservation Reserves are under the jurisdiction of the WPA. Apart from the WPA, coastal areas are protected under the Environment (Protection) Act, 1986, where coastal regulation zones are declared and rules formulated.

The WPA was primarily enacted for the conservation of terrestrial biodiversity. In 1972, only mammals and reptiles were included in the Act; birds were added in 1991 and

the section on 'FISHES' was added only in 2001. The mass exploitation of whale sharks in the northern Arabian Sea attracted international attention and conservation concerns^{46–48}. Consequently, the whale shark was included in the WPA on 28 May 2001. A subsequent order was released providing blanket protection to all 'Shark and Ray' (S.O. 665(E) dated 11 July 2001) under the WPA. This distressed the fishing sector as sharks were a regular component of fishery trade and consumption. The blanket ban did not consider that several species of elasmobranchs contributed to bycatch and there was no mechanism to avoid their incidental capture in fishing gear. There was serious opposition to the ban from different stakeholders and research institutions. Subsequently, the blanket ban was revoked and on 5 December 2001 the WPA was modified to include ten species of elasmobranchs, including the whale shark. Subsequently amendments to the Act have been proposed through the recent Wildlife (Protection) Amendment Bill, 2022 (Bill No. 159 C of 2021).

In addition to the WPA, India has several rules and regulations for conserving elasmobranchs at the national level. In August 2013, the MoEF&CC (Wildlife Division), GoI, adopted a policy advisory on shark finning (vide F. No4-36/2013WL, 21 August 2013), prohibiting the removal of shark fins from live sharks in the sea and advocated landing of the whole shark with fins intact in the body. On 6 February 2015, the Department of Commerce, Ministry of Commerce and Industry, GoI, through Notification No. 110/(RE-2013)/2009–2014 prohibited the export of fins of all species of sharks, and further through Notification No. 111/(RE-2013)/2009–2014 prohibited the import of fins of all shark species. In addition to these specific measures, India

Table 1. Existing national and state regulations and compliance level

Policy	Current authority	Current implementing agency	Compliance level	Duration	Remarks
Management of fisheries in coastal waters within 12 nm	State Government	State Fisheries Department	Limited	Throughout the year, Marine Fishing Regulation Acts (MFRAs)	Collaboration with other law enforcement agencies to enhance compliance and also improve cooperation with fisher community to implement the same
Closed season in territorial waters	State Government	State Fisheries Department	Good	Once every year, 61 days (15 April to 14 June along the east coast, and 1 June to 31 July along the west coast)	
Fisheries spatial zones for artisanal fisheries in territorial waters	State Government	State Fisheries Department	Limited	Throughout the year, MFRA	Mechanism of implementation must be participatory, with support of local fisher community, village-level governance mechanism and enforcement agencies
Fishing efforts in exclusive economic zone (EEZ)/fishing boat license and registration	State Government	State Fisheries Department	Limited	Throughout the year	
Closed season in EEZ beyond 12 nm	Central Government	Coast Guard, in coordination with state governments	Excellent	Once in a year, 45 days	
Wildlife Protection Act (WPA)	Central Government	State Forest Departments, WCCB	Limited	Throughout the year	Need to consider other high-risk groups and species that are of conservation concern at the regional level
Minimum legal size	State Government	Fisheries Department	Good	Throughout the year	Needs to be implemented in all maritime states
Mesh size	State Government	Fisheries Department	Limited	Throughout the year	To be incorporated across all coastal states and Union Territories
Marine protected areas	Central Government	State Forest Departments	Good	Throughout the year	
Awareness	Open	Open	Limited		
Fin attached policy	Central Government	State Forest Departments, WCCB	Excellent	Throughout the year	
Blanket ban on shark fin export	Central Government, Ministry of Commerce	Customs, Coastguard, Navy, other security/screening agencies	Good	Throughout the year	Shark fins are mostly exported to Southeast Asian markets as a delicacy. The blanket ban on shark fin exports initiated their illegal trade. Fisher's share in consumer rupee decreased considerably. Certification program for sustainable harvest or whole shark export can be considered
Conservation incentives for release of marine WPA species	Maharashtra, Gujarat (restricted to whale shark)	State Forest Departments	Good	Throughout the year	Wider acceptance and documentation of the protected fauna
Marine protected area	State Government/ Central Government	State Forest Departments	Good	Throughout the year	Restricted/no access, zones. Based on ecosystem importance of species

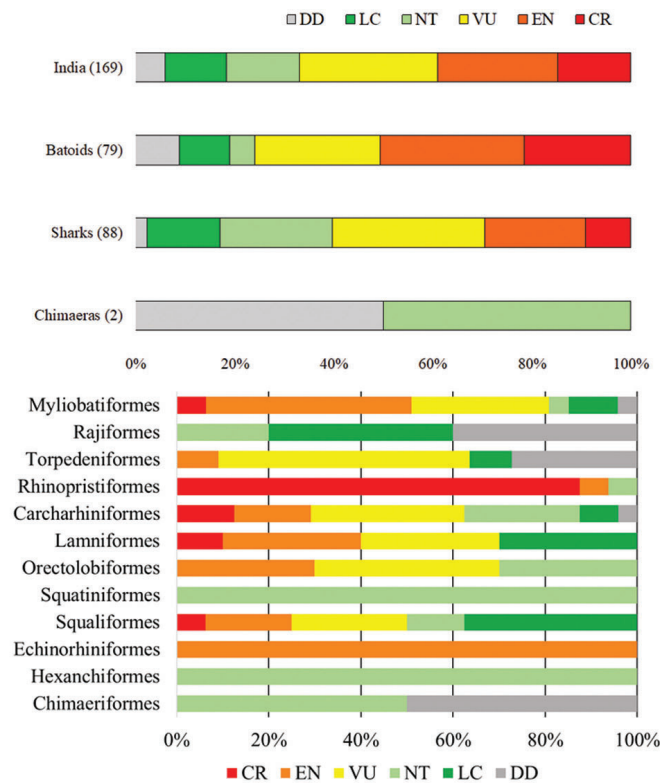


Figure 3. IUCN Red List status of elasmobranchs in the Indian waters.

has also regulated fishing practices through several generic tools (Table 1), the impacts and reach vary considerably.

State laws (Marine Fishery Regulation Acts)

Marine fisheries management is a shared responsibility between GoI and the State Governments of nine coastal states and four Union Territories (UTs), with the jurisdiction of the states and UTs being inside the territorial sea and that of GoI being in the EEZ beyond 12 nm, with support from the former (Article 21 of the Indian Constitution; NPMF, 2017). States manage their marine fisheries following MFRAs, which are mostly related to operational guidelines for fishing with several provisions such as areas of fishing based on gear, mesh size regulation and seasonal fishing ban (Table 1).

Regional and international commitments

At the regional and international levels, India has been a signatory to many conventions and commissions committed to conserving elasmobranchs. The United Nations-International Plan of Action (UN-IPOA) Sharks in 1999 was one of the earliest efforts at the global level and is a voluntary plan, where each country needs to manage and conserve sharks through a national plan of action (NPOA). In 2015, ICAR-CMFRI published the *Guidance on NPOA*

*for Sharks in India*¹⁵, highlighting the existing research and policy gaps, and priorities that need to be addressed. A draft NPOA-Shark has been prepared for India by the Bay of Bengal Programme Intergovernmental Organisation (BoBP-IGO).

India is also a signatory to CITES, CMS, regional plans through the Indian Ocean Tuna Commission (IOTC), CBD and Sustainable Development Goals (SDG), etc. to name a few, and has committed to implement various provisions in these agreements. Commitments to CITES, CMS and IOTC are binding.

Challenges to effective conservation of elasmobranchs in India

Species diversity and taxonomic gaps

About 174 species of elasmobranchs belonging to 44 families have been documented from Indian waters, which may be an underestimate pending several new species/records^{15,48-50}. Among these, 168 species have been assessed for extinction risk globally in the updated IUCN Red List of Threatened Species, including 25 species listed as Critically Endangered (15%), 41 as Endangered (24%) and 47 species as Vulnerable (28%) (Figure 3). Currently, no diversity studies focus exclusively on elasmobranchs on a national scale. Most diversity studies are restricted to assessments made on commercial landings from a small region^{37,50,51}

and/or discontinuous and limited data from exploratory surveys in the Indian EEZ^{52,53}. With recent advances in taxonomy, the nomenclature of many elasmobranch species is continuously being revised. However, India's conservation actions and Government agencies have not kept up with these changes, as is evident from the status quo of the names *Himantura fluviatilis* (now a synonym *Pastinachus sephen*), *Glyphis glyphis* (not confirmed in the Indian waters) and *Pristis microdon* (now *Pristis pristis*) in the WPA, which are scientifically invalid or of uncertain occurrence in the Indian waters. While this manuscript was under preparation, a Wild Life (Protection) Amendment Bill, 2021 (159 of 2021) was proposed for WPA, with some changes to the listing of a few elasmobranch species (https://rajyasabha.nic.in/rsnew/Committee_site/MainPage.aspx). Table 2 presents some of these and the changes suggested at the consultative workshop. Taxonomic issues have wider regional relevance for conservation and management at the species level. There is an urgent need for a focused study on the Indian Ocean region, with special emphasis on resolving taxonomic ambiguities through molecular genetic studies^{48,54,55}.

Studies on genetic population structure provide important information on population boundaries and subpopulation structuring, which are important for the development of management measures. Recent studies on genetic population structure of the scalloped hammerhead shark, *Sphyrna lewini* using mitochondrial markers⁵⁶ and the oceanic whitetip shark, *Carcharhinus longimanus*⁵⁷ revealed panmictic population and lack of significant genetic differentiation in the Indian waters. These findings can help in informed management decisions for the species in the region as a single stock, warranting the need for joint management measures for better regional conservation impact.

Diversity and spatial extent of fisheries

India has probably one of the most diverse fishing fleets in the world in terms of fishing craft and gears, with 166,333 fishing craft operating from the mainland⁵⁸. They operate along a coastline of over 8000 km in length and an EEZ of 2.02 million km² with high habitat diversity. The absence of a formal data submission system like a log book makes monitoring and continuous data collection a logistical nightmare. Even with data collection programmes as mentioned above, continuous long-term, species-specific catch data for elasmobranchs are lacking, which precludes any robust status assessments at the species level, thereby impeding robust management decisions for conservation of the species.

Limited information on stock and migration

The overreliance on traditional fishery-based monitoring and other basic research has undermined providing crucial information on the stock and migration of sharks. Analysis of

population structure either through genetic studies or morphometrics provides information on population boundaries and subpopulation structuring, which is important for the development of management measures. Studies on the genetic population structure of sharks using mitochondrial markers showed significant gene flow, connectivity, and local barriers in mixing^{56,57}. Most sharks are characterized by a small, effective population size. Hence such studies make it possible to develop better and more effective stock-specific conservation and management measures than those recommended through traditional fishery and length-based stock assessments alone. In the case of shared or migratory stocks, a joint assessment by all the concerned countries in the region must be recommended for regional management measures.

Valuable bycatch

Majority of the landed elasmobranchs are bycatch in gears like trawl nets, pelagic longlines and gillnets^{14,15,59,60}. This makes the accounting of elasmobranch fishing difficult and provides practically no clue on the catch rates for these resources by gear, time or area. Elasmobranchs, especially sharks, being a valuable resource, mitigation actions (to reduce bycatch) are often not accepted and pose challenges in implementation¹⁴. As a result, there have been limited efforts to implement bycatch mitigation, even though studies show opportunities for conserving certain species⁶⁰. On-board release of sharks is being practised in the coastal states of Gujarat and Maharashtra, where monetary incentives are provided for on-board live release^{60,61}. Similarly, using bycatch reduction techniques like mesh-size regulation in trawl nets and bycatch reduction devices remains limited and needs to be scaled up⁶⁰. In 2018, a collaborative study among ICAR-CIFT, ICAR-CMFRI and WWF-India was initiated to reduce shark bycatch and manage shark resources in Gujarat⁴⁰. Such studies need to be expanded to all the coastal states and must be accepted by the SFDs as a necessary measure, and a step towards responsible fisheries management and sustainable fishing.

Overreliance on WPA for conservation of marine fauna

Though the WPA is the overarching conservation apparatus in India, threatened marine fauna (even those listed in Schedule I of the WPA) have received little attention compared to their terrestrial counterparts in multiple aspects, including research grants, access and dedicated conservation programmes/projects. Many conservation measures and actions are adopted from those already in place for terrestrial resources, without considering the unique ecological settings and requirements in the marine ecosystem, where most species have a high interaction with livelihood generation, that is, fisheries. While including marine species

Table 2. Recommended modifications suggested in the current WPA list of elasmobranchs based on the National Consultative Workshop on Threatened Elasmobranchs in India (Kochi, February 2020)

Suggested action		Remarks
Species currently listed in the WPA under Schedule I		
<i>Carcharhinus hemiodon</i>	To be retained. Requires intensive surveys to establish population status in Indian waters.	Not reported from India for more than 30 years.
<i>Glyphis gangeticus</i>	To be retained. Requires intensive surveys to establish population status in Indian waters.	There are no recent confirmed records (decades) of sightings or landings, except for the report of a single specimen observed in Mumbai, Maharashtra.
<i>Glyphis glyphis</i>	May be removed. The species name can be removed and it can be listed as <i>Glyphis</i> spp.	The status of <i>Glyphis glyphis</i> in Indian waters remains to be confirmed or is uncertain.
<i>Rhincodon typus</i>	To be retained.	National conservation programmes and awareness campaigns are needed.
<i>Urogymnus asperrimus</i>	Requires intensive surveys to understand the stock status of <i>Urogymnus</i> spp. in Indian waters. To be retained as <i>Urogymnus asperrimus</i> or as <i>Urogymnus</i> spp.	Rarely reported due to non-importance in fishery, trade or having a curious feature.
<i>Himantura fluviatilis</i>	To be retained until existence/identity is confirmed or removed.	Uncertain species. Dedicated studies on river stingrays are needed.
<i>Rhynchobatus djiddensis</i>	To be retained as <i>Rhynchobatus</i> spp. Or other species in India to be protected.	<i>Rhynchobatus</i> spp. is a species complex and multiple species occurring in Indian waters have a similar high risk of extinction.
<i>Pristis microdon</i>	To be retained as <i>Pristis</i> spp. or <i>Pristis pristis</i> .	Dedicated national conservation programmes are needed.
<i>Pristis zijsron</i>	To be retained as <i>Pristis</i> spp. or <i>Pristis zijsron</i> .	
<i>Anoxypristis cuspidata</i>	To be retained.	
Conservation status		Remarks
Species to be considered on priority needing research support and conservation attention in India		
Giant freshwater stingray <i>Urogymnus polylepis</i>	Critically Endangered (CR) in the IUCN Red List	In India, currently known from northern Bay of Bengal (Andhra Pradesh, Odisha and West Bengal, and their rivers). It is assumed that Indian populations are under severe threat due to habitat degradation, as elsewhere in the known distribution globally. Their larger size often makes them highly vulnerable in unprotected riverine regions. Can be included in the WPA as <i>Urogymnus polylepis</i> or <i>Urogymnus</i> spp.
Manta ray, <i>Manta</i> sp.	CMS species	This large-sized batoid is under threat as evident from less observations in the recent past. Though mostly taken as bycatch, the body parts and gill plates have high market demand. Migration and stock studies are needed in the Indian context.
Devil rays, <i>Mobula</i> spp.	CMS species	Mobulids are sparsely distributed in Indian waters, with localized aggregations being reported; these are caught as bycatch and in targeted fisheries. Gill plates and meat have a high demand in international and local markets. Targeted fisheries.
Guitar fish, <i>Glaucostegus</i> spp.		Four species are known from India, viz. <i>G. granulatus</i> , <i>G. obtusus</i> , <i>G. typus</i> , and <i>G. thouin</i> ; all are assessed as CR.
Stripenose guitar fish, <i>Acroteriobatus variegatus</i>	CR species	Small-sized, poorly known, restricted distributed. Reduce trawl fleet in known distribution range.
Scalloped hammerhead, <i>Sphyrna lewini</i>	Endangered	Taken as bycatch in various gears. Dominated by juveniles. Catch declines and effective population size reductions reported.

in the WPA, due consideration needs to be given to the fact that irrespective of the status of protection accorded, a species may become accidentally entangled in nets laid for

other species. Consequently, the fishers are penalized. Such enforcement measures instil mistrust in the minds of the fishers, resulting in nondisclosure of elasmobranch

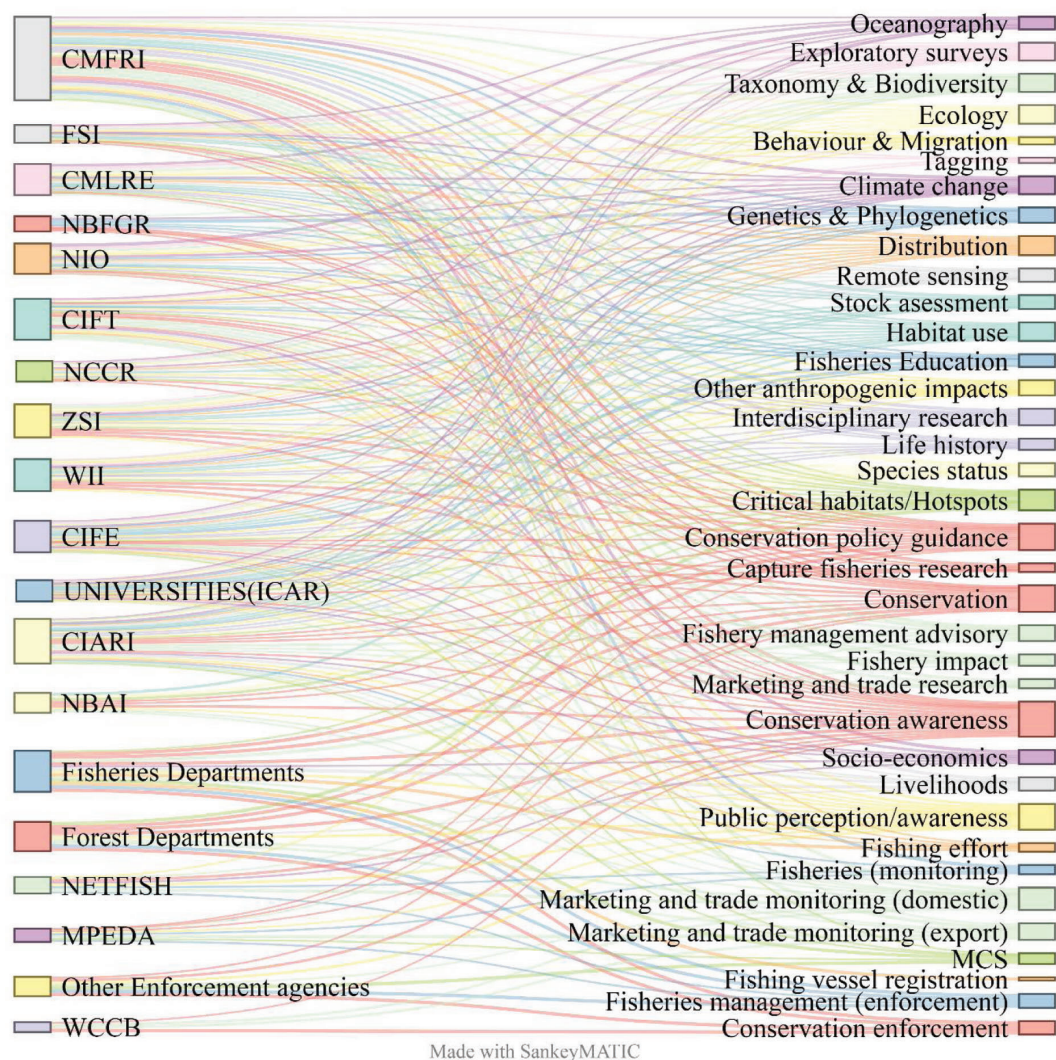


Figure 4. Sankey network diagram showing broad and overlapping research areas of public-funded organizations. Linkage colour is the research theme colour. Institution box colours are non-representative.

catches, even of unprotected species. Penalization for by-catch and accidental entangling must be levelled compare to wilful capture.

Apart from this, there is still no mechanism or process for undertaking captive breeding for the recovery of Critically Endangered elasmobranchs. While the National Zoo Policy 1998 and the Central Zoo Authority envisaged under the WPA give direction and have a process in place for conservation breeding, they do not address how these processes are to be envisioned and realized for marine species such as elasmobranchs.

Multiple governance, jurisdiction and weak linkages

As mentioned earlier, marine fisheries management and conservation are vested with a large number of agencies and ministries in India, often with diverse mandates. Thus the coordination between them is a challenge leading to pro-

cedural delays and time-consuming paperwork. Moreover, many of these agencies are handicapped by a dearth of technical expertise regarding elasmobranchs, which hinders effective management decisions, enforcement and implementation. Often, research undertaken by different institutions under various ministries has overlapping subjects and objectives with limited or no collaboration (Figure 4). The interaction between ministries and institutions is comparatively low, or often peripheral, on matters related to fish, fisheries and marine faunal conservation, management and implementation of management action. Better linkage between institutions through workshops and collaborative projects can help resolve such overlap (Box 1).

Limited community and stakeholder involvement

One of the major hurdles in the effective implementation of management or conservation measures is the wide gap

Box 1. Key recommendations for improving elasmobranch conservation and management in India*Research*

- National research programmes may be initiated, linking institutions and focusing on taxonomy, diversity, spatio-temporal abundance, population stock status assessments, threats to critical habitats and mitigation measures to develop risk assessment framework in a regional context, for threatened and exploited species and devise species recovery plans for endangered and threatened groups such as river sharks, sawfish and Pondicherry shark.
- An open-access National Gene Bank through already existing schemes of preserving genes/genetic details of endangered species may be established to facilitate the use of genetic tools in the control of illegal trade in protected elasmobranchs and other marine species.
- Non-use values in tourism related to marine fauna and identifying potential sites for diving/marine watch programmes which will contribute to livelihoods without actual harvest of the concerned species may be explored.

Grassroot

- A network of interest groups, including elasmobranch researchers, conservationists, policymakers, specialist fisher groups and elasmobranch traders across mainland India and the islands, may be established to exchange, through a specially designed public portal, information, advice and referrals to assist in meeting the objectives of elasmobranch conservation.
- Linkage between key Government organizations may be improved and provisions may be made to ensure inclusion of nominated members from these organizations, universities and NGOs in developing policy advisories.
- Inter-agency coordination mechanism for trade control, especially for CITES-listed species reported and recorded within Indian waters, with proper reporting to the CITES Secretariat, may be put in place.
- Capacity enhancement of enforcement agencies for better implementation and monitoring of illegal trade and wildlife crime in marine species, particularly sharks, and the conservation of other vulnerable species may be prioritized.
- Scientifically supported awareness-generation programmes for stakeholders involved in the supply chain, ranging from fishermen to traders, exporters and consumers may be conducted through Government departments on a regular basis.
- Inclusion of the proposed 'Sagar Mitras' as a conservation-oriented network in the coastal villages of India. The Sagar Mitras can function as both a primary field data source for WPA-protected marine species as well as impart awareness to fishermen on protecting WPA-listed elasmobranch species.
- Stakeholder-inclusive action plans may be adopted to address trade-off between conservation and livelihood.

Governance

- A suitable body such as the 'National Board for Marine Life' or 'Coastal and Marine Ecosystem Cell' as suggested in NWAP 2017 may be constituted to work closely with governmental, and scientific organizations, academic institutions and NGOs. Members of this Board may consist of representatives of various departments including, but not limited to, the MoEF&CC, DoF, State Fisheries Departments, ICAR and MPEDA, as well as eminent researchers. The mandate of this Board would be to formulate conservation strategies for marine fauna through robust species protection criteria, listing and delisting of marine species in the WPA through regular assessments and implementation of the same, and improved guidelines and conservation policies related to protecting marine life.
- Suitable amendments may be made to the WPA and regularly updated on the basis of scientific assessments to have broader conservation and management plans rather than blanket protections. A standard set of scientifically justified criteria may be developed to assess marine species, particularly elasmobranchs, for listing in the WPA. Conservation efforts may be designed, implemented and adapted to address the objectives of each Schedule, with provision for delisting and shifting the species between the Schedules, every five years, after stakeholder consultations between researchers, policy makers, fishers and traders.
- Conservation of non-iconic or small/medium-sized marine fauna which are caught as bycatch may be brought under the ambit of the MFRAs through relevant modifications and or additions to the WPA in new Schedules without significantly affecting the livelihoods of the fishermen; the conservation of large-sized marine fauna may be continued under WPA. This would also enable increased use of MFRAs for conservation with region-specific interventions. Species thus considered may be listed under different categories such as absolute protection, harvest control trade control and data deficient, and provided with different levels of protection (Table 2).
- National Plan of Action-Sharks, updated to suit present-day needs and with revised timelines may be adopted and implemented as early as possible within all coastal states and Union Territories.

in priorities among stakeholders, researchers and managers. For the stakeholders, increasing their fish catch and improving livelihoods are the priorities, whereas for the researchers/managers, conservation along with minimizing negative impacts on livelihoods and enabling sustainable exploitation is the priority. While many countries such as the Philippines have community involvement in fisheries regulations and marine conservation⁶², India has not legislated such participatory approaches. For engaging fishing communities and

other stakeholders, ICAR-CMFRI and BOBP-IGO have convened several stakeholder consultations across the coastal states in the recent decade, to prepare national documents like Non-Detrimental Findings for CITES-listed species⁶³ and NPOA-Sharks. Numerous awareness campaigns on protected species of elasmobranchs are also being conducted, thus making the process more inclusive^{21,39,40,64}. Although several organizations and NGOs undertake regional or local-level stakeholder consultations, and are

involved in conservation actions related to elasmobranchs, it is often limited in reach. Legislating the participatory approach under the National Marine Fisheries Policy and the MFRAs, and joint initiatives between government and non-government organizations are warranted for effective dissemination and implementation of conservation measures.

Conclusion

This article highlights the need for increased attention on elasmobranch conservation in India, and the hurdles and lacunae in developing a robust conservation policy. It also discusses the outcome of the first national consultative meeting on elasmobranch conservation, particularly of threatened and protected species. On the basis of the discussions held during the national workshop and the context detailed above, we put forth some recommendations (Box 1) that, if implemented, would support the integrated sustainable management of elasmobranch fisheries and their conservation in India. These recommendations are presented under three categories of interventions – research, grassroots and governance, and come with a cautionary note that any actual policy change must be taken only after significant inputs are sought and received from the fishing community and multiple stakeholders. Improved collaboration, regional and national conservation actions, better understanding among research institutions, academics and NGOs, and participatory research are crucial for effective conservation. There must be synergy among research, policy and region-based management involving amendments in the fisheries laws, amendments in the WPA, moving beyond the WPA for elasmobranch conservation, and temporal and spatial management policies tailored for the fishery, location and species.

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