Non-detriment Finding by the UK CITES Scientific Authority *Isurus oxyrinchus* (Shortfin mako)

1. Summary

Stock	Comments	UK SA Opinion
North Atlantic	Unable to make a confident non-detriment finding	Negative
South Atlantic	Unable to make a confident non-detriment finding	Negative
Mediterranean	Unable to make a confident non-detriment finding	Negative
Indian Ocean	Unable to make a confident non-detriment finding	Negative
North Pacific	Subject to current rates of offtake only	Positive
South Pacific	Subject to current rates of offtake only	Positive

Isurus oxyrinchus (shortfin mako) is the second-most common oceanic shark caught by high-seas longline and net fisheries after the blue shark (*Prionace glauca*). It is caught globally, targeted and as bycatch, in coastal and pelagic commercial and small-scale longline, purse seine, and gillnet fisheries. The species has low productivity and life history traits that make it intrinsically vulnerable to over-exploitation. The prevalence and price of mako shark meat and fins in both international and domestic trade indicate a high level of legal trade pressure, especially when taking into consideration the biological and life history traits of this species, making it particularly susceptible to overfishing[1]. A considerable proportion of catches have been recorded as immature shortfin mako. Furthermore, there is a likelihood that fishing-induced mortality not accounted for by landed catch is considerably higher than estimates. The shortfin mako is estimated to be declining in all oceans, other than the South Pacific where it may be increasing. Steep population declines have occurred in the North and South Atlantic, with declines also evident, though not as steep, in the north Pacific and Indian Oceans.

In the Indian Ocean, shortfin mako is considered subject to overfishing but not overfished[2], however with trajectories showing consistent trends towards being overfished. In the North Atlantic ICCAT scientists (2019) recognised that to accelerate the rate of stock recovery and to increase the probability of success, ICCAT should adopt a non-retention policy as has already been done for other shark species. There is a significant risk that South Atlantic stocks will follow a similar path if fishing effort is also not reduced. There is little or no management in areas associated with the largest declines, and where there are management measures, these appear to have had little influence on landing trajectories.

Accordingly, *Isurus oxyrinchus* was assessed for the IUCN Red List in 2018 as Endangered globally. The UK has determined the species to be of *significant conservation concern requiring a high degree of precaution in making an NDF*. Taking into consideration it's conservation status, estimated levels of offtake and projected declines, and in accordance with the precautionary principle, **the UK CITES Scientific Authority is unable to make a non-detriment finding for offtake of shortfin mako (*Isurus oxyrinchus*) sharks from all regions of the Atlantic and Indian oceans. Furthermore, we recommend not accepting catch from either stock until the**

[1] Overfishing refers to **fishing mortality (F)**, or the rate of fish killed by catching them (i.e., the proportion of fish caught). There is an ideal proportion of fish to catch that will produce MSY—this is called $\mathbf{F_{MSY}}$. If the proportion of fish caught (F) is greater than F_{MSY}, overfishing is happening. If F is less than F_{MSY}, underfishing is happening. Fishing mortality is usually given as a ratio of $\mathbf{F/F_{MSY}}$; a ratio over 1 means overfishing.

[2] Overfished refers to the **biomass (B)** of a population, or stock, of fish. This is the amount of fish in the water. There is some amount of biomass, B, that will produce MSY—this is $\mathbf{B_{MSY}}$. If the biomass of fish in the water is well below B_{MSY}, the stock is overfished, or depleted. If the amount of fish in the water is more than would produce MSY it is underfished.

associated declines and trajectories are reversed and demonstrate stock recovery. However, in principle, the UK may be able to accept catch from the Pacific stock at current rates of offtake (i.e., not exceeding average of estimated total annual catch levels from previous 5 years) given the North Pacific stock is unlikely to be in an overfished condition and the South Pacific stock is reportedly increasing.

2. Legal status

CITES	Listed in Appendix II (29/11/2019) following the adoption of CoP18 Proposal 42[3] to include *I. oxyrinchus* and *I. paucus*. No CITES quotas or trade suspensions in place.
CMS	Listed in Appendix II (05/03/2009) and under Shark MOU (01/03/2010)
UNCLOS	Listed as a highly migratory species in Annex I (i.e., adopt measures for the conservation of the species)
EU Wildlife Trade Regulations 338/97	Listed in Annex B of the EU Wildlife Trade Regulations on 14/12/2019 (transposed into UK law as amended by the Environment and Wildlife (EU Exit) Regulations 2020).
Bern Convention	Listed in Annex 3 of the Bern Convention (i.e., species that need protection but can be exploited in exceptional cases)
Barcelona Convention	Listed in Annex II of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (under the Barcelona Convention).
IUCN Red List Status	Endangered (2018)

3. Intrinsic biological vulnerability & conservation concern

Summary of Intrinsic biological vulnerability
Overall rating: High
Isurus oxyrinchus (shortfin mako) has low productivity and biological traits that make it intrinsically vulnerable to over-exploitation, including: an intrinsic growth rate lower than 0.14 (0.031 to 0.123); a von Bertalanffy growth constant less than 0.15 (0.05 to 0.266); an average age of maturity greater than 8 years (7 to 21 years); a maximum age greater than 25 years (6 to 45 years); and a generation length above 10 years (25 years). Additionally, this species produces 4 to 25 pups per litter with a gestation period of 12 to 25 months and breeds every two or three years. This species may have undergone significant declines in abundance over various parts of its range. Due to estimated and inferred declines, together with the probable increase in fishing pressure and the life history characteristics that makes this species intrinsically vulnerable to overfishing, in 2019 it was both listed in CITES Appendix II at CoP18 and classified as ''Endangered'' in the IUCN Red List, a level of threat higher than the previous evaluation in 2009. The species has "very high vulnerability (83 of 100)" with low resilience, i.e., a "low, minimum population doubling time 4.5 - 14 years" (Fishbase, nd).

3.1 What is the level of intrinsic biological vulnerability of the species?		
Median age at maturity	Low	
	Medium	
	High	18-21 years (Rigby et al., 2019); 18.5 (Gallagher et al., 2014); 11-15 years for males and 18-21 years for females (Tsai et al., 2014)[4]. Regional estimates: 6 years for males and 16 years for females in western and central North Pacific

[3] https://cites.org/sites/default/files/eng/cop/18/prop/060319/E-CoP18-Prop-42.pdf
[4] Size is a better predictor of an organism's demographic contribution to a population than age for many elasmobranchs. Stage-structured models can deal easily with biological characteristics (e.g. maturity, fecundity) and fishery-related factors (e.g. size limits) that are more closely related to size than age (Tsai et al., 2014)

		Ocean (Semba et al., 2009); 7 years for males and 15 years for females in the Indian Ocean (Groeneveld et al., 2014), and 8 years for males and 18 years for females in western Atlantic (Doño et al., 2015). For the species In New Zealand waters, the ages at which 50% were mature were estimated as 6.9 years for males and 19.1 years for females. Von Bertalanffy growth equations produced indirect age at maturity estimates of 8–9 years for males and 20–21 years for females (Bishop et al., 2006).
	Unknown	
Median size at maturity	Low	
	Medium	
	High	Sexual maturity reached at 2.5-2.9 m total length (TL[5]) in females; males mature at a smaller TL of 1.7-2.0 m (Groeneveld et al., 2014). 280-298 cm TL for females and 201 cm TL for males (Dulvy et al., 2008). N-E Atlantic including Gulf of Mexico: Females - 263-291 cm fork length (FL), median 280 cm FL and median weight at maturity of 275 kg. Males - 173-187 cm FL, median 182 cm FL and weight of 64 kg (Natanson et al., 2020). Male sizes at maturity in sharks captured by a Brazilian longline fleet in the SW Atlantic Ocean were 137-182 cm TL. Only immature females (104-230 cm TL) were observed in this study (Canani and Oddone, 2020). There is a large sexual difference in the size at maturity, with males maturing at about 195 cm TL, while females do not mature until 265–280 cm (Stevens, 2008). Western North Atlantic median TL at maturity for females was 298 cm, greater than females from the southern hemisphere (273 cm) (Mollet et al., 2000). Population growth rates differ by sex and display large variability (Yokoi et al., 2017). Shortfin makos show rapid growth in the first few years of life, followed by slow growth. Males and females grow at similar rates until age 7–9 years, after which relative male growth declines (Bishop et al., 2006).
	Unknown	
Maximum age/longevity in an unfished population	Low	
	Medium	
	High	Maximum age from 28–32 years in New Zealand, the Southwest Pacific, Southwest Atlantic, and Northwest Atlantic Oceans; generation length considered 24–25 years (Rigby et al., 2019). Maximum observed ages were 26 and 27 for males and females, respectively (Rosa et al., 2018). Longevity estimated at between 24-31 for males and 31-41 for females (Tsai et al., 2014). Actual longevity is likely to be even greater than the 29 years suggested in Bishops et al.'s study - as sample size increases so will the probability of sampling the older individuals in a population, thus increasing longevity estimates (Bishop et al., 2006).
	Unknown	
Maximum size	Low	
	Medium	
	High	Literature reports sexual dimorphism for this species, with males reaching maximum sizes of ~260 cm FL and females ~340 cm FL (Barreto et al., 2016); other studies have reported 440 cm (Biton-Porsmoguer et al., 2018) and 445 cm TL for females (Rigby et al., 2019). The largest recorded female caught in the North Atlantic was 366 cm FL and 330 cm in the South Atlantic; the largest

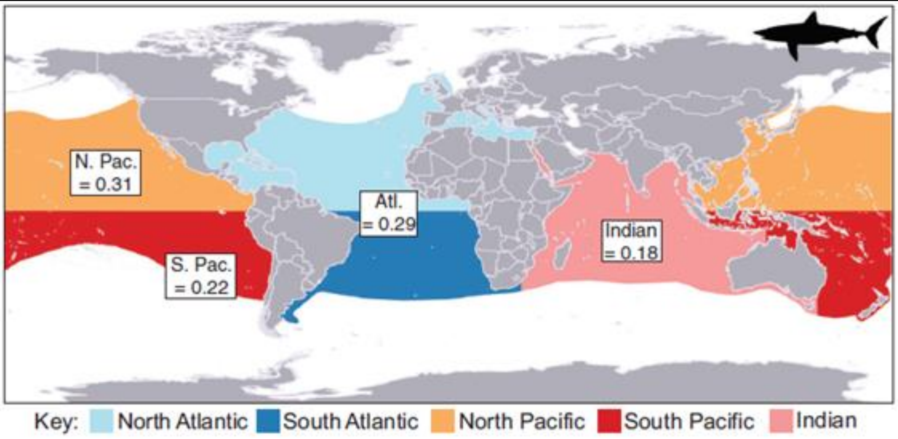
[5] Sharks are usually measured in 3 ways: total length (TL), fork length (FL, from tip of snout to caudal fork) and precaudal length (PCL, from tip of snout to precaudal pit). Other measures such as alternate length (distance between the origin of both dorsal fins), stretched total length (total length measured with the dorsal caudal lobe stretched along the main body axis), and total length as the sum of precaudal and dorsal caudal lobe lengths are also used (Mas et al., 2014)

		males were 279 cm and 250 cm in the respective regions. Females exhibited lower growth coefficients (*k*) and higher asymptotic[6] size than males. Estimates lie between 388 and 694 cm FL for females and 235-246 cm FL for males; k is 0.02-0.05 per year for females 0.11-0.13 per year for males - note large individuals usually lacking in sample[7] (Rosa et al., 2018). N-E Atlantic including Gulf of Mexico - the maximum size 338.5 cm FL for females and 283 cm FL for males (Several male shortfin makos in this sample are larger than previously measured males (e.g., 260 cm in Natanson et al., 2006); however, these measurements were verified and considered to represent an accurate size increase) (Natanson et al., 2006). Maximum weight 505.8 kg (Fishbase, nd). Female c.22 years was 373 cm TL (343 cm FL, 313 cm PCL) with mass of 600 kg (Lyons et al., 2015).
	Unknown	
Natural mortality rate (M)	Low	
	Medium	
	High	Natural mortality estimates were 0.14 for males and 0.15 for females (Bishop et al., 2006). Survival of age 0 class (0.87), annual survival rate for age 1+ is ~0.78-0.97, assumed mean 0.785 (Duarte et al., 2018). Female: 0.077–0.242, mean 0.107. Male: 0.093–0.200, mean 0.119 (Tsai et al., 2014). Annual survivorship - age 0+ (0.75-0.91) and age 1+ (0.79-0.94) (Dulvy et al., 2008).
	Unknown	
Maximum annual pup production (per mature female)	Low	
	Medium	Litter size is 4–25 pups (possibly up to 30, usually 10–18), with an estimated gestation period of 15–18 months and a three-year reproductive cycle (Rigby et al., 2019). The average litter size is 12; Breeding frequency appears to be every 3 years, giving an annual fecundity of four (Stevens, 2008). Mean litter size is 12.5 (Mollet et al., 2000; Gallagher et al., 2014). Size of mature female sharks does not appear to affect the number of pups produced, i.e., larger female sharks do not produce more pups (WCPFC, 2018).
	High	
	Unknown	
Intrinsic rate of population increase (r)	Low	
	Medium	
	High	Estimates include 0.113, with a range of minimum and maximum values of 0.060 and 0.132[8] (Semba et al., 2019), 0.102 (Yokoi et al., 2017), and 0.047 (Dulvy et al., 2008). For the Mexican Pacific Ocean with two different breeding periods (2-year and 3-year cycles) and three possible longevities (29, 31 & 41 years) 0.082-0.084 and 0.057-0.061 have been estimated (Mondragón-Sánchez et al., 2018).
	Unknown	
Geographic	Low	Widespread in temperate and tropical oceans to depths of 888 m (Rigby et al., 2019, Figure 1).

[6] They grow constantly until maturity, afterwards they continue to grow but at a reduced growth rate

[7] Rosa et al. (2018) report that in their study the maximum sizes for both males and females was similar to sizes reported in other studies. However, despite a wide sample length range the edges of the length range were poorly represented, with only a few individuals bellow 100 cm FL and a few larger than 210 cm for both males and females. The lack of large individuals, especially females, has been noted before and several hypotheses have been put forward. Rare occurrences of large individuals might be from preferences for deeper and/or further offshore waters, gear selectivity, low survival rate to maturity or the result of overfishing or any combinations between them.

[8] based on the life history parameter obtained in the Indian Ocean as much as possible (Semba et al., 2019)

distribution of stock		 **Figure 1.** The global range of shortfin mako, with range split into the five ocean basins and then further divided longitudinally (from Sherley et al., 2019) Globally important habitat areas for threatened pelagic sharks overlap significantly with industrial fishing activity in both space and time, and the exposure risk of sharks to fisheries in the high seas is spatially extensive – stretching across entire ocean-scale population ranges for some species, including the shortfin mako. The main commercially valuable pelagic sharks were grouped within the highest potential risk zones in the North Atlantic and east Pacific (blue and shortfin mako sharks). Overall, patterns suggest a future with limited spatial refuge from industrial longline fishing effort that is currently centred on ecologically important oceanic shark hotspots (Queiroz et al., 2019). Although the species is found throughout both temperate and tropical waters of both hemispheres, catch rates for this species are highest north of 20° N and south of 20° S, suggesting that the core habitat is in temperate and sub-tropical waters (FAO, 2019).
	Medium	
	High	
	Unknown	
Current stock size relative to historic abundance	Low	
	Medium	
	High	There are no data available on absolute global population size. Shortfin mako is estimated to be declining in all oceans, other than the south Pacific where it might be increasing. As regards stocks, the most recent scientific information refers to the Mediterranean, with historical declines above 96%. There are projected declines (for the next 10 years) of 60% in the North Atlantic and 41.6% in the Indian Ocean; the species is considered probably overfished and overexploited in the South Atlantic, with declines also evident, though not as steep, in the north Pacific. The weighted global population trend estimated a median decline of 46.6%, with the highest probability of a 50–79% reduction over three generation lengths (72–75 years) (Rigby et al., 2019). Abundance indices for the three major oceans can be found in Annex A.
	Unknown	
Behavioural factors	Low	
	Medium	
	High	Shortfin mako is regionally endothermic - maintaining the temperature of specific tissues elevated above ambient water temperature. Endothermic fish (e.g., tunas, billfishes, opahs, lamnid sharks) are pelagic predators that swim continuously, migrate over long distances, and encounter large, rapid changes

		in ambient temperature during repeated dives below the thermocline to pursue prey (Newton et al., 2015). Shortfin mako behaviour seems to differ between regions: specimens tagged in the SW Atlantic tended to stay in the same general area, whereas sharks tagged in the equatorial region travelled considerable distances throughout the Atlantic. Although overall depth and temperature ranges were large, sharks tagged spent most of their time in depths above 90 m and preferred a range of water temperatures from 18 to 22ºC during both day and night (ICCAT, 2019a). Tagged shortfin makos demonstrated varied movement patterns which included both coastal and oceanic habitats, in a study with a small sample size, over a year males made extensive large-scale migrations that crossed multiple management jurisdictions, whilst one female remained along the Gulf of Mexico continental shelf (Gibson et al., 2021). In the Indian Ocean larger mako sharks (age >15 and age >7 years for females and males, respectively) tended to occur in equatorial and tropical regions, while smaller specimens appeared at higher latitudes in more temperate waters (Wu et al., 2021). Vessels overlap substantially with areas of the ocean frequented by sharks, leaving these wide-ranging animals with scant refuge from fishing pressure (Baum, 2019). Regions of high overlap between oceanic tagged sharks and fishing vessels included the North Atlantic Current/Labrador Current convergence zone and the Mid-Atlantic Ridge southwest of the Azores (Queiroz et al., 2016). The species remained within relatively localized areas for extended periods of time, in addition to long-distance movements away from and returning to preferred habitats. This behavioural trait was considered to contribute to how frequently aggregations are exploited, as area-focused longlining in preferred habitats of sharks will have higher catch rates than elsewhere (Queiroz et al., 2016). Persistent use of localized areas that overlap fishing effort indicates potential for overexploitation at the ocean-basin scale (Queiroz et al., 2016). Over 19% of tags attached to shortfin mako (*n* = 119) were returned by vessels in the Atlantic: thought the highest species-specific return rate for sharks recorded on an ocean scale, indicating high fishery-induced mortality (Queiroz et al., 2019). Recorded mean daily movement of *Isurus* spp. across all oceans is about 38 km (Queiroz et al., 2019). In the eastern North Pacific, there was a high degree of variability between individuals in their vertical and horizontal movements, a strong influence of body size and season on movements, and repetitive use of certain areas by individuals (Nasby-Lucas et al., 2019). In the Indian Ocean in terms of size distributions there were some spatial trends with larger specimens tending to occur in the central and eastern areas and smaller specimens in the southwest (Coelho et al., 2018). In the southeast Pacific, males were more common than females closer to the coast and further south. In the central south Pacific, strong sexual segregation was found with more females to the east of -140 degrees and more males to the west (Quiroz and Hoyle, 2019). Australasian shortfin mako are highly migratory and frequently make long-distance movements. However, individuals also exhibit fidelity to relatively small geographic areas for extended periods (Corrigan et al., 2018). Nursery areas are found along the continental margins in both the western and eastern Pacific Ocean, and larger sub-adults and adults are observed in greater

		proportions in the Central Pacific Ocean. A single stock is assumed in the North Pacific Ocean (WCPFC, 2018). Juveniles tagged in New Zealand spent most of their time during a six-year study period (2012-2017) within its Exclusive Economic Zone. Mako sharks often migrate long distances, but they may also occur close to shore and for extended periods, making it difficult to classify their behaviour on the continuum from oceanic nomad to coastal resident (Francis et al., 2019). In Japan most of the hotspots for ‘immature’ shortfin mako (90-160 cm PCL) occurred in coastal waters, while most hotspots for ‘subadult and adult’ (>160 cm PCL) occurred predominately in the offshore waters of Japan (Kai et al., 2017). In the Southern California Bight region, age 0-1 shortfin makos spent 97.0% of their time at <40 m (24.8% at <2 m). Additionally, it has been observed that shortfin makos move seasonally along the coast, northward from late summer to early autumn and southward from late autumn to early winter. Age classes exhibited latitudinal segregation, with larger shortfin makos found farther north (Nosal et al., 2019). Catch data report that juveniles make up a high proportion of long-line fisheries catch for the shortfin mako. This is likely to have particularly detrimental impacts on the population. Juvenile survival rather than fecundity is a crucial factor contributing to population growth rate, especially in longer-lived sharks given their life-history traits (Bonanomi et al., 2017). Climate-driven expansions of ocean hypoxic zones are predicted to concentrate pelagic fish in oxygenated surface layers. Research in the North Atlantic found blue shark (*Prionace glauca*) – the shortfin mako, with a similar distribution, is regularly caught by blue shark fisheries and alongside blue sharks in swordfish and tuna fisheries - maximum dive depths decreased due to combined effects of decreasing dissolved oxygen (DO) at depth, high sea surface temperatures, and increased surface-layer net primary production. This suggests potential aggregation along suitable DO gradients contributed to habitat compression and higher fishing-induced mortality (Vedor et al., 2021).
	Unknown	
Trophic level	Low	
	Medium	
	High	Mako sharks are at the highest level of the marine food web and may compete for the same food resources with the main target species of commercial fisheries: the swordfish *Xiphias gladius* and the tuna *Thunnus* spp. (Biton-Porsmoguer et al., 2017). Shortfin mako occupies a higher trophic level than both blue shark *Prionace glauca* and common thresher *Alopias vulpinus* (Lyons et al., 2019). It has a generalist feeding strategy in the eastern Pacific Ocean, with a strong preference for teleost fishes, and dolphin carcasses (Klarian et al., 2018) and mature California sea lion *Zalophus californianus* have also been found in stomach contents (Lyons et al., 2015). The decline of large sharks can contribute to increases in the abundance of prey species and this can induce cascading effects in some ecosystems. These effects are driven by direct predation and non-consumptive mechanisms (‘risk effects’). Risk effects act on an entire population, can be at least as influential as consumptive effects, and may be substantial even for prey that are rarely consumed (Ferretti et al., 2010).

	Unknown	

3.2 What is the severity and geographic extent of conservation concern?

The shortfin mako was estimated to be declining in all oceans, other than the south Pacific where it is considered increasing (Rigby et al., 2019). It has low population increase rates and suffers high fishing mortality throughout its range (Dulvy et al., 2008). Fishing is the main threat – the shortfin mako is caught globally as target and bycatch in coastal and pelagic commercial and small-scale longline, purse seine, and gillnet fisheries, and is generally retained for the high-value meat as well as its fins. Steep population declines have occurred in the north and south Atlantic, with declines also evident, though not as steep in the north Pacific and Indian Oceans (Rigby et al., 2019). There is little or no management in areas associated with the largest declines, and where there are management measures these appear to have had little influence on landing trajectories (Davidson et al., 2016).

Regionally, this species has been assessed as 'Critically Endangered' for the Mediterranean (Walls and Soldo, 2016), 'Endangered' for the Atlantic, 'Vulnerable' for the Indian Ocean and North Pacific and 'Least Concern' for the South Pacific. However, within these regions there are areas where the threat status is both higher and lower than its regional assessment (Rigby et al., 2019, Table 1). Table 2 shows estimated declines and increases in the four ocean regions.

Table 1. Regional assessments in 2019 of *Isurus oxyrinchus* for IUCN Red List (from Rigby et al., 2019)
Notes: *The "likely status" is assigned based on the category containing the highest posterior probability, with the exception that VU is also selected where LC obtained the highest probability, but it is < 50%. All probabilistic statements are based on the rate of change over three generation lengths (GL). The Global change is based on weighting the regional posterior probabilities by the proportional area (PA) weighting*

Region	GL (years)	Data length (years)	PA weighting	Median change	LC	NT	VU	EN	CR	Likely status
Atlantic[1]	25	68	0.29	-60.0	0	0.1	9.9	**90.0**	0	**EN**
N. Pacific[2]	24	42	0.31	-36.5	20.9	15.6	**43.3**	20.3	0	**VU**
S. Pacific[3]	24	19	0.22	+35.2	**69.4**	4.2	9.0	13.4	3.9	**LC**
Indian[4]	24	45	0.18	-47.9	4.5	7.6	**44.3**	**43.6**	0	**VU**
Global	—	—	—	**-46.6**	22.5	7.2	26.1	**43.3**	**0.9**	**EN**

[1] ICCAT (2017): Figure 2a, BSP2-JAGS biomass page 23
[2] ISC (2018): Figure ES4, page 12
[3] Francis et al. (2014): Figure 25, right panel, page 43
[4] Brunel et al. (2018): Figure 6B, page 14

Stock assessments rely on 'fisheries-dependent' data, and oceanic pelagic sharks such as a shortfin mako typically have relatively little reliable data (Kai et al., 2017). The patchy availability of these data has meant that the full extent to which sharks interact with fishing fleets on the high seas — and the impacts of these fisheries on them — to a large extent remains unknown. However, vessels fishing on the high seas overlap substantially with areas of the ocean frequented by sharks (Baum, 2019; Queiroz et al., 2019). A primary limitation is individual countries with competing national interests self-report data to international fisheries organizations, leading to misreporting that can compromise suitability for spatial management. For example, China's distant-water fleet, among the world's most active fleets, has been estimated to underreport catch by one order of magnitude (White et al., 2019). The real number of shortfin mako caught is uncertain. The landing data only show known catches, but the unknown catches (e.g., illegal discards at sea) may be even greater than the known ones (Duarte et al., 2018).

Table 2. Assessment of *Isurus oxyrinchus* in the regions in which it occurs. Increases are shown in green; inconclusive data and declines between 1 and 40% are shown in yellow; declines greater than 40% are shown in red. [https://cites.org/sites/default/files/eng/cop/18/prop/060319/E-CoP18-Prop-42.pdf]

Region	North Atlantic **(1)**	South Atlantic **(2)**	Mediterranean **(3)**	Indian Ocean **(4)**	South Pacific **(5)**	North Pacific **(6)**
% of the total distribution of the species **(7)**	14.50%	12.00%	1.10%	17.90%	22.00%	32.50%
Historical decline first 10 years with data vs. last 10 years	39%	Not available	>96%	26%	Not available	16.4%
Recent decline (0 to 10 years back)	32% (annual rate 4.2%)	Not available	Not available	18.8% (annual rate 2.1%)	2009-2013, no % estimated	Increase of 1.8% (annual rate of increase of 0.18%)
Projected decline (next 10 years)	60%	Not available	Not available	41.6%	Not available	Not applicable
Results of stock assessments **(8)**	Overfished and overexploited (90% prob.)	Overfished and overexploited (19% prob.)	Decline	Overfished but not overexploited	Not available	Neither overfished nor overexploited (>50% prob.)

Notes: 1= Estimated based on Table 7 of the publication by the ICAAT SCRS (2017); 2= Based on information provided by the ICCAT SCRS (2017); 3= Based on Ferretti (et al., 2008); 4= Estimated based on Figure 6B of Brunel et al. (2018); 5= Based on Rice (et al., 2015) and Clarke (et al., 2013a); 6 = Estimated based on Table 7

Atlantic Stock

Conservation or stock assessment status	**High**	**North Atlantic:** overfished state and experiencing overfishing **South Atlantic:** possibly overfished and possibly experiencing overfishing
Population trend	**High**	Annual rates of decline 1950-2017 of 1.2%, estimated median decline of 60.0% over three generation lengths (75 years), with the highest probability of 50–79% reduction

In the Atlantic Ocean, following a long period of decline since 1970, abundances of oceanic sharks began to stabilize at low levels after 2000 (overall decline of 46.1%; 95% credible interval, 30.7–61.1%) (Pacoureau et al., 2021). Catch and stock assessments for the Atlantic are shown below in Table 3 and Figure 2.

Table 3. Estimated catches (t) of Shortfin mako (*Isurus oxyrinchus*) by area, ATN (North Atlantic) and ATS (South Atlantic) (adapted from ICCAT, 2019b)

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL		5841	8406	7701	5727	5861	4469	5179	4792	5531	7225	6528	6970	6620	6946	5682	6605	7254	6979	7338	5778	6126	5739	6111	5902	5547
	ATN	3659	5306	5306	3534	3845	2858	2587	2677	3426	3987	4000	3695	3574	4158	3800	4541	4767	3718	4431	3595	2852	2964	3347	3116	2388
	ATS	2182	3100	2395	2187	2008	1606	2588	2107	2103	3235	2526	3259	3036	2786	1881	2063	2486	3258	2905	2183	3274	2774	2765	2786	3158

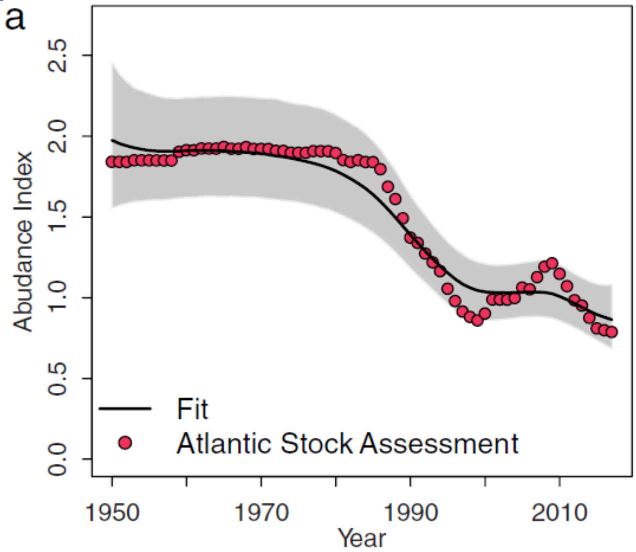


Figure 2. The fit (black line) and 95% credible intervals (grey polygon) to the observed timeseries of biomass estimates (red points) from the shortfin mako stock assessment for the North Atlantic (from Sherley et al., 2019)

It has been noted that ICCAT data for non-retained sharks are very incomplete and most likely underestimate true catches. Additionally, very few Contracting Parties and Cooperating non-Contracting Parties (CPCs) report dead discard estimates for non-retained sharks (Coelho et al., 2020).

North Atlantic

- There was a 90% probability of the North Atlantic stock being in an overfished state and experiencing overfishing (ICCAT, 2018).
- Projections indicated that the current catch will not allow the stock to rebuild by 2070 and overfishing will continue (ICCAT, 2019b).
- MSY has been projected to be less than 1,100 t. However, continued short-term population declines, regardless of the total allowable catch (TAC) level and for many years after fishing pressure is reduced are projected, because it takes many years for the surviving recruits to reach maturity and begin to contribute to the spawning stock size (Courtney and Rice, 2020).
- Fishing mortality was viewed as too high, but the biomass was estimated at B_{MSY}[9]. Given the high fishing mortality, the stock would be expected to decline below B_{MSY} in the near future (Maguire and Cortés, 2019).
- The new paradigm for the North Atlantic shortfin mako is summarized by Winkler et al. as: “The Good, the Bad and the Ugly”. The existence of large mature sharks not caught in ICCAT fisheries has probably retarded the stock collapse (“The Good”). This biomass is as cryptic to the fishery as it is unobservable in the available abundance data (“The Bad”). By ignoring the strong lag effect between exploitable and reproductive biomass, earlier surplus production model assessments have probably contributed to a false perception about the long-term sustainably of the fishery, but even the 2017 state-space implementations with informed prior remain at high risk to overestimating the rebuilding potential. The inability to predict the long-term impact of unsustainable fishing over the last 30 years has likely created a “time bomb” scenario towards a collapse of the mature biomass (“The Ugly”). While it is probably too late to halt the collapse, rebuilding chances will depend on the time it takes to implement effective management interventions (Winkler et al., 2020)
- The shortfin mako was ranked the second most vulnerable elasmobranch species, after the silky shark, at risk of overexploitation by pelagic longline fleets in the Atlantic Ocean (Cortés et al., 2010).
- Globally, the shortfin mako has a mean monthly spatial overlap of 36.8% with longline fishing, in the North Atlantic it is 62.4% (Queiroz et al., 2019).

[9] Biomass that enables a fish stock to deliver maximum sustainable yield (MSY)

- North Atlantic catches increased from 2,964 t in 2015 to 3,347 t[10] in 2016 and then decreased to 3,116 t in 2017, further decreasing to 2,388 t in 2018. It is not clear if the decrease can be attributed to Rec. 17-08 or to continued decrease in stock size (ICCAT, 2019b).
- The CPUE series available for the 2017 shortfin mako stock assessments showed decreasing trends since approximately 2010 for the North Atlantic stock and generally increasing trends since approximately 2008 for the South Atlantic stock (FIRMS, 2020).
- US pelagic longline data indicate an initial decline followed by a recovery since about the late 1990s, and then a declining trend since about 2010 (Cortés, 2017). Cortés (2017) proposes that the lack of strong trends in all series suggests that the status of the stock is stable, yet the declining trend since 2009-2011 should continue to be closely monitored. However, Maguire and Cortés (2019) note that models do not capture the biological characteristics of shortfin mako shark productivity[11].
- Catch data are claimed to be grossly underestimated. Projections indicated that catch levels (3,600 t for nominal (Task I) catches and 4,750 t for the alternative catches estimated based on ratios (Task II), mean of 2011-2015) in the North Atlantic would cause continued population decline (Sims et al., 2018).
- Mako sharks in the western North Atlantic are considered experiencing greater fishing mortality than previously inferred from fisheries-dependent data, although underestimations are unlikely to be regional. Estimates were 5–18 times higher than those associated with maximum sustainable yield, suggesting both data used in stock assessments may considerably underestimate fishing mortality (Byrne et al., 2017).
- With a constant annual catch of 1,000 t the probability of recovery would only be 25% by 2040. To stop overfishing and start rebuilding, the constant annual catch should be 500 mt or less. This will achieve the goal of stopping overfishing in 2018 with a 75% probability, but it only has a 35% probability of rebuilding the stock by 2040. Only an annual catch of zero will rebuild the stock by 2040 with a 54% probability (ICCAT, 2017).
- With a size limit and discard mortality of 25%, the weight of dead discards was equal to or greater than the weight of the retained catch. A live release policy that caused retention of only 36% of all sharks with a discard mortality of 25% also caused a large volume of dead discards. Thus, to rebuild the population, the TAC had to be reduced to about 400 t, so that the total mortality (= retained catch plus dead discards) would be below the level of about 800 t required to cause an increasing trend. In general, the projections showed that, if fishers are unable to avoid catching shortfin mako sharks, and the ones that are discarded have a substantial mortality rate, then it is necessary to greatly decrease the retained catch to allow the population to rebuild (ICCAT, 2019b).
- The outlook is thought to be more pessimistic because mostly juveniles are removed and thus it can be anticipated that spawning stock will keep declining for years after fishing pressure has been reduced and before new recruits reach maturity (FIRMS, 2020).
- The NOAA (2020) published landings estimates[12] for ‘Pelagic sharks other than blue and porbeagle’ (three shark species including shortfin mako[13]) in 2019 of 44 mt dressed weight[14] (dw), 9% of the 2019 quota of 488 mt dw. NOAA (nd) describes “U.S. wild-caught Atlantic shortfin mako shark is a smart

[10] About 130,000 individuals (Sims et al., 2018)

[11] Surplus production models assume that the biomass next year is related to the biomass this year, plus growth (including recruitment), minus catch and natural mortality. The shortfin mako shark fishery is based essentially on immature fish; this means that the component of surplus production related to somatic growth of fish already recruited to the fishery is included in surplus production models, but the recruitment component related to the offspring production by the mature component is not included. For a species like shortfin mako shark that produces 12 pups or less per spawning event, the production of recruits is expected to be closely related to the abundance of mature females (Maguire and Cortes, 2019).

[12] Preliminary landing estimates in metric tons (mt) dressed weight (dw) for the Atlantic shark commercial fisheries, based on dealer reports and other information received throughout the year. The estimates include landings by state-only permitted vessels, federally permitted vessels, and the 2019 shark research fishery participants (NOAA, 2020).

[13] Other two species are the common thresher shark *Alopias vulpinus* (Vu) and oceanic white tip shark *Carcharhinus longimanus* (CR).

[14] “Dressed … means in relation to all species of sharks and ghost sharks (including elephant fish), the body of a fish from which the head, gut, and fins have been removed” (Francis, 2014)

seafood choice because it is sustainably managed and responsibly harvested under U.S. regulations." The longfin mako is not permitted to be landed.

- Reported catches have had apparent inconsistencies and several shortfin mako data series in the last two decades for both the North Atlantic (longlines: Belize, China PR, Korea, Mexico, Panama, Senegal; gillnets: Venezuela) and South Atlantic (longlines: Belize, Korea, Panama, Philippines, Vanuatu; gillnets: Côte d'Ivoire) are still incomplete (ICCAT, 2019a).
- Countries reporting 2018 catches of North Atlantic Shortfin Makos include (in order of magnitude): EU (Spain & Portugal), Morocco, US, Japan, Korea, Belize, Canada, and Mexico. EU fishing vessels are responsible for 65% of reported catches of North Atlantic shortfin makos from January through June 2018.
- The Report of the Shark Species WG to ICCAT (ICCAT, 2019a[15]) indicated that a TAC of 700 t would end overfishing immediately with a 57% probability, however this TAC would only have a 41% probability of rebuilding the stock by 2070. They further recommended, given the vulnerable biological characteristics of this stock and the pessimistic findings of the projections, to accelerate the rate of recovery and to increase the probability of success that **the Commission adopt a non-retention policy** as it has already done with other shark species.

South Atlantic

- The nominal (Task I) catch of shortfin mako in South Atlantic in 2018 was 3158.4 t (ICCAT, 2019b).
- The stock status was assessed as possibly overfished and possibly experiencing overfishing (ICCAT, 2019b).
- The Report of Shark Species Working Group to ICCAT (ICCAT, 2019a) stated: "*Given that fishery development in the South predictably follows that in the North and that the biological characteristics of the stock are similar, there is a significant risk that this stock could follow a similar history to that of the North stock. If the stock declines it will, like the North stock, require a long time for rebuilding even after significant catch reductions*." To avoid this situation and considering the uncertainty in the stock status, the Working Group recommended that minimum catch levels should not exceed the minimum catch in the last five years of the assessment.
- The CPUE series available for the 2017 shortfin mako stock assessments showed decreasing trends since approximately 2010 for the North Atlantic stock and generally increasing trends since approximately 2008 for the South Atlantic stock. The combined probability of the stock being overfished was 32.5% and that of experiencing overfishing was 41.9%. However, the ICCAT (International Commission for the Conservation of Atlantic Tunas) Committee considered results for the South Atlantic to be highly uncertain owing to the conflict between catch and CPUE data (ICCAT, 2019b).
- The South Atlantic estimates were deemed unreliable, although they inferred that fishing mortality is likely unsustainable. This concern is corroborated analysis of standardized catch rates on longlines in the South Atlantic that revealed steep declines of 99% in the average CPUE of 1979–1997 and 1998–2007 (Rigby et al., 2019).
- Estimates of unsustainable harvest rates in the South Atlantic appear to be quite robust, whereas the biomass depletion and B/BMSY estimates are highly uncertain (Winkler et al., 2017).
- Most shark populations affected by longlines in the South Atlantic are currently depleted, but these populations may recover if fishing effort is reduced accordingly. However, concurrently Brazil has been newly identified among the largest - and fastest expanding - consumer market for shark products worldwide (Barretto et al., 2016; Okes and Sant, 2019).
- In the southern Atlantic, shortfin makos are much more common in the Brazilian longline fishery than longfin makos, which are caught infrequently and are commonly grouped with the longfin as well as with other shark species in fisheries records. Among the top five countries in terms of numbers of blue and mako sharks landed, Brazil ranked third and fifth respectively in the southwestern and equatorial Atlantic Ocean (Fredou et al., 2015).

[15] https://www.iccat.int/Documents/SCRS/DetRep/SMA_SA_ENG.pdf

Indian Ocean

Conservation or stock assessment status	**Medium**	**Indian Ocean** Ecological Risk Assessment: highly vulnerable.
Population trend	**Medium**	No quantitative stock assessment currently available for Indian Ocean. However, trend analysis of the biomass for 1971–2015 (45 years) revealed annual rates of decline of 0.9%, consistent with a median decline of 47.9% over three generation lengths (72 years), with the highest probability of 30–49% reduction.

- In the Indian Ocean, shark abundances have declined steeply since 1970 (overall decline of 84.7%; 95% credible interval, 75.9–92.1%) (Pacoureau et al., 2021).
- The Indo-Pacific sub-population of shortfin mako continues to be assessed as Vulnerable, although ~44% of the posterior also indicated Endangered for this region (Sherley et al., 2019).
- The relative biomass is predicted to have had a continuously decreasing trend over time which indicates that the shortfin mako in the Indian Ocean is subject to overfishing but not overfished; however, with trajectories showing consistent trends towards the overfished and subject to overfishing status (Brunel et al., 2018). The trend analysis of the biomass for 1971–2015 revealed annual rates of decline of 0.9%, consistent with a median decline of 47.9% over three generation lengths (72 years) (Rigby et al., 2019).
- Population depletion has mainly been the result of the lack of fishing limits (Dulvy et al., 2017). Shortfin mako is regarded as the most vulnerable shark species to pelagic longline fisheries in the IOTC (Indian Ocean Tuna Commission) area (Murua et al., 2018).
- There is no quantitative stock assessment currently available for shortfin mako in the Indian Ocean: catch estimates are highly uncertain, and therefore the stock status is unknown (IOTC, 2019b).
- The shortfin mako was one of the most common bycatch species of the Taiwanese tuna longline fishery (Taiwan was second-largest shortfin mako shark-catching nation) in the Indian Ocean (Wu et al., 2021).
- Information on bycatch species of Chinese longline fishery, especially on sharks, rays, and sea turtles, was rarely reported. Between 2012-2015 China reported 21 shortfin mako as bycatch, 0.78% of reported bycatch, of which 4 (19%) were discarded (ranked second after blue shark, 443 and 16.4%). The species was caught in all areas fished (Gao and Dai, 2016).
- Reported catch in 2018 was 1,499 t, and the average 2014-2018 was 1,582 t per year. 'Not elsewhere sharks', which may include makos, was 35,758 t in 2018, 2014-2018 average 47,537 t (IOTC, 2019).
- Since 2015 catches of all sharks have been over 100,000 tonnes, of which ~60% are pelagic, 59% by the gillnet fishery where most reported as 'shark group' (89 % SKH). 14% reported catch by longline, of which 8% shortfin mako, 2% mako sharks, and 26% 'sharks.' In the longline fleet, more shark species are considered at higher vulnerability due to higher susceptibility in comparison to the purse seiner and gillnet gear, mainly because longline fleet is broadly distributed over almost the entire Indian Ocean (Murua et al., 2018).
- Additionally, mako sharks may be included under titles such as SHK or RSK (requiem shark) – the 'not included elsewhere' shark catch for the Indian Ocean in 2018 was 35,758 tonnes (IOTC, 2019).
- Fishing pressure has been high for over 50 years; finning and discarding has also been reported to be occurring in offshore and high seas fisheries. A review of fisheries management in the Indian Ocean suggested that the shortfin mako is fully or over exploited (Cailliet et al., nd).
- Common in pelagic longline fisheries in the Indian Ocean, often targeted by some semi-industrial, artisanal, and recreational fisheries and are bycatch of industrial fisheries (Semba et al., 2019).
- The western Indian Ocean is one of two regions with the greatest declines in shark and ray landings 2003-2011of 45,928 t – indicating declines in shark populations – however because many countries do not report landing to the species level it is difficult to assess species-specific declines. Three nations with Indian Ocean coastlines ranked as having the greatest declines – Pakistan (32,281 t), Sri Lanka (25,176 t), and Thailand (21,051 t) (Davidson et al., 2016).

- Piracy in the western Indian Ocean has resulted in the displacement and may help explain declines in landings. There has been a subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. Some longline vessels have returned to their traditional fishing areas in the northwest Indian Ocean. It is therefore unlikely that catch and effort on shortfin mako shark has declined in the southern and eastern areas and may have resulted in localised depletion there (IOTC, 2019).
- Estimated annual catch rates (standardized CPUE) of the Japanese fleet showed a decreasing trend with high fluctuations from the beginning of 1990s until 2009, and then the trends of the catch rates slightly increased. This suggests that shortfin mako abundance declined due to higher catch rates and fishing effort in 1990s and at the beginning of 2000s, and the population recovered slightly due to the reduction of catch in conjunction with the reduction of fishing effort (Kai and Senba, 2019).
- Species-specific catch data from South Africa commonly exhibit high inter-annual variability which is not an indication of performance but rather an artefact of 'criss-crossing' IOTC/ICCAT boundaries. In the IOTC region in 2016, a minor movement eastward by the fishery resulted in a higher proportion of fish being caught, and an increase of 87% in shortfin mako catches was observed from 2015 to 2016. There was also a reciprocal decrease in catch in the ICCAT area of competence in 2016. For transient species the boundary obviously does not exist, and vessels regularly 'ignore' it too. There are reporting concerns regarding the artificially high inter-annual variability and the potential for inconsistent catch trends associated with stocks that transition across the RFMO boundary. These may influence the outcome of stock assessments that include South African catch statistics. This is particularly true for shortfin mako as South Africa is a major contributor to total catch; approximately 32% of all reported catches in the IOTC area. Furthermore, the RFMO boundary bisects the preferred feeding ground for juveniles during winter and spring and potential nursery area, which is supported by high catch rates compared with fishing grounds further east (Parker et al., 2017)[16].
- The greatest fishing effort by the Portuguese fleet 1998-2016 occurred in the south-western Indian Ocean. In areas closer to Africa smaller specimens were caught, and size tended to increase for more eastern longitudes. 2,690 specimens were caught 2011-2016 with sizes ranging from 64-350 cm (Coelho et al, 2017, Figure 3).

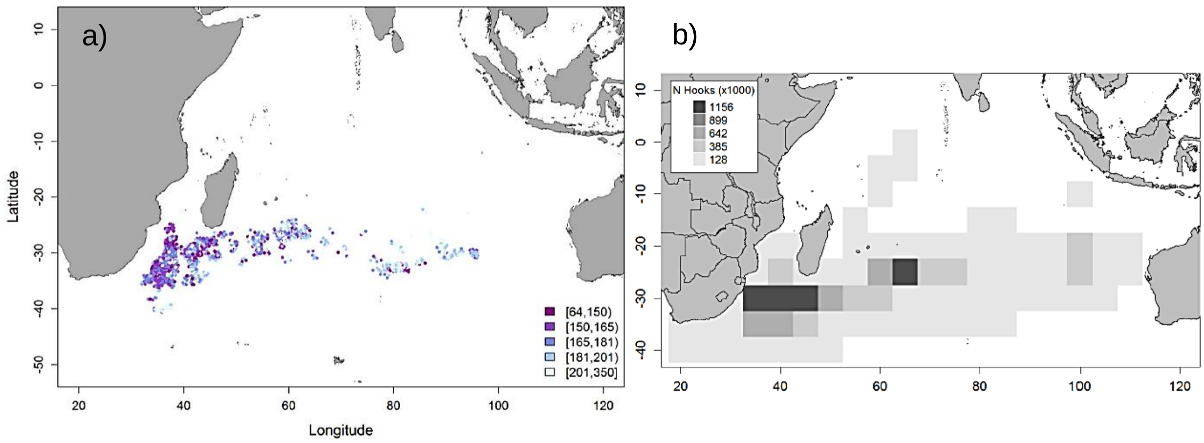


Figure 3. a) Distribution of the size samples of SMA from the Portuguese pelagic longline fleet in the Indian Ocean for the 2011-2016 period and **b)** effort distribution of the Portuguese pelagic longline fleet for the 1998-2016 period in the Indian Ocean (from Coelho et al., 2017)

- Extrapolation to total fishing effort indicated a near 10-fold increase in shortfin mako fishing mortality caught in the coastal southeast Atlantic Ocean and southwest Indian Ocean by a South African-flagged pelagic longline fishery, compared to an earlier study (1998–2005). Escalating shortfin mako fishing

[16] If the eastern South Atlantic and south-western Indian Ocean stocks are one contiguous population, we recommend NDFs treat them as such

mortality was attributed to increased targeting to supply higher market demand. It was estimated that the South African-flagged pelagic longline fishery caught ~150,000 blue sharks and 50,000 shortfin makos during 2015. Of these, an estimated 24,000 blue sharks and <1000 shortfin makos were released in a good physical condition. The combined fishing mortality (retained and discarded dead or in a poor condition) estimate of 175,000 sharks was nearly an order of magnitude greater than average mortalities of 16,000 – 22,000 sharks/year incurred by the same fleet in 1998–2005 (Jordaan et al., 2020).

North and South Pacific

- In the Pacific Ocean, abundances decreased steeply before 1990, and then declined at a slower rate (overall decline of 67.0%; 95% credible interval, 53.6–79.4%) (Pacoureau et al., 2021).

Conservation or stock assessment status	**Low**	**North Pacific:** stock is likely (>50%) not in an overfished condition and overfishing is likely (>50%) not occurring **South Pacific:** ‘Least Concern’, but note areas where shortfin mako ‘Critically Endangered’, ‘Endangered’ and ‘Vulnerable’
Population trend	**Medium**	**North Pacific:** annual rates of decline of 0.6%, consistent with a median decline of 36.5% over three generation lengths (72 years), with the highest probability of 30–49% reduction **South Pacific:** increasing

- The North Pacific shortfin mako stock is considered likely (>50%) not in an overfished condition and overfishing is likely (>50%) not occurring. It should be noted that there is uncertainty in fishery data and key biological processes, especially stock recruitment. Additionally, there is uncertainty in the estimated historical catches of North Pacific shortfin mako shark (WCPFC, 2019). Statistically, it is arguable whether ‘>50%’ merits a consideration of ‘likely’ or not, especially noting the various uncertainties. It might be more precautionary to state the North Pacific stock is possibly not overfished and overfishing is possibly not occurring.
- The trend analysis of the modelled spawning abundance (SA) for 1975–2016 (42 years) revealed annual rates of decline of 0.6%, consistent with a median decline of 36.5% over three generation lengths (72 years), with the highest probability of 30–49% reduction over three generation lengths. Although the stock assessment used a long data time series of 40 years, the trend analysis considered the population change over a longer period of 72 years, which results in a greater decline than that of the stock assessment (Rigby et al., 2019).
- Recruitment was estimated on average to be 1.1 million age-0 sharks 1975-2016. During the same period, the SA was estimated, on average, to be 910,000. The SA in 2016 was estimated to be 860,200 and was 36% higher than the estimated SA at MSY. Fishing intensity in 2015 was 62% of fishing intensity at MSY ((WCPFC, 2019).
- The total estimated catch of North Pacific shortfin mako reached a peak of 7,068 mt in 1981 and then declined in the early 1990s, with catches fluctuating between 1,948 mt and 2,395 mt since the early 1990s. Drift gill nets accounted for the highest catches during the early period, but the catches have been predominantly from longline fisheries since 1993 (ISC[17] Shark Working Group, 2018).
- The CPUE declined between 2011 and 2019 (Figure 4).

[17] ISC - International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean

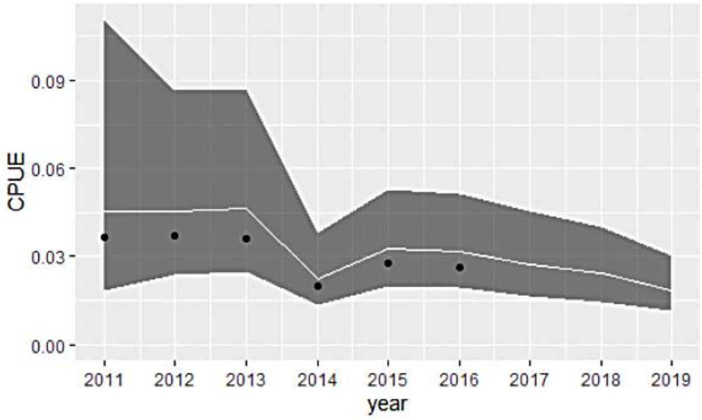


Figure 4. Annual estimate CPUE for *Isurus oxyrinchus* in the North Pacific Ocean. The white line is the least squared means and the black dots are point estimates from previous analysis. The grey shadow shows 95% confidence interval (from Kainaiwa et al., 2021)

- A total of 224,786 shortfin mako were landed at Nanfangao fish market, Taiwan (ROC), between January 1989 and December 2019 (116,281 females and 108,505 males). The high proportion of immature sharks (two modes of 100 cm and 150 cm) caught raise serious questions about the sustainability of the fishery (Liu et al., 2021).

Western and Central Pacific
- Shortfin mako catches ranged between c. 25 and 40% in weight of the total annual bycatch species by the Spanish surface longline fleet targeting swordfish in the eastern and western Pacific areas (Abascal et al., 2011).
- In the western and central North Pacific, mainly 60-240 cm PCL (0-20 years old) individuals are caught as bycatch by Japanese commercial pelagic longline fisheries targeting tuna and billfish (Kai et al., 2017)
- Annual fishing mortalities were lowest in the Western Pacific Ocean (ICCAT, 2019a)
- The Western Central Pacific (49,920 t) is one of two regions with the greatest decline in landings 2003-2011 (Davidson et al., 2016).

Eastern Pacific
- Information available for mako shark in the Eastern Pacific Ocean is relatively limited (ICCAT, 2019a), with RFOs splitting the Pacific Ocean between Northern and Southern stocks.
- In 2018, an IATTC (Inter-American Tropical Tuna Commission, the regional management authority for the Eastern Pacific stock) report ranked both shortfin and longfin mako sharks as highly vulnerable in the region, based on an assessment of vulnerability and susceptibility scores (IATTC, 2019).
- Mako shark catch has been reported as minimal from purse-seine vessels in the Eastern Pacific Ocean (IATTC, 2019).
- 2017 catch from longline fisheries was reported as 1,606 metric tons in 2017 down from a peak of 2,500 metric tons in 2014, with the caveat that values should be considered a minimum estimate due to incomplete reporting for the region (IATTC, 2019). However, these figures do not correspond with data in the publicly available IATTC database[18], and data reported to IATTC by some countries is in numbers of sharks rather than by weight, with no conversions made by IATTC to amalgamate these data.
- In the Chinese tuna longline fisheries in the Pacific Ocean 2010-2018, bycatch accounted for 30.4% of the total catch, the majority of bycatch was other bony fishes (15.5%) and sharks (7.3%). The highest bycatch rates of elasmobranchs were in the eastern tropical Pacific (Wang et al., 2021).
- Spain has developed an NDF document for the import of shortfin mako from the Eastern Pacific Ocean from Panama to Spain (2020) which cites "many problems with the IATTC elasmobranch database", and a lack of survey data for the Eastern South Pacific.

[18] https://www.iattc.org/PublicDomainData/IATTC-Catch-by-species1.htm

South Pacific

- There is no existing stock assessment for the South Pacific shortfin mako and therefore catch rate indicators provide the best available information to estimate the extent of any stock decline (FAO, 2019).
- The south Pacific population appears to be increasing but with fluctuating catch rates (Rigby et al., 2019). I There was a slightly positive rate of change (+0.48), but uncertainty was very high. This region is assessed as Least Concern, however in over 30% of this region the species meets the criteria for more threatened Red List categories (Sherley et al., 2019).
- Makos comprised a very small proportion of the longline catch and were even less common in the purse seine fishery (Clarke et al., 2011).
- The fishery for pelagic sharks in the south-eastern Pacific is conducted mainly by longline and gillnet fleets from Chile, but distant water fleets from various countries are also involved. In Chile, it is caught in a targeted manner in the northern part of the country, but also as bycatch. The majority caught are juveniles and there are no administration measures that regulate their capture and protect the sustainability of these resources in the long term (IFOP[19], 2020).
- The South Pacific has recorded large catches from artisanal fleets that target shortfin mako and blue sharks. The average annual catch 2001-2018 by large and small artisanal fleets was 933 (range 2,305-117) and 8,287 (15,095-2,167) individuals respectively. The industrial fleet's average catch over this period was 2,962 (5,526-801) (Quiroz and Hoyle, 2019, Figure 5).

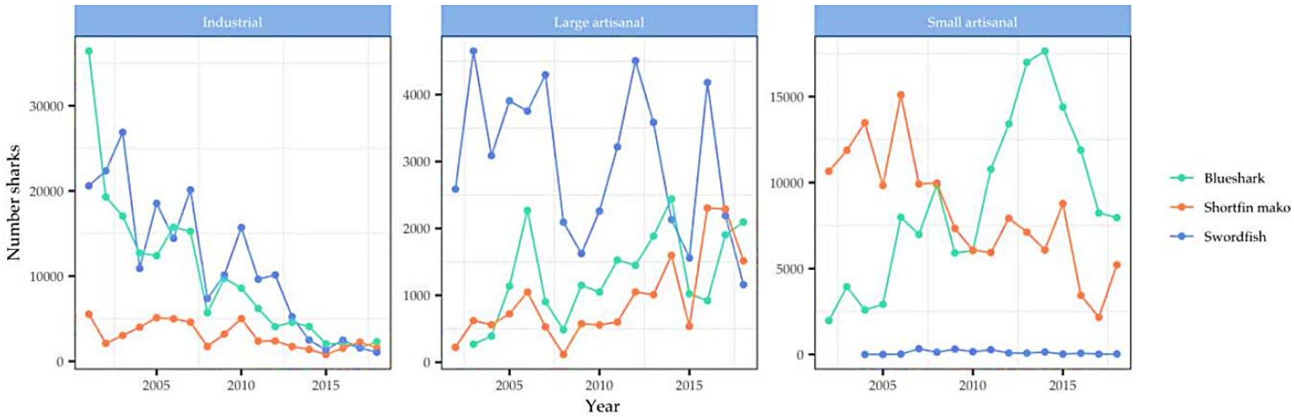


Figure 5. Catch time series of blues shark, shortfin mako and swordfish in the South Pacific by type of fleet (from Quiroz and Hoyle, 2019)

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**
Magnitude of legal trade	**Low**	
	Medium	
	High	Reported catches and landings; market value of products and prominence in international trade of meat and fins
	Unknown	
	Level of confidence Low Medium High	

[19] IFOP- Instituto de Fomento Pesquero, Chile's Fisheries Development Institute

Reasoning

Oceanic sharks

For all 31 oceanic shark species, the risk of extinction, indicated by IUCN Red List category, has substantially increased since 1980. The Red List Index[20] declined from a retrospective estimate of 0.86 (range, 0.74–0.90) in 1980 to 0.56 in 2018, comparable to cycads (palm-like plants), the most threatened group of completely assessed species on Earth. Globally, the abundance of oceanic sharks declined by 71.1% (95% credible interval, 63.2–78.4%) from 1970 to 2018, at a steady rate averaging 18.2% per decade (Figure 6). The declines in populations and increased extinction risk of oceanic sharks are attributed to overfishing. There has been a more than twofold increase in fishing with longlines and seine nets, the gears that catch the most oceanic sharks, during the past half-century. Concomitantly, oceanic shark catch rates have increased threefold since 1970, resulting in an 18-fold increase in relative fishing pressure. Overfishing of oceanic shark populations has far outpaced the implementation of fisheries management and trade regulations. Relatively few countries impose catch limits specific to oceanic sharks, and fewer still can demonstrate population rebuilding or sustainable fisheries for these species (Pacoureau et al., 2021).

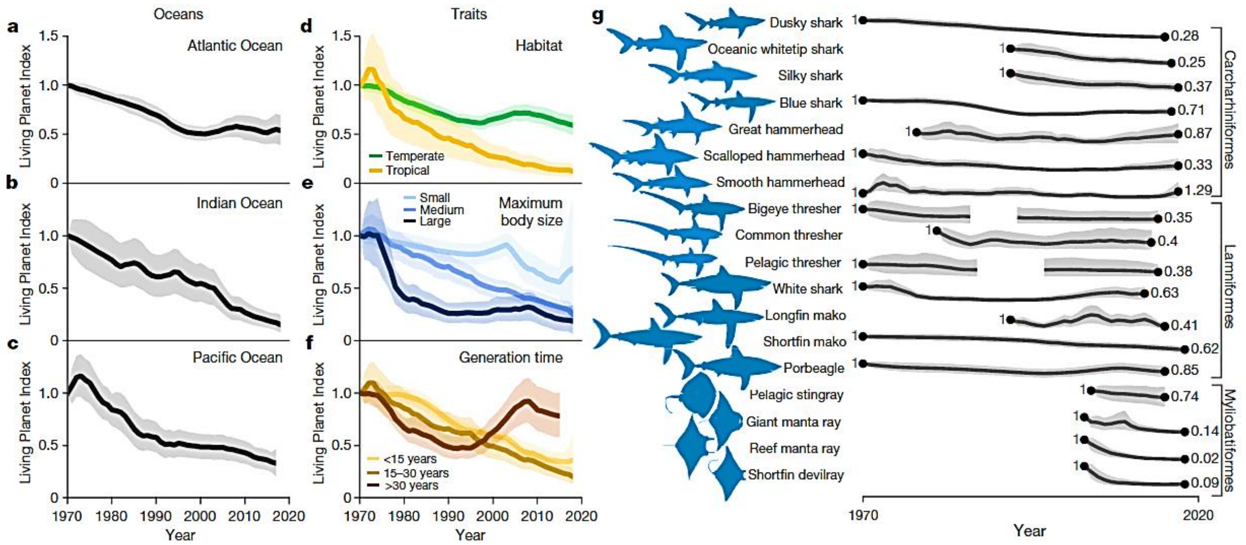


Figure 6. Living Planet Index[21] for 18 oceanic sharks from 1970 to 2018 disaggregated for each of the oceans and traits: a) Atlantic Ocean; b) Indian Ocean; c) Pacific Ocean; d) geographical zone; e) body size (maximum total length divided into three categories: small, ≤250 cm; medium, 250–500 cm; large, >500 cm); f) generation time; g) species. Lines denote the mean and shaded regions the 95% credible intervals (from Pacoureau et al., 2021).

Shortfin mako

Between 2009-2017 total capture production for shortfin mako globally was estimated at over 11,000mt per year (Okes and Sant, 2019). Shortfin mako is the second-most common oceanic shark caught by high-seas longline and net fisheries after the blue shark (*Prionace glauca*) and is caught globally as target and bycatch in coastal and pelagic commercial and small-scale longline, purse seine, and gillnet fisheries (Rigby et al., 2019). It is important to note that mako sharks are often grouped in catch, landing and trade data reports (Frédou et al., 2015). The longfin mako is less abundant, but according to the study by Clarke (2006), most traders reported that they classified its fins in the same category as those of the shortfin

[20] A measure of change in extinction risk.

[21] The Living Planet Index (LPI) is a measure, since 1970, of the state of the world's biological diversity based on population trends of vertebrate species from terrestrial, freshwater and marine habitats. The LPI has been adopted by the Convention of Biological Diversity (CBD) as an indicator of progress towards its 2011-2020 target to 'take effective and urgent action to halt the loss of biodiversity' (LPI, nd).

mako and thresher sharks (*Alopias* spp., also included in CITES Appendix II), due to their similar appearance and market value (CoP18 Prop. 42).

Europe and South America are the largest retail markets for shark meat globally. The top 20 importers of shark meat have remained stable over the last ten years with Brazil, Spain, Uruguay and Italy accounting for 57% of average global imports over this time, and several locations remain both major importers and exporters, including Spain, Uruguay, Portugal and Peru (Okes and Sant, 2019). Mako sharks are commercially important as highlighted by the reported catch and landings data in Section 2, and products utilised include fresh, frozen, and dried or salted meat for consumer countries such as Spain, where it has historically been traded domestically on the Mediterranean Coast (Okes and Sant, 2019; Vannuccini, 1999). In 2013 the wholesale prices for mako shark meat in Spain were USD14.17/kg for fresh and USD5.21/kg for frozen; attaining similar prices to that of swordfish (Clarke *et al*, 2013).

As well as being targeted for its highly valued meat, the liver oil, cartilage, and squalene are utilised in cosmetics and pharmaceuticals (Vannuccini, 1999). Shark fins can attain a much higher price than the meat, and countries such as Spain export fins to Asian markets where the species is ranked as the fifth most common encountered in the fin trade in Hong Kong SAR (Okes and Sant, 2019; Fields et al., 2018). In 2011, the export value of shark fin from Spain was estimated at USD50/kg for dried fins (Dent, 2015). Despite the high species diversity found in Hong Kong markets, the contemporary fin trade appears to be dominated by a small number of species, with trade skewed to a few globally distributed species including mako (Fields et al., 2018).

The shortfin mako accounted for 2.77% of fins sampled in Hong Kong markets in 2014-2015. The trend in the annual import volume of fins in one of the world's largest hubs of the fin trade is similar to the trend for global chondrichthyans landings reported to the FAO, which peaked in 2003 and have since declined. That the fin trade has not declined even more given the inherent vulnerability of this group may be explained by geographical shifts in sources, species substitution, or both (Fields et al., 2018).

Shortfin mako derivatives (and other CITES-listed shark species) have been identified for sale in fishmongers and fish and chip shops in England, highlighting the use of 'umbrella' sales terms that do not specifically identify a species (Hobbs et al., 2019). Species such as sharks are often mislabelled, and CITES listed species potentially disguised as legally traded products (Sims and Frost, 2019).

To summarise, the prevalence of mako shark meat and fins in both international and domestic trade and the high price of mako shark meat and fins indicate a high level of legal trade pressure, especially when taking into consideration the biological and life history traits of this species making it particularly susceptible to overfishing.

Magnitude of illegal trade	**Low**		
	Medium	Prominence of mako products and specimens in seizures	
	High		
	Unknown		
	Level of confidence		
	Low	Medium	High

Reasoning
Shark fishing and the trade in shark products, including fins, is legal for many species and in many parts of the world; however much of it is unregulated and unmanaged (Murdock and Villanueva, 2019). High seas monitoring and surveillance is minimal, and many of the shark fins in international trade originate from unmanaged fisheries which lack monitoring and enforcement capacity. It can therefore be assumed that a

large proportion of shark products on the global market are the result of Illegal, unregulated, and unreported (IUU) fishing (Savody de Mitcheson, 2018).

Shark finning is illegal in many countries, and there are many accounts of mako shark fins appearing in illegal trade. Mako shark fins (as identified by DNA barcoding) have been found in seizures which took place in Brazil and were attributed to both Brazilian and foreign (Spanish and Chinese) fishing companies, for example (da Silva Ferrette et al., 2019). Mako shark products have also been identified in US law enforcement cases where intentional mislabelling and lack of appropriate permitting and paperwork has occurred (Murdock and Villanueva, 2019).

Due to the inherent nature of the illegal trade in shark products it is difficult to determine the extent of this trade and its pressure on mako shark populations. Nevertheless, it is apparent that some illegal trade does occur, and it is likely that further illegal trade goes undetected.

3.2 What is the severity of fishing pressure on the stock of the species concerned?

Factor	Level of severity of trade pressure	Indicator/metric
a) Fishing mortality (retained catch)	**Low**	
	Medium	
	High	• Caught globally as target and bycatch in coastal and pelagic commercial and artisanal longline, purse seine, and gillnet fisheries • High overlap of fishing vessels with areas frequented by sharks • Generally retained for the high-value meat as well as fins. Only permitted to be retained if landed dead in ICCAT region.
	Unknown	
	Level of confidence Low Medium High	

Reasoning

The meat of the shortfin mako is of high-value and hence it is targeted (Dulvy et al., 2008; French et al., 2015). Despite a lack of population data and uncertainties regarding stock assessments, the species has undergone significant declines in abundance over various parts of its range. The main threat is fishing, vessels overlap substantially with areas of the ocean frequented by sharks (see Queiroz et al.).

High susceptibility to longline gear (IOTC, 2019). A study of Canadian pelagic longliners found that about half died during capture or after discarding (Campana et al. 2016

ICCAT Rec. [17-08][22] aims to reduce shortfin mako fishing mortality but its effectiveness has not been assessed yet. Although there is large uncertainty in the future productivity assumption for this stock, the Stock Synthesis projections show that there is a long lag time between when management measures are implemented and when stock size starts to rebuild. This fact emphasizes the importance of taking immediate action to reduce fishing mortality and rebuild the stock (ICCAT, 2019a).

Factor	Level of severity of trade pressure	Indicator/metric
b) Discard mortality	**Low**	
	Medium	

[22] https://www.iccat.int/Documents/Recs/compendiopdf-e/2017-08-e.pdf

	High	A post-release mortality of 25% (ICCAT, 2019b), 28.4% (Gallagher et al., 2014) and 23-31% (Keller et al., 2020) has been estimated, but larger specimens may have lower post-release mortality rates (ICCAT, 2019a), with similar findings reported also by for longfin mako (Gallagher et al., 2014). Although the use of circle hooks – a supposed mitigation measure - was shown to either decrease or have no effect on at-haulback mortality, their use significantly increased the likelihood of mouth hooking, which is associated with lower rates of post-release mortality (Keller et al., 2020). In the pelagic longline fishery in the Gulf of Gabès, catch rates of shortfin mako increased when circle hooks were used instead of 'J' hooks, calling into question the adoption of the use of circle hooks as a management measure in that specialized fishery (Saidi et al., 2020). In a recreational fishery, post-release survival rate was 90% when caught on rod and reel and subjected to fight times up to 513 minutes and handled for up to 12 minutes (French et al., 2015).
	Unknown	
	Level of confidence Low Medium High	

Reasoning
Survival rate after release is around 70% for longline, less for purse seine and gillnet (ICCAT Recommendation 17-08). About half died during capture or after discarding (Campana et al. 2016). High susceptibility to longline gear (IOTC, 2019). With a size limit and discard mortality of 25%, the weight of dead discards was equal to or greater than the weight of the retained catch. A live release policy that caused retention of only 36% of all sharks with a discard mortality of 25% also caused a large volume of dead discards (ICCAT, 2019b).

c) Size/age/ sex selectivity	**Low**	
	Medium	
	High	Juveniles appear to dominate the catch
	Unknown	
	Level of confidence Low Medium High	

Reasoning
Juveniles appear to dominate the catch: 58% caught off California coast by longline were aged 0–2, sex ratio 1:1, and here there is interannual and spatial variability in catch per unit effort (CPUE) that is poorly understood (Runcie et al., 2016); Almost all makos (90-99%) caught by pelagic longliners in the S-W Indian Ocean 2005-2010 were immature (Groeneveld et al., 2014). Most sharks (shortfin mako and blue shark) caught by Spanish and Portuguese longline vessels in the north-eastern Atlantic in 2012 and 2013 were juveniles (Biton-Porsmoguer et al., 2018). Between 2009 and 2020, the shortfin mako catch was dominated by juveniles in the Japanese offshore shallow-set longline fishery targeting swordfish and blue shark (Semba, 2021). The mean fork length of 850 specimens caught in the US tuna- and swordfish-directed pelagic longline fishery in the western Atlantic Ocean and Gulf of Mexico from 1995 to 2012 fisheries was 137.57 cm (Gallagher et al., 2014), indicating a catch dominated by sharks yet to reach sexual maturity. Similarly, the size composition of shortfin mako shark caught by the Taiwanese tuna longline fishery in the North Pacific Ocean implied that the catches comprised mostly immature fish, and the high proportion of immature sharks may have serious impact on the sustainability of the fishery (Liu et al., 2021). The shortfin mako shark exhibits sexual segregation, as well as segregation between juveniles and

other stages (Tsai et al., 2014). Juvenile survival rather than fecundity is a crucial factor contributing to population growth rate, especially in longer-lived sharks (Bonanomi et al., 2017). Larger sharks have a higher mercury concentration, and so are less desirable to fisheries (Biton-Porsmoguer et al., 2018).

d) Magnitude of illegal, unreported and unregulated (IUU) fishing	**Low**	
	Medium	
	High	
	Unknown	IUU of sharks occurs globally and is supplied from global sources, it is considered common, although to what extent is unquantifiable.
	Level of confidence Low Medium High	

Reasoning IUU threatens the sustainability of legal trade, however quantitative data at the source of resource extraction are sparse (Clarke et al., 2006). IUU occurs globally and major centres, e.g., in Asia, are supplied from global sources (Jabado et al., 2015; Sebastian et al., 2008). Shortfin mako accounted for 2.77% of fins sampled in Hong Kong markets in 2014-2015 (Fields et al., 2018). Globally, sharks, including shortfin mako, are identified in illegal trade (e.g., Giovos et al., 2020; da Silva Ferrette et al., 2019; Barreto et al., 2017; Asis et al., 2016). Most of this fishing and trade – which outpaces the productivity of these slow-growing species – is poorly monitored and largely unregulated (Camhi et al., 2007).

4. Existing management measures

Existing management measures	**Is the measure generic or species-specific?**	**Description/comments/source of information**
Regional/International		
The Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention)	Species-specific *(Isurus oxyrinchus)*	Annex II: Endangered or threatened species; Parties shall ensure the maximum possible protection and recovery of, while prohibiting the damage to and destruction of, these species
CITES	Species-specific (*Isurus oxyrinchus* and *Isurus paucus)*	Appendix II: International trade in specimens of Appendix-II species may be authorized by the granting of an export permit or re-export certificate. Permits or certificates should only be granted if the relevant authorities are satisfied that certain conditions are met, above all that trade will not be detrimental to the survival of the species in the wild.
EU Scientific Review Group	*Isurus oxyrinchus*	Negative opinion formed for the North Atlantic stock (as defined by ICCAT). Negative opinions formed for Panama and Senegal[23].
CMS	Species-specific (*Isurus oxyrinchus* and *Isurus paucus)*	Appendix II: The Convention encourages the Range States to species listed on Appendix II to conclude global or regional Agreements for the conservation and management of individual species or groups of related species.

[23] https://speciesplus.net/species#/taxon_concepts/98243/legal. Most recently accessed: 30/03/2022

		Sharks MoU Annex 1: Signatories should endeavour to achieve and maintain a favourable conservation status for these species based on the best available scientific information and taking into account their socio-economic value.
CCBST	Generic	CCSBT encourages both Members and Cooperating Non-Members to comply with a variety of binding and non-binding measures to protect species ecologically related to Southern bluefin tuna, including sharks.
GFCM	Species-specific *(Isurus oxyrinchus)*	Rec. GFCM/36/2012/3: shark species listed under Annex II of the Barcelona Convention cannot be retained on board, trans-shipped, landed, transferred, stored, sold, or displayed or offered for sale and must be released unharmed and alive to the extent possible.
FAO	Generic	IPOA Sharks: International Plan of Action for Conservation and Management of Sharks based on which states should adopt and implement a national plan of action for conservation and management of shark stocks (NPO Sharks) if their vessels conduct directed fisheries for sharks or if their vessels regularly catch sharks in non-directed fisheries
IATTC	Generic	Inter-American Tropical Tuna Commission (non-binding management measures) Res. C-16-01: Amendment of resolution C-15-03 on the collection and analysis of data on fish-aggregating devices Res. C-16-04: Amendment to resolution C-05-03 on the conservation of sharks caught in association with fisheries in the eastern Pacific Ocean
ICCAT	Generic	International Commission for the Conservation of Atlantic Tunas Res. 95-02: Cooperation with FAO to study status of stocks & shark by-catches Res. 03-10: Resolution by ICCAT on the sharks fishery Rec. 04-10: Recommendation by ICCAT concerning the conservation of sharks caught in association with fisheries managed by ICCAT Rec. 07-06: Supplemental recommendation by ICCAT concerning sharks Rec. 11-10: Recommendation by ICCAT on information collection and harmonization of data on bycatch and discards in ICCAT fisheries Rec. 13-10: Recommendation on Biological Sampling of Prohibited Sharks Species by Scientific Observers
ICCAT	Species-specific (*Isurus oxyrinchus*)	Rec. 10-06: Recommendation by ICCAT on Atlantic Shortfin mako sharks caught in association with ICCAT fisheries Rec. 14-06: Recommendation by ICCAT on Shortfin mako caught in association with ICCAT fisheries Rec. 17-08: Recommendation by ICCAT on the conservation of North Atlantic stock Shortfin mako caught in association with ICCAT fisheries
IOTC	Generic	Indian Ocean Tuna Commission Res. 13/06: On a scientific and management framework on the conservation of shark species caught in association with IOTC managed fisheries Res. 15/09: On a fish aggregating devices (FADs) working group Res.17/05: On the conservation of sharks caught in association with fisheries managed by IOTC Res. 17/07: On the prohibition to use large-scale driftnets in the IOTC Area Res 17/08: Procedures on a FADs Management Plan including limitation on number of FADs, more detailed specifications of catch reporting

		from FAD sets, & development of improved designs to reduce incidence of entanglement of non-target species
OLDEPESCA	Generic	Latin American Organization for Fisheries Development (non-binding recommendations)
OSPAR	Generic	Protecting and conserving the North-East Atlantic and its resources. The North-East Atlantic Environment Strategy (NEAES) 2030: objectives aim to address the triple challenge of climate change, biodiversity loss and pollution.
The United Nations Convention on the Law of the Sea (UNCLOS)	Species-specific (*Isurus oxyrinchus* and *Isurus paucus)*	Annex I: States whose nationals fish in the region for the highly migratory species listed in Annex I shall cooperate directly or through appropriate international organizations to ensure the conservation and optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone.
WCPFC	Generic	CMM 2008-04: Conservation and management measures to prohibit the use of large sale driftnets on the high seas in the Convention Area CMM 2009-02: Conservation and management measures on the application of high seas FAD closure and catch retention CMM 2010-07: Conservation and management measures for sharks CMM 2014-05: Conservation and management measures for sharks
SPRFMO	Generic	CMM 05-2021: Conservation and Management Measure for the Establishment of the Commission Record of Vessels Authorised to Fish in the Convention Area

5. NON-DETRIMENT FINDING AND RELATED ADVICE

Isurus oxyrinchus (shortfin mako) is the second-most common oceanic shark caught by high-seas longline and net fisheries after the blue shark (*Prionace glauca*). It is caught globally, targeted and as bycatch, in coastal and pelagic commercial and small-scale longline, purse seine, and gillnet fisheries. The species has low productivity and life history traits that make it intrinsically vulnerable to over-exploitation. The prevalence and price of mako shark meat and fins in both international and domestic trade indicate a high level of legal trade pressure, especially when taking into consideration the biological and life history traits of this species, making it particularly susceptible to overfishing[24]. A considerable proportion of catches have been recorded as immature shortfin mako. Furthermore, there is a likelihood that fishing-induced mortality not accounted for by landed catch is likely to be considerably higher than estimates. The shortfin mako is estimated to be declining in all oceans, other than the South Pacific where it may be increasing. Steep population declines have occurred in the North and South Atlantic, with declines also evident, though not as steep, in the north Pacific and Indian Oceans.

In the Indian Ocean, shortfin mako is considered subject to overfishing but not overfished[25], however with trajectories showing consistent trends towards being overfished. In the North Atlantic ICCAT scientists (2019) recognised that to accelerate the rate of stock recovery and to increase the probability of success, ICCAT should adopt a non-retention policy as has already been done for other shark species. There is a significant risk that South Atlantic stocks will follow a similar path if fishing effort is also not reduced. There

[24] Overfishing refers to **fishing mortality (F)**, or the rate of fish killed by catching them (i.e., the proportion of fish caught). There is an ideal proportion of fish to catch that will produce MSY—this is called **F_{MSY}**. If the proportion of fish caught (F) is greater than F_{MSY}, overfishing is happening. If F is less than F_{MSY}, underfishing is happening. Fishing mortality is usually given as a ratio of **F/F_{MSY}**; a ratio over 1 means overfishing.

[25] Overfished refers to the **biomass (B)** of a population, or stock, of fish. This is the amount of fish in the water. There is some amount of biomass, B, that will produce MSY—this is **B_{MSY}**. If the biomass of fish in the water is well below B_{MSY}, the stock is overfished, or depleted. If the amount of fish in the water is more than would produce MSY it is underfished.

is little or no management in areas associated with the largest declines, and where there are management measures, these appear to have had little influence on landing trajectories.

Accordingly, *Isurus oxyrinchus*was assessed for the IUCN Red List in 2018 as Endangered globally. The UK has determined the species to be of *significant conservation concern requiring a high degree of precaution in making an NDF*. Taking into consideration it's conservation status, estimated levels of offtake and projected declines, and in accordance with the precautionary principle, **the UK CITES Scientific Authority is unable to make a non-detriment finding for offtake of shortfin mako (*Isurus oxyrinchus*) sharks from all regions of the Atlantic and Indian oceans. Furthermore, we recommend not accepting catch from either stock until the associated declines and trajectories are reversed and demonstrate stock recovery. However, in principle, the UK may be able to accept catch from the Pacific stock at current rates of offtake (i.e., not exceeding average of estimated total annual catch levels from previous 5 years) given the North Pacific stock is unlikely to be in an overfished condition and the South Pacific stock is reportedly increasing.**

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Annex A

Observed (black or empty points and stars indicate different time-series) and modelled (black line) abundance indices for shortfin mako (*I. oxyrinchus*). The thick black line denotes the mean of the estimated abundance index and the shaded regions denote 95% credible intervals (adapted from Pacoureau et al., 2021).