Resolution 2025-08, an opportunity to step up science driven conservation and management measures for sharks in tuna and multi-species fisheries at IOTC?

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Abstract

In 2025 the IOTC Commission adopted a new Resolution 25/08 On the Conservation of Sharks in Association with Fisheries managed by IOTC after having failed to adopt meaningful measures for sharks over the last 10 years and having let stocks being overexploited without limits. The adopted resolution includes many compromises so that consensus could finally be achieved after two failed attempts to adopt a shark resolution in the years before but includes several scientific tasks that require follow up by the WPEB and the SC to deliver advice for adoption at the 2026 Commission Meeting. While these tasks obviously require capacity from scientists, they provide a long-awaited opportunity applying science to lead real improvements on the water and advise the Commission on tangible conservation and management measures for sharks at IOTC, e.g. by defining catch limits for blue sharks, recommending species in need for further protection and outlining best handling and release procedures for unwanted bycatch. Input to the design and objectives for a study to compare shark mortality for different gear modifications, improved reporting requirements at species level and defining terms of reference for a long-term shark research study are also included in this mandate. This paper analyses possible approaches to respond to the requested tasks and proposes concrete measures as part of a systematic "bycatch mitigation" approach in line with the widely recognized mortality reduction hierarchy formulated by Milner-Gulland et al. in 2018. Such a systematic mortality reduction hierarchy should be used to guide the advice formulated for the Commission and specifically provide the table of contents when agreeing on terms of reference for the longtime shark project to be initiated for the IOTC's Area of Competence. These be laid out in such a way as to drive transition from the previous approach, driven mostly by a call for more research and data collection towards an integrated approach characterized by effective catch minimization measures and/or avoidance strategies for the management and conservation of sharks and rays that are informed and supported by science. Suggested terms of reference and specific measures are identified and discussed. As a priority SMART objectives addressing mortality reduction should be identified, agreed upon and recommended for adoption by the Commission in 2026 and the SMART objectives for the long-term shark research project might also be integrated into an IOTC Regional Plan of Action for elasmobranchs, which could serve to inform scientific NDFs for the export of CITES listed species from the IOTC Area of Competence.

1. Introduction: Resolution 2025-08 and its Intent

The Indian Ocean is often referred to as a hotspot of biodiversity, particularly for its unique megafauna. However, it is also an area of significant conservation concerns, particularly for sharks and rays. During the 2023 ISRA workshop, the Western Indian Ocean was found to exhibit "*125 Important Shark and Ray Areas, 1 candidate ISRA, and 45 Areas of Interest*". (Jabado et al., 2023) However, despite this unique importance, shark populations in the Indian Ocean have suffered from severe declines over the past decades with an increasing number of shark species have been listed as globally threatened by the IUCN. Half of all pelagic elasmobranch species are already classified as Endangered or even as

Critically Endangered (Pacoureau et al., 2021) and the global abundance of sharks and rays has been halved over the last 50 years, while their risk of extinction has increased by 19% since 1970 (Dulvy et al., 2021; Dulvy et al 2024).

In the IOTC Area of Competence sharks are both, a targeted species and a common bycatch in the fisheries targeting tuna and tuna-like species, yet IOTC has continued to manage elasmobranchs only as a "bycatch" since its mandate officially covers only species listed in Annex B of the IOTC Agreement, which currently does not include any pelagic sharks or rays. During the 2nd IOTC Performance Review, this has been criticized as resulting in "*incomplete fisheries management and conservation coverage*" for sharks as long as "managed" only as a bycatch. (IOTC Performance Review 2016). IUCN has also highlighted that two thirds of threatened sharks, rays and chimaeras are at risk of extinction from overfishing alone with most sharks caught as a "bycatch" yet 99% of them being retained, marketed, and traded (Jabado et al. 2024). IOTC has however demonstrated in the past, that it can adopt management and conservation measures going beyond pure bycatch management e.g. when adopting Resolution 18/02 *On management measure for the Conservation of blue sharks caught in association with IOTC fisheries* that did call for limiting blue shark mortality and allocating quotas between CPCs based on the stock assessment planned for 2021. This Resolution had further tasked the Scientific Committee to provide advice for candidate limit, threshold and target reference points for the conservation and management of blue sharks in the IOTC Area of Competence. However, as repeatedly experienced at RFMOs, such commitments easily get forgotten if not followed up upon. This also happened to Resolution 18/02 when the stock assessment had been postponed to 2023, and no further actions were taken in 2021 following the outcome of the stock assessment suggested that the stock was in the Green Zone of the Kobe plot. However, this outcome should not have prevented completion of the agreed measures in Resolution 18/02. Similarly, the Commission has in the absence of successful stock assessments failed to act on several threatened shark species with most probably overfished stocks, despite repeated advice from the Scientific Committee that the Commission should take a precautionary approach and should consider the implementation of additional measures to reduce mortality e.g. of shortfin mako sharks, oceanic whitetip sharks, and silky sharks. No additional measures have been adopted for elasmobranchs, beyond already existing ones that require the reporting of shark catches, full utilization of sharks and three retention bans for oceanic whitetip sharks, thresher sharks and mantas and mobulids. Thereby the IOTC has even been lagging far behind other tuna RFMOs, that had started adopting additional measures for threatened shark species. ICCAT has even started acknowledging its obligation to manage targeted sharks in a similar way as other target species and adopted for the first time Total Mortality Limits for blue sharks and for shortfin mako sharks and rebuilding plans with a predefined probability of success for shortfin mako sharks. ICCAT has also agreed to start development of MSE tested Management Procedures for blue sharks. (ICCAT Rec 19-07, Rec 19-08; Rec 21-09, Rec 22-11, Rec 23-10 and Rec 23-11)

However, in 2022 the Maldives triggered an important change in the mindset of the Contracting Parties to the IOTC Commission when submitting a comprehensive shark proposal including substantial improvements for the management and conservation of sharks and introducing for the first time ever a definition for sharks. The proposal also included the intent to define catch limits for blue sharks, adopt bycatch mitigation measures for threatened shark species, and replacing the IOTC's finning prohibition for sharks landed frozen by a "Fins Naturally Attached policy (IOTC-2023-S27-PropR[E]). Although no consensus had been possible in 2023, the Maldives resubmitted the proposal in 2024 (IOTC-2024-S28-PropV), this time co-sponsored also by Pakistan, which triggered a request by the Commission to the Scientific Committee to review existing studies and the potential of gear modifications in longline gear to reduce shark mortality. Although the proposal had received broad support from many other coastal States on the floor the Commission failed once again to achieve consensus, so that the proponents decided to withdraw the proposal. Nevertheless, the Commission requested in its report that the SC should start MSE for the development of Management Procedures for blue sharks (IOTC Commission Report 2024). In 2025 the proposal was resubmitted for the third time, co-sponsored by Pakistan and South Africa, and this time the Commission adopted the proposal in its Revision 1 as Resolution 2025/08, including several compromises to the initial requests but also including several tasks the WPEB and SC for further assessments and additional advice to be provided for the next Commission Meeting in 2026.

While this has been a long and sometimes disappointing road the IOTC took for its journey towards improved management and conservation measures for sharks, it also outlines the increasing recognition by CPCs that such improved measures are urgently needed. Managers finally accepted that the past approach is no longer applicable and more holistic measures informed by science and a precautionary approach are needed to halt the decline of shark populations in the Indian Ocean and the consequences for the complete ecosystem resulting from such a decline. By adopting this resolution managers have transitioned from previously perceived "road blockers" to "conservation enablers" and have handed over several tasks for further refinement and improvements of measures to the scientists and the Scientific Committee. This could thereby be perceived as both, a blessing and a curse as obviously scientists are best equipped to inform managers on refined and/or additional measures as needed for the conservation, but they also need adequate resources to do so, which therefore also should be committed to by the Commission.

In summary, this provides a unique opportunity to apply best scientific practices and globally acknowledged mitigation strategies in a systematic way and to step up IOTC from lagging far behind to a leader in shark and ray conservation among tuna RFMO. This paper summarises the tasks and mandates of Resolution 25/08 as addressed to the WPEB and the SC and provides inputs for consideration for each of those, including reference to UNCLOS requirements to the sustainable management of species that are retained for their commercial value and suggesting a holistic mitigation hierarchy to reduce shark mortality as described in the literature.

Resolution 25/08 makes the following requests to the WPEB and the Scientific Committee that are therefore analysed and discussed as part of this paper.

(1) to establish terms of reference in 2025 for a long-term scientific project for sharks
(2) to review and approve the scientific design of studies proposed for the comparison of shark mortality at IOTC for different leader types
(3) to develop improved safe handling guidelines for all sharks and for whale sharks in particular
(4) to respond to the question whether whale sharks qualify for specific protection as a non-retention species (automatic if recommended by SC in 2025).
(5) to recommend improvements for reporting of shark data
(6) to propose a TAC for blue sharks based on the outcome of the 2025 stock assessment
(7) to define terms of reference for reporting and review of the effectiveness of the allowed alternatives to a "Fins Naturally Attached" (FNA) policy for sharks landed frozen

2. Analysis and Discussion

Regardless, whether sharks are a targeted species or a bycatch and therefore require different approaches for their conservation the actual measures needed to reduce shark mortality are often the same, ensuring the sustainable management of both, if implemented and enforced consistently. The Resolution 25/08 as adopted by the Commission therefore includes elements for both the sustainable management of stocks targeted for commercial reasons and the conservation of stocks with an either unknown or overexploited stock status.

2.1. A long-term shark research and conservation project as an opportunity to define an effective mitigation hierarchy for both, targeted species and incidental bycatch

Resolution 25-08 Para 38 "*The IOTC Scientific Committee shall, through the IOTC Working Party on Ecosystems and Bycatch, continue its work on identifying and monitoring the status of sharks until such time as comprehensive assessments are possible for all relevant sharks, including those listed in paragraph 3, silky sharks, hammerhead sharks and mako sharks. The IOTC Scientific Committee shall establish terms of reference for a long term-project on sharks in the IOTC area of competence to be considered by the Commission at its annual Session in 2026, with the aim to ensure the collection of data required for performing reliable stock assessments for key shark species, including those listed in paragraph 3, silky sharks, hammerhead sharks and mako sharks*."

In the IOTC Area of Competence sharks are both, a targeted species and a bycatch species. Depending on the respective fleet and the specific shark species, shark "bycatch" is either "wanted" as commercially valuable or a truly "incidental" respectively "unwanted" bycatch that is mostly not retained. Nevertheless, the IOTC Commission has kept calling all sharks to be a "bycatch" and thereby avoided managing them sustainably despite the globally alarming state and the even more dire situation of many stocks of shark species in the Indian Ocean (Worm et al 2024). Despite several attempted stock assessments only two stocks have a known status in the IOTC Area of Competence, i.e. blue sharks and shortfin mako sharks, the latter being overfished and experiencing overfishing (IOTC SC Report, 2024). For the other six key shark species the annual Executive Summaries state an unknown stock status and warn that measures should be taken to reduce mortality specifically for silky sharks and oceanic whitetip sharks. Poor compliance with reporting of shark data has prevented successful stock assessments for these and other threatened shark species. In the absence of scientific advice effective measures that have been proposed to reduce fishing related mortality have been rejected or delayed calling only for more research and more data (Mandelik et al., 2005; Tolotti et al., 2015). This pattern of avoidance of bycatch mitigation measures is well established and has been criticized by many scientists (Cronin et al. 2022, Juan Jorda et al. 2022).

In this context it is therefore important to note that Resolution 25/08 indeed outlines in Para 41 that the Scientific Committee is tasked to develop "*options for candidate limit, threshold and target reference points for the conservation and management of all sharks caught in association with IOTC fisheries, prioritising sharks caught for commercial purposes."* Thereby the Commission recognizes that many shark species at IOTC are not a "bycatch", but a species caught for commercial reasons or a targeted species. This includes the obligation to manage these stocks sustainably via the development of reference points. (IOTC TCPM 2025) This task should be included as part of the long-term shark project and could be informed by the development of MSE tested MPs for blue sharks that the WPMSE has agreed to start preparations for already in 2025. (IOTC WPMSE 2025)

Only eight shark species, i.e. blue sharks, silky sharks, oceanic whitetip sharks, mako sharks, porbeagle sharks, scalloped hammerhead sharks, bigeye thresher sharks, and pelagic thresher sharks are at all reviewed on an annual basis with information updated and summarized in the Executive Species Summaries, while at least 20 other shark species also interact with IOTC fisheries on a regular basis (Patterson et al. 2024).

IATTC has adopted a list of 18 sharks in 2024, including e.g. also galapagos sharks, copper sharks, crocodile sharks, and whale sharks as being under the purview of IATTC (IATTC Res-C-24-05) and therefore of specific concern for research and conservation and for the 2025 Commission Meeting the IATTC Scientific Staff has also proposed a list of seven rays to be included as being under the purview of the IATTC (IATTC SAC-16-08, 2025), including pelagic stingrays, mantas and mobulids. While some of these sharks may not be relevant for IOTC, most of them e.g. crocodile sharks, whale sharks certainly also interact with IOTC fisheries. As IOTC Res 25-08 defines "sharks" as all species belonging to the 8 orders of *Selachimorpha* and all species of the order of *Rhinopristiformes* all relevant shark and ray species according to that definition but also additional rays interacting with IOTC fisheries should be considered as part of a long-term scientific project.

Therefore, also at IOTC an extended list of elasmobranch species interacting with IOTC fisheries should be established and defined as key shark species for which at least annual Executive Summaries are generated and reviewed, including at least those sharks and rays known to have regular interactions with IOTC fisheries and prioritizing IUCN threatened or near threatened elasmobranchs.

As part of the planned long-term project however, not only data collection for stock assessments but the collection of extended data for investigations on how to reduce mortality of sharks and rays most effectively but also in a cost-efficient way should be considered into the scope of the research activities.

This should also include the evaluation and comparison of different mitigation measures for the various species, including but not limited to the evaluation of retention bans as an initial measure to remove commercial incentives from targeting potentially overfished stocks in the absence of TACs and Management Procedures. For such a review critically endangered and endangered shark species and those shark species that are already subject to retention bans in adjacent tuna RFMOs should be prioritized. Specifically, for all species of hammerhead sharks being already subject to a retention ban at ICCAT and silky sharks, which are subject to a retention ban at both, WCPFC and ICCAT, retention bans should be considered also at IOTC to strengthen their protection, noting that vessels fishing in the

Indian Ocean often also fish in the South Atlantic or in the Pacific. The threatened state of these species requires immediate action even prior to reviewing outcomes from the planned stock assessments for scalloped hammerheads and silky sharks in 2026.

Milner-Gulland et al., 2018 defined a globally applicable mitigation hierarchy including five categories of measures listed according to their importance to mitigate impacts of fisheries on bycatch species

(1) **Avoid capturing** of the species e.g. via spatiotemporal management and depth prohibitions

(2) **Minimize the likelihood** of capturing it e.g. by requiring the use of certain gear modifications while prohibiting the use of other gear types or modifications in an area; this also could apply to allowing or banning certain set types and requiring certain dFAD designs; furthermore, total allowable catch limits for each (bycatch) species respectively mortality limits could be agreed and enforced

(3) **Remediate the capture** by increasing the chance of survival on board and after having been released by the application of best handling and release procedures or by taking away commercial incentives from bycatch when banning the retention and commercialization of such bycatch

(4) **Compensate the damage** done to the population via monetary compensations for the mortality to fund conservation measures at a per capita of bycatch rate

(5) **Stipulate and finance further research** on the impact of occurring bycatch on populations e.g. by improving data collection, increasing observer coverage and performing stock assessments or by initiating and funding additional research projects

The 'Avoid' tier has been recognized to have the greatest impact and 'Research' the least impact to reduce immediate bycatch mortality (Booth et al., 2019) and while avoiding and minimisation are effective output controls if enforced, remediation and compensation are input controls that are per definition less effective in reducing mortality even if enforced. These are therefore considered as second tier behind output controls, while further research by its own is unsuitable to reduce mortality on the water. Cronin et al. 2022 analyzed existing policies and requirements as adopted by tuna RFMOs for elasmobranchs concluding that those hardly ever reflect the proposed mitigation hierarchy with all out of 34 assessed measures including further research activities such as stock assessments but avoidance being included in only one and minimisation measures only in 8 policies. 23 conservation and management measures included remediation measures. The terms of reference for the planned long-term study should therefore consider these apparent gaps and mistakes made in the past and pursue a more holistic approach focusing on the reduction of elasmobranch mortality in line with the bycatch mitigation hierarchy, while emphasizing avoidance over minimisation and both of them over remediation and compensation measures. Further research activities should always be aligned with these needs in particular and being supplementary measures rather than priorities on their own.

An IOTC Regional Plan of Action for Sharks could summarize the outcome of these discussions providing guidance for priorities and how to evaluate outcomes by defining SMART objectives also in the respective NOPA Sharks, another shortcoming that has been criticized as lacking in most, if not all of the existing NOPAs till today (Gillman et al 2023). Deliverables for a Regional and National Plans of Action for Sharks should apply the principles of good project management (SMART = Specific, Measurable, Appropriate, Realistic and Timebound) to help direct research activities, align these with activities initiated by CPCs in their national waters and to provide scientific justification for NDFs for CITES App II listed species for use by all CPCs. Taking a regional approach to the sustainable removal of sharks in the IOTC Area of Competence, whether taken as an incidental bycatch or a sustainably managed stock of commercial interest should always integrate the bycatch mitigation hierarchy to manage shark mortality, but for those species of commercial interest proactive development of MSE tested Management Procedures should also be initiated.

Further research should focus on minimisation of shark bycatch and particularly the bycatch of threatened sharks for the three most widely used gear types, prioritizing the avoidance or at least the minimisation of catch of critically endangered and endangered elasmobranchs.

2.1.1. High bycatch mortality of juvenile sharks mandates research into bycatch avoidance and minimization supplemented by mortality remediation through best handling and release technologies

The following example demonstrates an area where further research is needed to reduce mortality of juvenile sharks caught as bycatch when purse seine fishing vessels set on dFADs. Due to the association of juvenile silky sharks and oceanic whitetip sharks with floating objects this fishing practice results in large bycatch quantities of juvenile sharks and is specifically high in the Indian Ocean (Clavareau et al. 2020). High on-board mortality and low post release survival rates of these juvenile sharks require future scientific research into avoidance and minimization of silky shark bycatch. The table below summarises bycatch quantities and dead discards in one of the largest dFAD purse seine fleets in the Indian Ocean based on data submitted by the European Union to the IOTC Secretariat in the 2024 National Report.

EU Member State	No of vessels in 2023	Shark species	2021	2022	2023
		Number of animals	Dead discards / live releases	Dead discards / live releases	Dead discards / live releases
Observer coverage %			(44%)	(25%)	(45%)
France	11	FAL	1949 / 1235	3014 / 1987	3360 / 2257
		OCS	6 / 18	9 / 31	25 / 101
		not further specified *Carcharhinidae*			7 / 12
Observer coverage %			(24%)	(40%)	(29%)
Spain	14	FAL	1621 / 3910	894 / 2223	2200 / 2870
		OCS	20 / 7	14 / 5	41 / 145
		not further specified *Carcharhinidae or Carcharhiniformes*	11 / 0	0 / 1	44 /12
Observer coverage %			n/a	n/a	100%
Italy	1	FAL	n/a	n/a	530 / 200
		OCS	n/a	n/a	11 / 12
		not further specified *Carcharhinidae*	n/a	n/a	704

Table 1: Overview on reported discards in EU purse seine fisheries as reported as part of the EU National Report 2024

In the Spanish purse seine fleet 60-70% of silky sharks are reported to have been released alive while live releases from the French fleet only remain around 40% despite similar observer coverage. For oceanic whitetip sharks the percentage of live releases ranged between 75 and 80% for both fleets. The Italian vessel had 100% observer coverage and provides additional differentiation of sharks released alive as either intermediate or alive with a total live release ratio for silky sharks of less than 40%. Assuming that "intermediate condition" at time of release describes animals that are most probably subject to very high post release mortality and in view of the also substantially lower live release rate of only 50% reported for oceanic whitetip sharks by the Italian vessel the following concludes.

- Dead discard ratios are known to vary between species and oceanic whitetip sharks are reported to be more robust than silky sharks (Sabarros et al. 2023). However, substantial differences in dead / live ratios are also observed between fleets and further vary within the same fleet between years. This could either be indicative of varying efforts taken in applying best handling and release practices or the result of significant differences in bycatch and age composition in different fleets, as younger i.e. smaller silky sharks are known to be less likely to survive the brailing process and exposure once on board of the purse seine vessels. (Hutchinson et al. 2015) and larger bycatch numbers will result in less time available to apply best practices for each animal.

- Silky shark bycatch in purse seine fleets remains concerningly high with a projected bycatch rate of 1,000 – 2,000 animals per large purse seine vessel each year, when estimating bycatch based on data from EU fleets at an observer coverage of 25 – 45% while the EU fleet has been the only fleet submitting discard data in its National Reports as requested (IOTC SC 2024; EU National Report).
- Other CPCs fishing on purse seine should be expected to have at least similar bycatch rates although neither Oman (2 large vessels in 2023), nor Mauritius (5[1] large vessels in 2023) nor Seychelles (13 large vessels in 2023) have reported silky sharks or oceanic whitetip sharks as bycatch in their purse seine fleets (neither retained nor discarded) for 2023 in their National Reports. Korea (2 large vessels in 2023) reported only 9 metric tonnes of silky sharks as discarded in 2023 but without indication of the status at the time of discarding and Indonesia (205 small to mid-size purse seine vessels in 2023) reported neither any silky shark bycatch nor the fate of such bycatch in its National Report. This section of the report is obligatory to complete by all CPCs.
- For these 48 large scale purse seine vessels bycatch rates of juvenile silky sharks can reasonably be expected to easily exceed 100,000 animals per year as previously estimated for the Indian Ocean purse seine fleet (Ziegler 2022b) and this doesn't even account for silky shark bycatch in the Indonesian purse seine fleet in which silky sharks are often retained with observer coverage, if any, being very low. These numbers also don't include the percentage of very small silky sharks of less than 100 cm respectively less than 85 cm caught when setting on dFADs, that Perez San Juan et al. reported are unlikely to be found even when human observers are on board. These very small sharks were only detected as part of an extensive, scientific port sampling program conducted at Port Victoria, Seychelles between 2021 and 2022 for the Spanish purse seine fleet. The authors extrapolated an additional silky shark bycatch rate of at least 6,313 animals at a sampling rate of 16 % of all fishing operations (Perez San Juan et al. 2021 & 2024). Forget also estimated that on-board observer reports may underestimate silky shark bycatch by 50 – 81% (Forget et al. 2021)
- Other ETP species are also a regular bycatch in purse seine fleets especially when vessels are setting on dFADs but these bycatches have so far not been much compiled. This includes mantas and devil rays, pelagic stingrays and several threatened shark species such as hammerhead sharks, thresher sharks and not further differentiated Carcharhinidae sharks, demonstrating that additional bycatch reporting at species level should also be required for purse seine fleets. (IOTC SC 2024; EU National Report)

2.2. Gear modifications as an effective output control to minimize the mortality of endangered, threatened and protected (ETP) sharks

Res 25/08 Para 15 requires that "*In order for any CPCs to continue to use wire trace north of 20S at least one CPCs will undertake scientific fishing trials to assess the effects of leader materials on the mortality of vulnerable shark species (including oceanic whitetip shark, silky shark, shortfin mako and thresher sharks) and blue sharks*" and that the design of the study has to be presented to the Scientific Committee for approval in 2025.

Many studies have been conducted in other ocean basins and mainly in the Western Central Pacific, demonstrating the potential to reduce shark mortality when banning the use of wire traces. In a workshop conducted by the IOTC WPEB in 2024 global experts from all ocean basins reviewed the available studies on the use of leader material and the use of hook shapes (IOTC WPEB(DP) 2024) and concluded the following in the report.*"WPEB NOTED on the basis of its review of global research that a prohibition on the use of wire leaders and shark lines by longline and other fisheries operating in the IOTC would likely result in a reduction in both the observed catch and the fishing mortality of shark species*." However, no political consensus was possible to accept this conclusion at the 2025 Commission Meeting and the adopted Resolution 25/08 now requests as a compromise that a scientific study should be conducted in 2026 comparing shark mortality for different leader materials, applying a study design that has to be approved by the Scientific Committee in 2025, and reporting study results to the Scientific Committee in 2027.

[1] One vessel started operation only in December 2023

This study design should of course follow best scientific practice and exhibit a balanced study design with a sufficiently large sample size, while keeping all other variables of the fishing trials constant in both groups. Differences in these other set characteristics and different catch composition in different fishing areas could distort outcomes and create bias, resulting either in higher or lower overall shark mortality for each type of leader material. In this regard the habitat distribution of the respective shark species of concern and the areas where the species is typically caught need to be addressed in the study design. The study therefore needs to be conducted over an area not only limited to North of 20° South since main fishing efforts for blue sharks within the IOTC Area of Competence and expected bycatch of other shark species is concentrated South of 20° South, in the area between 20° South and 40° South, as depicted in the Figures below. These effort distributions are taken from the National Reports of the French longliner fleet, the Spanish longliner fleet and the Portuguese longliner fleet operating in the Indian Ocean and highlight where main fishing efforts take place. Especially fishing efforts for swordfish and blue sharks catching also substantial numbers of endangered shortfin mako sharks are almost exclusively located South of 20° South. Effort distribution should also be considered for all other longline fleets to ensure all areas with substantial shark catches are included into the study.

Figure 1 shows the sets of French longliners in the IOTC area for 2023 extending to South of 20° South and Figure 3 shows the nominal catch efforts of the 14 Spanish longline vessels in 2023 comparing these with the efforts of the years 2019 – 2023, that show that a clear shift of fishing efforts and shark catches towards more Southern latitude regions has occurred. At a reported catch of 285, respectively 397 mt of shortfin mako sharks in 2022 and 2023, shortfin mako shark catches totaled to more than 10% in weight of the catch of blue sharks. Overall catch composition of the Spanish fleet consists of 49% blue sharks, 42% swordfish and 6% shortfin mako (IOTC SC 2024; EU National Report Spain). Figure 2 shows blue shark catches from 2 Portuguese longliners in 2023 targeting swordfish and blue sharks in the area South of 20° South with catches of more than 700 mt of blue sharks. Blue shark catches of the fleet have exceeded swordfish catches since 2021 and shortfin mako sharks are the second biggest shark catch of the fleet although no shortfin mako sharks were by the Portuguese fleet in 2023. (all graphs as displayed in the Annexes to the National Report of the EU for IOTC SC 2024)

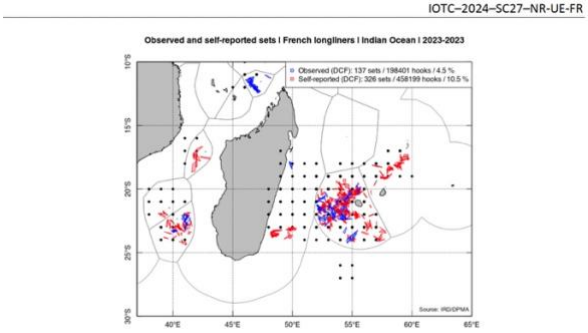


Figure 4b-1. *Carte de la répartition spatiale des opérations de pêche de palangre observées par des observateurs embarqués et l'auto-échantillonnage (programme DCF) pour la Réunion en 2023.*

Figure 1: Fishing effort distribution of French longline fleet in IOTC area of competence in 2023 (IOTC SC 2024, EU National Report, French)

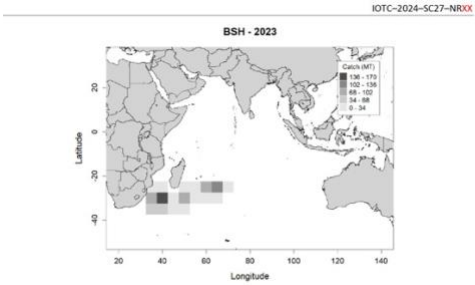


Figure 3a. Map of distribution of the catches (MT) by major species in the IOTC area of competence in 2023: SWO (swordfish) – *Xiphias gladius*; BSH (blue shark) – *Prionace glauca*. Note: different catch scales.

Figure 2: Blue shark catches in 2023 for 2 Portuguese longliners (IOTC SC 2024, EU National Report, Portugal)

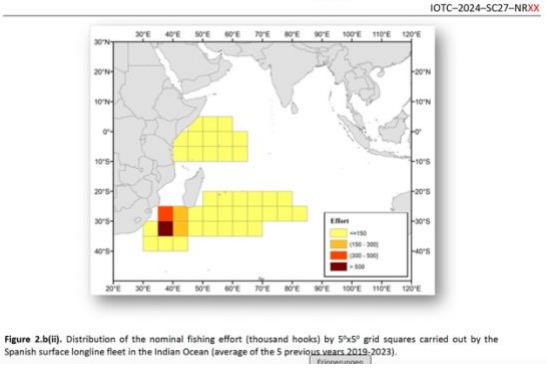


Figure 2.b(ii). Distribution of the nominal fishing effort (thousand hooks) by 5°x5° grid squares carried out by the Spanish surface longline fleet in the Indian Ocean (average of the 5 previous years 2019-2023).

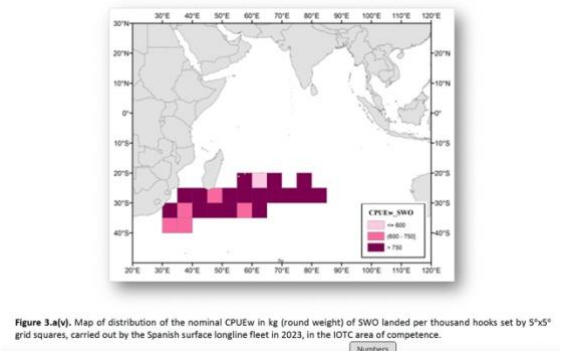


Figure 3.a(v). Map of distribution of the nominal CPUEw in kg (round weight) of SWO landed per thousand hooks set by 5°x5° grid squares, carried out by the Spanish surface longline fleet in 2023, in the IOTC area of competence.

Figure 3: Nominal catch effort distribution of Spanish longline fleet targeting swordfish and blue sharks at IOTC – comparison between 2019 and 2023 and in 2023 (IOTC SC 2024, EU National Report, Spain)

Therefore, key areas for shortfin mako sharks in the South of the Indian Ocean should also be included into the study design to reflect the actual catch efforts and catch composition of the longline fleets in the Indian Ocean. Otherwise, statistical significance of outcomes could be reduced or even misleading, when excluding important shark fishing areas. We therefore suggest to firstly include all fishing fleets that have either reported high catch rates of the respective shark species in past years or to shift the study region to areas with an expected higher presence of all shark species of interest. At least oceanic whitetip sharks, silky sharks, mako sharks, and thresher sharks should be covered by the studied fishing area, as well as blue sharks.

Including shortfin mako mortality into this study will be especially important as despite the clear scientific advice from the Scientific Committee the adopted Resolution 25-09 includes neither a total allowable mortality limit (TAC) nor a quota allocation to reduce mortality by at least 60% compared to the average mortality in the last couple of years. Such a reduction is projected to be required to stop overfishing and start rebuilding of this overfished stock within a time of 10 years providing a 50% probability of success (IOTC SC 2024). However, a probability of only 50% is generally considered being still too low and other commercially valuable stocks have mostly been agreed to require at least a 60% probability. The adopted retention ban applies only to live shortfin mako sharks but allows retention of all dead animals without a limit, as long as there is either an observer on board or the vessel has a functioning EMS (IOTC Res 25/09).

Therefore, assessing the impact of wire leaders on the reduction of mortality of shortfin mako as part of this study will be important but will only be possible if including also the main catch areas for shortfin mako sharks, between 25° South and 35° South.

2.3. Starting output controls as an ‘ad interim’ management of blue sharks in preparation of the development of MSE tested Management Procedures

Res 24/08 Para 26 defines for blue sharks that “*based on the review and the results of the stock assessment to be conducted in 2025, updated reported catch information by each CPC and taking into account the IOTC Scientific Committee’s advice, the Commission shall consider at its 2026 Session specific conservation and management measures for blue sharks, including a total allowable catch, catch limits for each CPC*”.

When assessing the outcome of the 2025 stock assessment for blue sharks the WPEB needs to take into consideration that total mortality information has remained poor due to low compliance with reporting requirements for shark catch data and discard reporting. A precautionary approach should thus be taken when recommending a TAC for this species and projections should require at least a 60% probability for this stock to stay in the green quadrant of the Kobe plot for both, short term and midterm projections. Aware that NOAA 2023 suggests a 70% probability should be applied for the management of pelagic shark stocks, IOTC should not accept a lower probability for this stock than generally applied e.g. for the management of swordfish and tuna stocks by other major tuna RFMOs (e.g. ICCAT Rec 23-04).

Most catches of blue sharks are reported by Indonesia, Taiwan, China, EU-Spain, EU-Portugal, and the Seychelles, but catches are also reported by several other CPCs and have clearly increased over the past

few years as demonstrated in Figure 4, whereas overall reporting compliance as reported by the IOTC Compliance Committee (IOTC CoC 2025) has not improved significantly in the same time.

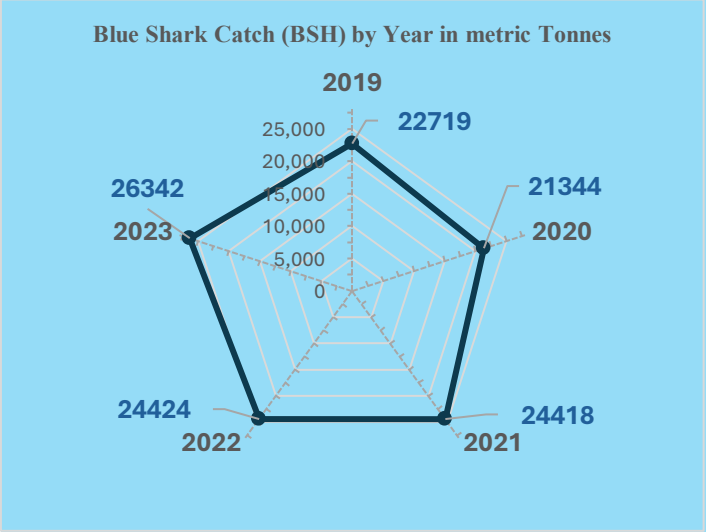


Figure 4: Reported Catches of Blue Sharks for 2019 - 2023 at IOTC in metric tonnes; catch data as reported in IOTC Executive Summaries for blue sharks published as Annex to the SC reports in 2020, 2021, 2022, 2023 and 2024

Therefore, based on the results of the 2025 stock assessment the WPEB and SC should propose an 'ad interim' TAC for blue sharks in line with projections to keep the stock in the Green quadrant of the Kobe plot with a high probability of at least 60% and this TAC should be proposed for adoption at the 2026 Commission Meeting, including an allocation scheme for quotas of major fishing nations, leaving an unallocated margin for mortality as a bycatch in those fisheries that do not retain blue sharks. The ICCAT Rec. 23-10 and Rec 23-11 might be used as a blueprint for the terms for an IOTC blue shark resolution. In addition, the resolution should also include a clause requiring reporting of total mortality including discards by all CPCs retaining blue sharks as a prerequisite for a quota in the following year. While a total limit and quota allocation for blue sharks had already been requested as part of previous IOTC resolutions (e.g. IOTC Res 18/02) the lack of follow up on the defined terms and requirements at WPEB and SC Meetings and the lack of reminding the Commission about such overdue tasks at the next Commission Meeting has repeatedly stalled progress in the past, despite the good intents of the previously adopted resolutions. Therefore, WPEB and SC should this time take the lead and follow up on all scientific tasks, providing clear, science-based recommendations to the Commission for its 2026 Meeting, while also advising managers to take a precautionary approach in the absence of fully conclusive outcomes and results.

2.4. Remediation measures in response to conservation needs and international obligations for the conservation of whale sharks and other threatened migratory sharks

Resolution 25/08 Para 3 requires CPCs to "*ensure that their flag vessels do not retain on board, transship, land and store any part or whole carcass of the following sharks: (1) oceanic whitetip sharks; (2) thresher sharks; and (3) whale sharks*" but the new retention ban for whale sharks will only come into effect on 1 July 2026, "*and only if the IOTC Scientific Committee explicitly and unambiguously recommends, in accordance with paragraph 43 of this Resolution, a retention ban for whale sharks*".

The SC needs to explicitly confirm that this retention ban should come into place, following the example of ICCAT that had adopted a retention ban for whale sharks in its 2023 Commission Meeting (ICCAT Rec 23-12) provided that its Scientific Committee would confirm in its 2024 Meeting that whale sharks qualify as "*a taxon of the greatest biological vulnerability and conservation concern for which there are very few data*".

Whale sharks (*Rhincodon typus*) are one of only six elasmobranch taxa listed on CMS App I which lists migratory species that are thought to be threatened with extinction, and CMS Parties that are Range States to such Appendix I-listed species shall "*prohibit the taking*" of such species, while CMS also

considers flag vessels that fish outside national jurisdictional waters but interact with listed migratory species to also be a Range State (CMS). Whale sharks are also listed on the MOU Sharks and are currently listed on CITES App II therefore requiring an NDF for introduction from the High Seas and export to confirm that the removals from the wild do not threaten the survival of the population in the wild and/or performing its function in the ecosystem (CITES).

Whale sharks are highly vulnerable to overfishing due to their slow growth, late reproductive maturation, and extended longevity, which leads to an increased likelihood of population decline. Two populations are known to exist that rarely mix between the Atlantic Ocean and Indo-Pacific Ocean and 75% of the global whale shark population is believed to occur in the Indo-Pacific, with only 25% estimated to occur in the Atlantic. Detailed data on its biology and global distribution remains however limited. (Ellis et al 2024)

The population of whale sharks has been subject to an overall decline of 63% in the Indo-Pacific over the last 75 years (three generations), resulting in a subpopulation assessment of Endangered. Therefore, *Rhincodon typus* is globally listed as Endangered under criteria A2bd+4bd with a decreasing population trend due to decreasing numbers of mature animals. Major contemporary threats to whale sharks include fisheries catches, bycatch in nets, and vessel strikes. (Pierce et al 2016). The 2021 IUCN green list assessment rates the species as 'largely depleted' requiring concerted and sustained conservation efforts to allow the population to recover within the next 100 years. (Pierce et al. 2021)

Although whale shark has been one of the first elasmobranchs listed on CITES App II in 2003 the global situation of the species has continued deteriorating and therefore whale shark is now proposed to be transferred from App II to App I at the CITES COP in Uzbekistan in 2025 as NDFs by exporting nations have often not been based on sound scientific evidence. The proposed listing transfer also highlights concerns that international trade is the main driver for the declining populations of this species.

While the Atlantic subpopulation appears to be less threatened than the Indo-Pacific subpopulation, with an overall population decline of ≥30%, resulting in a subpopulation assessment of Vulnerable A2b+4b the SCRS has unanimously concluded at its September 2024 meeting: "*The available information on whale shark life-history characteristics, conservation status, and paucity of scientific data on whale sharks indicate that whale sharks in the Atlantic Ocean can be considered a taxon of the greatest biological vulnerability and conservation concern for which there are very few data. For the above reasons, the Committee recommends that the Commission give full effect to Rec. 23-12. Given the dearth of data on whale shark interactions in ICCAT fisheries, the Committee considers that it is particularly important to comply with the reporting provisions in paragraph 5 of Rec. 23-12.*"

WCPFC had already adopted a retention ban for whale sharks in 2012 (WCPFC CMM 2012-04) which came into effect in 2014 prohibiting the retention of whale sharks and requiring their safe release from the net if encircled accidentally and requires the reporting of the animal's condition at time of release.

Therefore, the IOTC WPEB and SC could not possibly come to a different conclusion especially as whale sharks are already protected by national regulations in many CPCs. Although the IOTC has so far not generated a species summary for this species, this omission should also be corrected to monitor the status of this endangered species which interacts especially with purse seine and gill net fisheries in the Indian Ocean.

In addition, Res 25/08 calls to the Scientific Committee to review annually which other shark species might be in need of specific protection through a prohibition of their retention, mentioning explicitly silky sharks, mako sharks and hammerhead sharks.

Silky sharks have no recent stock assessment as an attempt to perform an assessment in 2018 had failed. A new attempt is planned for 2026. At IOTC most catches of silky sharks listed as IUCN Vulnerable are taken by Iran and Pakistan, each reporting several hundred tonnes, followed by Taiwan, Sri Lanka and Madagascar. Both, WCPFC and ICCAT have banned the retention of silky sharks.

At IOTC critically endangered great hammerhead catches of about 10 tonnes per year are reported by Comoros and critically endangered scalloped hammerhead sharks are taken by a series of fisheries with both, Sri Lanka and Kenya reporting several hundred tonnes per year (almost 500 tonnes by Kenya in 2022). Oman reports about 200 tonnes of IUCN vulnerable smooth hammerheads per year and Indonesia reports between 1,600 and 2,000 tonnes of unspecified hammerhead catches per year by its coastal but also by its industrial fleets. The stock status of hammerheads at IOTC is unknown and although an assessment of scalloped hammerheads is planned for 2026 the outcome is highly uncertain in view of

the lack of reported mortality in the past and the absence of species-specific data in most fisheries (Ziegler 2024). ICCAT has banned the retention of all but one species of hammerhead sharks.

Other sharks listed on both CMS App I and CITES App II include endangered basking sharks (*Cetorhinus maximus*) and vulnerable great white sharks (*Carcharodon carcharias*). While the range of great white sharks spans all oceans basking sharks are reported in the Indian Ocean only for Southern Australia, Indonesia, and for South Africa (Ebert et al. 2013, Fahmi and White 2015), but both species can reasonably be expected to interact with at least some IOTC fisheries and should therefore also be assessed, whether they could potentially benefit from a future retention ban. Furthermore, critically endangered sand tiger sharks (*Carcharias taurus*) have been listed on CMS App I in 2024 requiring all Range States to prohibit their take and sand tiger sharks are distribute circumglobally (SEAFDEC 2016; Tyabji et al. 2020) and have been reported to interact with several IOTC fisheries.

In summary all species protected by international conventions should be assessed by the Scientific Committee and proposed for addition to the IOTC list of species of which the retention is prohibited.

2.5. Remediation of shark mortality by improving best handling and release practices for sharks – a review of existing state of the art

Resolution 25-08 Para 11 requires that "*CPCs shall ensure that their flag vessels, when a shark is released, release the shark as soon as practically possible, taking into consideration the safety of the crew and observer, in accordance with the Minimum Standards for Safe Handling And Live Release Procedures set out in* ***Annex III****. The IOTC Scientific Committee shall review these Minimum Standards by 31 December 2025 and provide recommendations to the Commission on further improvements of the Minimum Standards for consideration and adoption at its annual Session in 2026*."

Over the years many practices for the release of unwanted shark bycatch have been developed and tested to allow them to be released as unharmed as possible. In this context it should be noted that the effectiveness of applied measures always depends on the specific gear, species and how well trained crew members are in applying the respective measures, but mostly how much time and effort they are able and willing to dedicate towards the unharmed release of sharks, as such release efforts always compete with other tasks that have to be performed during hauling of the catch and further processing once the catch is on board of the vessel.

As an overarching rule, releasing the sharks while still in the water, releasing them as quickly as possible and if they have been brought on board prioritising their release as fast and gently as possible are key to reduce on-board mortality and increasing chances of post release survival. As such a sufficient number of crew members being able to focus on releasing bycaught sharks, having adequate tools or even better technical features readily available for release, and of course the number of animals requiring release at a time are decisive success parameters. Therefore, avoidance of catching sharks in the first place should always be given priority over the release of unwanted sharks following the well-established hierarchy of bycatch mitigation.

However, once a shark has been caught limiting the time prior to release and ensuring the application of best handling practices for release are imperative for reducing on board and post release mortality.

While some guidance has been adopted by most RFMOs and included in either specie-specific or overarching shark CMMs, existing guidance remains mostly vague, fully voluntary, and does in most cases not even provide gear or species-specific advice that can be pursued by the crew. No mandatory bycatch release technologies are required when commissioning new vessels and equipping them for operation. Often measures differ between RFMOs and sometimes even contradictory, while most of them are not mandatory and always condition to prioritising the safety of the crew and to not compromising other procedures on board.

More detailed guidance has recently been summarized by scientists (IATTC SAC-15-11 2024) based on decades of field work and fisheries' experience and should be considered as a compendium of best handling and release guidance that can be applied across all oceans, including IOTC. Several other scientists have published additional gear specific measures mostly for purse seiners and longline vessels, but continuous review and updates should be done as part of a periodic review of the new resolution.

Provided guidance should be as practical and easy to perform as possible but indeed be as prescriptive as possible and the crew must be trained in their application. All required equipment and tools should

have to be on board of the vessel and ready to be used before starting the setting or hauling of fishing gear.
The bycatch compendium compiled by the scientific staff of IATTC has been translated into specific requirements of "Does" and "Don'ts" for this year's Scientific Committee Meeting of IATTC (IATTC SAC-16-10) representing a state-of-the-art approach while at the same time straight forward to apply.
And while safety of the crew should of course always be a priority it should not be used to avoid having to apply existing best practice or be used as an excuse to avoid the loss of target catch or to avoid extra efforts as needed to release bycaught sharks as quickly and safely as possible. In this aspect also some recommendations included in Res 25-08 should therefore, be reviewed and revised by more appropriate guidance as provided in IATTC SAC-16-10.

2.5.1. Best handling and release practices for whale sharks

Resolution 25-08 Para 29 determines "*that best practice guidelines for the safe release and handling of encircled whale sharks are to be developed by the IOTC Scientific Committee by 31 December 2025 and subsequently submitted to the Commission for consideration and endorsement at its annual Session in 2026.*"

As whale sharks have been of specific concern for many years and require different handling procedures due to their large size and weight IATTC, ICCAT, and WCPFC have already adopted best handling and release practices for whale sharks for purse seine nets that should also be considered by IOTC. Hutchinson et al have summarised generally recognised practices in 2025 in SAC-16-10 – Shark Best Handling and Release Practices – REV 7 and provided detailed descriptions for best release practices based on several other authors and researchers (see also Escalle et al. 2016 & 2018; Hutchinson et al. 2020). ICCAT's Rec 23-12 (in effect since 2025) recommends in its App I similar measures for the safe handling of incidentally caught whale sharks which together could be summarised, as

- leaving whale sharks in the water for release.
- prioritizing release of whale sharks prior to brailing or when the shark surfaces.
- if head of the animal points to the stern of the boat, having a crewmember to open the net and/or cut a few meters of net in front of the shark's mouth to release it.
- if head of the animal points towards the bow of the boat, the crew in charge of the net hauling operation could maneuver the winch and the capstan to bring the whale shark close to the hull, then stand the animal on the net to roll it outside the sack corkline. If the individual does not go out of the net by itself, a rope can be placed under the animal and attached to the float line to help rolling the animal out of the net
- Small whale sharks of less than 2 m 'brailing' may be used to release the animal from the net without bringing it on board

Both sets of best handling and release guidance warn, **NOT** to (SAC-16-10)

- bring the animal on board of the vessel regardless of size.
- start the brailing process for the catch while the shark is still in the purse seine net
- attempt brailing sharks of more than 2 m for release
- pull or tow a whale shark by the tail or caudal peduncle or by a loop hooked around its gills
- to leave towing ropes attached to the trunk of the animal
- to gaff whale sharks or bore holes into a fin

WCPFC suppl_CMM 2024-05-1 provides specific advice for the safe release of encircled whale sharks encircled in purse seine fisheries and since 2015 requires "*that when a whale shark is encountered in a purse seine net in PNA waters the net roll must be immediately stopped"* to release the whale shark.

2.5.2. Best handling and release practices for sharks – gear specific advice

Resolution 25/08 Para 24 determines "*The IOTC Scientific Committee shall review these Minimum Standards by 31 December 2025 and provide recommendations to the Commission on further improvements of the Minimum Standards for consideration and adoption at its annual Session in 2026.*"

At tuna RFMOs the most commonly used gear types resulting in shark bycatch are pelagic longlines, purse seine nets, and gill nets, while other gear types such as pole and line or handlines may also cause shark bycatch although at a lower degree and usually are also associated with overall smaller catch sizes, more direct interaction of the crew with the catch, and better possibilities to quickly release individual sharks. Overall, however the same principles and measures as described for the other gear types also apply.

2.5.2.1. For purse seine vessels

Sharks caught as a bycatch during purse seine fishing generally face high at vessel mortality and chances of survival strongly depend on when in the fishing process sharks are brought on board but also on the age respective size of the sharks. Juvenile silky sharks show the highest mortality rates and are the main shark bycatch when purse seiners are setting on dFADs, making up for 0.2 – 2% of the total catch by weight with 30 – 60% on board mortality and 60 – 90% overall mortality due to low post release survival rates, as a result of the physical stress they had been exposed to during the catch and release process (Filmalter et al. 2013; Poisson et al 2014a; Eddy et al. 2016; Grande et al. 2022; Murua et al. 2022).

Oceanic whitetip sharks may also be caught during purse seine fishing but have been reported to be subject to lower on-board mortality rates and higher post release survival rates, being generally less fragile than silky sharks (Sabarros et al. 2023). Hammerhead sharks, bull sharks, tiger sharks and other shark species may also be caught as a bycatch in purse seine nets but are less commonly observed while mobulids and devil rays in dependence of the fishing area are also species of concern in purse seine fisheries. The PNA purse seine fishery in the WCPFC reported 3,485 interactions with oceanic mantas between 2019 and 2021 with only 15.8% of the animals having been released alive (MSC PNA 2024). Therefore, applying best handling and release practices tailored to these species, e.g. as described in the recently adopted ICCAT conservation measure (ICCAT Rec 2023-14) and the use of manta sorting grids is recommended also by Murua et al in a species specific compilation of best handling and release practices for purse seine fisheries that spans sharks, mantas and mobulids, whale sharks and large cetaceans, and sea turtles. (Murua et al. 2024)

Survivorship is always compromised once the sharks are confined in the sack (Poisson et al. 2014; Hutchinson et al. 2015; Eddy et al.2016) and are further compromised when the sharks end up in the lower well decks. Especially juvenile animals need to be returned back to the water as quickly as possible to limit the increase of blood lactate levels when no longer free swimming and to reduce physical stress when buried under the weight of the tuna catch. (Hutchinson et al. 2015, Onandia et al. 2021). Hutchinson et al. (2024) summarised post release survival rates from studies across all oceans demonstrating decreased chances of survival for later stages of the purse seine fishing process and therefore IATTC SAC-16-10 provides best handling and release recommendations based on these studies specific for each stage, from the net hauling stage, the sacking up stage, and the brailing stage, where fish are brought on board.

(1) Releasing silky sharks and other sharks from the open net while still free swimming would maximise chances of survival based on all existing studies but is not applied in routine processes as too difficult and strongly weather dependent (Restrepo et al. 2018)

(2) Survival rates of sharks entangled in the net during haul back can still be higher than 80% (Poisson et al. 2014a; Hutchinson et al. 2015; Onandia et al. 2021) if the sharks are released early in the net hauling process and returned to the sea immediately.

Therefore,

- the net area containing the entangled shark, should be rolled over the turntable and then the main boom should be moved to starboard or to port (depending on the vessel's orientation) and the net should be rolled back (or 'dropped') so that the shark is lowered to the deck and not thrashing in the air on a rolling vessel. (SAC-16-10)
- Once the net has been dropped and the entangled shark is lowered to the deck the crew should safely cut the net away from the animal. (SAC-16-10)
- Sharks should be maneuvered into a stretcher/cradle or ramp immediately and take them to the opposite side of the vessel from the net for immediate release. (SAC-16-10)

- If a portable or fixed ramp is available for release this should be wetted and the sharks can be released via this device directly to the sea. The use of the ramp can reduce time on board to about 2 minutes showing similar on deck mortality as previously reported by Onandia et al (2021) and an increased chance of post release survival for both silky sharks and oceanic whitetip sharks, thereby providing a cheaper alternative to double conveyor belts although so far sample size for these portable release ramps has been very limited (Murua et al. 2025)

(3) Survival rates of sharks that are present on the top of the sack and are brought on board during the first few brails are substantially higher than for those brought on board in later brails. Survival rates are seriously compromised once the animals have entered the loading hatch and release is initiated from the lower (well) decks (2022 Poisson et al 2014a; Hutchinson et al. 2015; Eddy et al. 2016; Onandia et al. 2021; Grande et al. 2022).

(4) The presence of double conveyer belts for the separate release of bycatch allows for immediate and safe release handling of sharks by limiting their exposure to air and the weight pressure they are exposed to during the brailing process to a few minutes. This has been proposed to substantially reduce at vessel mortality and to also improve post release survival. (Onandia et al. 2021, Grande et.al 2022)

Therefore,

- Vessels should, whenever possible separate bycatch on the working/main deck before passing the loading hatch (SAC-16-10)
- Effective bycatch separation methods and Bycatch Reduction Devices such as double conveyer belts or hoppers with a controlled door and a ramp extension (Murua et al. 2022; Onandia 2021; Poisson et al. 2014b) should be installed on board and mobile devices should be used on smaller vessels. Alternatively mobile devices that can be connected without the need of human handling of the animals such as suggested by Murua et al. (2025) could be used.
- Maneuver sharks into a stretcher/cradle or ramp immediately and release it on the opposite side of the vessel from the net. (SAC-16-10)
- In cases when the passage of sharks through the loading hatch can't be avoided, sharks should be released as quickly as possible (e.g. via a bycatch waste chute, or via using stretchers). (SAC-16-10)

The following should **NOT** be done when handling sharks (SAC-16-10)

- Roll sharks through the power block.
- Use gaffs or hooks to maneuver sharks.
- Leave sharks abandoned on deck.
- Hang sharks by the tail.
- Drag sharks across the deck by the tail.
- Allow visible sharks to pass through the loading hatch

Tools on board and ready to use when starting the net haul include (SAC-16-10)

- Stretcher or cradle.
- Portable release ramp that can be attached to a release door and wetted with an attached hose (Murua et al. 2025)
- Bycatch sorting devices for work deck/main deck (e.g., hopper with a door, ramp).
- Bycatch/waste chute on lower/well deck

2.5.2.2. For longline vessels (also applicable to other surface fleet fisheries)

Over the last 15 years several studies have been conducted across ocean basins to assess shark mortality and post release survival rates in longline fisheries including reviews of different gear modifications (IATTC SAC-15-11corr; IATTC SAC-16-10; IOTC WPEB(DP) 2024; Bowlby et al. 2020; Francis et al. 2023; Hutchinson et al. 2021; Musyl & Gillman 2018)

Most studies showed that removing sharks from the water for gear removal reduces survival rates and increases time to recovery (Bowlby et al. 2020, Campana et al. 2016, Hutchinson et al. 2021) while stress and air exposure is reduced when animals are not lifted on board especially for larger vessels with

a freeboard of > 1 meter where fishermen can't directly reach the waterline with their hands, thereby requiring gaffing for handling of the animals when bringing them on board.

Studies have also shown that the amount of trailing gear left on an animal has a negative effect on post release survival and causes delayed mortality rates for multiple species (Francis et al. 2023; Hutchinson et al. 2021).

Therefore, SAC-16-10 recommends:

- Slow the vessel and line hauling rate (if applicable) to bring the shark alongside the vessel for identification and removal of gear.
- Avoid bringing sharks on board for gear removal, if possible.
- If attempting to remove hooks, use pliers or dehookers or long-handled de-hookers for vessels with high freeboards (i.e. > 1 meter).
- When hooks are not removed, use line cutters to cut the line as close to the hook or mouth as possible leaving no more than 1 meter of gear attached to the animal and ensuring that weights are removed.
- If sharks must be brought on board for gear removal (should only be done if freeboard is less than 1 m)
  - Use a net, lasso or second point of attachment to help lift them onboard
  - Maneuver shark using manual restraint of the pectoral fins and the caudal peduncle (this may require two crew members depending on the size of the animals)
  - Use a stretcher or cradle for handling and restraint for the safety of the crew and to reduce injury to the animal.
  - Return the animals to the sea as quickly as possible.

The following should **NOT** be done when handling sharks (SAC-16-10)

- Use drag or lazy lines or drag sharks behind the vessel until the hook rips free of the jaw or until the animal is easier to handle.
- Electrocute or stun sharks.
- Lift sharks onboard without a net or second point of attachment to support the weight of the animal, noting it is not recommended to lift sharks onboard the vessel.
- Attempt to remove a hook from a live shark if the hook is not visible.
- Cut into or damage the jaw to remove hooks.
- Lift or maneuver sharks by the gill slits, or spiracles.
- Insert gaffs, hooks, or similar instruments into the bodies of live sharks.
- Lift and drop sharks from the vessel height to rip the hook from the shark's jaw.

Tools on board and ready to use when start to haul the line(s) (SAC-16-10)

- Net
- Pliers
- Short handled de-hooker
- Long-handled de-hooker (equal or greater in length than the vessel's freeboard)
- Line cutter- capable of cutting through all lines used in the gear
- Long-handled line cutter (equal or greater in length than the vessel's freeboard)
- Wire/bolt cutter capable of cutting all hooks used on the vessel
- Stretcher/cradle

2.5.2.3. For gillnets

Gillnet fisheries are usually multispecies fisheries and may include also the use of other gear on board. Bycatch rates and mortality of sharks and rays are usually high, and chances of survival mostly depend on species and soak time. However, elasmobranch bycatch is mostly retained and commercialised if not targeted in the first place.

Therefore, avoiding shark bycatch in the first place is the best mitigation measure for gillnets and a study to test the potential of avoidance of elasmobranch bycatch in gillnets in the IOTC Area of Competence has been suggested several times and again at the 2024 WPEB Meeting (IOTC WPEB(AS) 2024) and was also noted by the SC in 2024 (IOTC SC 2024). However, so far, no study design has been discussed or planned by the SC, although available literature has demonstrated that green LED lights in gillnets are not only helpful to avoid sea turtle bycatch (Allman et al. 2021) but also have great potential for reducing elasmobranch bycatch by up to 95%, so reducing the total biomass of elasmobranchs in the catch from 16% to 1% as the animals can see the wavelength of the emitted light and avoid swimming into the nets while the catch of target species is not or only minimally impacted. (Senko et al. 2022) Other studies found orange LED lights to be even more effective in reducing elasmobranch bycatch with CPUEs being most significantly decreased for *Myliobatiformes, Rhinopristiformes* and *Carcharhiniformes* as compared to gillnet catches without illumination. (Burgher et al 2025). In the Mediterranean Sea the use of even cheaper flashing LEDs emitting light of a wavelength of 520 nm also resulted in a significant reduction of bycatch for both, sea turtles and batoids (Snape et al. 2024).

Existing recommendations for best handling and release of sharks that must not be retained and are unwanted is limited as summarised in SAC-16-10 but should at least attempt to:

- Prioritize release of live non-retained sharks.
- Leave sharks in the water for gear removal.
- Carefully cut the net away from the animal, allowing it to swim away from the gear.
- Ensure the weight of the net below the entangled animal is supported during gear removal.

This requires the use of a line cutter capable of cutting through all materials used in the gillnet but thereby the net will be damaged requiring repair, which is often too expensive for small fishing vessels.

Therefore, avoiding elasmobranch bycatch in the first place without compromising other target catch is the most important bycatch mitigation for gillnets. The use of LED lights illuminating the nets and making them visible to elasmobranchs and other ETP species such as marine mammals and sea turtles has shown great potential for multispecies bycatch mitigation via avoidance, respectively minimisation and should thus be prioritised if transition from gillnets to other gear is not an option. With about one third of all tuna catches in the IOTC Area of Competence being made by gillnets and Iran accounting for about 40% of all gillnet catches while India, Pakistan and Indonesia together account for another 38% of total catches (IOTC Multi Taxa Bycatch Mitigation 2022) there is a clear need for action that should also be addressed by the SC when reviewing measures to reduce shark mortality. Specifically, critically endangered hammerhead species are particularly vulnerable to gillnet fishing but also several other pelagic sharks with low chances of survival even if released (Moazzam et al 2022).

2.6. Strengthening finning ban as a remediation measure – annual review of the effectiveness of alternatives to 'Fins Naturally Attached '

Resolution 25/08 Para 11 requires that "*Each year in their compliance questionnaire, the CPC shall report the information on the implementation of the alternatives in paragraph 8:*

- *any enforcement difficulties encountered from observer, electronic monitoring, aerial, boarding, and landing inspection reports;*
- *how monitoring of authorised vessels has been enhanced;*
- *how many vessels used the alternative measures in the previous year;*
- *how compliance is enforced at sea and in port, including how possible incidents of disproportionate fin counts, high grading and species substitution have been addressed.*
- *an explanation of why the fleet has adopted its fin-handling practice; and*
- *any other information Compliance Committee might deem necessary* "

While this is a compliance and not a scientific task, considerations should be taken ahead of the first reporting period for next year's Compliance Committee Meeting to update the compliance reporting templates accordingly. It will be important to ensure that all required information can be provided by the CPCs in an easy to fill but conclusive format in order to allow for timely compilation of all required data by the Secretariat and for review of progress on an annual basis. Only then will a meaningful review

of compliance with the adopted measures and reporting requirements be possible. The effectiveness of the respective alternative measure (if any) chosen by each CPC as announced by 1. September 2025 should be summarized and compared to the acknowledged best practice of landing all sharks with their fins naturally attached in 2026 and 2027 for review of the adopted alternative measures in 2028.

Therefore, the new compliance reporting template could be finalized by the Secretariat and presented to all CPCs for review as soon as possible, ideally at the Scientific Committee Meeting in December for further scientific input before adopting it for use.

2.7. Stipulating better data by closing the gaps in reporting requirements and facilitating compliance with reporting requirements

Resolution 25-08 Para 33 states "*The Commission, on advice from the IOTC Scientific Committee, shall develop and consider for adoption at its annual Session in 2026 mechanisms to encourage CPCs to comply with their reporting requirements on sharks, notably on the most vulnerable shark species as identified by the IOTC Scientific Committee*."

IOTC urgently needs to step up compliance with reporting obligations outlined in Resolutions 15/02 and 15/01, mandating the reporting of all shark catches whether landed or discarded. As a matter of fact, however, so far only very limited discard reporting is available at all and only few CPCs have so far submitted data on discarded sharks as part of their National Reports or otherwise, although the active resolutions require this reporting for all gear types at least for major shark species. Total mortality of sharks in the Indian Ocean is highly uncertain for all sharks including those of substantial commercial value with more as more than 30,000 tonnes of sharks are annually reported as 'nei' (not reported elsewhere) and sharks are often reported only at a highly aggregated level (Carcharhinidae) or even only as 'various sharks'.

The Compliance report summary for 2024 highlights that only 52% of the CPCs fully reported their retained catches across all fishery categories and 33% of CPCs did consecutively not provide data according to reporting obligations. When reviewing the National Reports submitted by CPCs in 2024 not all of the 28 submitted reports include data on discarded sharks and out of the purse seine fishing fleets only the EU and Korea have reported shark discards, suggesting that all other purse seine fleets have either not reported discards or have retained all bycaught sharks (IOTC CoC 2025). However, large purse seine vessels operated by EU companies but flagged to the Seychelles have previously reported silky shark discards for MSC certifications (Ziegler 2022a) thereby exhibiting consistent noncompliance with discard reporting requirements as part of the National Report.

Comparing available discard data for some key shark species for each gear substantial gaps are also apparent for those fleets that claim having close to 100% nominal observer coverage (e.g. large purse seine vessels) whereas the reported discards from longline fleets are, if at all reported, extremely limited by the low observer coverage of only 5% still required by IOTC. No discard reporting at all exists from gillnet fisheries which is partially also due to existing gaps and inconsistencies in reporting requirements for sharks for different gear types.

Resolution 15/02 requires all fleets (including coastal fleets) to submit "*Estimates of the total catch by species and gear, [….] (separated, whenever possible, by retained catches in live weight and by discards in live weight or numbers) for all species under the IOTC mandate as well as the most commonly caught elasmobranch species according to records of catches and incidents as established in Resolution 15/01 on the recording of catch and effort data by fishing vessels in the IOTC area of competence (or any subsequent superseding Resolution)*."

Resolution 15/01 requires the mandatory reporting according to Res 15/02 requirements for the following elasmobranch species per gear type and lists the reporting of additional species only as 'optional'. As outlined in Table 2 the reporting requirements differ substantially by gear type and most species do not have to be reported for all relevant gear types, even when known to be a regular bycatch in those gears. Mantas and devil rays are known to be caught in purse seine fisheries but are still optional for reporting, as well as hammerhead sharks and tiger sharks, bull sharks and other elasmobranchs.

For gillnets silky sharks don't have to be reported at species level and critically endangered scalloped hammerhead sharks only have to be reported at genus level for longline and gillnet fisheries and don't have to be reported at all for purse seine fleets, although most of the 9 different species of hammerhead

sharks can be easily distinguished and especially scalloped hammerheads and silky sharks are a known bycatch in all fisheries, but in gillnet fisheries in particular (Moazzam et al. 2022). As a result of this poor reporting and differentiation requirements most fisheries do not report sharks or simply report them as 'sharks', regardless of whether they are retained or discarded.

For hammerhead sharks there is also a high segregation of catches between areas with juvenile sharks being caught mostly in coastal waters while adults are caught in pelagic waters, both catch operations driven by different gear and fishing dynamics. Therefore, the stock status of scalloped hammerhead at IOTC is unknown and an attempt to perform an indicative stock assessment in 2022 had failed due to the lack of reliable time series and CPUE data (Geng 2022). A new assessment is planned for 2026.

Reporting obligation	Longlines	Purse seine	Gillnets and other surface fisheries	Pole and Line
Mandatory	Blue shark (*Prionace glauca*) - BSH Mako sharks (*Isurus* spp.) - MAK Porbeagle shark (*Lamna nasus*) - POR Hammerhead sharks (*Sphyrna* spp.) -SPN Silky shark (*Carcharhinus falciformis*) - FAL Other sharks - SKH Thresher sharks (*Alopias* spp.) - THR Oceanic whitetip shark (*Carcharhinus longimanus*) - OCS	Whale sharks (*Rhincodon typus*) (in number) - RHN Thresher sharks (*Alopias* spp.) - THR Oceanic whitetip shark (*Carcharhinus longimanus*) - OCS Silky sharks (*Carcharhinus falciformis*) - FAL	Blue shark (*Prionace glauca*) - BSH Mako sharks (*Isurus* spp.) - MAK Porbeagle shark (*Lamna nasus*) - POR Hammerhead sharks (*Sphyrna* spp.) - SPN Other sharks - SHK Whale sharks (*Rhincodon typus*) (in number) - RHN Thresher sharks (*Alopias* spp.) - THR Oceanic whitetip shark (*Carcharhinus longimanus*) - OCS	Sharks SHK Rays
Optional	Tiger shark (*Galeocerdo cuvier*) - TIG Crocodile shark (*Pseudocarcharias kamoharai*) - PSK Great white shark (*Carcharodon carcharias*) - WSH Mantas and devil rays (*Mobulidae*) - MAN Pelagic stingray (*Pteroplatytrygon violacea*) - PLS Other rays	Mantas and devil rays (*Mobulidae*) MAN Other sharks - SHK Other rays	Tiger shark (*Galeocerdo cuvier*) - TIG Crocodile shark (*Pseudocarcharias kamoharai*) - PSK Mantas and devil rays (Mobulidae) - MAN Pelagic stingray (*Pteroplatytrygon violacea*) - PLS Other rays	

Table 2: Reporting requirements for sharks for each gear; information summarised from IOTC Resolution 15-01;

Aligning and completing the list of shark species that require reporting at species level for all fisheries based on existing, documented bycatch composition should be done as a priority and Resolution 15/01 updated in 2026 based on scientific recommendation from the WPEB and SC accordingly. Only species which are difficult to tell apart should be allowed to be recorded at family or genus level and all fisheries should be required to have up to date species identification guides on board to facilitate reporting.

In particular, the following shark species should be included into the list of species mandatory for all gear types

- Silky sharks to be added also for gillnets and pole and line fisheries
- Hammerhead sharks to be reported at species level at least for scalloped, smooth and great hammerhead sharks for all gear types (explicitly including purse seine fisheries)

- Mantas and devil rays to be reported at species level differentiating at least between manta rays (giant manta and reef manta) and other devil rays adding them for mandatory reporting at least for purse seine fisheries and for gillnet fisheries instead of optional
- Great white sharks as mandatory for all gear types
- Oceanic whitetip sharks as mandatory for all gear types

However, it will remain a challenge how to improve compliance with reporting of elasmobranch catch data including discards and success will strongly depend on making it easier for those fisheries that still lack electronic batch logbooks or other electronic reporting facilities. This is especially important for developing Coastal States which often also have long coastlines with poor infrastructure and operate large numbers of small scale fishing vessels that fish exclusively in coastal waters and the EEZs, but are also responsible for substantial elasmobranch catches, many of them being caught as a bycatch in multi-species and multi-gear fisheries but also being deliberately targeted. Therefore, improving reporting compliance should be made a priority and a workshop for Coastal States should be hosted by the IOTC in 2026 discussing alternatives to existing methodology for the reporting and submission of shark data and how the availability of shark catch data could be reasonably be improved. Financial support for such a workshop and resulting measures should be provided from all CPCs as data availability is a key prerequisite to improve assessments of stock status of elasmobranch species at the IOTC and to inform management decisions on required conservation and management measures.

Further reporting requirements on gear specification as outlined in Res 15/01 may also require review and adaptation, especially in support of the additional requirement made in Res 25/08 to report "*the distribution and level of the use of wire leaders and monofilament leaders (and other leader types, if applicable) by CPC.*" The resolution mandates the Secretariat to compile such data by July 2026 and the continued collection of more detailed information on the type of leader materials used in longline fisheries (although the differentiation between monofilament leaders and other leader types has already been required in the past but not consistently be provided) should be better specified:

- Specific type of leaders used per vessel and/or trip including a list of material description as monofilament, multifilament, wire, others to be described (e.g. tared filament) should be required
- Distribution of leader types per set if using more than one type at the same time
- Specification of hook type (J-hook, circle hook, tuna hook and large circle hook) used in combination with each leader type

This would also provide supportive information for the design of the planned scientific study on the impact of leader types on the mortality of vulnerable shark species (including oceanic whitetip shark, silky shark, shortfin mako shark and thresher shark).

3. Conclusion and Recommendations

Adoption of Resolution 25/08 may have been the start for turning the tide for sharks in the Indian Ocean as the Resolution provides scientists with a mandate to assess and develop effective measures to limit shark mortality at IOTC, for both, targeted species and incidental bycatch. Thereby the Resolution also signals the end of an era in which sharks were treated as an "only bycatch" species, exploited without limits a policy that has clearly failed halting the risk of shark extinction in the Indian Ocean.

However, the defined tasks and requested responses from scientists also highlight that there are many gaps that now need to be closed and that adequate resources will be needed to do so. In this aspect it is important to refer to existing knowledge and advice from other ocean basins and to collaborate closely between fisheries scientists and NGOs, to avoid "reinventing the wheel" and instead focus on new research where really needed. This could include additional research for gear modifications and new methods to avoid and minimise shark bycatch, while already established remediation measures from other RFMOs and available state of the art scientific advice should be translated to the Indian Ocean wherever possible.

The tasks assigned to scientists by Resolution 25/08 demonstrate the intent of the Resolution to step up shark management and shark conservation efforts at IOTC, but further guidance and information from scientists is needed to do so successfully.

The best way to address all systematically address, close the existing gaps, drive change on the water and establish a long-term sustainable management of shark populations, would be to establish a systematic bycatch mitigation hierarchy workplan with prioritisation of measures and implementation of SMART objectives to limit the mortality of threatened shark species in combination with the development of MSE tested Management Procedures for commercially targeted species.

While on the long-term time axis an ecosystem-based approach to both, MPs and bycatch mitigation measures, should be the objective, single species approaches may be faster to establish and implement as a short to mid-term strategy and both should be proposed by scientists as part of the long-term shark research project.

Generally, priorities for implementation should be recommended by scientists based on the IUCN threatened status of species, the respective fishing practices and the commercial importance of sharks for IOTC fisheries.

The Resolution provides a unique opportunity for science to take the lead for shark conservation in the IOTC Area of Competence and could even serve as a blueprint for other tuna RFMOs. Therefore, this opportunity must by no means be wasted by falling back into the traditional call for more data and more research as a stand-alone measure but instead should integrate data and scientific research into a systematic hierarchy set up to reduce shark mortality and to systematically review the effectiveness of the implemented and envisioned measures throughout the duration of this project. This project should be timed to continue until a good environmental health and full recovery of depleted stocks has been achieved and/or the implemented measures have proven to be suitable achieving and maintaining such a state for all stocks.

When defining the terms of reference for the envisioned long-term shark project this mitigation hierarchy should be outlined subdividing the overall project into immediate actions that are to be presented to the Commission for approval by next year, further actions to be completed within the next 2-3 years and long-term aspects that are expected running until 2035 with annual updates on the achieved progress.

Following a mortality mitigation hierarchy and aware that many of the discussed tasks are due to be delivered to the Commission for review and adoption at its 2026 Commission Meeting, the split of key recommendations as listed below might help avoiding excessive work, prioritising work on the most important topics for which no precedence exists while referring and endorsing already existing prior knowledge and experience from other ocean basins wherever available and applicable to the Indian Ocean.

Therefore, the objective should be to step up efforts over time, away from an approach focused on Remediation, Compensation and Research & Data Collection towards an approach of Minimisation and Avoidance of mortality that is guided and supported by scientific research. Three phases are proposed for such a project with SMART objectives and deliverables for each phase. These SMART objectives could also be summarised into a Regional Plan of Action for Sharks for the IOTC Area of Competence, that is

- Specific to reducing mortality of elasmobranchs and rebuilding depleted stocks,
- Measurable achievements in relation to an agreed mitigation hierarchy
- Appropriate measures suitable for either commercially fished sharks, or threatened bycatch species, or both
- Realistic to be achieved within the foreseen timeframe of the project and supported by adequate funding
- Timebound including milestones and evaluation / review periods

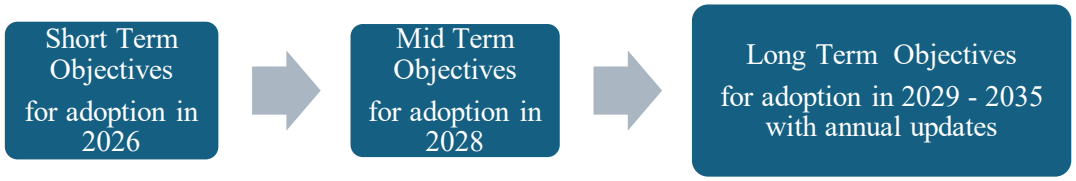


Figure 5: Longterm research project on sharks should be divided into three separate phases, each of which can be performed independently from each other or building up on the outputs and results of previous project phases.

Figure 6 below outlines how the three phases of the project could be structured including tasks and deliverables split over the five categories of the mitigation hierarchy including both, threatened bycatch species and sharks targeted for commercial reasons.

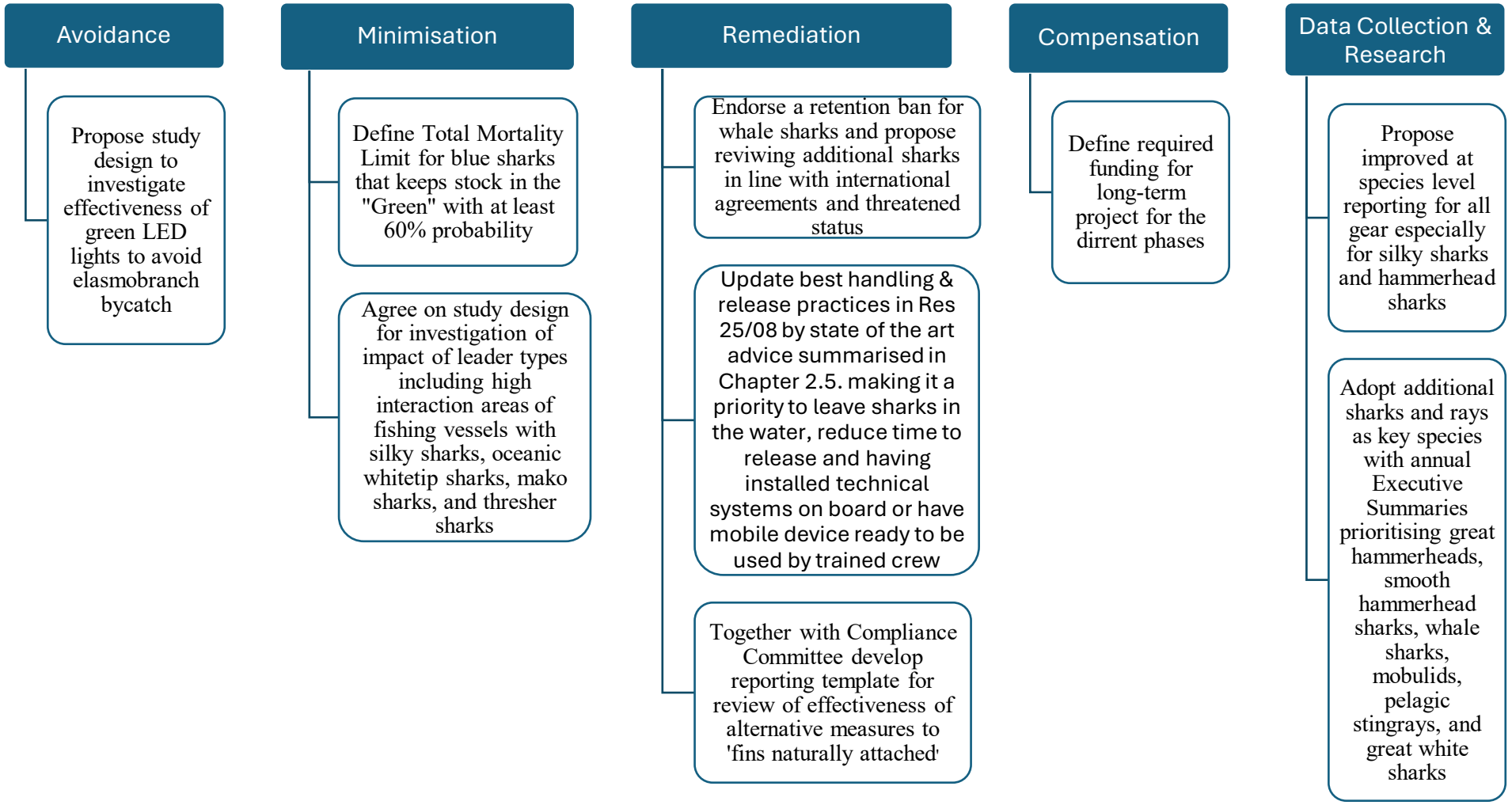
Phase I refers to the requests made in 2025 to the WPEB and SC by the Commission to be presented to the Commission for adoption in its 2026 meeting.

Phase II outlines next steps the scientists should initiate and deliver to the Commission for adoption in 2028 including follow up from actions already defined in Resolutions 25/08 and 25/09 for review and adoption in 2028.

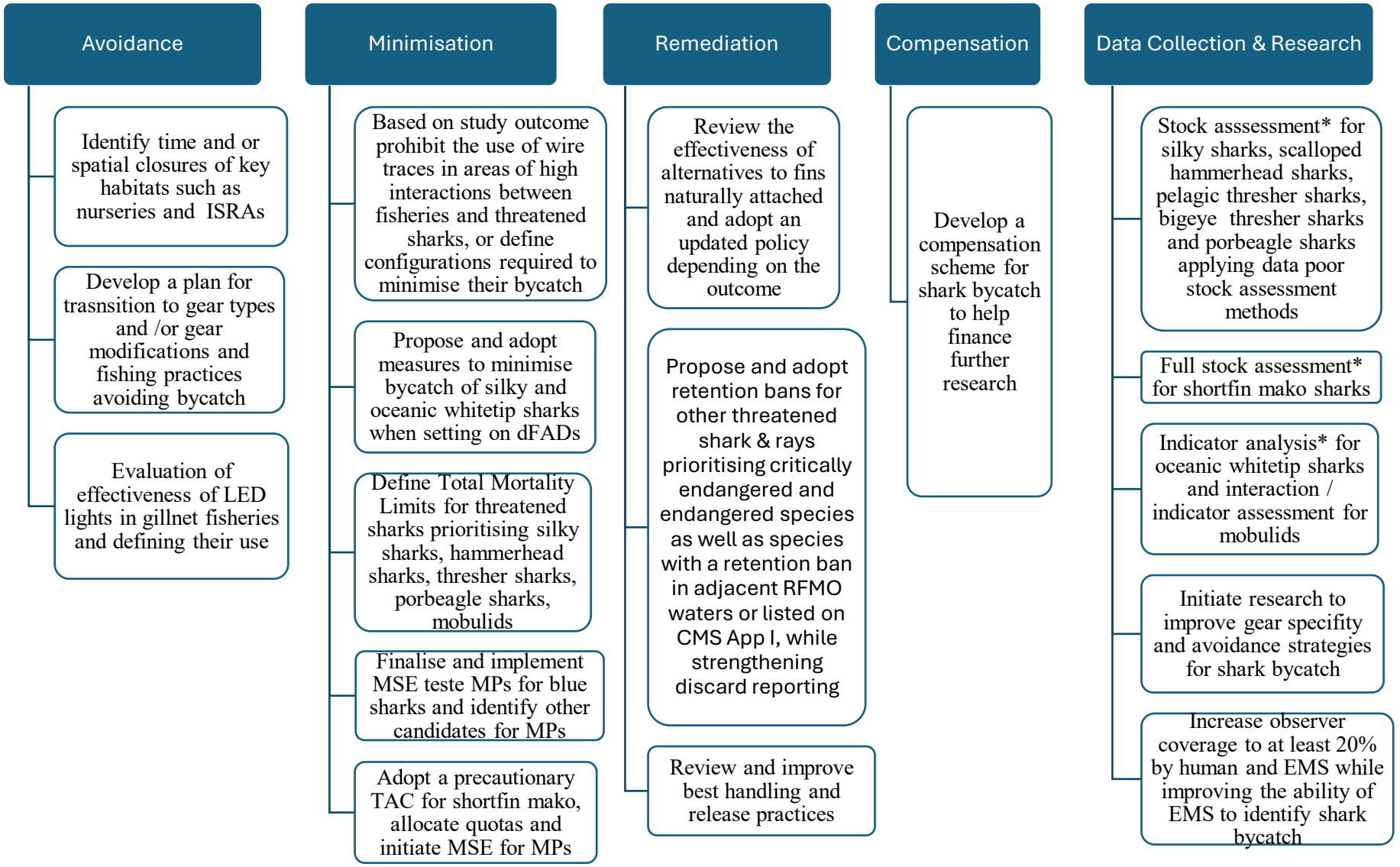
Phase III provides an outlook for the long-term continuation of the science project to effectively reduce shark mortality by application of science-based solutions for the avoidance of shark bycatch and phase out of gear types with high shark bycatch. Measures should pursue an ecosystem-based management and apply a wholistic bycatch mitigation hierarchy for the long-term sustainable management of all elasmobranch populations. Implementing measures informed by science instead of calling for more research marks an essential shift to intercept the vicious cycle that has resulted in about 40% of all elasmobranchs in the Indian Ocean being threatened by extinction (Pollom et al 2024).

In summary, Resolution 25/08 lays out a path that scientists should now endorse to go to finally change the tide for sharks at IOTC and transform IOTC from a tuna RFMO that has been lagging behind for many years into a role model for other RFMOs to also follow to restore healthy and resilient ecosystems. Resilient marine ecosystems depend on healthy elasmobranch populations but are essential to support global food security and livelihoods, to help combating the negative impacts of global warming and climate change, and other ecosystem services that strongly depend on resilient marine ecosystems.

Short Term = Phase 1 2025/2026



Mid Term = Phase 1I 2026 - 2028



Long-term = Phase III 2029 - 2035

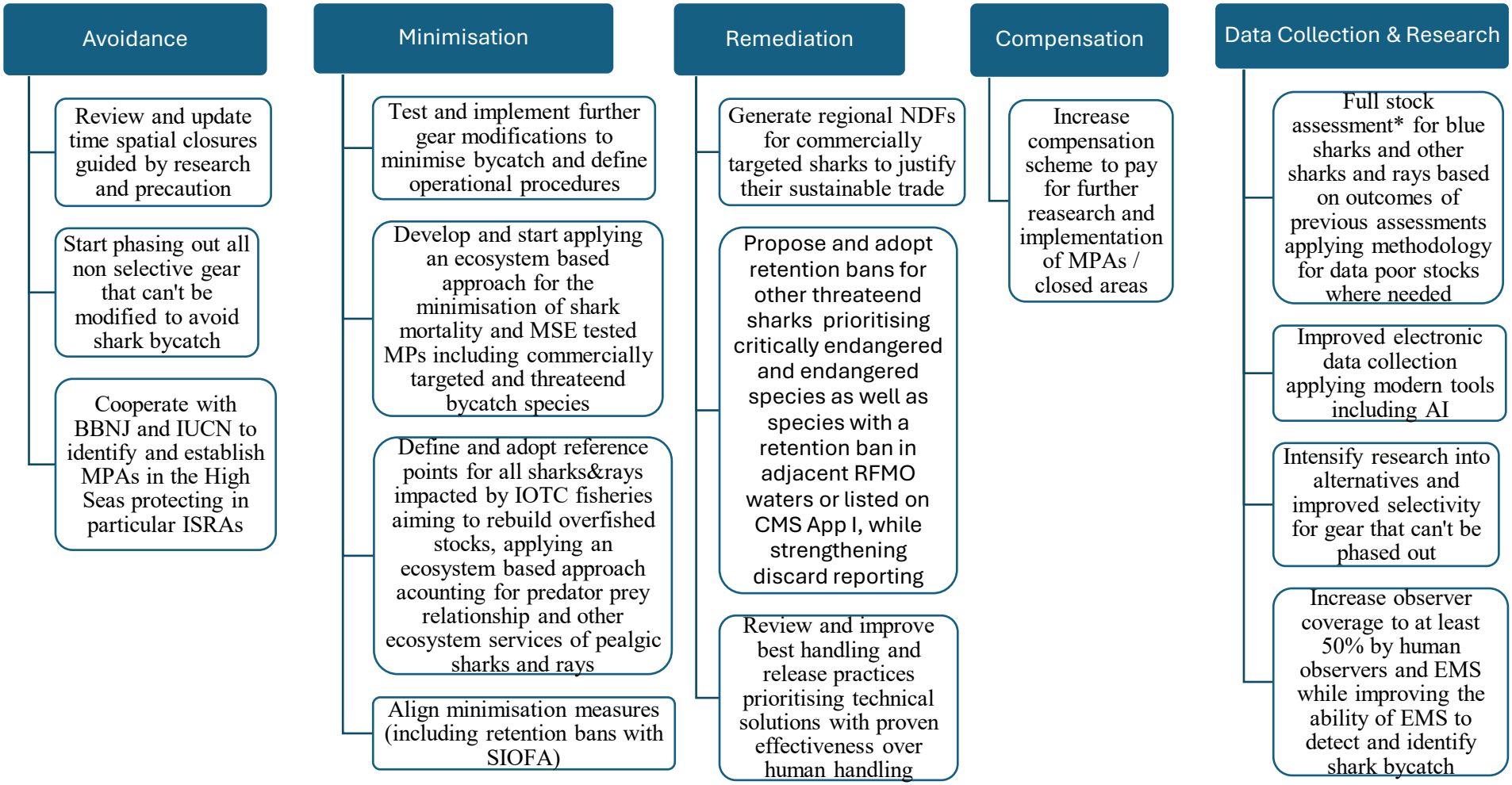


Figure 6: Terms of reference for a long-term shark research project divided in 3 phases, each of them set up following the mortality reduction hierarchy and over time moving from remediation and data collection to minimisation and avoidance as the key objectives to guide scientific research and translating scientific advice into effective management and conservation measures.
** Stock assessments and indicator analysis as already listed in the workplan of the Scientific Committee*

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