Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



# STATUS OF SHARKS IN THE INDIAN OCEAN

**PREPARED BY: IOTC SECRETARIAT, 4 OCTOBER 2011**

## PURPOSE

To encourage the Working Party on Ecosystems and Bycatch (WPEB) to develop clear and concise draft Executive Summaries for shark species in the Indian Ocean, for the consideration of the Scientific Committee.

## BACKGROUND

Each year the IOTC Scientific Committee (SC) provides status advice and recommendations on sharks to the Commission in two main formats based on assessments or other stock status indicators determined by the Working Party on Ecosystems and Bycatch. Firstly, advice is tabulated at the front of the SC report and includes recent annual catches, maximum sustainable yield estimates (not known for any shark species), in conjunction with stock status advice to the Commission. Secondly, a more detailed stock status description is provided in the report text outlining the current stock status, recommendations to the Commission and in some cases an outlook section. These two forms of advice are generally combined into an Executive Summary for each shark stock during the SC meeting however, due to time limitations the SC places little emphasis on how the information is presented in the Executive Summaries

In 2009, the IOTC performance review panel published a report outlining 75 recommendations to improve the functioning of the IOTC (Anon 2009[1]). Recommendation 30 from the review states: "New guidelines for the presentation of more user friendly scientific reports in terms of stock assessments should be developed. …".

The advice provided by the working parties and the SC has at times been unclear. As such, there is a clear need for the WPEB to provide the SC with a clear set of recommendations and advice concerning the status of sharks in the IOTC area of competence.

## DISCUSSION

The advice and recommendations provided to the Commission varies greatly among the reports of the various Working Parties, including the Executive Summaries, depending on the indicators used to determine stock status and the level of information available to the Working Parties and SC. Where possible, indicators should be standardised and a minimum level of information be contained in the Executive Summaries. To this aim, a small group of experts on sharks, under the guidance of the Secretariat, have developed a revised draft set of Executive Summaries for five shark species and one family group (Attachment A) so that the WPEB may more readily communicate its opinion on the status of the shark resources in the Indian Ocean to the Scientific Committee (note that text in red or highlighted in yellow remain to be updated). The text contained in the 'Status', 'Outlook' and 'Recommendation' sections are illustrative only, and will be updated at the WPEB07 meeting. A resource stock status summary for thresher sharks (family Alopiidae) will need to be developed during the WPEB07 by participants.

## RECOMMENDATION

That the Working Party on Ecosystems and Bycatch:

1) **RECOMMEND** that the IOTC Secretariat update the draft 'Resource stock status summaries' for sharks in the Indian Ocean with the latest 2010 catch data, and for these to be provided to the Scientific Committee for its consideration.
2) **RECOMMEND** that the Scientific Committee note and revise as necessary, the six draft "Status of Indian Ocean shark resources".

[1] Anon. 2009, Report of the IOTC Performance Review Panel, January 2009, Indian Ocean Tuna Commission.

**ATTACHMENTS**

**Attachment A:** Draft: Status of the Indian Ocean blue shark (*Prionace glauca*) resource.

**Attachment B:** Draft: Status of the Indian Ocean oceanic whitetip shark (*Carcharhinus longimanus*) resource.

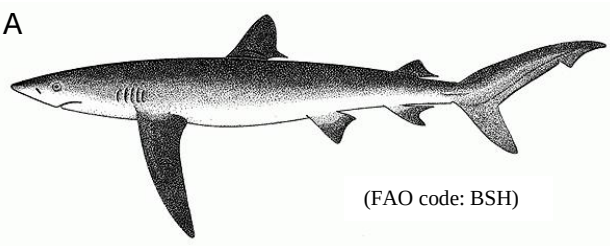
**Attachment C:** Draft: Status of the Indian Ocean scalloped hammerhead shark (*Sphyrna lewini*) resource.

**Attachment D:** Draft: Status of the Indian Ocean shortfin mako shark (*Isurus oxyrinchus*) resource.

**Attachment E:** Draft: Status of the Indian Ocean silky shark (*Carcharhinus falciformis*) resource.

ATTACHMENT A

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



(FAO code: BSH)

***DRAFT: DEVELOPED FOR THE CONSIDERATION OF THE SCIENTIFIC COMMITTEE***

# DRAFT: STATUS OF THE INDIAN OCEAN BLUE SHARK (*PRIONACE GLAUCA*) RESOURCE

**TABLE 1.** Status of blue shark (*Prionace glauca*) in the Indian Ocean – IUCN threat status

| Common name | Scientific name | IUCN threat status | | |
|---|---|---|---|---|
| | | Global status | WIO | EIO |
| Blue shark | *Prionace glauca* | Near Threatened | – | – |

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
SOURCES: IUCN (2007, 2011)

The WPEB **RECOMMENDED** the following management advice for blue sharks in the Indian Ocean, for the consideration of the Scientific Committee:

## INDIAN OCEAN STOCK – MANAGEMENT ADVICE

The WPEB **RECOMMENDED** the following management advice for blue shark in the Indian Ocean, for the consideration of the Scientific Committee, noting that there remains considerable uncertainty about the relationship between abundance and the standardized CPUE series from the Japanese longline fleet, and about the total catches over the past decade.

***Stock status.*** The current IUCN threat status of 'Near Threatened' applies to blue sharks globally (Table 1). Trends in the Japanese CPUE series suggest that the longline vulnerable biomass has declined/increased to about XX% of the level observed in YYYY. There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for blue shark in the Indian Ocean therefore the stock status is highly uncertain. Blue sharks are commonly taken by a range of fisheries in the Indian Ocean and in some areas they are fished in their nursery grounds. Because of their life history characteristics – they are relatively long lived (16–20 years), mature at 4–6 years, and have relativity few offspring (25–50 pups every year), the blue shark is vulnerable to overfishing. Blue shark assessments in the Atlantic and Pacific oceans seem to indicate that blue shark stocks can sustain relatively high fishing pressure.

***Outlook.*** Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on blue shark will decline in these areas in the near future, and may result in localised depletion.

The WPEB **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Noting that current catches are estimated at an average ~xx,xxx t over the last five years, ~xx,xxx t in 2010, maintaining or increasing effort will probably result in further increases/declines in biomass, productivity and CPUE.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

**SUPPORTING INFORMATION**

*(Information collated from reports of the Working Party on Ecosystems and Bycatch and other sources as cited)*

## CONSERVATION AND MANAGEMENT MEASURES

Blue shark in the Indian Ocean are currently subject to a number of conservation and management measures adopted by the Commission:

- Resolution 05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC* includes minimum reporting requirements for sharks, calls for full utilisation of sharks and includes a ratio of fin-to-body weight for shark fins retained onboard a vessel.
- Resolution 08/04 *Concerning the recording of catch by longline fishing vessels in the IOTC area* sets out the minimum logbook requirements for longline fishing vessels over 24 metres length and under 24 metres if they fish outside the EEZ of their flag State. As per this resolution, catch of all sharks must be recorded.
- Resolution 10/03 *Concerning the recording of catch by fishing vessels in the IOTC area* sets out minimum logbook requirements for all purse-seine vessels 24 metres length overall or greater and those under 24 metres if they fish outside the EEZs of their flag States. As per this resolution, catch and discard of all shark species should be recorded.
- Resolution 11/04 *on a Regional Observer Scheme* requires data on blue 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.

*Extracts from Resolutions 09/06 and 11/04*

**RESOLUTION 05/05 CONCERNING THE CONSERVATION OF SHARKS CAUGHT IN ASSOCIATION WITH FISHERIES MANAGED BY IOTC**

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 08/04 CONCERNING THE RECORDING OF CATCH BY LONGLINE FISHING VESSELS IN THE IOTC AREA**

1. Each flag CPC shall ensure that all long line fishing vessels flying its flag and authorized to fish species managed by IOTC be subject to a data recording system. ….

**RESOLUTION 11/04 ON A REGIONAL OBSERVER SCHEME**

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

## FISHERIES INDICATORS

### *General*

Blue shark (*Prionace glauca*) is the most common shark in pelagic oceanic waters throughout the tropical and temperate oceans worldwide (Fig. 1). It has one of the widest ranges of all the shark species and may also be found close inshore. Adult blue sharks have no known predators; however, subadults and juveniles may be preyed upon by shortfin makos, white sharks, and adult blue sharks. Fishing is a major contributor to adult mortality. Table 2 outlines some of the key life history traits of blue shark in the Indian Ocean.

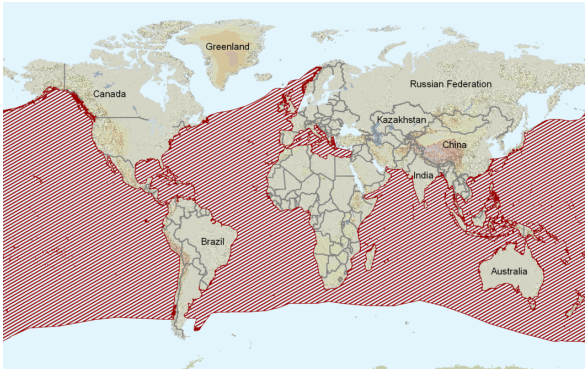



**Fig. 1.** The worldwide distribution of the blue shark (source: www.iucnredlist.org)

**TABLE 2.** Biology of Indian Ocean blue shark (*Prionace glauca*)

| Parameter | Description |
|---|---|
| Range and stock structure | In the tropical Indian Ocean, the greatest abundance of blue sharks occurs at depths of 80 to 220 m, in temperatures ranging from 12 to 25°C. The distribution and movements of blue shark are strongly influenced by seasonal variations in water temperature, reproductive condition, and availability of prey. Long-distance movement have been observed for blue sharks, including transoceanic route from Australia to South Africa. The blue shark is often found in large single sex schools containing individuals of similar size. Subtropical and temperate waters appears to be nursery grounds south of 20°S, where small blue sharks dominate, but where all range of sizes from 55 to 311 cm FL are recorded. In contrast mature fish dominate in the equatorial waters (FL > 185 cm). Area of overlap with IOTC management area = high.<br>No information is available on stock structure. |
| Longevity | Bomb radiocarbon dating of Indian Ocean blue sharks showed that males of 270 cm FL may attain 23 years of age. Preliminary data for Indian Ocean shows that male may reach 25 and females 21 years old. In the Atlantic Ocean, the oldest blue sharks reported were a 16 year old male and a 15 year old female. Longevity is estimated to be around 20 years of age in the Atlantic. |
| Maturity (50%) | Age: Sexual maturity is attained at about 5 years of age in both sexes.<br>Size: not available. |
| Reproduction | Blue shark is a viviparous species, with a yolk-sac placenta. Once the eggs have been fertilised there is a gestation period of between 9 and 12 months. Litter size is quite variable, ranging from four to 135 pups and may be dependent on the size of the female. The average litter size observed from the Indian Ocean is 38, very similar to the one reported in the Atlantic Ocean, 37. Generation time is about 8-10 years. In Indian Ocean, between latitude 2 ºN and 6 ºS, pregnant females are present for most of the year.<br>• Fecundity: relatively high (25-50)<br>• Generation time: 8-10 years<br>• Gestation Period: 9-12 months<br>• Annual reproductive cycle |
| Size (length and weight) | Maximum size is around 380 cm FL.<br>New-born pups are around 40 to 51 cm TL.<br>Length–weight relationship for both sexes combined in the Indian Ocean is TW=0.159*10-4 * FL2.84554. |

SOURCES: Gubanov & Gigor'yev (1975); Anderson & Ahmed (1993); ICES (1997); Scomal & Natansen (2003); Mejuto et al (2005); Mejuto & Garcia-Cortes (2006); IOTC 2007; Matsunaga (2007); Rabehagosoa et al. (2009); Romanov & Romanova (2009); (Anon (2010)

### *Fisheries*

Blue sharks are often targeted by some semi-industrial and artisanal fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and anecdotally in the purse seine fishery). However, in recent years longliners are occasionally targeting this species, due to an increase in its commercial value worldwide. The blue shark appears to have a similar distribution to swordfish. Typically, the fisheries take blue sharks between 180–240 cm FL or 30 to 52 kg. Males are slightly smaller than the females. In other Oceans, angling clubs are known to organise shark fishing competitions where blue sharks and mako sharks are targeted. Sport fisheries for oceanic sharks are apparently not so common in the Indian Ocean.

There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights. FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

The practice of shark finning is considered to be regularly occurring and on the increase for this species (Clarke 2008; Clarke et al. 2006) and the bycatch/release injury rate is unknown but probably high.

**TABLE 3.** Estimated frequency of occurrence and bycatch mortality in the Indian Ocean pelagic fisheries.

| Gears | PS | LL | | BB/TROL/HAND | GILL | UNCL |
|---|---|---|---|---|---|---|
| | | SWO | TUNA | | | |
| Frequency | rare | abundant | | rare | unknown | unknown |
| Fishing Mortality | unknown | 13 to 51 % | 0 to 31% | unknown | unknown | unknown |
| Post release mortality | unknown | 19% | | unknown | unknown | unknown |

SOURCES: Boggs (1992); Romanov (2002, 2008); Diaz & Serafy (2005); Ariz et al. (2006); Peterson et al. (2008); Romanov et al. (2008); Campana et al. (2009); Poisson et al. (2010)

### *Catch trends*

The catch estimates for blue shark are highly uncertain as is their utility in terms of minimum catch estimates. Four CPCs have reported detailed data on sharks (i.e. Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka) while nine CPCs have reported partial data or data aggregated for all species (i.e. Belize, China,

Japan, Korea, Malaysia, Oman, Seychelles, Mauritius, UK-territories). For CPCs reporting longline data by species (i.e. Australia, Spain, Portugal, United Kingdom and South Africa), 74% of the catch of sharks by longliners, all targeting swordfish, were blue sharks.

**TABLE 4.** Catch estimates for blue shark in the Indian Ocean for 2009 and 2010.

| **Catch** | | **2009** | **2010** |
|---|---|---|---|
| Most recent catch | Blue shark | 9,941 | 9,416 t |
| | nei-sharks | 62,229 t | 61,966 |
| Mean catch over the last 5 years (2006–2010) | Blue shark | | 8,924 t |
| | nei-sharks | | 64,838 t |

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights. In 2010, seven countries reported catches of blue sharks in the IOTC region.

***Nominal and standardised CPUE Trends***

Data not available at the IOTC Secretariat. There are no surveys specifically designed to assess shark catch rates in the Indian Ocean. Trends in localised areas might be possible in the future (for example, from the Kenyan recreational fishery). Historical research data shows overall decline in CPUE while mean weight of blue shark in this time series are relatively stable (Romanov et al. 2008) and standardized CPUE for Japanese fisheries between 1971–2005 was showing stable trends (Matsunaga 2007).

***Average weight in the catch by fisheries***

Data not available.

***Number of squares fished***

Catch and effort data not available.

## STOCK ASSESSMENT

No quantitative stock assessment for blue shark has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

## LITERATURE CITED

Anderson RC and Ahmed H, 1993. The shark fisheries in the Maldives. FAO, Rome, and Ministry of Fisheries, Male, Maldives.

Anonymous, 2010. Blue Shark Record. 'Tag Times News' No 5 December 2010.

Ariz J, Delgado de Molina A, Ramos ML, and Santana JC, 2006. Check list and catch rate data by hook type and bait for bycatch species caught by Spanish experimental longline cruises in the south-western Indian Ocean during 2005. IOTC-2006-WPBy-04 2006.

Boggs CH, 1992. Depth, capture time and hooked longevity of longline-caught pelagic fish: timing bites of fish with chips. Fishery Bulletin 90:642-658.

Campana SE, Joyce W and Manning MJ, 2009. Bycatch and discard mortality in commercially caught blue sharks *Prionace glauca* assessed using archival satellite pop-up tags. Marine Ecology Progress Series 387:241-253.

Clarke S, 2008. Use of shark fin trade data to estimate historic total shark removals in the Atlantic Ocean. Aquat. Living Res. 21:373-381.

Clarke SC, McAllister MK, Milner-Gulland EJ, Kirkwood GP, Michielsens CGJ, Agnew DJ, Pikitch EK, Nakano H, and Shivji MS, 2006. Global estimates of shark catches using trade records from commercial markets. Ecology Letters 9:1115-1126.

Diaz GA and Serafy JE, 2005. Longline-caught blue shark (*Prionace glauca*): factors affecting the numbers available for live release. Fish. Bull. 103:720-724.

Gubanov EP and Gigor'yev VN, 1975. Observations on the Distribution and Biology of the Blue Shark *Prionace glauca* (Carcharhinidae) of the Indian Ocean // Raspredelenie i nekotorye cherty biologii goluboj akuly *Prionace glauca* L. (Carcharhinidae) Indijskogo okeana. Voprosy Ikhtiologii 15:43-50.

IOTC, 2007. Compilation of information on blue shark (*Prionace glauca*), silky shark (*Carcharhinus falciformis*), oceanic whitetip shark (*Carcharhinus longimanus*), scalloped hammerhead (*Sphyrna lewini*) and shortfin mako (*Isurus oxyrinchus*) in the Indian Ocean. IOTC-2007-WPEB-INF01. 18 p.

ICES, 1997. ICES Demersal Fish Committee 1997 Report of the Study Group on Elasmobranchs. ICES CM /G:2, 123p.

IUCN, 2007. IUCN Species Survival Commission's Shark Specialist Group. Review of Chondrichthyan Fishes.

IUCN, 2011. IUCN Red List of Threatened Species. Version 2011.1. www.iucnredlist.org

Matsunaga H, 2007. Standardized CPUE for blue sharks caught by the Japanese tuna longline fishery in the Indian Ocean, 1971-2005. IOTC-2007-WPEB-17.

Mejuto J and Garcia-Cortes B, 2006. Reproductive and distribution parameters of the blue shark *Prionace glauca*, on the basis of on-board observations at sea in the Atlantic, Indian and Pacific Oceans. ICCAT Col. Vol. Sci. Pap. Vol. 58(3):951-973.

Mejuto J, Garcia-Cortes B and Ramos-Cartelle A, 2005. Tagging-recapture activities of large pelagic sharks carried out by Spain in collaboration with the tagging programs of other countries. SCRS/2004/104 Col. Vol. Sci. Pap. ICCAT, 58(3): 974-1000.

Petersen S, Nel D, Ryan P and Underhill L, 2008. Understanding and mitigating vulnerable bycatch in southern African trawl and longline fisheries. 225 p. WWF South Africa Report Series.

Poisson F, Gaertner JC, Taquet M, Durbec JP and Bigelow K, 2010. Effects of the lunar cycle and operational factors on the catches of pelagic longlines in the Reunion Island swordfish fishery. Fish. Bull. 108:268–281.

Rabehagasoa N, Bach P, Campana S, Lorrain A, Morize E, Romanov EV and Bruggemann H, 2009. Individual age and growth of the blue shark (*Prionace glauca*) in the South West Indian Ocean: Preliminary results. IOTC-2009-11. 16 p.

Romanov EV, 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin 100:90-105.

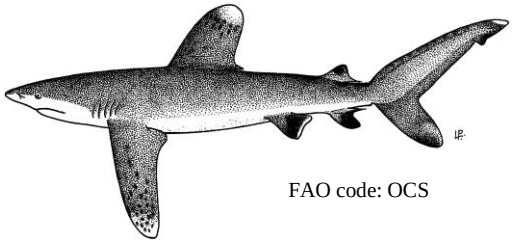
Romanov EV, 2008. Bycatch and discards in the Soviet purse seine tuna fisheries on FAD-associated schools in the north equatorial area of the Western Indian Ocean. Western Indian Ocean Journal of Marine Science 7:163-174.

Romanov E, Bach P, Romanova N, 2008. Preliminary estimates of bycatches in the western equatorial Indian Ocean in the traditional multifilament longline gears (1961-1989) IOTC Working Party on Ecosystems and Bycatch (WPEB) Bangkok, Thailand. 20-22 October, 2008. 18 p.

Romanov E and Romanova N, 2009. Size distribution and length-weight relationships for some large pelagic sharks in the Indian Ocean. IOTC-2009-WPEB-06. 12 p.

Scomal GB and Natanson LJ, 2003. Age and growth of the blue shark (*Prionace glauca*) in the North Atlantic Ocean. Fishery Bulletin 101:627-639.

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



FAO code: OCS

***DRAFT: DEVELOPED FOR THE CONSIDERATION OF THE SCIENTIFIC COMMITTEE***

# DRAFT: STATUS OF THE INDIAN OCEAN OCEANIC WHITETIP SHARK (*CARCHARHINUS LONGIMANUS*) RESOURCE

**TABLE 1.** Status of oceanic whitetip shark (*Carcharhinus longimanus*) in the Indian Ocean – IUCN threat status

| Common name | Scientific name | IUCN threat status | | |
|---|---|---|---|---|
| | | Global status | WIO | EIO |
| Oceanic whitetip shark | *Carcharhinus longimanus* | Vulnerable | – | – |

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
SOURCES: IUCN (2007, 2011)

The WPEB **RECOMMENDED** the following management advice for oceanic whitetip sharks in the Indian Ocean, for the consideration of the Scientific Committee:

## INDIAN OCEAN STOCK – MANAGEMENT ADVICE

The WPEB **RECOMMENDED** the following management advice for oceanic whitetip sharks in the Indian Ocean, for the consideration of the Scientific Committee, noting that there remains considerable uncertainty about the relationship between abundance and the standardized CPUE series from the Japanese longline fleet, and about the total catches over the past decade.

***Stock status.*** The current IUCN threat status of 'Vulnerable' applies to oceanic whitetip sharks globally (Table 1). Trends in the Japanese CPUE series suggest that the longline vulnerable biomass has declined/increased to about XX% of the level observed in YYYY. There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for oceanic whitetip sharks in the Indian Ocean therefore the stock status is highly uncertain. Oceanic whitetip sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived, mature at 4–5 years, and have relativity few offspring (<20 pups every two years), the oceanic whitetip shark is vulnerable to overfishing. Despite the lack of data, it is apparent from the information that is available that oceanic whitetip shark abundance has declined significantly over recent decades.

***Outlook.*** Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on oceanic whitetip sharks will decline in these areas in the near future, and may result in localised depletion.

The WPEB **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Noting that current catches are estimated at an average ~xx,xxx t over the last five years, ~xx,xxx t in 2010, maintaining or increasing effort will probably result in further increases/declines in biomass, productivity and CPUE.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

**SUPPORTING INFORMATION**

*(Information collated from reports of the Working Party on Ecosystems and Bycatch and other sources as cited)*

## CONSERVATION AND MANAGEMENT MEASURES

Oceanic whitetip sharks in the Indian Ocean are currently subject to a number of conservation and management measures adopted by the Commission:

- Resolution 05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC* includes minimum reporting requirements for sharks, calls for full utilisation of sharks and includes a ratio of fin-to-body weight for shark fins retained onboard a vessel.
- Resolution 08/04 *Concerning the recording of catch by longline fishing vessels in the IOTC area* sets out the minimum logbook requirements for longline fishing vessels over 24 metres length and under 24 metres if they fish outside the EEZ of their flag State. As per this resolution, catch of all sharks must be recorded.
- Resolution 10/03 *Concerning the recording of catch by fishing vessels in the IOTC area* sets out minimum logbook requirements for all purse-seine vessels 24 metres length overall or greater and those under 24 metres if they fish outside the EEZs of their flag States. As per this resolution, catch and discard of all shark species should be recorded.
- Resolution 11/04 *on a Regional Observer Scheme* requires data on blue 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.

*Extracts from Resolutions 09/06 and 11/04*

**RESOLUTION 05/05 CONCERNING THE CONSERVATION OF SHARKS CAUGHT IN ASSOCIATION WITH FISHERIES MANAGED BY IOTC**

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 08/04 CONCERNING THE RECORDING OF CATCH BY LONGLINE FISHING VESSELS IN THE IOTC AREA**

1. Each flag CPC shall ensure that all long line fishing vessels flying its flag and authorized to fish species managed by IOTC be subject to a data recording system. ….

**RESOLUTION 11/04 ON A REGIONAL OBSERVER SCHEME**

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

## FISHERIES INDICATORS

### *General*

Oceanic whitetip shark (*Carcharhinus longimanus*) is one of the most common large sharks in warm oceanic waters. It is typically found in the open ocean but also close to reefs and near oceanic islands (Fig. 1). Table 2 outlines some of the key life history traits of oceanic whitetip shark in the Indian Ocean.

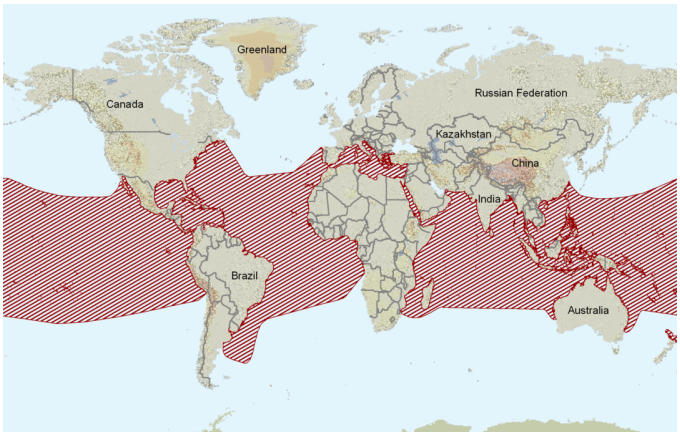



**Fig. 1.** The worldwide distribution of the oceanic whitetip shark (source: www.iucnredlist.org)

**TABLE 2.** Biology of Indian Ocean oceanic whitetip shark (*Carcharhinus longimanus*)

| Parameter | Description |
|---|---|
| Range and stock structure | The population dynamics and stock structure of the oceanic whitetip shark in the Indian Ocean are not known.<br>Area of overlap with IOTC management area = high. |
| Longevity | Maximum age observed was 11 years for the Central and Western Pacific and, 14 years for males and 17 years for females years for the South-Western Atlantic Ocean. |
| Maturity (50%) | Both males and females mature at around 6 to 7 years old or about 180–109 cm TL in the western South Atlantic Ocean and 4--5 years or 170–190 cm TL in the Central and western Pacific Ocean. |
| Reproduction | Oceanic whitetip sharks are viviparous. Litter sizes range from 1-15 pups (mean=6.2) in the Pacific Ocean, with larger sharks producing more offspring. Each pup is approximately 60-65 cm at birth. In the south western Indian Ocean, oceanic whitetip sharks appear to mate and give birth in the early summer, with a gestation period which lasts about one year. The reproductive cycle is believed to be biennial. The locations of the nursery grounds are not well known but they are thought to be in oceanic areas.<br>• Fecundity: medium (<20 pups)<br>• Gestation Period: 12 months<br>• Generation time: 11 years<br>• Reproductive cycle is biennial |
| Size (length and weight) | Oceanic whitetip sharks are relatively large sharks and grow to up to 350 cm FL. Females grow larger than males. The maximum weight reported for this species is 167.4 kg. Length–weight relationship for both sexes combined in the Indian Ocean is TW=0.386*10-4 * FL2.75586 |

SOURCES: Mejuto et al (2005); Romanov & Romanova (2009)

### *Fisheries*

Oceanic whitetip sharks are targeted by some semi-industrial and artisanal fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and purse seine fishery).

There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (*i.e.* do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights. FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

The practice of shark finning is considered to be regularly occurring for this species (Clarke 2008; Clarke et al. 2006) and the bycatch/release injury rate is unknown but probably high.

**TABLE 3.** Estimated frequency of occurrence and bycatch mortality in the Indian Ocean pelagic fisheries.

| **Gears** | **PS** | **LL** | | **BB/TROL/HAND** | **GILL** | **UNCL** |
|---|---|---|---|---|---|---|
| | | **SWO** | **TUNA** | | | |
| Frequency | common | common | | common | common | unknown |
| Fishing Mortality | Study in progress | 58% | | unknown | unknown | unknown |
| Post release mortality | Study in progress | | | unknown | unknown | unknown |

SOURCES: Romanov (2002, 2008); Ariz et al. (2006); Peterson et al. (2008); Romanov et al. (2008); Poisson et al. (2010)

### *Catch trends*

The catch estimates for oceanic whitetip shark are highly uncertain as is their utility in terms of minimum catch estimates. Four CPCs have reported detailed data on sharks (i.e. Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka) while nine CPCs have reported partial data or data aggregated for all species (i.e. Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, Mauritius, UK-territories). For CPCs reporting longline data by species (i.e. Australia, Spain, Portugal, United Kingdom and South Africa), 0.6% of the catch of sharks by longliners, all targeting swordfish, were oceanic whitetip sharks, and for CPCs reporting gillnet data by species (i.e. Sri Lanka), 7% of the catches of shark were oceanic whitetip sharks.

**TABLE 4.** Catch estimates for oceanic whitetip shark in the Indian Ocean for 2009 and 2010.

| **Catch** | | **2009** | **2010** |
|---|---|---|---|
| Most recent catch | Oceanic white tip shark | 245 t | 450 t |
| | nei-sharks | 62,229 t | 61,966 t |

| | | |
|---|---|---|
| Mean catch over the last 5 years (2006–2010) | Oceanic white tip shark | 265 t |
| | nei-sharks | 64,838 t |

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights. In 2010, seven countries reported catches of oceanic whitetip sharks in the IOTC region.

***Nominal and standardised CPUE Trends***

Data not available at the IOTC Secretariat. Historical research data shows overall decline in CPUE and mean weight of oceanic whitetip shark (Romanov et al 2008). Anecdotal reports suggest that oceanic white tips have become rare throughout much of the Indian Ocean during the past 20 years. Indian longline research surveys reported zero catches from the Arabia Sea during 2004–09 (John and Varghese 2009).

***Average weight in the catch by fisheries***

Data not available.

***Number of squares fished***

Catch and effort data not available.

## STOCK ASSESSMENT

No quantitative stock assessment for blue shark has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

## LITERATURE CITED

Ariz J, Delgado de Molina A, Ramos ML, and Santana JC, 2006. Check list and catch rate data by hook type and bait for bycatch species caught by Spanish experimental longline cruises in the south-western Indian Ocean during 2005. IOTC-2006-WPBy-04 2006.

Clarke S, 2008. Use of shark fin trade data to estimate historic total shark removals in the Atlantic Ocean. Aquat. Living Res. 21:373-381.

Clarke SC, McAllister MK, Milner-Gulland EJ, Kirkwood GP, Michielsens CGJ, Agnew DJ, Pikitch EK, Nakano H, and Shivji MS, 2006. Global estimates of shark catches using trade records from commercial markets. Ecology Letters 9:1115-1126.

IUCN, 2007. IUCN Species Survival Commission's Shark Specialist Group. Review of Chondrichthyan Fishes.

IUCN, 2011. IUCN Red List of Threatened Species. Version 2011.1. www.iucnredlist.org

John ME and Varghese BC, 2009. Decline in CPUE of oceanic sharks in the Indian EEZ: urgent need for precautionary approach. IOTC-2009-WPEB-17.

Mejuto J, Garcia-Cortes B and Ramos-Cartelle A, 2005. Tagging-recapture activities of large pelagic sharks carried out by Spain in collaboration with the tagging programs of other countries. SCRS/2004/104 Col. Vol. Sci. Pap. ICCAT, 58(3): 974-1000.

Petersen S, Nel D, Ryan P and Underhill L, 2008. Understanding and mitigating vulnerable bycatch in southern African trawl and longline fisheries. 225 p. WWF South Africa Report Series.

Poisson F, Gaertner JC, Taquet M, Durbec JP and Bigelow K, 2010. Effects of the lunar cycle and operational factors on the catches of pelagic longlines in the Reunion Island swordfish fishery. Fish. Bull. 108:268–281.

Romanov EV, 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin 100:90-105.

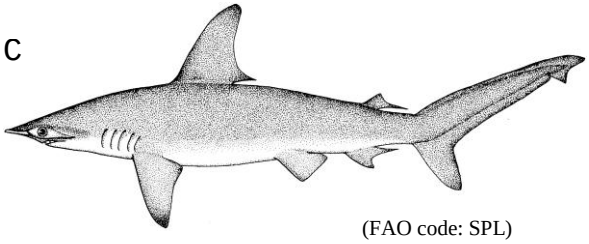
Romanov EV, 2008. Bycatch and discards in the Soviet purse seine tuna fisheries on FAD-associated schools in the north equatorial area of the Western Indian Ocean. Western Indian Ocean Journal of Marine Science 7:163-174.

Romanov E, Bach P, Romanova N, 2008. Preliminary estimates of bycatches in the western equatorial Indian Ocean in the traditional multifilament longline gears (1961-1989) IOTC Working Party on Ecosystems and Bycatch (WPEB) Bangkok, Thailand. 20-22 October, 2008. 18 p.

Romanov E and Romanova N, 2009. Size distribution and length-weight relationships for some large pelagic sharks in the Indian Ocean. IOTC-2009-WPEB-06. 12 p.

ATTACHMENT C

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



(FAO code: SPL)

***DRAFT: DEVELOPED FOR THE CONSIDERATION OF THE SCIENTIFIC COMMITTEE***

# DRAFT: STATUS OF THE INDIAN OCEAN SCALLOPED HAMMERHEAD SHARK (*SPHYRNA LEWINI*) RESOURCE

**TABLE 1.** Status of scalloped hammerhead shark (*Sphyrna lewini*) in the Indian Ocean – IUCN threat status

| Common name | Scientific name | IUCN threat status | | |
|---|---|---|---|---|
| | | Global status | WIO | EIO |
| Scalloped hammerhead shark | *Sphyrna lewini* | Endangered | Endangered | Least concern |

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
SOURCES: IUCN (2007, 2011)

The WPEB **RECOMMENDED** the following management advice for scalloped hammerhead sharks in the Indian Ocean, for the consideration of the Scientific Committee:

## INDIAN OCEAN STOCK – MANAGEMENT ADVICE

The WPEB **RECOMMENDED** the following management advice for scalloped hammerhead shark in the Indian Ocean, for the consideration of the Scientific Committee.

***Stock status.*** The current IUCN threat status of 'Endangered' applies to blue sharks globally and specifically for the western Indian Ocean (Table 1). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for scalloped hammerhead shark in the Indian Ocean therefore the stock status is highly uncertain. Scalloped hammerhead sharks are commonly taken by a range of fisheries in the Indian Ocean. They are extremely vulnerable to gillnet fisheries. Furthermore, pups occupy shallow coastal nursery grounds, often heavily exploited by inshore fisheries. Because of their life history characteristics – they are relatively long lived (over 30 years), and have relativity few offspring (<31 pups each year), the scalloped hammerhead shark is vulnerable to overfishing.

***Outlook.*** Maintaining or increasing effort will probably result in further declines in biomass and productivity. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on scalloped hammerhead shark will decline in these areas in the near future, and may result in localised depletion.

The WPEB **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The primary source of data that drive the assessment (total catches) is highly uncertain and should be investigated further as a priority.
- Noting that current catches are estimated at an average ~xx,xxx t over the last five years, ~xx,xxx t in 2010, maintaining or increasing effort will probably result in further increases/declines in biomass and productivity.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

**SUPPORTING INFORMATION**

*(Information collated from reports of the Working Party on Ecosystems and Bycatch and other sources as cited)*

## CONSERVATION AND MANAGEMENT MEASURES

Scalloped hammerhead shark in the Indian Ocean are currently subject to a number of conservation and management measures adopted by the Commission:

- Resolution 05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC* includes minimum reporting requirements for sharks, calls for full utilisation of sharks and includes a ratio of fin-to-body weight for shark fins retained onboard a vessel.
- Resolution 08/04 *Concerning the recording of catch by longline fishing vessels in the IOTC area* sets out the minimum logbook requirements for longline fishing vessels over 24 metres length and under 24 metres if they fish outside the EEZ of their flag State. As per this resolution, catch of all sharks must be recorded.
- Resolution 10/03 *Concerning the recording of catch by fishing vessels in the IOTC area* sets out minimum logbook requirements for all purse-seine vessels 24 metres length overall or greater and those under 24 metres if they fish outside the EEZs of their flag States. As per this resolution, catch and discard of all shark species should be recorded.
- Resolution 11/04 *on a Regional Observer Scheme* requires data on blue 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.

*Extracts from Resolutions 09/06 and 11/04*

**RESOLUTION 05/05 CONCERNING THE CONSERVATION OF SHARKS CAUGHT IN ASSOCIATION WITH FISHERIES MANAGED BY IOTC**

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 08/04 CONCERNING THE RECORDING OF CATCH BY LONGLINE FISHING VESSELS IN THE IOTC AREA**

1. Each flag CPC shall ensure that all long line fishing vessels flying its flag and authorized to fish species managed by IOTC be subject to a data recording system. ….

**RESOLUTION 11/04 ON A REGIONAL OBSERVER SCHEME**

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

## FISHERIES INDICATORS

### *General*

Scalloped hammerhead shark (*Sphyrna lewini*) is widely distributed and common in warm temperate and tropical waters (Fig. 1). It is also found in estuarine and inshore waters. In some areas, the scalloped hammerhead shark forms large resident populations. In other areas, large schools of small-sized sharks are known to make seasonal migrations polewards. Scalloped hammerhead sharks feeds on pelagic fishes, rays and occasionally other sharks, squids, lobsters, shrimps and crabs. Table 2 outlines some of the key life history traits of scalloped hammerhead shark in the Indian Ocean.

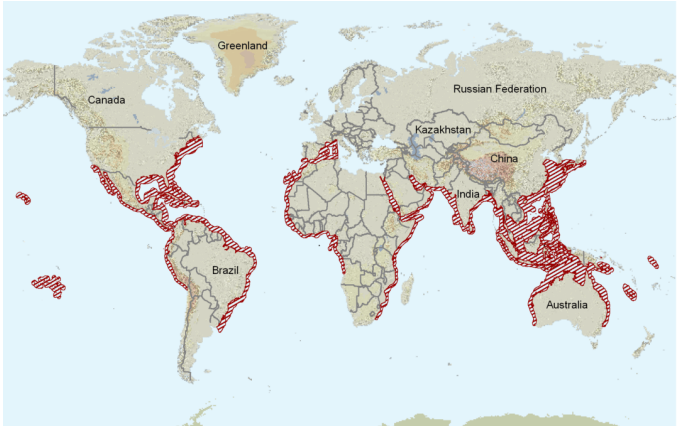



**Fig. 1.** The worldwide distribution of the scalloped hammerhead shark (source: www.iucnredlist.org)

**TABLE 2.** Biology of Indian Ocean scalloped hammerhead shark (*Sphyrna lewini*)

| Parameter | Description |
|---|---|
| Range and stock structure | The scalloped hammerhead shark is widely distributed and common in warm temperate and tropical waters down to 900 m. It is also found in estuarine and inshore waters. In some areas, the scalloped hammerhead shark forms large resident populations. In other areas, large schools of small-sized sharks are known to migrate seasonally polewards. Area of overlap with IOTC management area = high.<br>There is no information available on stock structure. |
| Longevity | The maximum age for Atlantic Ocean scalloped hammerheads is estimated to be over 30 years with the largest individuals reaching over 310 cm TL. In the Eastern Indian Ocean, females are reported to reach 350 m TL |
| Maturity (50%) | Males in the eastern Indian Ocean mature at around 140-165 cm TL. Females mature at about 200 cm TL. In the northern Gulf of Mexico females are believed to mature at about 15 years and males at 9-10 years. |
| Reproduction | The scalloped hammerhead shark is viviparous with a yolk sac-placenta. Litters consist of 13-23 pups (mean=16.5). The reproductive cycle is annual and the gestation period is 9-10 months. The nursery areas are in shallow coastal waters.<br>• Fecundity: medium (<31 pups)<br>• Generation time: 17-21 years<br>• Gestation Period: 9-10 months<br>• Reproductive cycle is annual |
| Size (length and weight) | The maximum size for Atlantic Ocean scalloped hammerheads is estimated to be over 310 cm TL. In the Eastern Indian Ocean, females are reported to reach 350 m TL<br>New-born pups are around 45-50 cm TL at birth in the eastern Indian Ocean. |

SOURCES: Stevens and Lyle (1989); Jorgensen et al (2009)

### *Fisheries*

Scalloped hammerhead sharks are often targeted by some semi-industrial, artisanal and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and purse seine fishery). There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights. FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

The practice of shark finning is considered to be regularly occurring and on the increase for this species (Clarke 2008; Clarke et al. 2006, Holmes et al. 2009) and the bycatch/release injury rate is unknown but probably high.

**TABLE 3.** Estimated frequency of occurrence and bycatch mortality in the Indian Ocean pelagic fisheries.

| Gears | PS | LL | | BB/TROL/HAND | GILL | UNCL |
|---|---|---|---|---|---|---|
| | | SWO | TUNA | | | |
| Frequency | rare | common | | absent | common | unknown |
| Fishing Mortality | unknown | unknown | unknown | unknown | unknown | unknown |
| Post release mortality | unknown | unknown | unknown | unknown | unknown | unknown |

SOURCES: Romanov (2002, 2008); Dudley & Simpfendorfer (2006); Romanov et al. (2008)

### *Catch trends*

The catch estimates for scalloped hammerhead are highly uncertain as is their utility in terms of minimum catch estimates. Four CPCs have reported detailed data on sharks (i.e. Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka) while nine CPCs have reported partial data or data aggregated for all species (i.e. Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, Mauritius, UK-territories).

**TABLE 4.** Catch estimates for scalloped hammerhead shark* in the Indian Ocean for 2009 and 2010.

| Catch | | 2009 | 2010 |
|---|---|---|---|
| Most recent catch | Scalloped hammerhead shark | 21 t | 22 t |
| | nei-sharks | 62,229 t | 61,966 t |
| Mean catch over the last 5 years (2006–2010) | Scalloped hammerhead shark | | 16 t |
| | nei-sharks | | 64,838 t |

* catches likely to be misidentified with the smooth hammerhead shark (*S. zygaena*) which is an oceanic species.

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights. In 2010, seven countries reported catches of scalloped hammerhead sharks in the IOTC region.

***Nominal and standardised CPUE Trends***

Data not available at the IOTC Secretariat. However, Indian longline research surveys, in which scalloped hammerhead sharks contributed up to 6% of regional catch, demonstrate declining catch rates over the period 1984–2006 (John and Varghese 2009). CPUE in South African protective net shows steady decline from 1978.

***Average weight in the catch by fisheries***

Data not available.

***Number of squares fished***

Catch and effort data not available.

## STOCK ASSESSMENT

No quantitative stock assessment for blue shark has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

## LITERATURE CITED

Clarke S, 2008. Use of shark fin trade data to estimate historic total shark removals in the Atlantic Ocean. Aquat. Living Res. 21:373-381.

Clarke SC, McAllister MK, Milner-Gulland EJ, Kirkwood GP, Michielsens CGJ, Agnew DJ, Pikitch EK, Nakano H, and Shivji MS, 2006. Global estimates of shark catches using trade records from commercial markets. Ecology Letters 9:1115-1126.

Dudley SFJ and Simpfendorfer CA, 2006. Population status of 14 shark species caught in the protective gillnes off KwaZulu-Natal beaches, South Africa. Marine and Freshwater Research 57:225-240.

Holmes BH, Steinke D and Ward RD, 2009. Identification of shark and ray fins using DNA barcoding. Fisheries Research 95:280-288.

IUCN, 2007. IUCN Species Survival Commission's Shark Specialist Group. Review of Chondrichthyan Fishes.

IUCN, 2011. IUCN Red List of Threatened Species. Version 2011.1. www.iucnredlist.org

John ME and Varghese BC, 2009. Decline in CPUE of oceanic sharks in the Indian EEZ: urgent need for precautionary approach. IOTC-2009-WPEB-17.

Jorgensen SJ, Klimley AP and Muhlia-Melo AF, 2009 Scalloped hammerhead shark *Sphyrna lewini*, utilizes deep-water, hypoxic zone in the Gulf of California. Journal of Fish Biology, 74, 1682-1687.

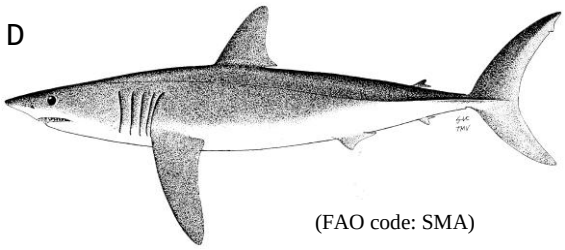
Romanov EV, 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin 100:90-105.

Romanov EV, 2008. Bycatch and discards in the Soviet purse seine tuna fisheries on FAD-associated schools in the north equatorial area of the Western Indian Ocean. Western Indian Ocean Journal of Marine Science 7:163-174.

Romanov E, Bach P, Romanova N, 2008. Preliminary estimates of bycatches in the western equatorial Indian Ocean in the traditional multifilament longline gears (1961-1989) IOTC Working Party on Ecosystems and Bycatch (WPEB) Bangkok, Thailand. 20-22 October, 2008. 18 p.

Stevens JD and Lyle ....1989. .....

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



(FAO code: SMA)

***DRAFT: DEVELOPED FOR THE CONSIDERATION OF THE SCIENTIFIC COMMITTEE***

# DRAFT: STATUS OF THE INDIAN OCEAN SHORTFIN MAKO SHARK (*ISURUS OXYRINCHUS*) RESOURCE

**TABLE 1.** Status of shortfin mako shark (*Isurus oxyrinchus*) in the Indian Ocean – IUCN threat status

| Common name | Scientific name | IUCN threat status | | |
|---|---|---|---|---|
| | | Global status | WIO | EIO |
| Shortfin mako shark | *Isurus oxyrinchus* | Vulnerable | – | – |

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
SOURCES: IUCN (2007, 2011)

The WPEB **RECOMMENDED** the following management advice for shortfin mako sharks in the Indian Ocean, for the consideration of the Scientific Committee:

## INDIAN OCEAN STOCK – MANAGEMENT ADVICE

The WPEB **RECOMMENDED** the following management advice for shortfin mako shark in the Indian Ocean, for the consideration of the Scientific Committee, noting that there remains considerable uncertainty about the relationship between abundance and the standardized CPUE series from the Japanese longline fleet, and about the total catches over the past decade.

***Stock status.*** The current IUCN threat status of 'Vulnerable' applies to shortfin mako sharks globally (Table 1). Trends in the Japanese CPUE series suggest that the longline vulnerable biomass has declined/increased to about XX% of the level observed in YYYY. There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for shortfin mako shark in the Indian Ocean therefore the stock status is highly uncertain. Shortfin mako sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 30 years), females mature at 18–21 years, and have relativity few offspring (<25 pups every two or three years), the shortfin mako shark is vulnerable to overfishing.

***Outlook.*** Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on shortfin mako shark will decline in these areas in the near future, and may result in localised depletion.

The WPEB **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Noting that current catches are estimated at an average ~xx,xxx t over the last five years, ~xx,xxx t in 2010, maintaining or increasing effort will probably result in further increases/declines in biomass, productivity and CPUE.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

**SUPPORTING INFORMATION**

*(Information collated from reports of the Working Party on Ecosystems and Bycatch and other sources as cited)*

## CONSERVATION AND MANAGEMENT MEASURES

Shortfin mako shark in the Indian Ocean are currently subject to a number of conservation and management measures adopted by the Commission:

- Resolution 05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC* includes minimum reporting requirements for sharks, calls for full utilisation of sharks and includes a ratio of fin-to-body weight for shark fins retained onboard a vessel.
- Resolution 08/04 *Concerning the recording of catch by longline fishing vessels in the IOTC area* sets out the minimum logbook requirements for longline fishing vessels over 24 metres length and under 24 metres if they fish outside the EEZ of their flag State. As per this resolution, catch of all sharks must be recorded.
- Resolution 10/03 *Concerning the recording of catch by fishing vessels in the IOTC area* sets out minimum logbook requirements for all purse-seine vessels 24 metres length overall or greater and those under 24 metres if they fish outside the EEZs of their flag States. As per this resolution, catch and discard of all shark species should be recorded.
- Resolution 11/04 *on a Regional Observer Scheme* requires data on blue 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.

*Extracts from Resolutions 09/06 and 11/04*

**RESOLUTION 05/05 CONCERNING THE CONSERVATION OF SHARKS CAUGHT IN ASSOCIATION WITH FISHERIES MANAGED BY IOTC**

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 08/04 CONCERNING THE RECORDING OF CATCH BY LONGLINE FISHING VESSELS IN THE IOTC AREA**

1. Each flag CPC shall ensure that all long line fishing vessels flying its flag and authorized to fish species managed by IOTC be subject to a data recording system. ….

**RESOLUTION 11/04 ON A REGIONAL OBSERVER SCHEME**

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

## FISHERIES INDICATORS

### *General*

Shortfin mako shark (*Isurus oxyrinchus*) is widely distributed in tropical and temperate waters warmer than 16°C (Fig. 1) and is one of the fastest swimming shark species. It is known to leap out of the water when hooked and is often found in the same waters as swordfish. This species is at the top of the food chain, feeding on fast-moving fishes such as swordfish and tunas and occasionally on other sharks. Table 2 outlines some of the key life history traits of shortfin mako shark in the Indian Ocean.

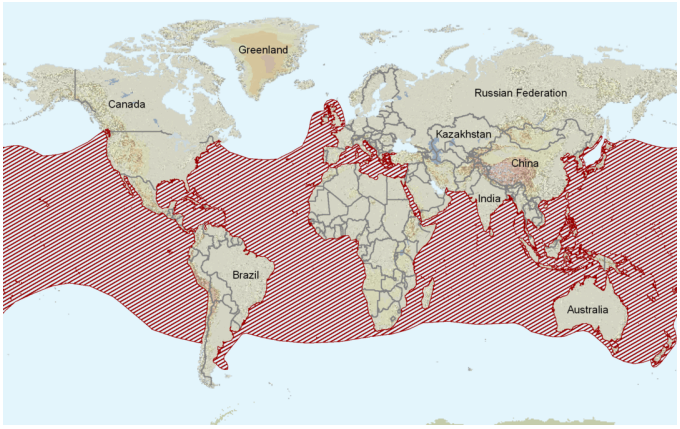



**Fig. 1.** The worldwide distribution of the shortfin mako shark (source: www.iucnredlist.org)

**TABLE 2.** Biology of Indian Ocean shortfin mako shark (*Isurus oxyrinchus*)

| Parameter | Description |
|---|---|
| Range and stock structure | Widely distributed in tropical and temperate waters warmer than 16°C. Makos prefer epipelagic and littoral waters from the surface down to depths of 500 meters. Shortfin mako is not known to school. It has a tendency to follow warm water masses polewards in the summer. Tagging results from the North Atlantic Ocean showed that makos migrated over long distances and this suggests that there is a single well-mixed population in this area. Area of overlap with IOTC management area = high.<br>No information is available on stock structure of shortfin mako sharks in the Indian Ocean. |
| Longevity | Maximum lifespans reported for this species are 32 years for females and 29 years for males in the western North Atlantic. |
| Maturity (50%) | Sexual maturity is estimated to be reached at 18-19 years or 290-300 m TL for females and 8 years or about 200 m TL for males in the western North Atlantic and 19-21 years or 207-290 m TL for females and 7-9 years or 180-190 m TL for males in the western South Pacific. In the western South Indian Ocean maturity was estimated at about 270 m TL for females and 190-210 m TL for males. The length at maturity of female shortfin mako sharks differs between the Northern and Southern hemispheres. |
| Reproduction | Female shortfin mako sharks are aplacental viviparous. Developing embryos feed on unfertilized eggs in the uterus during the gestation period, whose length is subject to debate but is believed to last 15-18 months. Litter size ranges from 4 to 25 pups (mean=12.5), with larger sharks producing more offspring. The nursery areas are apparently in deep tropical waters. The length of the reproductive cycle is up to three years. Generation time is estimated to be 14 years.<br>• Fecundity: medium (<25 pups)<br>• Generation time: 23 years<br>• Gestation Period: 15-18 months<br>• Reproductive cycle is biennial or triennial |
| Size (length and weight) | Maximum size of shortfin mako sharks in Northwest Atlantic Ocean is 4 m and 570 kg. In the Indian Ocean a female individual of 248 cm FL and 130 kg TW was aged as 18 years old. Length–weight relationship for both sexes combined in the Indian Ocean is TW=0.349*10-4 * FL2.76544.<br>New-born pups are around 70 cm (TL). |

SOURCES: Bass et al. (1973); Mejuto et al (2005); Romanov & Romanova (2009)

### *Fisheries*

Shortfin mako sharks are often targeted by some semi-industrial, artisanal and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and anecdotally by the purse seine fishery). In other Oceans, due to its energetic displays and edibility, the shortfin mako shark is considered one of the great gamefish of the world. There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights. FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

The practice of shark finning is considered to be regularly occurring for this species (Clarke 2008; Clarke et al. 2006) and the bycatch/release injury rate is unknown but probably high.

**TABLE 3.** Estimated frequency of occurrence and bycatch mortality in the Indian Ocean pelagic fisheries.

| Gears | PS | LL | | BB/TROL/HAND | GILL | UNCL |
|---|---|---|---|---|---|---|
| | | SWO | TUNA | | | |
| Frequency | rare | common | | rare–common | unknown | unknown |
| Fishing Mortality | unknown | 13 to 51 % | 0 to 31% | unknown | unknown | unknown |
| Post release mortality | unknown | 19% | | unknown | unknown | unknown |

SOURCES: Romanov (2002, 2008); Ariz et al. (2006); Dudley & Simpfendorfer (2006); Peterson et al. (2008); Romanov et al. (2008)

### *Catch trends*

The catch estimates for shortfin mako shark are highly uncertain as is their utility in terms of minimum catch estimates. Four CPCs have reported detailed data on sharks (i.e. Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka while nine CPCs have reported partial data or data aggregated for all species (i.e. Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, Mauritius, UK-territories). For CPCs reporting longline data by species (i.e. Australia, Spain, Portugal, United Kingdom and South Africa), 12% of the catch of sharks by longliners, all targeting swordfish, were shortfin mako sharks.

**TABLE 4.** Catch estimates for shortfin mako shark in the Indian Ocean for 2009 and 2010.

| Catch | | 2009 | 2010 |
|---|---|---|---|
| Most recent catch | Shortfin mako shark | 561 t | 738 t |
| | nei-sharks | 62,229 t | 61,966 t |
| Mean catch over the last 5 years (2006–2010) | Shortfin mako shark | | 990 t |
| | nei-sharks | | 64,838 t |

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights. In 2010, seven countries reported catches of blue sharks in the IOTC region.

***Nominal and standardised CPUE Trends***

Data not available at the IOTC Secretariat. Historical research data shows overall decline in CPUE and mean weight of mako sharks (Romanov et al. 2008). CPUE in South African protection net is fluctuating without any trend (Holmes et al. 2009).

***Average weight in the catch by fisheries***

Data not available.

***Number of squares fished***

Catch and effort data not available.

## STOCK ASSESSMENT

No quantitative stock assessment for blue shark has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

## LITERATURE CITED

Ariz J, Delgado de Molina A, Ramos ML, and Santana JC, 2006. Check list and catch rate data by hook type and bait for bycatch species caught by Spanish experimental longline cruises in the south-western Indian Ocean during 2005. IOTC-2006-WPBy-04 2006.

Bass AJ, D'Aubrey JD and Kistnasamy N, 1973. Sharks of the east coast of southern Africa. I. The genus *Carcharhinus* (Carcharhinidae). Oceanogr. Res. Inst. (Durban) Investig. Rep. 33: 168 pp.

Clarke S, 2008. Use of shark fin trade data to estimate historic total shark removals in the Atlantic Ocean. Aquat. Living Res. 21:373-381.

Clarke SC, McAllister MK, Milner-Gulland EJ, Kirkwood GP, Michielsens CGJ, Agnew DJ, Pikitch EK, Nakano H, and Shivji MS, 2006. Global estimates of shark catches using trade records from commercial markets. Ecology Letters 9:1115-1126.

Dudley SFJ and Simpfendorfer CA, 2006. Population status of 14 shark species caught in the protective gillnes off KwaZulu-Natal beaches, South Africa. Marine and Freshwater Research 57:225-240.

Holmes BH, Steinke D and Ward RD, 2009. Identification of shark and ray fins using DNA barcoding. Fisheries Research 95:280-288.

IUCN, 2007. IUCN Species Survival Commission's Shark Specialist Group. Review of Chondrichthyan Fishes.

IUCN, 2011. IUCN Red List of Threatened Species. Version 2011.1. www.iucnredlist.org

Mejuto J, Garcia-Cortes B and Ramos-Cartelle A, 2005. Tagging-recapture activities of large pelagic sharks carried out by Spain in collaboration with the tagging programs of other countries. SCRS/2004/104 Col. Vol. Sci. Pap. ICCAT, 58(3): 974-1000.

Petersen S, Nel D, Ryan P and Underhill L, 2008. Understanding and mitigating vulnerable bycatch in southern African trawl and longline fisheries. 225 p. WWF South Africa Report Series.

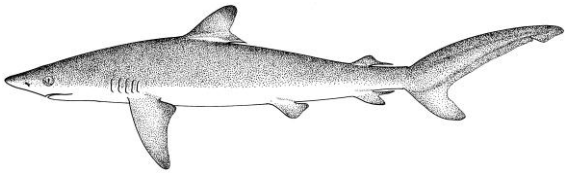
Romanov EV, 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin 100:90-105.

Romanov EV, 2008. Bycatch and discards in the Soviet purse seine tuna fisheries on FAD-associated schools in the north equatorial area of the Western Indian Ocean. Western Indian Ocean Journal of Marine Science 7:163-174.

Romanov E, Bach P, Romanova N, 2008. Preliminary estimates of bycatches in the western equatorial Indian Ocean in the traditional multifilament longline gears (1961-1989) IOTC Working Party on Ecosystems and Bycatch (WPEB) Bangkok, Thailand. 20-22 October, 2008. 18 p.

Romanov E and Romanova N, 2009. Size distribution and length-weight relationships for some large pelagic sharks in the Indian Ocean. IOTC-2009-WPEB-06. 12 p.

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



(FAO code: FAL)

***DRAFT: DEVELOPED FOR THE CONSIDERATION OF THE SCIENTIFIC COMMITTEE***

# DRAFT: STATUS OF THE INDIAN OCEAN SILKY SHARK (*CARCHARHINUS FALCIFORMIS*) RESOURCE

**TABLE 1.** Status of silky shark (*Carcharhinus falciformis*) in the Indian Ocean – IUCN threat status

| Common name | Scientific name | IUCN threat status | | |
|---|---|---|---|---|
| | | Global status | WIO | EIO |
| Silky shark | *Carcharhinus falciformis* | Near Threatened | Near Threatened | Near Threatened |

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
SOURCES: IUCN (2007, 2011)

The WPEB **RECOMMENDED** the following management advice for silky sharks in the Indian Ocean, for the consideration of the Scientific Committee:

## INDIAN OCEAN STOCK – MANAGEMENT ADVICE

The WPEB **RECOMMENDED** the following management advice for silky shark in the Indian Ocean, for the consideration of the Scientific Committee.

***Stock status.*** The current IUCN threat status of 'Near Threatened' applies to silky sharks in the western and eastern Indian Ocean and globally (Table 1). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for silky shark in the Indian Ocean therefore the stock status is highly uncertain. Silky sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 20 years), mature at 6–12 years, and have relativity few offspring (<20 pups every two years), the silky shark is vulnerable to overfishing. Despite the lack of data, it is clear from the information that is available that silky shark abundance has declined significantly over recent decades.

***Outlook.*** Maintaining or increasing effort will probably result in declines in biomass, productivity and CPUE. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on silky shark will decline in these areas in the near future, and may result in localised depletion.

The WPEB **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- Total catches are highly uncertain and should be investigated further as a priority.
- Noting that current catches are estimated at an average ~xx,xxx t over the last five years, ~xx,xxx t in 2010, maintaining or increasing effort will probably result in further increases/declines in biomass.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

**SUPPORTING INFORMATION**

*(Information collated from reports of the Working Party on Ecosystems and Bycatch and other sources as cited)*

## CONSERVATION AND MANAGEMENT MEASURES

Silky shark in the Indian Ocean are currently subject to a number of conservation and management measures adopted by the Commission:

- Resolution 05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC* includes minimum reporting requirements for sharks, calls for full utilisation of sharks and includes a ratio of fin-to-body weight for shark fins retained onboard a vessel.
- Resolution 08/04 *Concerning the recording of catch by longline fishing vessels in the IOTC area* sets out the minimum logbook requirements for longline fishing vessels over 24 metres length and under 24 metres if they fish outside the EEZ of their flag State. As per this resolution, catch of all sharks must be recorded.
- Resolution 10/03 *Concerning the recording of catch by fishing vessels in the IOTC area* sets out minimum logbook requirements for all purse-seine vessels 24 metres length overall or greater and those under 24 metres if they fish outside the EEZs of their flag States. As per this resolution, catch and discard of all shark species should be recorded.
- Resolution 11/04 *on a Regional Observer Scheme* requires data on blue 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.

*Extracts from Resolutions 09/06 and 11/04*

**RESOLUTION 05/05 CONCERNING THE CONSERVATION OF SHARKS CAUGHT IN ASSOCIATION WITH FISHERIES MANAGED BY IOTC**

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 08/04 CONCERNING THE RECORDING OF CATCH BY LONGLINE FISHING VESSELS IN THE IOTC AREA**

1. Each flag CPC shall ensure that all long line fishing vessels flying its flag and authorized to fish species managed by IOTC be subject to a data recording system. ….

**RESOLUTION 11/04 ON A REGIONAL OBSERVER SCHEME**

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

## FISHERIES INDICATORS

### *General*

Silky sharks (*Carcharhinus falciformis*) are one of the most abundant large sharks inhabiting warm tropical and subtropical waters throughout the world (Fig. 1). Table 2 outlines some of the key life history traits of silky shark in the Indian Ocean.

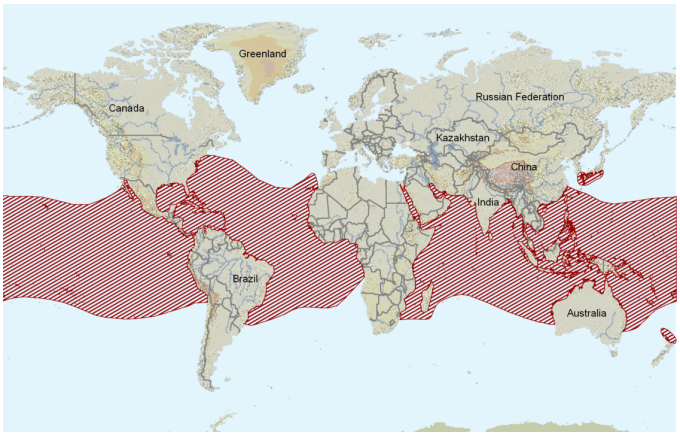



**Fig. 1.** The worldwide distribution of the silky shark (source: www.iucnredlist.org)

**TABLE 2.** Biology of Indian Ocean Silky sharks (*Carcharhinus falciformis*)

| Parameter | Description |
|---|---|
| Range and stock structure | Essentially pelagic, the silky shark is distributed from slopes to the open ocean. It also ranges to inshore areas and near the edges of continental shelves and over deepwater reefs. It also demonstrates strong fidelity to seamounts and natural or man-made objects (like FADs) floating at the sea surface. Silky sharks live down to 500 m. Typically, smaller individuals are found in coastal waters. Small silky sharks are also commonly associated with schools of tuna, particularly under floating objects. Large silky sharks associate with free-swimming tuna schools. Silky sharks often form mixed-sex schools containing similar sized individuals. Area of overlap with IOTC management area = high.<br>No information is available on stock structure. |
| Longevity | 20+ years for males; 22+ years for females in the southern Gulf of Mexico and maximum size is over 300 cm long.<br>Generation time was estimated to be between 11 and 16 years in the Gulf of Mexico years. |
| Maturity (50%) | The age of sexual maturity is variable. In the Atlantic Ocean, off Mexico, silky sharks mature at 10-12+ years. By contrast in the Pacific Ocean, males mature at around 5-6 years and females mature at around 6-7 years.<br>Size: not available. |
| Reproduction | The silky shark is a placental viviparous species with a gestation period of around 12 months. Females give birth possibly every two years. The number of pups per litter ranges from 9-14 in the Eastern Indian Ocean, and 2-11 in the Pacific Ocean.<br>• Fecundity: medium (<20 pups)<br>• Generation time: 11-16 years<br>• Gestation period: 12 months<br>• Reproductive cycle is biennial |
| Size (length and weight) | Maximum size is over 300 cm long FL.<br>New-born pups are around 75-80 cm TL or less at birth.<br>Length–weight relationship for both sexes combined in the Indian Ocean is TW=0.160*10-4 * FL2.91497. |

SOURCES: Strasburg (1958); Anderson & Ahmed (1993); Mejuto et al (2005); Matsunaga (2007); Romanov & Romanova (2009)

### *Fisheries*

Silky sharks are often targeted by some semi-industrial, artisanal and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and purse seine fishery). Sri Lanka has had a large fishery for silky shark for over 40 years.

There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights. FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

The practice of shark finning is considered to be regularly occurring and on the increase for this species (Clarke 2008; Clarke et al. 2006) and the bycatch/release injury rate is unknown but probably high.

**TABLE 3.** Estimated frequency of occurrence and bycatch mortality in the Indian Ocean pelagic fisheries.

| **Gears** | **PS** | **LL** | | **BB/TROL/HAND** | **GILL** | **UNCL** |
|---|---|---|---|---|---|---|
| | | **SWO** | **TUNA** | | | |
| Frequency | common | abundant | | common | abundant | abundant |
| Fishing Mortality | study in progress | study in progress | study in progress | unknown | unknown | unknown |
| Post release mortality | study in progress | unknown | unknown | unknown | unknown | unknown |

SOURCES: Romanov (2002, 2008); Ariz et al. (2006); Peterson et al. (2008); Romanov et al. (2008)

### *Catch trends*

The catch estimates for silky shark are highly uncertain as is their utility in terms of minimum catch estimates. Four CPCs have reported detailed data on sharks (i.e. Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka) while nine CPCs have reported partial data or data aggregated for all species (i.e. Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, Mauritius, UK-territories). For CPCs reporting longline data by species (i.e. Australia, Spain, Portugal, United Kingdom and South Africa), 1.5% of the catch of sharks by longliners, all targeting swordfish, were silky sharks, and for CPCs reporting gillnet data by species (i.e. Sri Lanka), 22% of the catches of shark were silky sharks.

**TABLE 4.** Catch estimates for silky shark in the Indian Ocean for 2009 and 2010.

| **Catch** | | **2009** | **2010** |
|---|---|---|---|
| Most recent catch | Silky shark | 543 t | 1,153 t |
| | nei-sharks | 62,229 t | 61,966 t |
| Mean catch over the last 5 years (2006–2010) | Silky shark | | 670 t |
| | nei-sharks | | 64,838 t |

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights. In 2010, seven countries reported catches of silky sharks in the IOTC region.

***Nominal and standardised CPUE Trends***

Data not available at the IOTC Secretariat. However, Maldivian shark fishermen report significant declines in silky shark abundance over past 20 years (Anderson 2009). In addition, Indian longline research surveys, in which silky sharks contributed 7% of catch, demonstrate declining catch rates over the period 1984–2006 (John & Varghese 2009). No long-term data for purse-seine CPUE are available, however there are verbal evidences of five-fold decrease of silky shark catches per set between 1980s and 2005s.

***Average weight in the catch by fisheries***

Data not available.

***Number of squares fished***

Catch and effort data not available.

## STOCK ASSESSMENT

No quantitative stock assessment for silky shark has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

## LITERATURE CITED

Anderson RC, 2009. Opinions count: decline in abundance of silky sharks in the central Indian Ocean reported by Maldivian fishermen. IOTC-2009-WPEB-08.

Ariz J, Delgado de Molina A, Ramos ML, and Santana JC, 2006. Check list and catch rate data by hook type and bait for bycatch species caught by Spanish experimental longline cruises in the south-western Indian Ocean during 2005. IOTC-2006-WPBy-04 2006.

Clarke S, 2008. Use of shark fin trade data to estimate historic total shark removals in the Atlantic Ocean. Aquat. Living Res. 21:373-381.

Clarke SC, McAllister MK, Milner-Gulland EJ, Kirkwood GP, Michielsens CGJ, Agnew DJ, Pikitch EK, Nakano H, and Shivji MS, 2006. Global estimates of shark catches using trade records from commercial markets. Ecology Letters 9:1115-1126.

IUCN, 2007. IUCN Species Survival Commission's Shark Specialist Group. Review of Chondrichthyan Fishes.

IUCN, 2011. IUCN Red List of Threatened Species. Version 2011.1. www.iucnredlist.org

John ME and Varghese BC, 2009. Decline in CPUE of oceanic sharks in the Indian EEZ: urgent need for precautionary approach. IOTC-2009-WPEB-17.

Matsunaga H, 2007. Standardized CPUE for blue sharks caught by the Japanese tuna longline fishery in the Indian Ocean, 1971-2005. IOTC-2007-WPEB-17.

Mejuto J, Garcia-Cortes B and Ramos-Cartelle A, 2005. Tagging-recapture activities of large pelagic sharks carried out by Spain in collaboration with the tagging programs of other countries. SCRS/2004/104 Col. Vol. Sci. Pap. ICCAT, 58(3): 974-1000.

Petersen S, Nel D, Ryan P and Underhill L, 2008. Understanding and mitigating vulnerable bycatch in southern African trawl and longline fisheries. 225 p. WWF South Africa Report Series.

Romanov EV, 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin 100:90-105.

Romanov EV, 2008. Bycatch and discards in the Soviet purse seine tuna fisheries on FAD-associated schools in the north equatorial area of the Western Indian Ocean. Western Indian Ocean Journal of Marine Science 7:163-174.

Romanov E, Bach P, Romanova N, 2008. Preliminary estimates of bycatches in the western equatorial Indian Ocean in the traditional multifilament longline gears (1961-1989) IOTC Working Party on Ecosystems and Bycatch (WPEB) Bangkok, Thailand. 20-22 October, 2008. 18 p.

Strasburg DW, 1958. Distribution, abundance, and habits of pelagic sharks in the central Pacific Ocean. Fish. Bull. U.S. Fish. Wildl. Serv, 58:335-61.