India Non-Detriment Finding for **Mako Sharks** *Isurus* spp. in the Indian Ocean | 2022 to 2026

CMFRI Marine Fisheries Policy Series No.19/2022
ISSN 2394-8019

Indian Council of Agricultural Research
Central Marine Fisheries Research Institute

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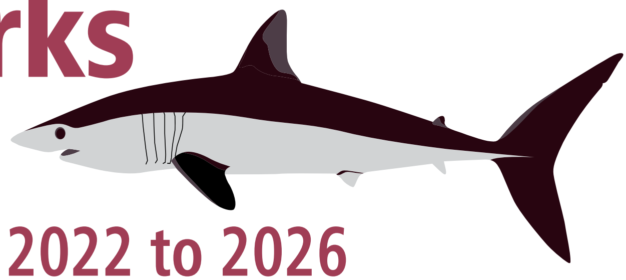
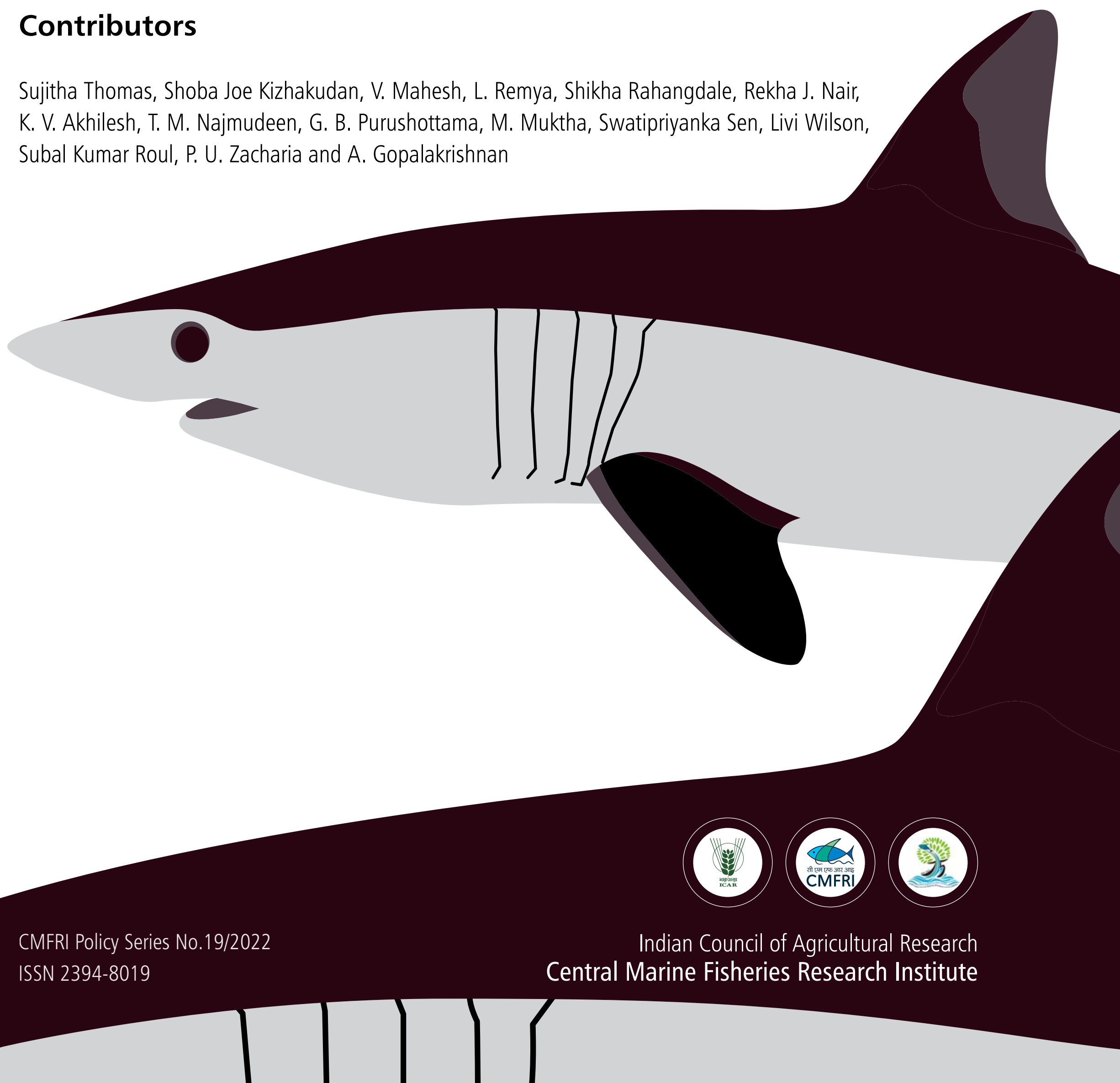


Contributors

Sujitha Thomas, Shoba Joe Kizhakudan, V. Mahesh, L. Remya, Shikha Rahangdale, Rekha J. Nair, K. V. Akhilesh, T. M. Najmudeen, G. B. Purushottama, M. Muktha, Swatipriyanka Sen, Livi Wilson, Subal Kumar Roul, P. U. Zacharia and A. Gopalakrishnan



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India Non-Detriment Finding (NDF) for Mako sharks, *Isurus* spp., in the Indian Ocean, 2022 to 2026

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Design: Blackboard, Kochi
Printed at: Print ExPress, Kaloor, Kochi

Publication, Production & Co-ordination
Library & Documentation Centre, CMFRI

CMFRI Marine Fisheries Policy Series No: 19

Citation: ICAR-CMFRI, 2022. India Non-Detriment Finding (NDF) for Mako sharks, *Isurus* spp., in the Indian Ocean. CMFRI Marine Fisheries Policy Series No:19. ICAR-Central Marine Fisheries Research Institute, Kochi, 64 pp.

Contents

Summary

This document was prepared by a designated Indian CITES Scientific Authority, the ICAR-Central Marine Fisheries Research Institute (CMFRI), and is the result of an online workshop of the Demersal Fisheries Division of the Institute that took place during 5-7 August 2021. The following NDF guideline was used:

Mundy-Taylor, V., Crook, V., Foster, S., Fowler, S., Sant, G., and Rice, J. 2014. *CITES Non-detriment findings guidance for shark species. 2nd, revised version. A framework to assist Authorities in making Non-detriment Findings (NDFs) for species listed in CITES Appendix II.* Report prepared for the German Federal Agency for Nature Conservation (Bundesamt fur Naturschutz, BfN). Available at https://cites.org/eng/prog/shark/Information_resources_from_Parties_and_other_stakeholders.

Contributors

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Acknowledgement

We acknowledge with gratitude the advice given by Daniel Fernando, Co-Founder, Blue Resources Trust, Sri Lanka and Rima Jabado, Regional Chair, Indian Ocean – IUCN Shark Specialist Group and Advisory Committee Member (Asia) – CMS Sharks MoU in the course of preparing this document.

Outcome

This mako sharks (*Isurus oxyrhinchus* and *Isurus paucus*) NDF for India is "**negative**" and does not support international trade in this species. Additional research is mandatory to assess the status of the species and improvements are made to existing fisheries and trade management and monitoring frameworks as outlined in Section 6.

This NDF will be re-evaluated after 5 years, to gauge progress against the recommendations in Section 6 and updated with newly acquired data, before agreeing to a new NDF for 2027-2031.

<table>
<tr><th colspan="4">Section 1. Preliminary considerations</th></tr>
<tr><th colspan="4">1.1 (a) Is the specimen subject to CITES controls?
(How did you identify the species?)</th></tr>
<tr><td>Species name</td><td>Product form</td><td>CITES Appendix</td><td>Source of identification</td></tr>
<tr><td>Mako Sharks
FAO Code: Isurus paucas (Longfin Mako): LMA
Isurus oxyrinchus (Shortfin Mako): SMA</td><td>Fins (international fin trade prohibited in India)
Meat (fresh and dried salted for human consumption) – more data is required to confirm international trade of meat.
Cartilage (data lacking)
Skin (international trade–leather) – more data is required
Liver oil (mixed with oil from other shark species, but domestic use only)
Jaws & teeth (international trade)</td><td>Appendix II</td><td>Detached fins can be identified using:
FAO shark fin guide or isharkfin software (FAO, 2016a or http://www.fao.org/ipoa-sharks/tools/software/isharkfin/en/).
Abercrombie 2016 http://www.pewtrusts.org/~/media/assets/2016/09/pewsharkguidesilkyandthresherenglishprint.pdf
For whole animal identification:
FAO Guides and expert identification by CMFRI
Pillai and Parakal, 2000
CMFRI, unpubl.
Utilization:
Clarke et al., 2006a, b; Fields et al., 2017; CMFRI, unpubl.</td></tr>
<tr><td>In view of the above, is the specimen subject to CITES controls?</td><td>YES</td><td></td><td>GO TO Question 1.1(b)</td></tr>
<tr><td>Concerns and uncertainties:</td><td colspan="3">There is a low risk that the species has been incorrectly identified; mako shark forms only about 0.3% of the total shark landings in India.
However, species-specific traceability is lacking in respect of mako shark product trade.
Lacking sufficient information on the export of meat, jaws, oil, cartilage and hide; if exported, these are usually packed along with similar products of other shark species.</td></tr>
</table>

1.1 (b) From which stock will the specimen be taken/was the specimen taken? (Can origin and stock be confidently identified?)		
	Description/comments	Sources of information
Ocean basin	Indian Ocean	
Stock location/ distribution/ boundaries	Some information is available on distribution of shortfin and longfin mako sharks and population parameters in the Indian EEZ, but stock parameters and stock structure information are not available. Shortfin mako comprises three known subpopulations: Atlantic, Eastern North Pacific and Indo-West Pacific. The shortfin mako utilizes a wide range of marine habitats worldwide. The occurrence of this species in the western Atlantic Ocean is from Gulf of Maine to southern Brazil and Argentina, including the Gulf of Mexico and Caribbean, while in the eastern Atlantic it occurs from Norway to South Africa, including the Mediterranean. The distribution in Indo-Pacific Ocean includes East Africa to Hawaii, Primorskiy Kray (Russian Federation) in the north, Australia and New Zealand in the south, and south of Aleutian Islands and from southern California, USA to Chile in the eastern Pacific. The longfin mako shark, *Isurus paucus* is oceanic, widespread in tropical and warm temperate waters, and possibly circumglobal, although its distribution is not well documented as it is not frequently encountered, or may be misidentified as shortfin mako. The occurrence of this species in the western Atlantic Ocean is from Gulf Stream of USA to southern Brazil. It occurs from Guinea to Ghana in the eastern Atlantic Ocean. In Western Indian Ocean the longfin mako shark is distributed off the coasts of South Africa, India, and Sri Lanka. The distribution within the Pacific Ocean includes from Japan to Australia in the west, the Hawaiian Islands in the central region, and Panama, Galapagos and Ecuador, in the east Pacific Ocean. Genetic studies indicate one global population; however, there is some genetic structuring between ocean basins. Shortfin and longfin mako are reported from western Indian Ocean (eastern Arabian Sea) and eastern Indian Ocean (western Bay of Bengal) including the seas around Andaman and Nicobar Islands. The landings are recorded from east and west coasts of India	Raje *et al.*, 2007; Kizhakudan *et al,* 2013; 2015 IOTC Shortfin Mako Executive summary (IOTC–2017–SC20–R[E]) Rogers *et al.*, 2015; Francis *et al.*, 2019 Rigby *et al.*, 2019a Ebert *et al.*, 2013; Maguire *et al.*, 2006; Rigby *et al.*, 2019b. Schrey and Heist 2003; Taguchi *et al.*, 2015; Corrigan *et al.*, 2018 Raje *et al.*, 2007 Kizhakudan *et al.*, 2013; 2015 Akhilesh *et al.*, 2014 Varghese *et al.*, 2017
Is this a shared stock (i.e., occurring in more than one EEZ and/or the high seas)?	Yes, straddling stock ranging between India's EEZ, the high seas and likely other Indian Ocean EEZ's (e.g., Sri Lanka, Maldives). There is no documented information on this, but as it is highly migratory, it is possibly a shared stock. However, stock studies are needed for the Indian Ocean to confirm the presence of multiple stocks, which may or may not be shared.	IOTC-2020-SC23-ES20

If the stock occurs in more than one EEZ, which other Parties share this stock?	The stock of shortfin mako occurs in the EEZ of the other littoral states of the Indian Ocean.	IOTC Shortfin Mako Executive summary (IOTC–2017–SC20–R[E])
If a high seas stock, which other Parties fish this stock?	Not much information on the high seas stock, however it is likely to be shared by other Indian Ocean EEZ's.	www.iotc.org
Which, if any, RFB(s) cover(s) the range of this stock?	With respect to the Indian Ocean region: • Indian Ocean Tuna Commission (IOTC), • Asia-Pacific Fishery Commission (APFIC), • The Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO), • Commission for the Conservation of Southern Bluefin Tuna (CCSBT), • The Regional Organization for the Conservation of the Environment in the Red Sea and Gulf of Aden (PERSGA), • Regional Commission for Fisheries (RECOFI), • South Indian Ocean Fisheries Agreement (SIOFA), and • Southwest Indian Ocean Fisheries Commission (SWIOFC).	http://iotc.org http://www.apfic.org http://www.bobpigo.org https://www.ccsbt.org/ http://www.persga.org/ http://www.fao.org/fishery/rfb/recofi/en http://www.fao.org/fishery/rfb/siofa/en http://www.fao.org/fishery/rfb/swiofc/en
Are all Parties listed above (which fish or share the stock concerned) Members of the relevant RFB(s)?	Yes. They are Members or Cooperating Non-Contracting Parties of IOTC. Most are CITES Parties and/or CMS, and some are also Signatories of the CMS Sharks MoU.	https://cites.org/eng/disc/parties/chronolo.php (http://www.cms.int/sharks/en/signatories-range-states)

Are there geographical management gaps?	Regional management: Mako sharks have long been highlighted as species in need of better management. Since the mid-1990s, their catch has increased dramatically, and regional fisheries management organizations (RFMOs) have largely failed to put in place management measures that would ensure a sustainable fishery. International management Despite being listed on the Convention on the Conservation of Migratory Species of Wild Animals (CMS) a decade ago and heavily caught in RFMOs, there has been limited management progress for these species. Even with a stock assessment showing population declines that exceed the CITES Appendix II listing criteria, ICCAT (International Commission for the Conservation of Atlantic Tunas) hasn't met the clear advice to prohibit mako retention in the North Atlantic, and reduce mortality elsewhere. This means that overfishing is likely to continue in the Atlantic. The Western and Central Pacific Fisheries Commission has shown steady declines in catch rates of mako sharks over the past decade and yet no management action has been taken, despite their high vulnerability and susceptibility to overexploitation. The governments of Bangladesh, Benin, Bhutan, Brazil, Burkina Faso, Cabo Verde, Chad, Cote d'Ivoire, Dominican Republic, Egypt, the European Union and its Member States, Gabon, Gambia, Jordan, Lebanon, Liberia, Maldives, Mali, Mexico, Nepal, Niger, Nigeria, Palau, Samoa, Senegal, Sri Lanka, Sudan and Togo proposed the shortfin mako shark and the look-alike species longfin mako shark for a CITES Appendix II listing National measures in the Indian Ocean: The management measures currently in place in the Indian Ocean vary across countries and are not implemented uniformly. Management measures in India are more in place for coastal fisheries. Export of shark fins is prohibited in India. Moreover, fins of mako sharks are not solely traded or exported; evidence from international markets indicates that they form part of elasmobranch products exported from India. Species-specific information on trade is lacking.	https://citessharks.org/shortfin-mako 18th Conference of the Parties (CoP18) of the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) Ministry of Environment and Forest (Wildlife Division) F. No.4-36/2013 WL. 21 Aug 2013 Govt. of India. Notification number 110/(RE-2013) 2009-14, dt 6 Feb 2015 and 111/(RE-2013) 2009-14, dt 6 Feb 2015 Hong Kong Customs Data (Bloom/Stan Shea, pers. comm.)
How reliable is the information on origin?	Medium	
Is information on origin sufficiently detailed for Question 1.2 to be answered? *(Apply this answer at end of Question 1.2)*		YES

1.2 Was (will) the specimen (be) legally obtained and is export allowed?		
Is the species:	Description/comments	Sources of information
Protected under wildlife legislation, a regional biodiversity Agreement, or (for a CMS Party) listed in CMS Appendix I?	Not protected under India's legislation or a regional agreement. Sharks have to be landed with all fins attached (since 2013). Mako sharks are listed on CMS Appendix II; India has been a CMS Party since 1983.	https://police.py.gov.in/Wildlife%20Ministry%20of%20environment%20and%20Forests/Policy%20on%20prohibition%20of%20(finning)%20of%20shark%20fins%20in%20the%20sea%20dt.25th%20august%202013.pdf http://www.cms.int/en/page/appendix-i-ii-cms http://www.cms.int/en/parties-range-states
Sourced from illegal fishing activities (e.g., in contravention of finning regulations, or where a TAC is zero or exceeded)?	No.	
Taken from a no-take marine protected area or during a closed season?	No.	
Taken in contravention of RFB recommendations, if any?	Not in the Indian Ocean/IOTC. N. B. WCPFC prohibit mako shark catch.	https://www.eli.org/sites/default/files/eli-pubs/legal-protections-sharks-rays-wcpfc.pdf
Listed as a species whose export is prohibited?	No.	
Of concern for any other reason?	Regulation prohibits export of all shark fins	Govt. of India. Notification number 110/(RE-2013) 2009-14, dt 6 Feb 2015 and 111/(RE-2013) 2009-14, dt 6 Feb 2015.
In view of the above and the final section of the Worksheet for Question 1.1 (b), was the specimen legally acquired and can exports be permitted?	YES	GO TO Question 1.3
Concerns and uncertainties:	There is limited information on the type and quantum of mako shark commodities that enter the export market. Evidence from international markets like Hong Kong suggest that mako shark commodities are a part of similar products of other shark species.	

1.3 What does the available management information tell us?		
Part 1. Global-level information		
	Description/comments	Sources of information
Reported global catch	The global production of mako sharks is not reported species-wise. In the continent-wise production estimates given by FAO, species-wise production of mako sharks is given from America, Europe, Asia, and Africa. Species-wise production of mako sharks is available in the FAO database for the period 2000-2019. The average global capture fisheries production of mako sharks during 2000-2019 was 10,847 t with a minimum of 6,469 t in 2000 and maximum of 14,538 t in 2011 followed by 14,335 t (2012) and 14,167 t (2014). The maximum commercial landings was reported from the Europe (avg. 5,492 t), followed by Asia (avg. 1,920 t), Africa (avg. 1,794 t), America (avg. 1,156 t), and Oceania (avg. 485 t). Shortfin mako is the prime species landed in commercial fisheries and the average catch of *Isurus oxyrinchus* in the last two decades was 10,810 t (99.6% of total mako shark) with a minimum of 6,469 t in 2000 and maximum of 14,538 t in 2011. Longfin mako is an oceanic dweller, rarely encountered in commercial fisheries. The average global catch of *Isurus paucus* in the last two decade was 40 t (0.4% of total mako sharks) only, with no landings (2013) to the maximum of 287 t in 2017 followed by 148 t in 2018 Indian Ocean contributed 17.7% of the global mako shark landings with the average catch in the last two decades being 1,918 t. Maximum landings were reported in 2016 (3,244 t) and the least was in 2001(883 t). Catches were predominantly represented by *Isurus oxyrinchus* and very meagre quantities (<1%) of *Isurus paucus* (mostly juveniles) were recorded in the fishery. Average landing of mako sharks in India during 2012-2020 was estimated at 29 t. The average landing of *I. oxyrinchus* along the Indian coast was about 26 t. Maximum catch was during 2016 (103.5 t) which decreased to only 1.7 t in 2020. *I. paucus* landings varied from 0.04 t to 19 t with the average landings of only 3 t (2012-2020) (Figure 10). Mako sharks forms only 0.3% of the total shark landings in India. There is no targeted fishery of these species and it occasionally forms a bycatch in the hook and line and gillnet fishery. Mako sharks rarely caught in trawl net as bycatch.	http://www.fao.org/figis/servlet/SQServlet?file=/usr/local/tomcat/8.5.16/figis/webapps/figis/temp/hqp_2256167727831196088.xml&outtype=html (FAO, 2020; Varghese *et al.*, 2017). ICAR-CMFRI, *unpubl. data* (Source: NMFDC, ICAR-CMFRI).

Species distribution	The shortfin mako shark *Isurus oxyrinchus* is highly migratory, found in all tropical and temperate waters (15° to 31°C) of the world oceans. Its horizontal movements are driven by changes in water temperature in the North Pacific, Southeast India and the North West Atlantic. It utilizes a wide range of marine habitats worldwide. It dwells in the open ocean, continental shelf, shelf edge, and shelf slope habitats during periods of transit. The shortfin mako has a worldwide distribution. The occurrence of this species in the western Atlantic Ocean is from Gulf of Maine to southern Brazil and Argentina, including the Gulf of Mexico and Caribbean, while in the eastern Atlantic it ranges from the Norway to South Africa, including the Mediterranean. The distribution in Indo-Pacific Ocean includes East Africa to Hawaii, Primorskiy Kray (Russian Federation) in the north, Australia and New Zealand in the south, and south of Aleutian Islands and from southern California, USA to Chile in the eastern Pacific. The longfin mako shark *Isurus paucus* is oceanic, widespread in tropical and warm temperate waters, and possibly circumglobal, although its distribution is poorly recorded. Distribution of the longfin mako is not well documented as it not encountered frequently, or is possibly misidentified as shortfin mako. The occurrence of this species in the western Atlantic Ocean is from Gulf Stream of USA to southern Brazil. It occurs from Guinea to Ghana in the eastern Atlantic Ocean. In Western Indian Ocean the longfin mako shark is distributed off the coasts of South Africa, India, and Sri Lanka. The distribution within the Pacific Ocean includes from Japan to Australia in the west, the Hawaiian Islands in the central region, and Panama, Galapagos and Ecuador, in the east Pacific Ocean. Mako sharks are reported from western Indian Ocean (eastern Arabian Sea) and eastern Indian Ocean (western Bay of Bengal) including the seas around Andaman and Nicobar Islands. The landings are recorded from east and west coasts of India.	Vaudo *et al*., 2016; Rogers *et al*., 2015; Casey and Kohler, 1992; Francis *et al*., 2019; Rigby *et al*., 2019a. Ebert *et al*., 2013; Maguire *et al*., 2006; Rigby *et al*., 2019b. Raje *et al*., 2007 Sobhana *et al*., 2013 Kizhakudan *et al,* 2013; 2015 Akhilesh *et al*., 2014 Varghese *et al*., 2017

Known stocks/ populations	Information on the population dynamics and stock structure are limited. Some information on the stock parameters of shortfin mako is available. But no studies are there on the longfin mako. Life history parameters seem to vary geographically, perhaps reflecting the existence of distinct stocks for different ocean basins. The species comprises three known subpopulations: Atlantic, Eastern North Pacific and Indo-West Pacific. There is no targeted fishery of these species and it occasionally forms a bycatch in the longlines and gillnet fishery. Mako sharks also rarely caught in trawl net as bycatch.	Barreto *et al.*, 2016; Pratt and Casey, 1983; Cailliet and Bedford, 1983; Chan, 2001; Hsu, 2003; Ribot-Carballal *et al.*, 2005; Bishop *et al.*, 2006; Cerna and Lincandeo, 2009; Doño *et al.*, 2014. Rogers *et al.*, 2015; Francis *et al.*, 2019 Sobhana *et al.*, 2013 NMFDC, ICAR-CMFRI
Main catching countries	The species are targeted and taken incidentally throughout its range by commercial fisheries, primarily high seas longline fleets, as well as by recreational fishermen, particularly in the United States, South Africa, New Zealand, and Europe. If carefully released, shortfin makos have relatively high chances for survival: ~90% in sport fisheries and as high as 75% from commercial longlines. According to FAO, total shortfin mako shark landings increased by 69% from 2004-2009 to 2010-2016. Sixty-two percent of 2006-2016 reported annual shortfin mako catches were attributed to vessels from Spain (35%), Taiwan (15%), and Portugal (12%). Longfin and shortfin makos are often caught alongside one another and confused and/or combined in fisheries statistics.	https://www.traffic.org/site/assets/files/3751/gsri-cop18-mako-sharks.pdf
Main gear types by which the species is taken	They are caught by high-seas longline and net fisheries, especially those pursuing tuna, billfish, and swordfish. In India, Mako sharks form a bycatch in the longlines and gillnet fishery and are rarely caught in trawl	Camhi *et al.*, 2008; Camhi *et al.*, 2009; Campana, 2016 NMFDC, ICAR- CMFRI (*unpubl. data*); Sobhana *et al.*, 2013; Varghese *et al.*, 2017
Global conservation status	*Current IUCN Status:* Shortfin mako Globally: Endangered (November 2019) Longfin mako Globally: Endangered (2019) Indian Ocean: Vulnerable	Rigby *et al.*, 2019a, b http://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T39341A2903170.en https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T60225A3095898.en Brunel *et al.*, 2018
Multilateral Environmental Agreements	Mako shark is listed on the Convention on Migratory Species (CMS) Appendix II and on Annex 1 of the Memorandum of Understanding on the Conservation of Migratory Sharks (since 2010).	Convention on Migratory Species https://www.cms.int/sharks/en/species/isurus-paucus https://www.cms.int/sharks/en/legalinstrument/sharks-mou

Part 2. Stock/context-specific information		
	Description/comments	Sources of information
Stock assessments	Limited quantitative stock assessment or fishery indicators of status are currently available for mako sharks in the Indian Ocean, therefore the stock status is highly uncertain. The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012 consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and its susceptibility to each fishing gear type. Shortfin mako sharks received the highest vulnerability ranking (No. 1) in the ERA rank for longline gear because it was characterised as one of the least productive shark species, and has a high susceptibility to longline gear. Shortfin mako sharks were estimated to be the third most vulnerable shark species in the ERA ranking for purse seine gear, but had lower levels of vulnerability than to longline gear, because of the lower susceptibility of the species to purse seine gear. IUCN global status assessment indicates a decreasing trend in populations of mako sharks Studies done elsewhere showed a trend in. Stock status study in New Zealand with most abundance indicators showed declining trends in recent years, particularly in the North region in 2017-18.	Groeneveld *et al.*, 2014 IOTC–2017–SC20–R Rigby *et al.*, 2019a, b Francis & Finucci (2019)
Main management bodies	National fisheries management agencies (in India: Ministry of Fisheries, Animal Husbandry & Dairying, Ministry of Agriculture and Farmers Welfare, Ministry of Environment, Forest and Climate Change) and the State Department of Fisheries. IOTC: Working Party on Ecosystems and Bycatch; Scientific Committee; Commission. CITES, CMS, BOBLME (Phase 2), CBD, and FAO–IPOA.	

Cooperative management arrangements	In addition to arrangements and support to scientific bodies and expert groups for the implementation of the Common Fisheries Policy (ICES- International Council for Exploration of the Sea, STECF Scientific Technical and Economic Committee for Fisheries, JRC-Joint Research Centre etc.), the European Union supports through voluntary contributions scientific research for sharks and mitigation of bycatch in the RFMOs to which it is Party (e.g. IOTC, WCPFC, IATTC, ICCAT). The Areas Beyond National Jurisdiction Program (ABNJ) aims to improve cooperation between tuna RFMOs. The IOTC and WCPFC are trialling a Bycatch Data Exchange Protocol Template (BDEP) that aims to provide a framework for consistent management of bycatch data within RFMOs. A 2016 IOTC report recommends that this BDEP continue in 2017 for the Indian Ocean (IOTC–2016–WPDCS12–28 Rev_1).	http://www.commonoceans.org/home/en/ UNCLOS Annex 1 Highly Migratory species www.un.org/unlcos/annex1 http://www.commonoceans.org/tuna-biodiversity/en/ IOTC–2016–WPDCS12–28 Rev_1. http://www.iotc.org/documents/bycatch-data-exchange-protocol-indian-ocean
Non-membership of RFBs	All of the main catching countries (India, Sri Lanka, Taiwan, China, Indonesia, I. R. Iran) are Members of IOTC.	MRAG, 2012; Murua *et al.*, 2012; http://www.iotc.org
Nature of harvest	In India, mako sharks form a bycatch in longlines and gillnet fishery, and are rarely caught in trawls. Mako is bycatch worldwide in tuna and broadbill swordfish fisheries, though there are some small target commercial fisheries, such as those off California and Spain (In the Southern Hemisphere, many shortfin mako have been taken as a valuable bycatch in surface longline and gillnets directed at tuna and billfish, especially those targeting albacore tuna (*Thunnus alalunga*), southern bluefin tuna and bigeye tuna. Shortfin mako are caught widely in the South Pacific longline fisheries and some purse-seine fisheries and often feature in the top five shark species observed being caught. They are caught by high-seas longline and net fisheries, especially those pursuing tuna, billfish, and swordfish.	NMFDC, ICAR-CMFRI Stevens, 2008. Lack and Meere, 2013 Camhi *et al.*, 2008; Camhi *et al.*, 2009; Campana, 2016
Fishery types	In India, the majority of mako shark are caught Elsewhere in the world it is by tuna longline and gillnet fisheries	NMFDC, ICAR-CMFRI Camhi *et al.*, 2008; Camhi *et al.*, 2009; Campana, 2016

Management units	In the Indian Ocean, the main body responsible is IOTC. India manages the mako shark stock (generic management along with stock of other fishery resources) through state and national authorities–Marine Fisheries Regulation Acts (MFRA) of States and National Marine Fisheries Policy. State Fisheries Departments (SFDs), Ministry of Fisheries, Animal Husbandry & Dairying (MoFAH & D, Ministry of Agriculture and Farmers Welfare (MoA), Ministry of Environment, Forests and Climate Change (MoEF & CC).	http://www.iotc.org https://www.ccsbt.org https://cof.gujarat.gov.in/contact-us.htm https://fisheries.maharashtra.gov.in/ http://fisheries.goa.gov.in/ http://www.karnataka.gov.in/fisheries/Pages/Home.aspx http://www.fisheries.kerala.gov.in/ http://www.fisheries.tn.gov.in/ https://www.py.gov.in/knowpuducherry/dept_fisheries.html http://apfisheries.gov.in/ http://www.odishafisheries.com/ http://www.wbfisheries.gov.in/wbfisheries/do/Forwordlink?val=32 http://agricoop.nic.in/# http://www.moef.nic.in/ http://dahd.nic.in/about-us/divisions/fisheries
Products in trade	Meat (fresh & dried (mostly)) is utilised domestically for human consumption in India. Extent of international meat trade (if any) is currently unknown. Jaws, teeth and skin enter international trade. Export of shark fin is currently prohibited. Oil is mixed with the liver oil of other shark species, but thought to be utilised domestically. Mako sharks are widely valued for their high-quality meat and fins, jaws and skin trade also attract fishery. Mako sharks accounted for at least 2.7 to 2.85% of the Hong Kong shark fin trade, the estimated equivalent of nearly a million makos (biomass ~40,000 t) a year clearly indicating the under reporting of exploitation worldwide. Longfin mako, *Isurus paucus* and hammerheads *Sphyrna* spp. are among the pelagic species known to have liver oil rich in vitamin A.	NMFDC, ICAR-CMFRI; Varghese *et al.*, 2017 Govt. of India. Notification number 110/(RE-2013) 2009-14, dt 6 Feb 2015 and 111/(RE-2013) 2009-14, dt 6 Feb 2015 Clarke *et al.*, 2006a, b; Fields *et al.*, 2017 Rose, 1996; Musick, 2004

<table>
<tr><th colspan="3">Part 3. Data and data sharing</th></tr>
<tr><td></td><td>Description/comments</td><td>Sources of information</td></tr>
<tr><td>Reported national catch(es)</td><td><table>
<tr><th>Year</th><th>Landings (t)</th><th>Year</th><th>Landings (t)</th></tr>
<tr><td>2012</td><td>32.3</td><td>2017</td><td>41</td></tr>
<tr><td>2013</td><td>10.7</td><td>2018</td><td>7.5</td></tr>
<tr><td>2014</td><td>14.6</td><td>2019</td><td>34.1</td></tr>
<tr><td>2015</td><td>12.7</td><td>2020</td><td>1.7</td></tr>
<tr><td>2016</td><td>108.4</td><td></td><td></td></tr>
</table></td><td>NMFDC, CMFRI; Demersal Fisheries Division (DFD), ICAR-CMFRI, unpubl. data</td></tr>
<tr><td>Are catch and/or trade data available from other States fishing this stock?</td><td>Capture fisheries data on “Mako sharks” is available in the FAO global capture fisheries database. Availability of catch/bycatch data from other States is variable across the region.</td><td>www.fao.org/fishery/statistics/software/fishstatj/en</td></tr>
<tr><td>Reported catches by other States</td><td>Access to these data managed by IOTC Secretariat are available: Nominal Catches, Catch and Effort, Size frequency data.</td><td>http://www.iotc.org/data/datasetshttp://www.iotc.org/documents/bycatch-datasets-available-0 (2016)</td></tr>
<tr><td>Catch trends and values</td><td>Despite the lack of sufficient data, there is some anecdotal information suggesting that mako shark abundance has declined over recent decades in the Indian Ocean, including from Indian longline research surveys.</td><td>IOTC–2017
Varghese et al., 2017.</td></tr>
<tr><td>Have RFBs and/or other States fishing this stock been consulted during or contributed data during this process?</td><td>No, this NDF will be made public in order to enable other range states to make informed decisions for the management of the stock as a whole for the Indian Ocean.</td><td></td></tr>
</table>

Section 2. Intrinsic biological and conservation concerns

2.1 What is the level of intrinsic biological vulnerability of the species?

Intrinsic biological factors	Level of vulnerability	Indicator/metric
Median age at maturity	Low	
	Medium	
	High	Mean age at maturity in Indian Ocean is 7 years for males and 18 years for females (Groeneveld *et al.*, 2014). In Indian waters also it has been estimated to be around 7 years (189 cm) for males and 18 years (266.5 cm) for females using Lm_{50} estimates (Varghese *et al.*, 2017; ICAR-CMFRI unpublished). This is almost in line with the global estimates of shortfin mako sharks (Compagno, 1984; Natanson *et al.*, 2006; Bishop *et al.*, 2006). Considering the females, high level of vulnerability is given
	Unknown	

Median size at maturity	Low	
	Medium	
	High	Size at maturity of mako sharks varies between ocean regions. Shortfin mako maturity ranging globally from 166 to 204 cm TL for males, and 265-312 cm TL for females (Rigby *et al.*, 2019a). In the Indian Ocean, size at maturity has been estimated at 190 cm FL for males and 250 cm FL for females (Groeneveld *et al.*, 2014), versus 189 cm TL for males and 266.5 cm TL for females (Varghese *et al.*, 2017). Size at maturity of longfin mako ranges globally from189-229 cm TL and 230-245 cm TL for females (Castro *et al.*, 1999; Compagno, 2001; Ruiz-Abierno *et al.*, 2021). In the Indian Ocean the size at maturity is almost in line with the other regions of the world (Last and Stevens, 2009; Varghese *et al.*, 2017).
	Unknown	
Maximum age/longevity in an unfished population	Low	
	Medium	
	High	Globally the maximum age recorded for shortfin mako is 28-32 years (Compagno,1984; Rigby *et al.*, 2019a). In the West and Central South Atlantic Ocean, the maximum age was recorded as 16-23 years for males and 19-28 years for females (Barreto *et al.*, 2016). In other regions 28-32 years has been recorded for females (Natanson *et al.*, 2006; Doño *et al.*, 2014).
	Unknown	
Maximum size	Low	
	Medium	
	High	*Isurus oxyrinchus*: maximum length reported globally is 445 cm (Rigby *et al.*, 2019a; Weigmann *et al.*, 2016). The maximum size reported from eastern Arabian Sea is 221 cm TL for males and 337 cm for females (Varghese *et al.*, 2017; Najmudeen T. M., *pers.obs.*). In western Bay of Bengal reported maximum length is 245 cm TL for males and 270 cm TL for females (Shoba J. K, *pers.obs.*). *Isurus paucus*: Globally, the maximum size reported is 427 cm TL (Castro *et al.*, 1999; Rigby *et al.*, 2019b). Maximum size reported from eastern Arabian Sea is 258 cm TL for males and 227 cm for females (Varghese *et al.*, 2017). In western Bay of Bengal, a female of 138 cm TL was reported in 2012 (Shoba J. K, *pers.obs.*).
	Unknown	
Natural mortality rate (M)	Low	
	Medium	
	High	*Isurus oxyrinchus*: female 0.13, male 0.16 (Kai and Yokoi, 2017); male 0.10 to 0.14, female 0.09 to 0.16 (Bishop *et al.*, 2006)
	Unknown	No information from India.

Maximum annual pup production (per mature female)	Low	
	Medium	*Isurus oxyrinchus*: 9-14 pups were recorded in Indian Ocean (Groeneveld *et al.*, 2014). 6 pups were recorded from a specimen sampled from landings in Indian waters (Shoba J. K., *pers.obs.*). Globally, 4-25 pups have been reported with average of 12 (Mollet *et al.*, 2000; Ebert and Stehmann, 2013). Numbers of pups per litter varies between oceans. Gestation period: 15-18 months, with females reported to give birth once in every 3 years (Mollet *et al.*, 2000; Rigby *et al.*, 2019a). *Isuruspaucus*: 2-8 pups reported globally (Castro *et al.*, 1999; Compagno, 2001). No information is available on gestation period/periodicity of births.
	High	
	Unknown	
Intrinsic rate of population increase (r)	Low	
	Medium	
	High	0.031 (Brunel *et al.*, 2018)
	Unknown	No information available from India
Geographic distribution of stock	Low	*Isurus oxyrinchus*: Widespread throughout tropical and temperate waters of all oceans. It is highly migratory (Rigby *et al.*, 2019a; Weigmann, 2016). *Isurus paucus*: Oceanic, widespread and highly migratory throughout temperate and tropical waters (Hueter *et al.*, 2016)
	Medium	
	High	
	Unknown	
Current stock size relative to historic abundance	Low	
	Medium	
	High	Globally, mako shark populations are projected to have undergone a reduction of 50-79% over the last three generations / 75 years (Rigby *et al.*, 2019a, b). *Isurus oxyrinchus*: Globally, shortfin mako shark landings showed increasing trend from 6,469 t in 2000 to the maximum of 14,538 t in 2011, with mean landing of 10,847 t (2000-2019). Catches dwindled in Indian waters from 103 t (2016) to only 1.7 t (2020) with average of 26 t during 2012-2020 (FAO, 2020; NMFDC, ICAR-CMFRI). *Isurus paucus*: The average global catch of longfin mako in the last two decade is 40 t only (0.4% of mako shark landings). Catches showed increasing trend from no landings to 287 t in 2017. In Indian waters *I. paucus* landings varied from 0.04 t to 19 t with the average landings of only 3 t during 2012-2020 (FAO, 2020; NMFDC, ICAR-CMFRI).
	Unknown	

Behavioural factors	Low	
	Medium	
	High	Due to their oceanic and migratory behaviour mako sharks are highly susceptible to pelagic longliners (IOTC, 2017). They are caught by high-seas longline and gillnet fisheries, especially those pursuing tuna, billfish, and swordfish (Camhi *et al.*, 2008; Campana, 2016). Mako sharks are taken as both, targeted and bycatch, throughout their distribution range. They form a bycatch in mechanized drift gillnet-cum-longliners and occasionally in trawlers too (NMFDC, ICAR-CMFRI *unpubl. data*; Sobhana *et al.*, 2013; Varghese *et al.*, 2017). Critical habitats are unknown.
	Unknown	
Trophic level	Low	
	Medium	
	High	*Isurus oxyrinchus*: 4.5, based on diet studies (Froese and Pauly, 2021) *Isurus paucus*: 4.5, Based on diet studies (Froese and Pauly, 2021)
	Unknown	

SUMMARY for Question 2.1 Intrinsic biological vulnerability of species			
High	Medium	Low	Unknown

Mako sharks are oceanic and epipelagic lamnids, with circumglobal distribution in tropical and subtropical waters.

Their critical habitats are unknown.

Isurus oxyrinchus reproduction is well understood. Several studies have reported aspects of its reproductive biology, with regional variations in birth period, gestation and size at maturity.

They are long lived (28-32 years), mature relatively late (18 years), and have relativity few offspring (<20 pups every three years). These life history characteristics make it vulnerable to overfishing.

Mako sharks have been caught by high-seas longline and gillnet fisheries in Indian Ocean and are especially vulnerable to both these gears.

This conclusion is derived primarily from: Bengil *et al.*, 2019; Bishop *et al.*, 2006; Branstetter, 1981; Campana *et al.*, 2004; Castro *et al.*, 1999; Compagno.,1984, 2001; Ebert and Stehmann, 2013; Froese and Pauly, 2021; Gilmore, 1993; Groeneveld *et al.*, 2014; Hueter *et al.*, 2016; Joung and Hsu, 2005; Last and Stevens, 2009; Mollet *et al.*, 2000; Natanson *et al.*, 2006, 2020; Rigby *et al.*, 2019a, b; Ruiz-Abierno *et al.*, 2021; Sobhana *et al.*, 2013; Stevens, 1983; Weigmann, 2016; Varghese *et al.*, 2017 and ICAR-CMFRI *unpubl. data*.

2.2: What is the severity and geographic extent of the conservation concern?

Conservation concern factors	Level of severity / scope of concern	Indicator/metric
Conservation or stock assessment status	Low	
	Medium	
	High	Indian Ocean Ecological Risk Assessment: most vulnerable.
	Unknown	

Comments: Few estimates of growth, size and age at maturity studies are available for mako sharks from the Indian Ocean (Bass *et al*., 1975; Groeneveld *et al*., 2014; Varghese *et al*., 2017). The Ecological Risk and Productivity Assessments determined that the shortfin mako was the most vulnerable shark species to overexploitation in pelagic longline fisheries in the Indian Ocean due to its low productivity and high susceptibility to this gear (IOTC., 2017). The IUCN Red List status has recently been changed to globally Endangered for both species (Rigby *et al*., 2019a, b).

Population trend	Low	
	Medium	
	High	Declining trends in population
	Unknown	

Comments:

Mako sharks forms only 0.3% of the total shark landings in India. Catches of *I. oxyrinchus* decreased in Indian waters from 103 t (2016) to only 1.7 t (2020) with average of 26 t during 2012-2020. *I. paucus* is oceanic, rarely encountered in fishing gears, landings varied from 0.04 t to 19 t with the average landings of only 3 t during 2012-2020 (NMFDC, ICAR-CMFRI unpubl. data).

Geographic extent/ scope of conservation concern	None	
	Low	
	Medium	
	High	Identified threats affect the Indian Ocean population as well as global population of the species.
	Unknown	

Comments:

Mako sharks are apex predators that has low biological productivity with a triennial reproductive cycle and late age at maturity. They are either targeted or landed as bycatch throughout their circumglobal distribution and received the highest vulnerability ERA ranking in the Indian Ocean. Catches from Indian waters are mostly bycatch in mechanized drift gillnet-cum-longliners and showed declining trend over the decade. Other countries bordering the Indian Ocean take mako sharks as bycatch while targeting tuna, billfish, and swordfish in gillnet and longline fisheries.

SUMMARY for Question 2.2

Severity and geographic extent of conservation concern

Assess the overall severity and geographic extent of the conservation concern for this species or stock (tick appropriate box below). Explain how conclusions were reached and the main sources of information used.

High	Medium	Low	Unknown

Explanation of conclusion and sources of information used:

This is a low productivity genus caught occasionally in the longlining, not a target fishery and limited information is available about the stock. Population trends in the other major ocean basins, combined with limited trend data and information on threats from the Indian Ocean, indicate that the status of the Indian Ocean stock is also of concern. The conservation needs and threats to this species are therefore high in the Indian Ocean.

Given the importance of mako sharks in various fisheries and the lack of data to evaluate the fishery and population trend in the Indian Ocean, mako shark population should be constantly monitored and managed to ensure their sustainability

This conclusion is derived primarily from: Bass *et al*., 1975; Camhi *et al*., 2008; Campana, 2016; Compagno, 2001; Fernando &Tanna, 2019; Fields *et al*., 2017; Groeneveld *et al*., 2014; IOTC., 2017; Mejuto *et al*., 2002; Mollet *et al*., 2000; Musick, 2004; Natanson *et al*., 2006; Rigby, *et al*., 2019a, b; Rose, 1996; Varghese *et al*., 2017 and ICAR-CMFRI *unpubl. data*.

Section 3. Pressures on species

3.1 What is the severity of trade pressure on the stock of the species concerned?

Factor	Level of severity of trade pressure	Indicator/metric	
(a) Magnitude of legal trade	Low		
	Medium	Reported shark catches and landings trends low and species-specific trade information limited.	
	High		
	Unknown		
	Level of confidence:		
	Low	**Medium**	High

Reasoning: Mako sharks are one of the high value shark species owing to good quality meat and fins. The meat can be consumed in fresh, frozen, dried and smoked form. The other parts like skin, jaws and liver could also be used (Rigby *et al.*, 2019a, b). The short fin mako sharks are among the major species in fin trade in Hong Kong (Fields *et al.*, 2017), China (Cardeñosa *et al.*, 2020) and UAE (Jabado *et al.*, 2015) markets. These sharks are mostly a bycatch of long line and gillnets set for large pelagic fishes like tunas and bill fishes but are never been discarded back to sea because of their high value. The total average landing of mako sharks along the Indian coast was only 29 t during 2012-20 (Source: NMFDC, CMFRI). Species-specific trade information is not available.

Factor	Level of severity of trade pressure	Indicator/metric
(b) Magnitude of illegal trade	Low	
	Medium	
	High	
	Unknown	Shark fin exports have been prohibited since 2015. Some shipments to Hong Kong have been reported as originating from India (TRAFFIC and CMFRI, 2019). Recently, Biodiversity, Cultural and National Heritage Protection (BCNP) Unit of Sri Lanka Customs seized a shipment containing dried shark fins belonging to *Isurus* and *Sphyrna* destined to Hong Kong market (https://www.customs.gov.lk/seizure-of-dried-fins-of-cites-listed-sharks-22-03-2021/). Shark fin are known to be smuggled from India to Sri Lanka for legal re-export from Sri Lanka (https://www.pressreader.com/sri-lanka/sunday-times-sri-lanka/20180218/281934543421820). Directorate of Revenue Intelligence (DRI), India seized 8000 kg of shark fins at Mumbai and Veraval in 2018 (https://indianexpress.com/article/cities/mumbai/dri-busts-illegal-exports-of-shark-fin-from-maharashtra-and-gujarat-5338320/) an offloaded a cargo shipped from Chennai congaing 4000 kg of shark fin at Malaysia (https://timesofindia.indiatimes.com/city/mumbai/4-ton-shark-fin-cargo-offloaded-in-malaysia/articleshow/65678493.cms) indicating the existence of illegal shark fin trade from India to International market

	Level of confidence:		
	Low	Medium	High

Reasoning: The seizure of several consignments in the recent past indicates the existence of illegal trade of shark fins from India, but it also shows the efficient network to restrict the same. Further the quantum of trade for the given species is highly uncertain given very limited reported landings from the country (NMFDC, CMFRI).

The Union Ministry of Commerce and Industry prohibited the export of fins of all species of shark, by way of a notification on February 6, 2015 (Notification No. 110 (RE-2013)/2009-2014) inserting a new entry in 'Chapter 3 of Schedule 2 of ITC (HS) Classification of Export and Import Items.' The new entry (31 A) resulted in the ban on export of all shark fins. The shark fins, may be applicable to fins of *Mako sharks* since there is no exclusive trade of the fins of these fishes; they are usually a part of fin consignments of shark species.

Letter from WWF India to MoEF & CC regarding potential illegal shark fin export- from India to Hong Kong, dated 18th April 2017- reports that from 2015-16, 139,558 kg of dried shark fin with a value of Hong Kong dollar 49,562,000/- was exported from India or via other countries to Hong Kong, and in Jan-Feb 2017 about 1,280 kg of suspected scheduled hammerhead sharks and oceanic white tip sharks were seized in four containers, one being from India without any relevant permits attached. The exact species composition of the consignments is unknown, hence the possibility of fins of mako sharks being a part of the same cannot be ruled out.

Hong Kong Customs trade data for imports from India, 1998-2016, peaked at over 430,000 kg in 2000 and then fell to $<$100,000 kg in 2007, recovered slightly for a few years and declined again to below 100,000 kg in 2012. By 2015, imports from India were 80,850 kg, and fell after the export ban to 58,708 kg, and further to 12476 kg in 2019 and 2799 kg in 2020 (HK Customs data provided by Bloom/Stan Shea, *per. comm.*). The steady decline in quantum of fins imported from India from 2015 to 2020 suggest that the consignments could be residual stock existing with the traders before implementation of the shark fin trade ban. It is not clear whether fresh stocks are included in these consignments.

3.2 What is the severity of fishing pressure on the stock of the species concerned?			
Factor	Level of severity of fishing pressure	Indicator/metric	
Fishing mortality (retained catch)	Low		
	Medium		
	High	The f/f_{msy} from Indian Ocean is at 2.57 (Brunel *et al* 2018)	
	Unknown		
	Level of confidence:		
	Low	Medium	High
Reasoning: The fisheries of mako shark should be considered a data deficient fishery, but some preliminary estimates from the Indian ocean indicated a population decline of nearly 50% over the period of 45 years (1971-2015) (Brunel *et al.*, 2018). There is virtually no discard of mako sharks from Indian fisheries; fisheries mortality (retained catch) is therefore ~100%. There is an overall declining trend in landings of *I. oxyrinchus* along Indian coast during 2012-2020 (NMFDC, CMFRI). Although the species is not a targeted species, it forms bycatch of long liners and gillnetters. The promotion of tuna long-lining and large mesh gillnets for large pelagic resources may render these shark species more vulnerable to fishing pressure.			
Discard mortality	Low	There are virtually no discards of mako sharks from Indian fisheries.	
	Medium		
	High		
	Unknown		
	Level of confidence:		
	Low	Medium	High
Reasoning: In India discard mortality is very low because all mako sharks caught are retained owing to its high value. The hooking mortality was estimated as 26% whereas the post-release mortality for pelagic longline was as high as 44%. Jordaan *et al.* (2020) estimated that only 4% of mako shark caught by pelagic long-liners of South Africa were discarded. 82% of the discarded mako sharks were already dead at the time of discard.			
Size/age/ sex selectivity	Low		
	Medium	There is no targeted or selective fishing for the species in India, however due to seasonal aggregations there may be occasional catches in good numbers of juveniles during December to March along Gujarat coast in multiday gillnetters (Shikha R., *pers.obs.*)	
	High	In the Indian EEZ this species is not exploited by purse seine. However tropical purse seine fisheries are highly selective for certain size-age classes, juvenile mako shark comprise the largest component of the incidental elasmobranch catch (ICAR-CMFRI, *unpubl. data*).	
	Unknown		
	Level of confidence:		
	Low	Medium	High

Reasoning: Varghese *et al.* (2017) reported no sex selective fishing for mako shark as there was no significant difference between the proportion of male and females in commercial landings at Kochi, India. But the concern was the capture of sub-optimal sized specimens. Almost all the females of mako shark were below the estimated length of maturity (TL_{m50}) and a major proportion of males were also below the TL_{m50}. Along NW coast of India, males were found dominant in mako shark landings (M: F =1.4:1). Almost all the catches were below the length at maturity, male size ranged from 74-186 cm (avg. 121 cm) and female sizes were in the range of 89-174 cm (avg. 128 cm); however, there was no targeted fishery for this resource (Shikha, R., *pers obs.*)			
Magnitude of illegal, unreported and unregulated (IUU) fishing	Low		
	Medium		
	High		
	Unknown	Information unavailable.	
	Level of confidence:		
	Low	Medium	High
Reasoning: No verifiable records from India on the IUU fishing of this species. Issues of IUU fishing by IOTC's IUU provisions (IOTC-2016-CoC13-CR27 Rev1). The BOBP-IGO organized the 'National Workshop for Preparation of Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing' during 23 – 24 April 2018 in Chennai and the Report of the Workshop was sent to the Ministry of Fisheries, Animal Husbandry and Dairying for further action at their end. Subsequently, the BOBP-IGO in collaboration with the member-countries (Bangladesh, India, Maldives, Sri Lanka) also organized a couple of activities to prepare the draft Regional Plan of Action on IUU Fishing (RPOA-IUU). The RPOA-IUU is now with the Bangkok Office of FAO and will be further taken up once the BOBLME Phase 2 starts (BOBP-IGO, 2021, personal communication).			

Section 4. Existing management measures

Preliminary compilation of information on existing management measures		
Existing management measures	Is the measure generic or species-specific?	Description/comments/sources of information
(Sub-) National		
Fins-attached policy	Generic	In August 2013, the Ministry of Environment and Forests (Wildlife Division) approved a policy advisory by ICAR-CMFRI on shark finning (vide F. No4-36/2013WL, 21 August 2013), prohibiting the removal of shark fins on board a vessel in the sea, and advocating landing of the whole shark
Ban on shark fin export – Dept of Commerce of Ministry of Commerce and Industry	Generic	The Union Ministry of Commerce and Industry prohibited the export of fins of all species of shark, by way of a notification on February 6, 2015 (Notification No. 110 (RE-2013)/2009-2014) inserting a new entry in 'Chapter 3 of Schedule 2 of ITC (HS) Classification of Export and Import Items.' The new entry (31 A) resulted in the ban on export of all shark fins.
Seasonal ban on mechanized fishing	Generic	Closure of mechanized fishing activities for 60 days from 15th April to 15th June along east coast and 1st June to 31st July along west coast (both days inclusive), implemented through State MFRAs.
No take zones	Generic	There are 129 Marine Protected Areas where fishing activities are regulated (Sivakumar, 2010; MOEF & CC GoI).
Fishing effort management; fleet size optimization; mainstreaming biodiversity conservation in production processes; species-specific and area-specific management plans; protection of iconic and endangered and threatened (ETP) species; spatial and temporal measures for sustainable utilization of resources; and creation of fish refugia	Generic	National Policy on Marine Fisheries – 2017 https://dahd.nic.in/news/notification-national-policy-marine-fisheries-2017

Gear-specific regulations	Generic	Regulation of mesh size, restrictions on operation of certain gears like ring seines, purse seines and pair trawling, implemented through State MFRAs. http://indianfisheries.icsf.net/en/page/827-Indian%20Legal%20Instruments.html http://old.icsf.net/icsf2006/uploads/resources/legalIndia/pdf/english/state/1112187832409***Gujarat_Marine_Fisheries_Rules_2003.PDF http://old.icsf.net/icsf2006/uploads/resources/legalIndia/pdf/english/state/1112240177836***Maharashtra_Marine_Fishing_Regulation_Rules,_1982.PDF http://164.100.150.120/mpeda/pdf/state_mfras/mfra_goa.pdf http://164.100.150.120/mpeda/pdf/state_mfras/mfra_karnataka_1987.pdf http://164.100.150.120/mpeda/pdf/state_mfras/mfra_kerala.pdf http://164.100.150.120/mpeda/pdf/state_mfras/mfra_tamil_nadu.pdf http://old.icsf.net/icsf2006/uploads/resources/legalIndia/pdf/english/state/1165227972133***Andra_Pradesh_Marine_Fishing_Regulation_Rules_1995_Amendment_dated_26th_October_2004.PDF http://164.100.150.120/mpeda/pdf/state_mfras/mfra_orrissa.pdf http://old.icsf.net/icsf2006/uploads/resources/legalIndia/pdf/english/state/1112241236819***West_bengal_Marine_Fishing_Regulation_(Amendment)_Rules,_1998.PDF
Regional/International		
IOTC Resolution 15/01 on the recording of catch and effort data by fishing vessels in the IOTC area of competence	Generic	Para. 1. Each flag CPC shall ensure that all purse seine, longline, gillnet, pole and line, handline and trolling fishing vessels flying its flag and authorized to fish species managed by IOTC be subject to a data recording system. Para. 10 (start). The Flag State shall provide all the data for any given year to the IOTC Secretariat by June 30th of the following year on an aggregated basis.
IOTC Resolution 11/04 on a regional observer scheme	Generic	Para. 10. Observers shall: b) Observe and estimate catches as far as possible with a view to identifying catch composition and monitoring discards, by-catches and size frequency.

IOTC Resolution 15/02 mandatory statistical reporting requirements for Contracting Parties and Cooperating Non-Contracting Parties (CPCs)	Species-specific	Para. 2. Estimates of the total catch by species and gear, if possible quarterly, that shall be submitted annually as referred in paragraph 7 (separated, whenever possible, by retained catches in live weight and by discards in live weight or numbers) for all species under the IOTC mandate as well as the most commonly caught elasmobranch species according to records of catches and incidents as established in Resolution 15/01 on the recording of catch and effort data by fishing vessels in the IOTC area of competence (or any subsequent superseding Resolution).
IOTC Resolution 05/05 concerning the conservation of sharks caught in association with fisheries. *Superseded by IOTC Res 17/05.*	Species-specific and generic	Para. 1. CPCs shall annually report data for catches of sharks, in accordance with IOTC data reporting procedures, including available historical data. Para. 3. CPCs shall take the necessary measures to require that their fishermen fully utilise their entire catches of sharks. Full utilisation is defined as retention by the fishing vessel of all parts of the shark excepting head, guts and skins, to the point of first landing.
Resolution 10/02.	Generic	Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's) indicated that the provisions, applicable to tuna and tuna-like species, are applicable to shark species
Resolution 11/04		Resolution 11/04 on a Regional Observer Scheme requires data on shortfin mako shark interactions to be recorded by observers and reported to the IOTC within 150 days. The Regional Observer Scheme (ROS) started on 1st July 2010.
IOTC Resolution 17/05 on the conservation of sharks caught in association with fisheries managed by IOTC.	Generic	Para. 2. Full utilisation of shark catches, with the exception of prohibited species. Para. 3. Prohibits the removal of fins on board vessels and the landing or carrying of fins that are not naturally attached before the point of first landing. Para. 6. CPCs shall report data for catches of sharks, in accordance with IOTC data reporting procedures. Para. 11. CPCs shall undertake research to make fishing gear more selective, look into prohibiting wire leaders, improve knowledge on biological data of sharks, mating/pupping areas and improve handling practices.
CMS	Species-specific	Listing of *Isurus oxyrinchus* and *Isurus paucus* in Appendix II of CMS in 2008
CITES	Species-specific	Listing of *Isurus oxyrinchus* and *Isurus paucus* in Appendix II of CITES in 2019

4.1 Are existing management measures appropriately designed and implemented to mitigate pressures affecting the stock?

Factor	Existing management measure(s)	Relevant monitoring, control and surveillance (MCS) measure(s)	Overall assessment of compliance regime *(tick as appropriate)*
Trade Pressure			
Magnitude of legal trade	In 2015, India introduced a ban on the export of all shark fins. All other product trade is legal.	Exports must be declared. Customs inspections of a random selection of containers is undertaken at the point of export. Wildlife Crime Control Bureau is responsible for the regulation/ monitoring of wildlife trade.	Unknown (no information on compliance) Poor (limited relevant compliance measures in place) **Moderate (some relevant compliance measures in place)** [highlighted] Good (comprehensive relevant compliance measures in place)
	Reasoning/comments: Limited information from other States fishing in the Indian Ocean and in the high seas. The market demand for both sharks and rays is strong in the regions. There is no restriction on domestic shark utilisation for consumption except for protected species. There is no mandatory information sharing for species in domestic trade, highly general export codes.		
Magnitude of illegal trade		There have been some seizures in Sri Lanka and Hong Kong of smuggled shark fins from India. Hong Kong Customs records imports by country, including from India, post-trade restrictions on fins. Regular customs/wildlife confiscations at borders, airports intended for illegal trade	Unknown (no information on compliance) Poor (limited relevant compliance measures in place) **Moderate (some relevant compliance measures in place)** [highlighted] Good (comprehensive relevant compliance measures in place)
	Reasoning/comments: Letter from WWF India to MoEF & CC regarding potential illegal shark fin export- from India to Hong Kong, dated 18th April 2017- reports that from 2015-16, 139558 kg of dried shark fin with value of Hong Kong dollar 49562000/- was exported from India or via other countries to Hong Kong and in Jan-Feb 2017, about 1280 kg of suspected scheduled hammerhead sharks and oceanic white tip sharks were seized in four containers one being from India without any relevant permits attached. Hong Kong Customs trade data for imports from India, 1998-2016, peaked at over 430,000 kg in 2000 and then fell to <100,000 kg in 2007, recovered slightly for a few years and declined again to below 100,000 kg in 2012. By 2015, imports from India were 80,850 kg, and fell after the export ban to 58,708 kg, and further to 12476 kg in 2019 and 2799 kg in 2020 (HK Customs data provided by Bloom/Stan Shea, *pers comm.).* The steady decline in quantum of fins imported from India from 2015 to 2020 suggest that the consignments could be residual stock existing with the traders before implementation of the shark fin trade ban. It is not clear whether fresh stocks are included in these consignments.https://www.customs.gov.lk/seizure-of-dried-fins-of-cites-listed-sharks-22-03-2021/)		

Fishing Pressure			
Fishing mortality (retained catch)	Average catch of mako sharks during 2012-2020 from Indian waters is estimated at 29 t. The average landing of *I. oxyrinchus* along the Indian coast is about 26 t. Maximum catch was during 2016 (103.5 t) which decreased to only 1.7 t in 2020. *I. paucus* landings varied from 0.04 t to 19 t with the average landings of only 3 t (2012-2020) (Figure 10). Mako sharks forms only 0.3% of the total shark landings in India. There is no targeted fishery of these species and they are mostly taken as bycatch in longline and gillnet fisheries and rarely caught in trawls net as bycatch (ICAR-CMFRI, *unpubl. data*) Closed seasons for all mechanised fisheries. Fishing effort controlled by mandatory fishing vessel licensing and registration	No on-board observer programme. Port monitoring takes place. Logbooks are not maintained properly. Nor are they shared with management authorities.	Unknown (no information on compliance) Poor (limited relevant compliance measures in place) Moderate (some relevant compliance measures in place) Good (comprehensive relevant compliance measures in place)
	Reasoning/comments: IOTC compliance continues to be improved.		

Discard mortality	No known discards from shark fisheries in India	Not applicable.	**Unknown (no information on compliance)**
			Poor (limited relevant compliance measures in place)
			Moderate (some relevant compliance measures in place)
			Good (comprehensive relevant compliance measures in place)
	Reasoning/comments: It is assumed that all dead sharks caught, except prohibited species, are fully retained on-board and utilised.		
Size/age/ sex selectivity		Monitoring in all maritime states along Indian coast.	Unknown (no information on compliance)
			Poor (limited relevant compliance measures in place)
			Moderate (some relevant compliance measures in place)
			Good (comprehensive relevant compliance measures in place)
	Reasoning/comments: The fishery is not high volume in comparison to other species, however considering the vulnerability of the resource, it may be monitored continuously.		
Magnitude of IUU fishing			Unknown (no information on compliance)
			Poor (limited relevant compliance measures in place)
			Moderate (some relevant compliance measures in place)
			Good (comprehensive relevant compliance measures in place)
	Reasoning/comments: Issues of IUU fishing by IOTC's IUU provisions (IOTC-2016-CoC13-CR27 Rev1). The BOBP-IGO organized the 'National Workshop for Preparation of Plan of Action to Prevent Deter and Eliminate Illegal, Unreported &Unregulated Fishing' during 23-24 April 2018 in Chennai. The Report of the Workshop was sent to the Ministry of Fisheries, Animal Husbandry and Dairying for further action. Subsequently, the BOBP-IGO in collaboration with the member-countries (Bangladesh, India, Maldives, Sri Lanka) also organized a couple of activities to prepare the draft Regional Plan of Action on IUU Fishing (RPOA-IUU). The RPOA-IUU is now with the Bangkok Office of FAO and will be further taken up once the BOBLME Phase 2 starts (BOBP-IGO, 2021, *pers. comm.*).		

<table>
<tr><th colspan="5">4.2 Are existing management measures effective/likely to be effective in mitigating pressures affecting the stock/population?</th></tr>
<tr><th>Factor</th><th colspan="2">Existing management measure(s)</th><th>Are relevant data collected and analysed to inform management decisions? (e.g. landings, effort, fisheries independent data)</th><th>Is management consistent with expert advice?</th></tr>
<tr><td colspan="5">Trade Pressure</td></tr>
<tr><td rowspan="7">(a) Magnitude of legal trade</td><td colspan="2" rowspan="4">Regulations in place and complied with. (Notification No. 110 (RE-2013)/2009-2014).</td><td>No data OR data are of poor quality OR data are not analysed (adequately) to inform management</td><td>No expert advice on management identified</td></tr>
<tr><td>Limited relevant data are collected AND analysed to inform management</td><td>Not consistent</td></tr>
<tr><td>Some relevant data are collected AND analysed to inform management</td><td>Consistent</td></tr>
<tr><td>Comprehensive data collected AND analysed to inform management</td><td></td></tr>
<tr><td colspan="4">Management measure(s) effective/likely to be effective?</td></tr>
<tr><td>Yes</td><td>Partially</td><td>No</td><td>Insufficient information</td></tr>
<tr><td colspan="4">Reasoning/comments: Only generic declaration of export is done in India.</td></tr>
<tr><td rowspan="6">(b) Magnitude of illegal trade</td><td colspan="2" rowspan="4">In general trade is monitored in different levels and actions taken according to national laws by Central Board of Excise and Customs and Wildlife Crime Control Bureau</td><td>No data OR data are of poor quality OR data are not analysed (adequately) to inform management</td><td>No expert advice on management identified</td></tr>
<tr><td>Limited relevant data are collected AND analysed to inform management</td><td>Not consistent</td></tr>
<tr><td>Some relevant data are collected AND analysed to inform management</td><td>Expert advice partially implemented</td></tr>
<tr><td>Comprehensive data collected AND analysed to inform management</td><td>Consistent</td></tr>
<tr><td colspan="4">Management measure(s) effective/likely to be effective?</td></tr>
<tr><td>Yes</td><td>Partially</td><td>No</td><td>Insufficient information</td></tr>
</table>

<table>
<tr><th colspan="5">Fishing Pressure</th></tr>
<tr><td rowspan="6">(a) Fishing mortality (retained catch)</td><td colspan="2" rowspan="4">No shark discards in fishery.
Limited relevant data are collected AND analysed to inform management
Some relevant data are collected AND analysed to inform management
Comprehensive data collected AND analysed to inform management</td><td rowspan="4">No data OR data are of poor quality OR data are not analysed (adequately) to inform management</td><td>No expert advice on management identified</td></tr>
<tr><td>Not consistent</td></tr>
<tr><td>Expert advice partially implemented</td></tr>
<tr><td>Consistent</td></tr>
<tr><td colspan="4">Management measure(s) effective/likely to be effective?</td></tr>
<tr><td>Yes</td><td>Partially</td><td>No</td><td>Insufficient information</td></tr>
<tr><td rowspan="6">(b) Discard mortality</td><td colspan="2" rowspan="4">No shark discards from Indian fisheries.
Limited relevant data are collected AND analysed to inform management
Some relevant data are collected AND analysed to inform management
Comprehensive data collected AND analysed to inform management</td><td rowspan="4">No data OR data are of poor quality OR data are not analysed (adequately) to inform management</td><td>No expert advice on management identified</td></tr>
<tr><td>Not consistent</td></tr>
<tr><td>Expert advice partially implemented</td></tr>
<tr><td>Consistent</td></tr>
<tr><td colspan="4">Management measure(s) effective/likely to be effective?</td></tr>
<tr><td>Yes</td><td>Partially | No</td><td>Insufficient information</td><td>NA</td></tr>
<tr><td rowspan="6">(c) Size/age/ sex selectivity</td><td colspan="2" rowspan="4">No measures adopted in India (no size specific targeted shark fisheries). Procedures proposed in FADs management plan, IOTC resolution 17/08.
Limited relevant data are collected AND analysed to inform management
Some relevant data are collected AND analysed to inform management
Comprehensive data collected AND analysed to inform management</td><td rowspan="4">No data OR data are of poor quality OR data are not analysed (adequately) to inform management</td><td>No expert advice on management identified</td></tr>
<tr><td>Not consistent</td></tr>
<tr><td>Expert advice partially implemented</td></tr>
<tr><td>Consistent</td></tr>
<tr><td colspan="4">Management measure(s) effective/likely to be effective?</td></tr>
<tr><td>Yes</td><td>Partially</td><td>No</td><td>Insufficient information</td></tr>
</table>

(d) Magnitude of IUU fishing	*NA*. No target shark fishing; no specific regulation of bycatch shark fisheries; limited monitoring of IUU fishing. Limited relevant data are collected AND analysed to inform management Some relevant data are collected AND analysed to inform management Comprehensive data collected AND analysed to inform management		No data OR data are of poor quality OR data are not analysed (adequately) to inform management	No expert advice on management identified Not consistent Expert advice partially implemented Consistent
	Management measure(s) effective/likely to be effective?			
	Yes	Partially	No	Insufficient information

Section 5. Non-Detriment Finding

Step 2: Intrinsic biological vulnerability and conservation concern

Intrinsic biological vulnerability (Question 2.1)	High	Medium	Low	Unknown

Step 3: Pressures on species			Step 4: Existing management measures
Pressure	Level of severity (Questions 3.1 and 3.2)	Level of confidence (Questions 3.1 and 3.2)	Are the management measures effective* at addressing the concerns/pressures/impacts identified? (Question 4.2) **taking into account the evaluation of management appropriateness and implementation under Question 4.1*
Trade pressures			
(a) Magnitude of legal trade	**High** Medium Low Unknown	**High** Medium Low Unknown	Yes **Partially** No Insufficient information Not applicable**
(b) Magnitude of illegal trade	High Medium Low **Unknown**	High **Medium** Low Unknown	Yes Partially No **Insufficient information** Not applicable**
** Only to be used where the trade pressure severity was assessed as "Low" for any of the Factors in Step 3 and a judgement is made that the impacts on the shark stock/population concerned are so low that mitigation is not required.			
Fishing pressures			
(a) Fishing mortality (retained catch)	**High** Medium Low Unknown	**High** Medium Low Unknown	**Yes** Partially No Insufficient information Not applicable**
(b) Discard mortality	High Medium **Low** Unknown	**High** Medium Low Unknown	Yes Partially No **Insufficient information** Not applicable**

(c) Size/age/sex selectivity of fishing	High **Medium** Low Unknown	**High** Medium Low Unknown	Yes **Partially** No Insufficient information Not applicable**
(d) Magnitude of IUU fishing	High Medium Low **Unknown**	High **Medium** Low Unknown	Yes Partially No **Insufficient information** Not applicable**
**Only to be used where the fishing pressure severity was assessed as "Low" for any of the Factors in Step 3 and a judgement is made that the impacts on the shark stock/population concerned are so low that mitigation is not required.			
Can a positive NDF be made?	YES–*go to B*	NO–*go to Step 6 and list recommendations for measures to improve monitoring/management under* Reasoning/*comments below*	
Are there any mandatory conditions to the positive NDF?	YES–*list under* Reasoning/*comments below and go to C*	NO–*go to C*	
Are there any other further recommendations?	YES–*go to Step 6*	NO	

Reasoning/comments:

This mako sharks (*Isurus oxyrhinchus* and *Isuru spaucus*) NDF for India is "**negative**" and does not support international trade in this species. Additional research is mandatory to assess the status of the species and improvements are made to existing fisheries and trade management and monitoring frameworks as outlined in Section 6.

This NDF will be re-evaluated after 5 years, to gauge progress against the recommendations in Section 6 and updated with newly acquired data, before agreeing to a new NDF for 2027-2031.

Section 6. Further measures	
Section 6.1: Improvement in monitoring or information is required	
Monitoring and data recommendations for mako sharks in the Indian Ocean	
Generic measures	
Recommendation	Potential leads
Fishery-dependent monitoring and research: Fishery monitoring:	
Improve the existing species-specific landing observation programme, through training and capacity-building of field staff.	ICAR- CMFRI, NGOs
Look into establishing an informal communication group (e.g. Instagram/ WhatsApp/Google) of shark identification experts (both local and international), to help field staff to identify sharks and/or shark products with a camera photo at short notice.	ICAR- CMFRI
Build upon the developing programme for introducing vessel monitoring systems.	State Fisheries Depts, FSI
Investigate options for introducing mandatory logbook reporting on species-wise landings by fishers.	State Fisheries Departments and ICAR-CMFRI
Use interviews with fishers to obtain enquiry-based information on shark (by) catch, particularly where access to logbooks is difficult; develop databases for records of species, catch, date and area of capture (geolocation), and gear types.	ICAR-CMFRI
Ensure that species-specific data provided to the Ministry of Fisheries, Animal Husbandry & Dairying are passed on to the FAO.	DoF, GoI
Identifying area & season breeding and nursery aggregations of the species, using a participatory approach with fishers.	ICAR-CMFRI
Research: Undertake biological and stock assessment studies, utilizing data on sex ratios, size/age structure, annual reproductive output, BRPs, and fishing effort collected at landing sites by CMFRI fisheries officers and population genetic studies on stocks of mako sharks	ICAR-CMFRI, Universities
Monitoring of domestic and international trade: Improve the level of trade data reporting – data declaration by traders (species, source of obtaining the product, size of fish (length & weight), quantity, product form).	CMFRI in collaboration with State Fisheries Departments and ICAR-CMFRI in collaboration with and stakeholders (fishers and traders)
Provide international trade data, as relevant, to CITES, FAO, IOTC.	MPEDA, DoF
Undertake market survey, interviews with fishermen & traders, collate information from Customs & other databases, and from trade channels	ICAR-CMFRI, Universities, NGOs
Recommend to the Marine Products Export Development Authority (Ministry of Commerce and Industry) that species-specific codes be added to the current generic product-specific codes for trade records; offer to collaborate with them to develop codes.	DoF and MPEDA
Promoting the use of genetic analysis by CMFRI for ambiguous products in trade and raise awareness with relevant government departments that this service exists.	ICAR- CMFRI

Resource-specific measures	
Recommendation	Potential leads
Taxonomic studies on mako sharks species (classic and molecular taxonomy)	ICAR-CMFRI
Fishery-independent population monitoring and research Tag and release: Develop and submit a proposal to an external funding agency to assess distribution, movement and post release mortality of mako sharks using electronic tags.	Fishery Survey of India, possibly in collaboration with other national research institutes and regional bodies IOTC, BOBP-IGO.
Develop and submit a proposal to an external funding agency to assess habitat ecology, critical habitats and post-release mortality of mako sharks using electronic tags and assess stock structure using genetic tags.	ICAR-CMFRI, possibly in collaboration with other national research institutes and regional bodies IOTC, BOBP-IGO.
Distribution and Abundance: Undertake resource-specific exploratory surveys Identify spatial and seasonal mako sharks breeding and nursery aggregations	Fishery Survey of India in collaboration with ICAR- CMFRI and Centre for Marine Living Resources & Ecology (CMLRE)
Fishery-dependent monitoring and research: Fishery monitoring: Use interviews with fishers to obtain enquiry-based information on mako sharks catch, particularly where access to logbooks is difficult; develop database for records of mako sharks catch, date and area of capture (geolocation) and gear types.	ICAR-CMFRI
Identifying area & season breeding and nursery aggregations of mako sharks, using a participatory approach with fishers.	ICAR-CMFRI, Universities
Research: Undertake biological and stock assessment studies on mako sharks in Indian waters, utilizing data on sex ratios, size/age structure, annual reproductive output, BRPs, and fishing effort collected at landing sites by CMFRI. Carry out population genetic studies on stock(s) of mako sharks in the Indian EEZ.	ICAR-CMFRI, Universities

Section 6.2: Improvement in management is required	
Management recommendations for mako sharks in the Indian Ocean	
Generic measures	
Recommendation	Potential leads
Strict implementation of each state's Marine Fishery Regulation Act (MFRA) regarding gear, mesh size, operation in no-take zones and closed seasons	State Fishery Department, Coastguard, Marine Enforcement Police
Strengthen Monitoring, Control and Surveillance (MCS)	State Fisheries Departments Coastguard and Marine Enforcement Police, Dept of Forestry, Wildlife Crime Control Bureau, MoEF& CC
Improve participatory management and inter-departmental coordination through fishery management councils, as developed under the FAO CCRF	National and State Fishery Management Councils
Create awareness through visual, print and electronic media and mass campaigns	CMFRI, NETFISH-MPEDA, NGOs
Seasonal closure of fishing in identified breeding/nursery grounds	States, through MFRAs
Improved surveillance to check for IUU fishing by foreign vessels, and develop protocol for identifying species on board	Indian Navy and Coastguard
Continue to monitor and where necessary improve compliance with existing fisheries management regulations (national, regional and international), including:	Department of Fisheries (DoF)
Adopt and implement the NPOA-Sharks for India with a special focus on plans for shark species listed in CITES and CMS, encourage and take part in regional initiatives to develop a regional shark plan.	DoF
Urge Ministry of Commerce and Industry to introduce HS codes for all shark products to collect improved data on imports and exports.	MPEDA
Increase awareness for shark processors, traders, and exporters regarding the fin export ban, and CITES requirements for the export of other products derived from CITES listed shark species (this includes export permits accompanied by the Legal Acquisition Finding and Non-Detriment Findings).	ICAR-CMFRI, MPEDA& NGOs
Resource-specific measures	
Recommendation	Potential leads
Develop a fisher awareness program aimed to: improve identification of juvenile and pregnant mako sharks, their seasonal abundance in specifc areas and techniques to maximize live release improve logbook data recording. provide an overview and increase awareness of mako sharks, biology, global status, and management measures in place both locally and internationally.	ICAR-CMFRI, SFDs, Universities, NGOs
Suggest Minimum Legal Size (MLS) for sustainable harvest of mako sharks species in India	ICAR-CMFRI

Timeline of activities for implementation of NDF recommendations

Sl. No	Activity	I YEAR	II YEAR	III YEAR	IV YEAR	V YEAR
1	Linkages and coordination with various organizations for implementation of NDF recommendations					
2.	Awareness programs and stakeholder meetings					
3	Fishery independent studies: Tag and release / stock assessment studies/ abundance and distribution studies					
4	Fishery dependent: catch and effort, participatory fishery monitoring					
5.	Trade monitoring and regulations					
6	Capacity building for stakeholders and managers					

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Appendix–1 Supporting information on mako sharks *Isurus* spp.

Mako sharks are warm-blooded, fast-swimming pelagic sharks that migrate through tropical and temperate seas of the world. They are susceptible to fishing mortality due to low intrinsic rate of population escalation. The shortfin mako *Isurus oxyrinchus* and longfin mako *Isurus paucus* are the two species representing the genus *Isurus*. Mako sharks are taken by oceanic, offshore and shelf fisheries, primarily in commercial long-line and hook and line fisheries throughout their range for valuable flesh. Mako sharks are also popular as important game fish among recreational anglers. Fins and jaws also highly valued and marketed globally (Compagno, 2001).

Taxonomy:

Kingdom	Animalia
Phylum	Chordata
Subphylum	Vertebrata
Class	Chondrichthyes
Subclass	Elasmobranchii
Order	Lamniformes
Family	Lamnidae
Genus	*Isurus*
Species	*Isurus oxyrinchus* *Isurus paucus*

Shortfin mako *Isurus oxyrinchus* Guitart, 1966

Isurus oxyrinchus has a slender, hydrodynamic body with pectoral fins that are broad, narrow-tipped and shorter than its head (Figure 1). Head is tapering with a sharp snout and large eyes. Teeth in the front of the jaws are long, narrow and non-serrated with reflexed tips. The teeth in the rear of the mouth are smaller and triangular. The first dorsal fin is extensively large and the second dorsal fin and anal fins are significantly smaller. The caudal fin is crescent shaped due to elongated lower lobe. The shortfin mako is dark blue colored on the dorsal side and white on its ventral side, under the snout and mouth region (Bass, 1986; Florida Museum webpage, 2018). From snout to tail, adult male shortfin mako sharks often reach over 2 meters while females can reach 3 meters or more (Mollet *et al*., 2000; Stevens, 1983).

Longfin mako (*Isurus paucus*) Rafinesque, 1810

Isurus paucus looks similar to *I. oxyrinchus* but can be differentiated by the longer pectoral fins which are as long as head or longer and relatively broad-tipped in young and adults (Figure 2). Snout typically narrowly to bluntly pointed, usually not acute. Cusps of upper and lower anterior teeth straighter, with tips not reversed (Compagno, 2001). The longfin mako shark is dark blue coloured on the dorsal side and white on its ventral side, with dusky margins on underside of snout and mouth region (Bass, 1986). Longfin makos are known to reach more than 4 m in length. The life span of the species is still unknown (Castro *et al.*, 1999; Compagno, 2001).

Biology

Isurus oxyrinchus

The Shortfin mako is a large bodied shark, growing to >4 m in total length (TL). It is a highly mobile, pelagic shark that is widespread throughout tropical and temperate waters of all oceans. The maximum size reported globally is 445 cm (Rigby *et al.*, 2019a; Weigmann, 2016). It has a lifespan of about 28-32 years and is a late maturing species; females generally mature at 265–312 cm TL (~18 years).

Studies from Indian waters are sparse; the size range in fishery varied between 70-337 cm TL with common landings of >1 m TL (Sobhana *et al.*, 2013; Shikha R., *pers.obs.*; Shoba J. K., *pers.obs.*; Sujitha T. *pers.obs.*). The smallest mature male reported to be 166 cm TL and the largest immature male was of 205 cm; length at first maturity (L_{T50}) was estimated at 189 cm. Females begin to mature at 257 cm TL onwards while the largest immature reported was 267 cm, length at first maturity (L_{T50}) for females estimated at 266.5 cm (Varghese *et al.*, 2017). Comparative estimates of maximum size with age and age at maturity and growth traits from different localities are presented in Table 1& 2. The asymptotic length estimated ranged from 255 cm fork length (FL) in Western & Central North Pacific Ocean to 580 cm FL in south-west South Atlantic Ocean. For Indian Ocean, preliminary estimates indicate the L_∞ to be 285 cm FL from the south-west Indian Ocean (Groeneveld *et al.*, 2014).

Table 1. Measures of maximum size, age and maturity parameters from different locations for shortfin mako

	Sex	Measure (TL cm)	Location	References
Max size	Combined	394	Global	Compagno.,1984
		269	Eastern Arabian Sea	Varghese *et al.*, 2017
		445	Global	Rigby *et al.*, 2019a
		445	Global	Weigmann., 2016
	M	283 (FL)	North Atlantic Ocean	Natanson *et al.*,2020
		267	South-east, Pacific Ocean, Caldera, Chile	Bustamante and Bennett, 2013
		221	Eastern Arabian Sea	Varghese *et al.*, 2017
		270	New Zealand	Bishop *et al.*, 2006
		186	Gujarat, India, North east Arabian sea	Shikha, R., *pers obs*, Gujarat
		192	South eastern Arabian sea	Najmudeen, T. M., *pers obs.*, Kerala
		245	Western Bay of Bengal	Shoba J. K., *pers obs.*, Tamil Nadu

	F	338.5 (FL)	North Atlantic Ocean	Natanson *et al.*, 2020
		338	South-east Pacific Ocean, Caldera, Chile	Bustamante and Bennett, 2013
		269	Eastern Arabian Sea	Varghese *et al.*, 2017
		347	New Zealand	Bishop *et al.*, 2006
		174	Gujarat, India, North east Arabian sea	Shikha, R., *pers obs*, Gujarat
		337	South eastern Arabian sea	Najmudeen, T. M., *pers obs.*, Kerala
		270	Western Bay of Bengal	Shoba J. K., *pers obs.*, Tamil Nadu
Size at maturity	M	195	Global	Compagno, 1984
		180.2	South-east Pacific Ocean, Caldera, Chile	Bustamante and Bennett, 2013
		181.5 (FL)	North Atlantic Ocean	Natanson *et al.*, 2020
		189	Eastern Arabian Sea	Varghese *et al.*, 2017
		185 FL	North Atlantic	Natanson *et al.*, 2006
		166–204	Global	Rigby *et al.*, 2019a
		190 (FL)	South-west Indian Ocean	Groeneveld *et al.*, 2014
		210	North western Pacific	Joung and Hsu, 2005
		195	Australia	Stevens, 1983
		180–185	New Zealand	Francis and Duffy, 2005
		160-170	South Africa	Cliff *et al.*, 1990
	F	280	Global	Compagno,1984
		280 (FL)	North Atlantic Ocean	Natanson *et al.*, 2020
		298.6 (275.6FL)	Northern Hemispheres	Mollet *et al.*, 2000
		273	Southern Hemispheres	Mollet *et al.*, 2000
		266.4	Eastern Arabian Sea	Varghese *et al.*, 2017
		275 (FL)	North Atlantic	Natanson *et al.*, 2006
		265-312	Global	Rigby *et al.*, 2019a
		280-291	Indian Ocean	Bass *et al.*, 1975
		337	Gulf of Mexico	Uchida *et al.*, 1987
		300	Gulf of Mexico	Branstetter, 1981
		280	Australia	Stevens, 1983
		250 (FL)	South-west Indian Ocean	Groeneveld *et al.*, 2014
		278	Northwestern Pacific	Joung and Hsu, 2005
		275–285	New Zealand	Francis and Duffy, 2005
		220	South Africa	Cliff *et al.*, 1990

Max age (years)	Combined	28	Global	Compagno,1984
		28–32	New Zealand	Bishop *et al.*, 2006
		28–32	North Atlantic	Natanson *et al.*, 2006
		28–32	Southern California	Wells *et al.*, 2013
		28–32	Western South Atlantic Ocean	Doño *et al.*, 2014
		28–32	Western and Central Atlantic	Barreto *et al.*, 2016
	M	16 to 23	West and Central South Atlantic	Barreto *et al.*, 2016
	F	28–32	Global	Rigby *et al.*, 2019
		19–28	West and Central South Atlantic	Barreto *et al.*, 2016
		28–32	North Atlantic	Natanson *et al.*, 2006
		28–32	Western South Atlantic Ocean	Doño *et al.*, 2014
Age at maturity (years)	M	3	Global	Compagno, 1984
		3–6	West and Central South Atlantic	Barreto *et al.*, 2016
		8	Canada	COSEWIC., 2019
		8	North Atlantic	Natanson *et al.*, 2006
		7-9	Pacific, New Zealand	Bishop *et al.*, 2006
		7	South-west Indian Ocean	Groeneveld *et al.*, 2014
	F	18–21	Global	Compagno, 1984
		5–7 (Avg. 5)	West and Central South Atlantic	Barreto *et al.*, 2016
		7 to >12	Canada	COSEWIC. 2019
		18	North Atlantic	Natanson *et al.*, 2006
		19-21	Pacific, New Zealand	Bishop *et al.*, 2006
		18+	South-west Indian Ocean	Groeneveld *et al.*, 2014

Table 2. Growth parameters of shortfin mako shark

Parameters	sex		Location	References
Lα (cm)		285 (FL) Combined	South-west Indian Ocean	Groeneveld *et al.*, 2014
	M	302 (FL)	Western NA	Pratt and Casey, 1983
		298 (FL)	Pacific, California	Cailliet and Bedford, 1983
		267 (FL)	Pacific, Australia	Chan, 2001
		321.8 (FL)	China	Hsu, 2003
		375.4 (FL)	Pacific, Baja	Ribot-Carballal *et al.*, 2005
		302.2 (FL)	Pacific, New Zealand	Bishop *et al.*, 2006
		268.07 (FL)	Pacific, Chile	Cerna and Lincandeo, 2009
		255 (FL)	Western & central North Pacific	Semba *et al.*, 2009
		416 (FL)	Southwest South Atlantic	Doño *et al.*, 2014
		291.5–340.2 (FL)	West and Central South Atlantic	Barreto *et al.*, 2016

	F	345 (FL)	Western NA	Pratt and Casey, 1983
		349 (FL)	Pacific, California	Cailliet and Bedford, 1983
		298 (FL)	Pacific, Australia	Chan, 2001
		403.62 (FL)	China	Hsu, 2003
		375.4 (FL)	Pacific, Baja	Ribot-Carballal *et al.*, 2005
		295.73 (FL)	Pacific, Chile	Cerna and Lincandeo, 2009
		340 (FL)	Western & central North Pacific	Semba *et al.*, 2009
		580 (FL)	Southwest South Atlantic	Doño *et al.*, 2014
		309.7-441.6 (FL)	West and Central South Atlantic	Barreto *et al.*, 2016
K (year^{1})		0.113 (Combined)	South-west Indian Ocean	Groeneveld *et al.*, 2014
	M	0.26	Western NA	Pratt and Casey, 1983
		0.07	Pacific, California	Cailliet and Bedford, 1983
		0.31	Pacific, Australia	Chan, 2001
		0.04	China	Hsu, 2003
		0.05	Pacific, Baja	Ribot-Carballal *et al.*, 2005
		0.05	Pacific, New Zealand	Bishop *et al.*, 2006
		0.08	Pacific, Chile	Cerna and Lincandeo, 2009
		0.16	Western and central NP	Semba *et al.*, 2009
		0.03	Southwest SA	Doño *et al.*, 2014
		0.08 to 0.20	West and Central South Atlantic	Barreto *et al.*, 2016
	F	0.2	Western NA	Pratt and Casey.,1983
		0.07	Pacific, California	Cailliet and Bedford, 1983
		0.15	Pacific, Australia	Chan, 2001
		0.04	China	Hsu, 2003
		0.05	Pacific, Baja	Ribot-Carballal *et al.*, 2005
		0.01	Pacific, New Zealand	Bishop *et al.*, 2006
		0.07	Pacific, Chile	Cerna and Lincandeo., 2009
		0.09	Western and central NP	Semba *et al.*, 2009
		0.02	Southwest SA	Doño *et al.*, 2014
		0.04–0.13	West and Central South Atlantic	Barreto *et al.*, 2016
L_0 (cm)		90 cm	South-west Indian Ocean	Groeneveld *et al.*, 2014
t_0 (year)	M	-1	Western NA	Pratt and Casey, 1983
		-3.75	Pacific, California	Cailliet and Bedford, 1983
		-0.95	Pacific, Australia	Chan, 2001
		-6.07	China	Hsu, 2003
		-4.7	Pacific, Baja	Ribot-Carballal *et al.*, 2005
		-9.04	Pacific, New Zealand	Bishop *et al.*, 2006
		-3.58	Pacific, Chile	Cerna and Lincandeo, 2009
		-6.18	Southwest SA	Doño *et al.*, 2014
		-4.47 to -2.38	West and Central South Atlantic	Barreto *et al.*, 2016

	F	-1 -3.75 -1.97 -5.27 -4.7 -11.3 -3.18 -7.52 -7.08 to -3.27	Western NA Pacific, California Pacific, Australia China Pacific, Baja Pacific, New Zealand Pacific, Chile Southwest SA West and Central South Atlantic	Pratt and Casey, 1983 Cailliet and Bedford, 1983 Chan, 2001 Hsu, 2003 Ribot-Carballal *et al.*, 2005 Bishop *et al.*, 2006 Cerna and Lincandeo, 2009 Doño *et al.*, 2014 Barreto *et al.*, 2016
Natural mortality (M) yr^{1}	M	0.16 0.10-0.24	North Pacific New Zealand	Kai and Yokoi, 2018 Bishop *et al.*, 2006
	F	0.13 0.09-0.16	North Pacific New Zealand	Kai and Yokoi, 2018 Bishop *et al.*, 2006
Relative fishing mortality (f/f_{MSY})	Pooled sample	2.57	Indian Ocean	Brunel *et al.*, 2018

Reproduction

Isurus oxyrinchus is viviparous, having a 3-year reproductive cycle that includes an 18-months resting period after parturition (Mollet *et al.*, 2000). The age at maturity varies from region to region. Males mature at 166-204 cm TL (7-8 years) and females at 265-312 cm TL (18-21 years) (Table 1). The litter size is between 4 to 25 pups, with an average litter size is around 12 pups, measure 60-70 cm total length at birth. The breeding season starts in winter and prolong to summer. Since the female matures during 18-21 years, the generation length of shortfin mako is considered to be 24-25 years (Table 3). In Indian waters the size at first maturity (L_{T50}) was estimated to be 189 cm for males and 266.5 cm for females (Varghese *et al.*, 2017). Mature females caught in the month of February and September in Arabian Sea and a pregnant female with 6 pups caught in Bay of Bengal during September indicate extended breeding from February to September in Indian waters (Varghese *et al.*, 2017; Shoba J. K. *pers.obs.*).

Table 3. Reproductive traits of shortfin mako shark

		Location	Reference
Litter Size	16 18 9-14 4-16 4-25 11 10-18 11	Gulf of Mexico Gulf of Mexico South-west Indian Ocean Canada Global North Atlantic Global Canadian Waters Northwestern	Uchida *et al.*,1987 Branstetter, 1981 Groeneveld *et al.*, 2014 Compagno, 1984 Ebert and Stehmann, 2013 COSEWIC., 2019 Rigby *et al.*, 2019a Campana *et al.*, 2004

Litter Size	10-18 4-25 Avg. 12 Avg. 12 4-16 6	Pacific Global North western Pacific Global Australia Bay of Bengal	Compagno, 2001 Garrick, 1967 Joung and Hsu, 2005 Mollet *et al.*, 2000 Stevens, 1983 Shoba J. K. *pers obs.*, Tamil Nadu
Size at birth (cm)	60–70 60–70 60–70 70 69.8 60–70 60–70 70 60–70 70 74	Global Global Eastern Mediterranean NW Atlantic Eastern Arabian Sea Global Global Pacific, New Zealand Indian Ocean Australia Northwestern Pacific	Rigby, *et al.*, 2019a Compagno, 1984 Gilmore, 1993 Mollet *et al.*, 2000 Varghese *et al.*, 2017 Garrick, 1967 Compagno, 2001 Bishop *et al.*, 2006 Bass *et al.*, 1975 Stevens, 1983 Joung and Hsu, 2005
Reproductive periodicity (years)	2-3 3 3 3 3 3 3	Global North Atlantic Canada Global Canadian waters Global Northwestern Pacific	Compagno, 1984 Ebert and Stehmann, 2013 COSEWIC., 2019 Rigby *et al.*, 2019a Campana *et al.*, 2004 Mollet *et al.*, 2000 Joung and Hsu, 2005
Breeding Season	Winter Winter/spring Spring/Summer Winter-Spring Late winter-mid spring Spring and summer February and September Dec. to July	Gulf of Mexico Gulf of Mexico Eastern Mediterranean North-west Atlantic Global South-east Pacific Ocean, Caldera, Chile Eastern Arabian Sea North-western Pacific	Uchida *et al.*,1987 Branstetter,1981 Gilmore,1993 Bengil *et al.*, 2019 Mollet *et al.*, 2000 Bustamante and Bennett, 2013 Varghese *et al.*, 2017 Joung and Hsu, 2005
Gestation time (months)	12-18 15-18 15–18 15–18 15–18 18 23-25	Global North Atlantic Canada Global Canadian waters Global North-western Pacific	Compagno,1984 Ebert and Stehmann, 2013 COSEWIC., 2019 Rigby *et al.*, 2019a Campana *et al.*, 2004 Mollet *et al.*, 2000 Joung and Hsu, 2005

Generation Age (years)	24–25 25 24–25 24–25 24–25 24–25 24–25	Global Canada New Zealand North Atlantic Southern California Western South Atlantic Ocean Western and Central Atlantic	Rigby *et al.*, 2019 COSEWIC., 2019 Bishop *et al.*, 2006 Natanson *et al.*, 2006 Wells *et al.*, 2013 Doño *et al.*, 2014 Barreto *et al.*, 2016

Isurus paucus

The longfin mako resembles the shortfin mako sharks, but has remarkably longer, broad pectoral fins and big-eyes. It is a poorly studied oceanic shark taken in tuna long-line and gillnet fisheries throughout its worldwide range in temperate and tropical waters (Hueter *et al.*, 2016). The maximum size reported globally is 427 cm (Rigby *et al.*, 2019b; Castro *et al.*, 1999). Though very scanty information available on biology, *I. paucus* is a late maturing species; females are reported to mature around 245 cm TL and males at 215 cm TL (Compagno, 2001; Ruiz-Abierno *et al.*, 2021). Longfin mako is lecithotrophic viviparous shark exhibiting oophagy and uterine cannibalism. The litter size is between 2-8 pups measuring 97-120 cm TL at birth (Castro *et al.*, 1999, Compagno 2001). Its breeding season is reported to be in winter in North-west Atlantic (Gilmore, 1983). Information on lifespan is not available for *I. paucus*, but data from the close relative *I. oxyrinchus* were used to estimate a generation length of 25 years (Natanson *et al.*, 2006). In Indian waters the species is rarely encountered and the size range in fishery varied between 80-258 cm TL with common landings of >1 m TL (Najmudeen, T. M. *pers.ob*s., Kerala; Shoba J. K. *per.obs*, Tamil Nadu; Sujitha T. *pers.obs*., Karnataka). Males mature between 189-225 cm; female maturity is unknown due to paucity of data on females caught (Varghese *et al.*, 2017). A comparison of maximum size and maturity estimates from different localities is given in Table 4 and estimates of reproductive traits are given in Table 5.

Table 4. Measures of maximum size, age, size at maturity from different locations for *Isurus paucus*

	Sex	Measure (TL cm)	Location	References
Max size	Combined	427 258 426.7	Global Eastern Arabian Sea Global	Rigby *et al.*, 2019b Varghese *et al.*, 2017 Castro *et al.*, 1999
	M	258 357 135	Eastern Arabian Sea North-west Cuba South eastern Arabian Sea	Varghese *et al.*, 2017 Ruiz-Abierno *et al.*, 2021 Sujitha T., *pers.ob*s., Karnataka.
	F	227 390 138	Eastern Arabian Sea North-west Cuba Bay of Bengal	Varghese *et al.*, 2017 Ruiz-Abierno *et al.*, 2021 Shoba J. K. *pers.ob*s., Tamil Nadu
Size at maturity	M	189-225 229 215 205–228	Eastern Arabian Sea Global North-west Cuba Australia	Varghese *et al.*, 2017 Castro *et al.*, 1999 Ruiz-Abierno *et al.*, 2021 Last and Stevens, 2009

	F	245 >245 230 245	North-west Atlantic Global Northwest Cuba Australia	Guitart-Manday, 1966 Compagno 2001 Ruiz-Abierno *et al.*, 2021 Last and Stevens, 2009

Table 5. Reproductive traits of longfin mako

		Location	Reference
Litter Size	2–8 2–8 2 2	Global Global North-west Atlantic NW Atlantic	Castro *et al.*, 1999 Compagno, 2001 Guitart-Manday, 1966 Gilmore, 1983
Size at birth (cm)	97–120 97–120 92 123 97	Global Global North-west Atlantic Global NW Atlantic	Castro *et al.*, 1999 Compagno, 2001 Guitart-Manday, 1966 Garrick, 1967 Gilmore, 1983
Breeding Season	Winter	NW Atlantic	Gilmore, 1983
Generation Age	25 years	North Atlantic Ocean	Natanson *et al.*, 2006

Diet

Mako sharks are considered apex predators throughout their range, occupying top trophic level as a tertiary predator (Cortés, 1999; Wood *et al.*, 2009). Mako sharks survive with a diverse diet (Meneses *et al.*, 2016), the specific contents of which depend on the geographic location, depth, time of year, and oceanic habitat of individuals (Preti *et al.*, 2012). Most common prey are oceanic teleosts, with anchovies, bluefish, bonitos, cod, herring, sardines, swordfish, and tuna (Compagno,1984; Preti *et al.*, 2012; Wood *et al.*, 2009). They also subsist on cephalopods, elasmobranchs, and marine mammals (Biton-Porsmoguer *et al.*,2015; Groeneveld *et al.*, 2014; Preti *et al.*, 2012). Mako sharks are ovoviviparous with developing embryos known to feed on unfertilized eggs during the 15-18-month gestation period (COSEWIC, 2019). Shortfin mako sharks must consume, on an average, nearly 4.5% of their bodyweight each day to meet their energy demands (Wood *et al.*, 2009), due to maximum metabolic rates and one of the highest routines among sharks (Sepulveda *et al.*, 2007).

In Indian Ocean, teleosts and cephalopods are the primary prey. Teleosts composed 68% of the total index of relative importance (IRI) and pelagic cephalopods accounted for 29% IRI (Rogers *et al.*, 2012). In the south western Indian Ocean, in mako sharks caught by swimmer/bather protection exclusion nets in inshore waters, elasmobranchs formed 73% of the diet than in other regions, while teleosts comprised 27% with spotted grunter and tunas as the most important species. However, in the offshore waters, elasmobranchs were essentially absent from the diet of makos caught in longlines. Groeneveld *et al.*, (2014) reported that teleosts were the primary food, comprising 84% of sampled stomachs with food and cephalopods made up around 14% of the diet of makos in the Indian Ocean.

Global Distribution and Habitat

The shortfin mako shark, *Isurus oxyrinchus* a highly migratory, found in all tropical and temperate waters (15° to 31° C) of the world oceans (Figure 3). Its horizontal movements are driven by changes in water temperature in the North Pacific, Southeast India and the North West Atlantic (Vaudo *et al.*, 2016; Rogers *et al.*, 2015; Casey and Kohler, 1992). The species comprises three known subpopulations: Atlantic, Eastern North Pacific and Indo-West Pacific. The shortfin mako utilizes a wide range of marine habitats worldwide. It dwells in open Ocean, continental shelf, shelf edge, and shelf slope habitats during periods of transit. It is found both, far offshore as well as close to shore (Rogers *et al.*, 2015; Francis *et al.*, 2019). *Isurus oxyrinchus* sometimes exhibits diving behavior at depths of 500 m (Vaudo *et al.*, 2016) and 1,700 m (Sims, 2015) in search of food (Abascal *et al.*, 2011). *Isurus oxyrinchus* has one of the highest metabolic rates relative to other active sharks (Sepulveda *et al.*,

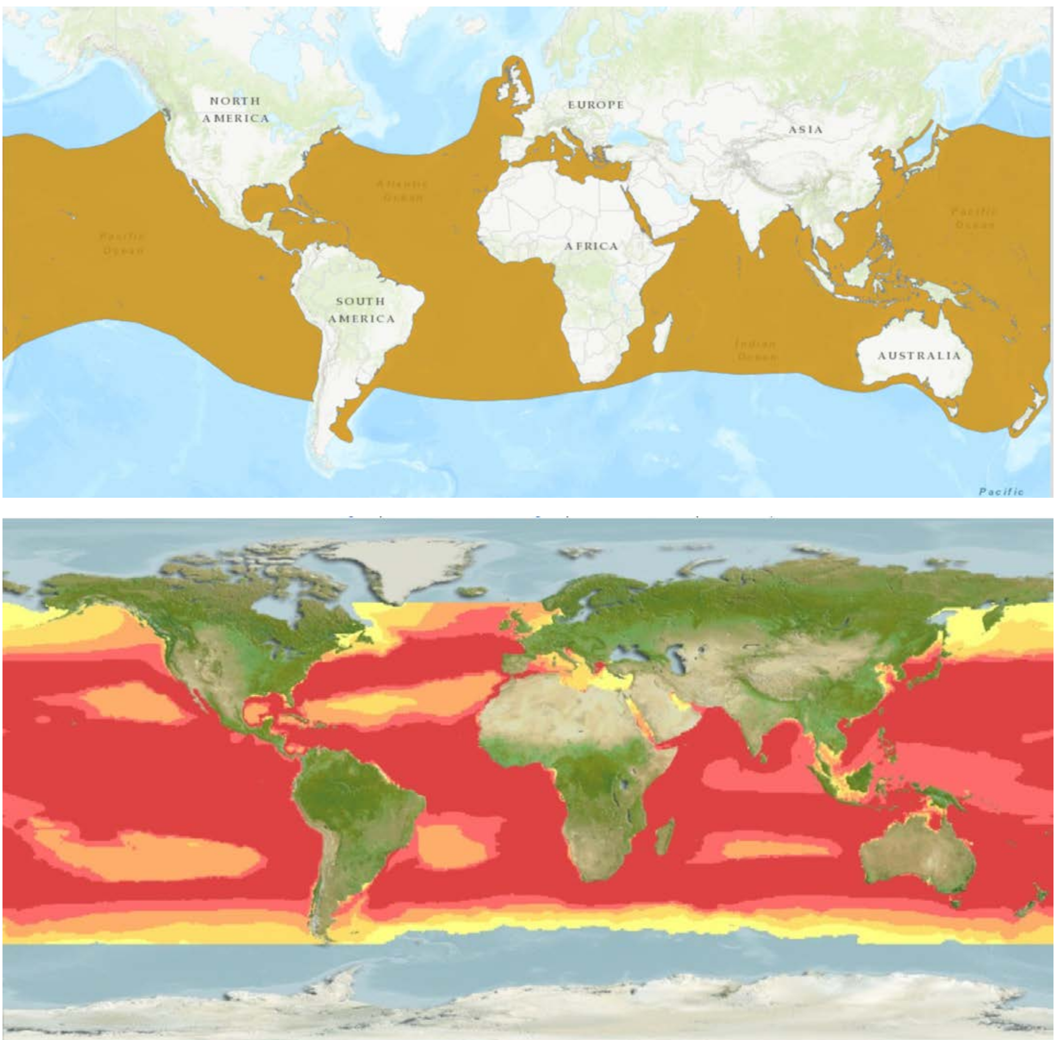

Figure 3. Global distribution of the shortfin mako (Rigby *et al.*, 2019a; Fishbase)

2007), and is known to b ethe fastest-swimming shark (70 km/hour) on record (Sims *et al.*, 2018).

Shortfin mako has a worldwide distribution. The occurrence of this species in the western Atlantic Ocean is from Gulf of Maine to southern Brazil and Argentina, including the Gulf of Mexico and Caribbean, while in the eastern Atlantic it appears from the Norway to South Africa, including the Mediterranean. The distribution in Indo-Pacific Ocean includes East Africa to Hawaii, Primorskiy Kray (Russian Federation) in the north, Australia and New Zealand in the south, and south of Aleutian Islands and from southern California, USA to Chile in the eastern Pacific (Rigby *et al.*, 2019a.)

The longfin mako shark, *Isurus paucus* is oceanic, widespread in tropical and warm temperate waters, and possibly circumglobal, although its distribution is poorly recorded (Ebert *et al.*, 2013). Distribution of the longfin

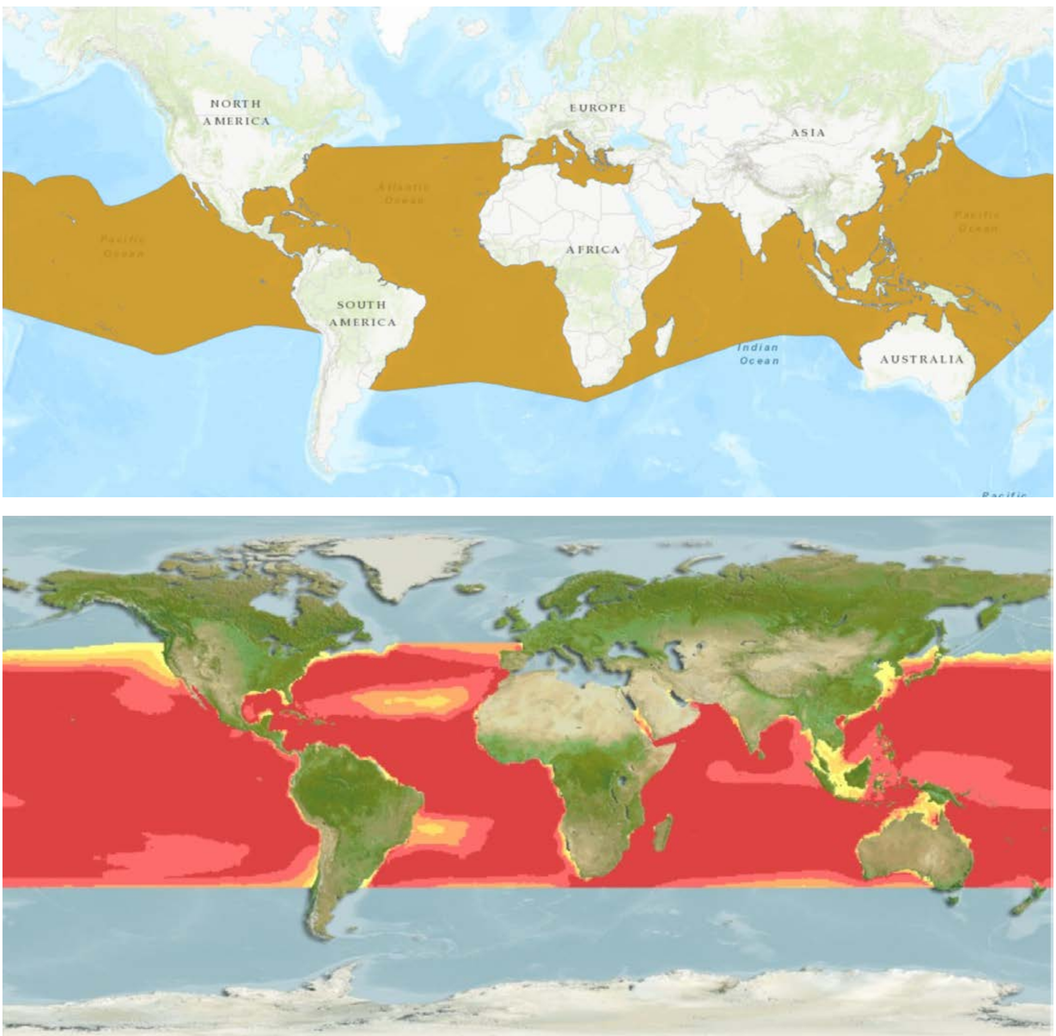

Figure 4. Global Distribution of *Isurus paucus* (Rigby *et al.*, 2019; Fishbase)

mako is not well documented as it is not frequently encountered in the commercial fishery. It may also be to misidentification as shortfin mako (Maguire *et al.*, 2006). The occurrence of this species in the western Atlantic Ocean is from Gulf Stream of USA to southern Brazil. It occurs from Guinea to Ghana in the eastern Atlantic Ocean. In Western Indian Ocean the longfin mako shark is distributed off the coasts of South Africa, India, and Sri Lanka. The distribution within the Pacific Ocean ranges from Japan to Australia in the west, the Hawaiian Islands in the central region, and Panama, Galapagos and Ecuador, in the east Pacific Ocean (Rigby *et al.*, 2019b).

Distribution in India

Isurus oxyrinchus is reported from western Indian Ocean (eastern Arabian Sea) and eastern Indian Ocean (western Bay of Bengal) including the seas around Andaman and Nicobar Islands. The landings are recorded from east and west coasts of India.

Isurus paucus is reported from western Indian Ocean (eastern Arabian Sea) and eastern Indian Ocean (western Bay of Bengal) including the seas around Andaman and Nicobar Islands. The landings are recorded from east and west coasts of India. Distribution of mako sharks along the Indian coast is given in Figure 5.

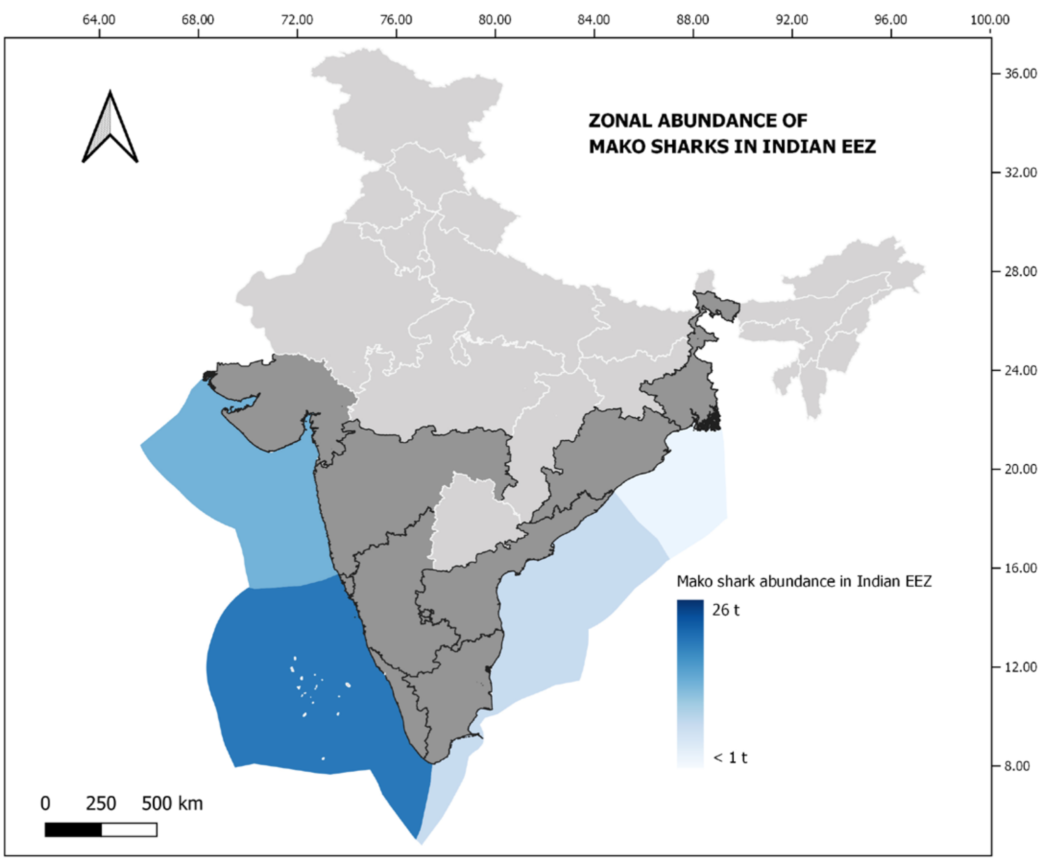

Fig.5. Zone-wise abundance (t) of mako sharks along the Indian coast (picture credit Shikha R., ICAR-CMFRI)

Global and Domestic Harvest

Country-wise production of mako sharks is not reported species-wise, globally. In the continent-wise production estimates given by FAO, species-wise production of mako sharks is given from the Americas, Europe, Asia, Australia and Africa for the period 2000-2019. The average production of mako sharks during this period was 10,847 t with a minimum of 6,469 t in 2000 and maximum of 14,538 t in 2011. The maximum commercial landings were reported from Europe (avg. 5,492 t), followed by Asia (avg. 1,920 t), Africa (avg. 1,794 t), Americas (avg. 1,156 t), and Oceania (avg. 485 t).

Shortfin mako is the prime species landed in commercial fisheries and the average catch of *Isurus oxyrinchus* in

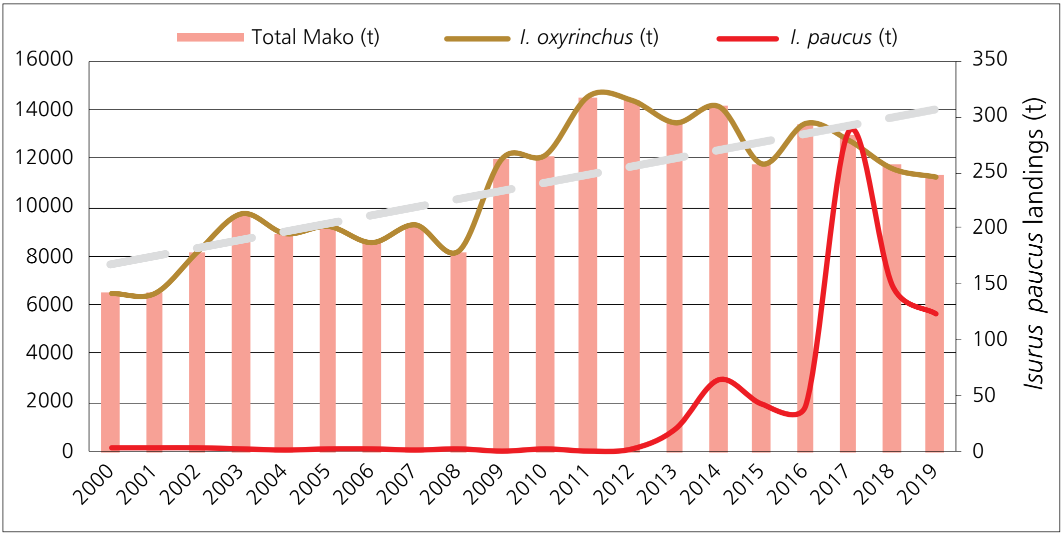

Figure 6. Global production of mako sharks with catch trend of *Isurus oxyrinchus* and *Isurus paucus* for 2000-2019 (source FAO, 2020)

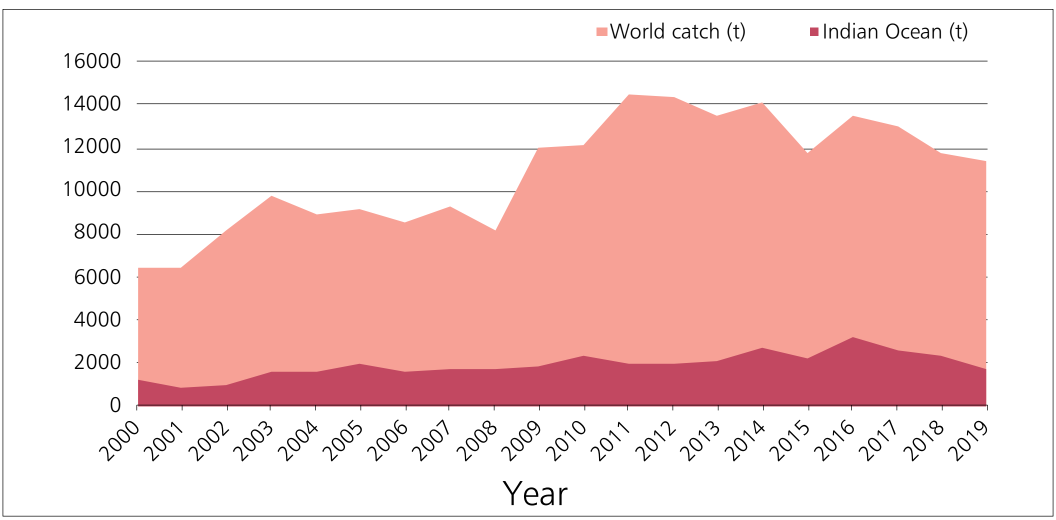

Figure7. Indian Ocean production of mako sharks (2000-2019) (source FAO, 2020)

the last two decades was 10,810 t (99.6%) with a minimum of 6,469 t in 2000 and maximum of 14,538 t in 2011. Longfin mako is an oceanic dweller, rarely encountered in commercial fisheries. The average global catch of *Isurus paucus* in the last two decades was 40 t (0.4%) only, ranging from no landings to a maximum of 287 t in 2017 (FAO, 2020) (Figure6).

The Indian Ocean contributed 17.7% of the global mako shark landings with the average catch in the last two decades estimated at 1,918 t. Maximum landings were reported in 2016 (3,244 t) and minimum in 2001 (883 t). Catches were predominantly represented by *Isurus oxyrinchus* and very meagre quantities (<1%) of *Isurus paucus* was landed in the fishery (Figure 7), which were mostly juveniles (FAO, 2020; Varghese *et al.*, 2017).

Fishery in India

Average catch of mako sharks during 2012-2020 from Indian waters was estimated at 29 t. The average landing of *Isurus oxyrinchus* along the Indian coast is about 26 t. Maximum catch was during 2016 (103.5 t) which decreased to 1.7 t in 2020 (Figure 8). *Isurus paucus* landings varied from 0.04 t to 19 t with average landings of only 3 t (2012-2020) (Figure 9). Mako sharks form only 0.3% of the total shark landings in India. There is no targeted fishery of these species and they occasionally form bycatch in long line and gillnet fisheries. Mako sharks are rarely caught in trawl nets (*Source: NMFDC, CMFRI*).

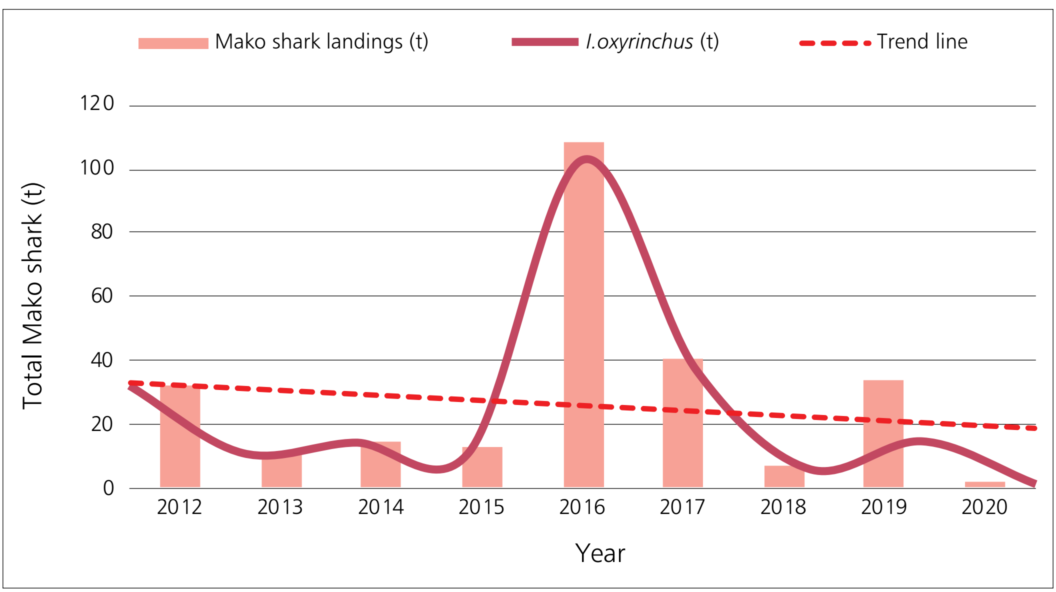

Figure 8. All-India landings of mako sharks and *Isurus oxyrinchus* during 2012-2020

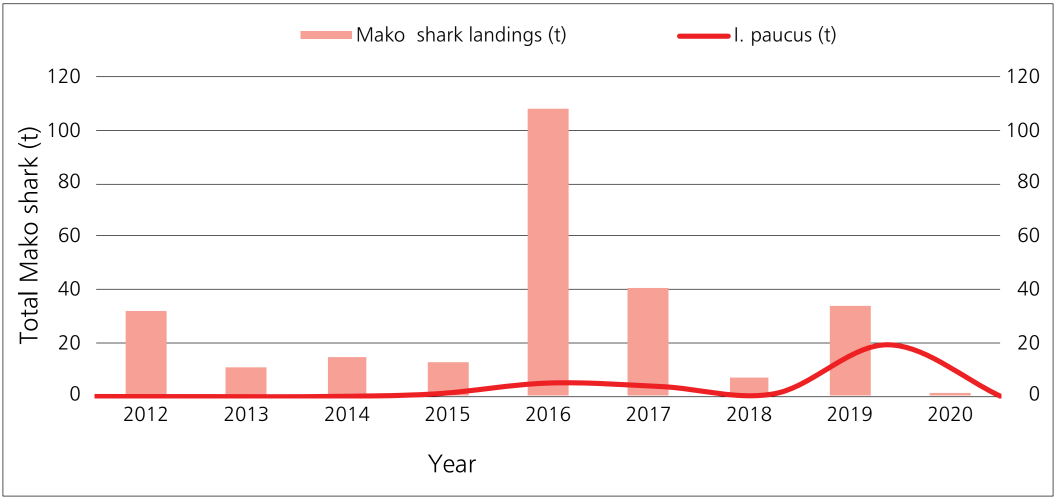

Figure 9. All-India landings of *Isurus paucus* (2012-2020)

Conservation status of mako sharks

Isurus oxyrinchus is listed as 'Endangered' in the International Union for the Conservation of Nature (IUCN)'s Red List (Rigby *et al.*, 2019a). From Indian ocean it is listed as Vulnerable (Brunel, *et al.*, 2018).

Isurus paucus is listed as 'Endangered' in the International Union for the Conservation of Nature (IUCN)'s Red List (Rigby *et al.*, 2019b). There is no global stock assessment currently in place for *Isurus paucus* due to insufficiency of catch data for mako sharks.

Threats and mortality

Mako sharks are fished worldwide and global catch estimates show increasing trend over two decades. These apex predators have low biological productivity with a triennial reproductive cycle and late age-at-maturity. The dominant threat to the mako shark populations globally is historic and ongoing commercial fishing. They are caught by high-seas longline and gillnet fisheries, especially those pursuing tuna, billfish, and swordfish. (Camhi *et al.*, 2008; Camhi *et al.*, 2009; Campana, 2016). Mako sharks are targeted and also taken as bycatch throughout their distribution range. The shortfin mako, *Isurus oxyrinchus* is the second-most common oceanic shark caught after blue shark *Prionace glauca*, in the shark bycatch of these fisheries (Mejuto *et al.*, 2002). Ecological Risk and Productivity Assessments determined that the shortfin mako was the second-most vulnerable shark species to overexploitation in pelagic longline fisheries in the Atlantic Ocean and the most vulnerable one in the Indian Ocean (IOTC, 2017). Mako sharks are widely valued for their high-quality meat and fins; jaws and skin trade also attract fishery. Mako sharks accounted for at least 2.7 to 2.85% of the Hong Kong shark fin trade, the estimated equivalent of nearly a million makos (biomass ~40,000 t) a year, which clearly indicates the under-reporting of exploitation (Clarke *et al.*,2006a, b; Fields *et al.*, 2017). Longfin mako, *Isurus paucus* and hammerheads, *Sphyrna* spp. are among the pelagic species known to have liver oil rich in vitamin A (Rose, 1996; Musick,2004). It is estimated that mako shark populations have undergone a reduction of 50-79% globally over the last three generations/75 years and the population trends appear to be decreasing (Rigby, *et al.*, 2019a, b).

From Indian waters, mako shark landings show a declining trend with the exception of landings in 2016. These sharks form only about 0.3% of the total shark landings in India. Mako sharks form a bycatch in mechanized drift gillnet-cum-longliners and sometimes, trawlers (NMFDC, CMFRI; Sobhana *et al*., 2013; Varghese *et al*., 2017). Their meat ismainly used for domestic consumption in India (ICAR-CMFRI, unpublished data). In Sri Lanka, which shares common waters with India, majority of mako shark landings are bycatch of tuna and billfish fisheries by single and multi-day gillnet and longliners. Mako sharks are retained due to their highly valued shark fins for international trade and domestic utilization of meat; either for consumption in fresh and dried forms (Fernando and Tanna, 2019). Though total ban on shark fin trade is implemented by the Government of India, illegal fin trade remains a concern with not much information on its magnitude.

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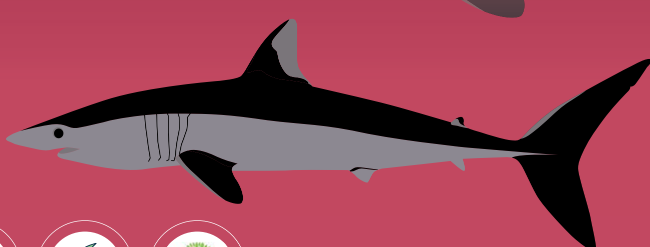
India Non-Detriment Finding for Mako Sharks *Isurus* spp. in the Indian Ocean | 2022 to 2026

Mako sharks are warm-blooded, fast-swimming pelagic sharks that migrate through tropical and temperate seas of the world. They are susceptible to fishing mortality due to low intrinsic rate of population escalation. The shortfin mako *Isurus oxyrinchus* and longfin mako *Isurus paucus* are the two species representing the genus *Isurus.* The dominant threat to the mako shark populations globally is historic and ongoing commercial fishing. These species warrant conservation management as they are highly vulnerable to increased fishing pressure including higher incidence of bycatch. Mako sharks were included in Appendix II of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) (other than manta rays which were listed earlier) at the 18th Meeting of the Conference of the Parties (CoP18, Geneva) in 2019.This mako sharks (*Isurus oxyrhinchus* and *Isurus paucus*) NDF for India is "negative" and does not support international trade in this species. Additional research is mandatory to assess the status of the species and improvements are made to existing fisheries and trade management and monitoring frameworks. This NDF will be re-evaluated after 5 years and updated with newly acquired data, before agreeing to a new NDF for 2027-2031.



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ISSN 2394-8019