An Assessment of Shark Finning in Indian Ocean Tuna Commission Fisheries

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1 Introduction

Shark finning is the practice of removing and retaining all or some of a shark's fins and discarding its carcass at sea[1]. With the adoption of the 1999 FAO International Plan of Action-Sharks the international community agreed to the principle of minimizing waste and discards from shark catches, citing in particular the need to retain carcasses if fins are removed (FAO 1999). Following this, regional fisheries management organizations, as well as some of their member States, adopted regulations designed to implement this principle.

One of the earliest of these was the United States' (U.S.) Shark Finning Prohibition Act of 2000 which created a rebuttable presumption that finning had occurred if the total weight of shark fins landed or found on board exceeds 5% of the total weight of shark carcasses[2]. The 5% figure had first been introduced into the U.S. fisheries management system in 1993 after it was calculated from a small sample of Atlantic sandbar sharks' wet fins and dressed carcasses (Cortés & Neer 2006). Further and substantial data from the U.S. observer programme averaged over years and species later confirmed 5% as a reasonable upper limit for the ratio. Although the shortcomings of using a single ratio for all species were recognized (i.e. some species with lower fin weights might be finned and not detected), implementing species-specific ratios was considered to be impractical in U.S. fisheries (ICCAT 2006).

Controls on the handling of shark fins were successively implemented in the tuna regional management organizations (RFMO) beginning with ICCAT in 2004 (ICCAT 2004), followed by IATTC and IOTC in 2005 (IATTC 2005, IOTC 2005) and WCPFC in 2006 (WCPFC 2006). Each of these management measures includes language calling for member States to require full utilization of sharks and not to allow "*onboard fins that total more than 5% of the weight of sharks onboard, up to the first point of landing*". However, each also allows for member States that do not require fins and carcasses to be offloaded together at the point of first landing to ensure compliance with the 5% ratio through certification, monitoring by an observer, or other appropriate measures. The term "finning" is not defined and there is no specific prohibition on the removal of shark fins at sea.

IOTC's original shark measure (Res. 05/05) required that the fin-to-body weight ratio of sharks be reviewed by the Scientific Committee and reported back to the Commission for revision, if necessary. Starting in 2006 and for several years thereafter the newly-

[1] This definition is in line with standard international usage (see IUCN Shark Specialist Group (http://www.iucnssg.org/uploads/5/4/1/2/54120303/iucnsharks_biodiversity100v2.pdf), United States government (https://www.congress.gov/106/plaws/publ557/PLAW-106publ557.pdf (bottom of p. 4)) and Wikipedia (https://en.wikipedia.org/wiki/Shark_finning)
[2] https://www.congress.gov/bill/106th-congress/house-bill/5461/text

established Working Party on Ecosystems and Bycatch (WPEB) considered the issue and reported its conclusions to the Scientific Committee (SC). In 2008 SC11produced a detailed response to the Commission including, *inter alia*, the following points:

- "*the current percentage fins:body weight ratio requirement has no clear scientific basis as a conservation measure for sharks in the Indian Ocean, rather it appears to be aimed at slowing down the rate of fishing or to deter fishing on sharks by not allowing fins only to be landed and requiring vessels to return to port more often to unload fins and body parts*";

- "*current scientific evidence clearly indicates that percentage fins:body weight varies widely among species, fin types used in calculations, the type of carcass weight used (whole or dressed), and the method of processing used to remove fins (fin cutting technique)*";

- "*it was recognized that the best way to guarantee that sharks are fully utilised is to require that the trunks be landed with the fins attached, and if fully implemented, this would facilitate the collection of data that would be highly beneficial in shark stock assessments*";

- "*operational factors (e.g. storage methods and product processing) are likely to make a requirement for the natural attachment of fins to the shark carcass difficult for some operators to apply*" (IOTC 2008)

In the following year, in response to a request from the Commission for more information, WPEB5 recommended that "*the 5% fin to body weight ratio measure be replaced with a resolution requiring sharks to be landed with fins naturally attached to the body*" (IOTC 2009a). At subsequent Scientific Committee meetings, however, some IOTC member States opposed the WPEB5 recommendation on the basis that the 5% ratio was already well-established in the other tuna RFMOs (IOTC 2009b). After further debate, SC14 advised the Commission to consider that the best way to encourage full utilisation of sharks, to ensure accurate catch statistics, and to facilitate the collection of biological information, would be to revise the measure to require that sharks be landed with fins attached. However, it was noted that such an action would have practical implementation and safety issues for some fleets and may degrade the quality of the product in some cases (IOTC 2011). This recommendation was repeated through 2015 (IOTC 2015a) but was not actioned by the Commission.

In 2017, the IOTC replaced Res. 05/05 with a new measure, Res. 17/05. The new measure requires fins to remain naturally attached until the first point of landing for sharks landed in fresh form, but continues to apply the provisions of Res. 05/05 to sharks landed in frozen form. The new measure also encourages progressive implementation of the fins naturally attached provision to all shark landings (IOTC 2017).

2 Objectives and Working Arrangements

At its Commission meeting in May 2018, the IOTC agreed that its subsidiary bodies would consider the following two requests:

- To analyse and document, wherever possible, whether the practice of shark finning still takes place in IOTC and to what extent, despite the adoption of Res. 17/05, and to review the compliance with the requirements contained in Res. 17/05, including

the shark finning prohibition and the fins naturally attached requirement adopted by IOTC (to be taken up by the Compliance Committee); and

- To identify possible means to improve the submission of complete, accurate and timely catch records for sharks, as well as the collection of species-specific data on catch, biology, discards and trade (to be taken up by the Scientific Committee).

The objective of this paper is to address these two requests from the perspective of data available to the IOTC Secretariat and thus to facilitate further discussion by the Compliance and Scientific Committees. Due to data confidentiality rules, the following analysis is based on access by the author to an anonymized extract of the transhipment database (i.e. containing only deployment ID, transhipment ID, date, species, product type and product weight) and Secretariat responses to a questionnaire concerning observer data holdings. All other information used was either provided by the Secretariat or is in the public domain. It is noted that IOTC CPCs may hold other information not available to the IOTC Secretariat that they may wish to contribute to these discussions.

3 Request to the Compliance Committee

The tasking to the Compliance Committee is composed of two parts. The first part refers to the practice of shark finning whereas the second part refers to compliance with the requirements of Res. 17/05. Although these questions are related they require separate consideration. This is because compliance with Res. 17/05 does not necessarily equate to the absence of shark finning. For sharks landed in fresh form, if there is full compliance then all fresh sharks are landed with their fins naturally attached and by definition shark finning has not occurred for fresh sharks. However, for frozen sharks, as the 5% ratio is a simplified figure designed to facilitate implementation across species and fleets, full compliance with the 5% ratio could in theory still allow some instances of finning to take place[3].

3.1 Review of compliance with IOTC shark finning measures

The following discussion reviews the IOTC's measures pertaining to shark finning and briefly summarizes two ongoing compliance processes involving implementation and annual reporting managed by the Secretariat. Other reporting, such as Annual Reports, may contain some information on shark utilization practices, but such reports are scientific in nature and would not be expected to report on compliance issues. Therefore they were not reviewed for this study. CPCs with additional information on compliance with shark finning controls in their own fleets or in domestic waters are encouraged to bring this information to the attention of the Secretariat.

As described in Section 1, IOTC first adopted controls on shark finning in 2005 in Res. 05/05. This measure was superseded by Res. 17/05 which came into effect on 3 October 2017 and provided for different controls on shark finning for sharks landed fresh and sharks landed frozen. The most recent IOTC compliance reporting cycle (for 2017) covers the new resolution.

[3] For example, Cortés & Neer (2006) found that the fin weight to dressed carcass weight ratio for silky shark (*Carcharhinus falciformis*) averages 2.5%. Therefore, in theory, silky shark fins separated from silky shark carcasses could be augmented by fins from other sharks whose carcasses have been discarded so that the weight of fins onboard would increase from 2.5% (the ratio if all fins actually were obtained from silky sharks) to 5.0% of the weight of the silky shark carcasses on board.

IOTC evaluates the compliance of its CPCs in two ways: 1) whether they have implemented a given resolution and 2) when there is a specific requirement in the resolution for CPCs to report information or activities to the Commission. Implementation is evaluated through the Implementation Reports which are prepared by CPCs to document actions taken in the past year to implement measures adopted by the Commission at the most recent session (or at earlier sessions if not reported on previously; Parts A and B). Typically CPCs will report whether they have fully, partially or not implemented the measure, and they may specify the legal instrument of implementation, but typically the reports will not provide details.

In the Implementation Reports for 2017, of 33 IOTC CPCs 26 provided some level of reporting on this measure. However, only seven CPCs referred to either the fins naturally attached/no removal of fins requirement (n=5; Australia, European Union, India, Japan and South Africa) or the 5% ratio (n=2; China and Korea). Those that refer to the 5% ratio simply state that they apply it. The remaining reporting CPCs either noted that the measure was not applicable (n=3), stated that they applied stricter measures (e.g. no retention of all sharks; n=3), or provided information that did not make clear how their fleets handled fins and carcasses (n=13).

The second form of compliance evaluation, i.e. against specific reporting requirements contained in resolutions, is captured either in the Implementation Report (Part C) or in other reporting required throughout the year. Compliance with these myriad reporting requirements is summarized annually in the Compliance Reports (most recently available for 2016). The only reporting requirements linked to Res. 05/05 are those relating to shark nominal catch, catch & effort and size frequency data. This will also be the case for Res. 17/05 in the future as there are no specific reporting requirements associated with the paragraph in the measure relating to the handling of shark fins.

In summary, only five CPCs report implementing a requirement that shark fins must remain naturally attached to carcasses (or not be removed). Only two CPCs report applying the 5% fins-to-carcass ratio but do not provide details. The majority of CPCs do not report specifically on what handling practices they require for fins and carcasses. As a result, from the reporting requirements for Res. 17/05 (and Res. 05/05 before it), it is difficult to evaluate for most CPCs whether and how a prohibition on shark finning is being maintained.

3.2 Review of information on the existence of finning

The other part of the request to the Compliance Committee is to consider whether shark finning still takes place in the IOTC. This is a broader question potentially touching on issues beyond compliance with the specific provisions of the past and present IOTC shark measures. There are several sources of information which may provide either evidence of, or raise questions about the possibility of, shark finning. These sources include reports of various inspection and observer data collection programmes and are described below.

3.2.1 Information from Inspection Programmes

Inspection programmes may take many forms. National authorities may inspect their flagged vessels at sea or in port but would not necessarily report any instances of shark

finning to the IOTC. There is also in theory the potential for inspections involving two or more member States to provide evidence of shark finning, for example, high seas boarding and inspection or port inspections. For the IOTC, there is as yet no established high seas boarding and inspection programme. The IOTC port inspection programme was first established in 2005 under Res. 05/03 and supplemented by port state measures under Res. 10/11 and Res. 16/11. Under this measure the port State is required to provide copies of all inspection reports to the IOTC Secretariat and the latter must post these on the secure part of the IOTC website. However, the Secretariat reports that it does not systematically review these reports and does not catalogue violations found with regard to specific activities such as finning.

3.2.2 Scientific Observer Programme (ROS)

Observer data provides another avenue for discovering information pertaining to shark finning. The IOTC's Regional Observer Scheme (ROS) requires 5% coverage for each gear type by fleet (Res. 11/04) but only a small number of CPCs are achieving this coverage rate (IOTC 2018). The ROS is designed to collect scientific data necessary to support stock assessments and is thus not well-suited to address the issue of shark finning per se. Nevertheless the ROS could provide relevant information in the form of fate and product weights (IOTC 2015b) and was examined for this study via a questionnaire to the Secretariat. Currently, the Secretariat is compiling data received from national programmes into a common database format and at the time of writing, 543 longline trips (2009-2017) and 366 purse seine trips (2005-2017) have been incorporated and are available for analysis (Table 1).

Table 1. Summary of observer trips incorporated into the IOTC ROS database by gear, year and fleet as of 22 October 2018.

GEAR	FLEET	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
Longline															
	EU.FRA					4	6	42	85	82	75	87	50	61	
	JPN								10	8	12	12	9		
	TOTAL														543
Purse Seine															
	EU.ESP											1	15		
	EU.FRA	1	8	11	13	3		12	7	10	41	53	60	56	
	KOR									1	2	1	2		
	MUS											5	8	4	
	SYC										6	46			
	TOTAL														366

In the longline dataset 3242 (2%) of the fish recorded as retained, and 20,256 (55%) of the fish recorded as discarded, were sharks or rays. Reporting on the fate of these fish is mandatory and a list of codes is provided which includes the code "DFR" ("discarded trunk - fins retained (shark only)"). However, the current practice at the time of writing is that when the national observer data are incorporated into the Commission's ROS database the information is simplified to either "discarded" or "retained" and the detail of the fins being kept while the carcass is discarded is not uploaded. Post-processing weights recorded for retained fish using product code "SF" ("fins (shark)") could also potentially indicate shark finning. Although these weight fields are mandatory for collection, but not for reporting to the Commission, a total 2,526 post-processing weights have been recorded and reported to the Commission for retained sharks. However, none of these used the "SF" code. Review of the ROS information is summarized in Figure 1.

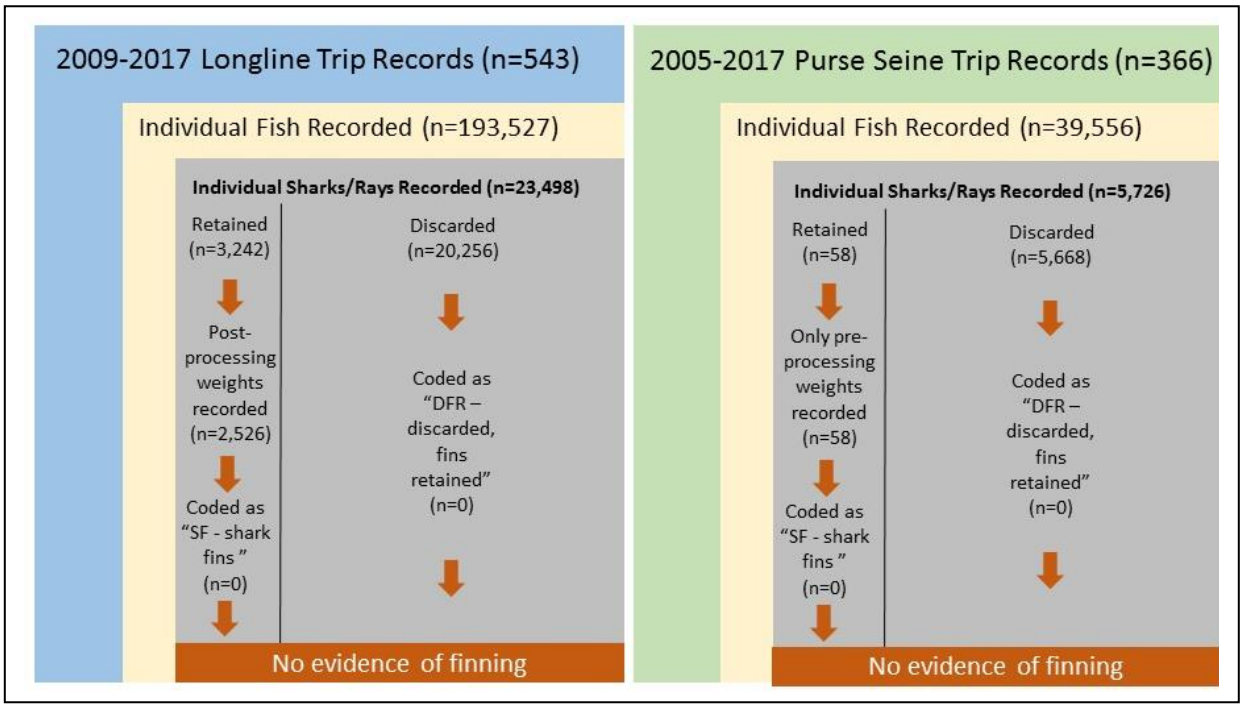

Figure 1. Summary of the number of observer trips, individual fish recorded, sharks discarded and retained, and records indicating finning in longline and purse seine observer records held in the IOTC ROS database as of 22 October 2018.

In summary, the scientific observer (ROS) data collected in the IOTC represents a small proportion of the total fishing effort in the area, and a portion of the collected data--including some information pertinent to shark finning--is either not required to be submitted to the Commission or has been simplified when uploaded to the consolidated ROS database. As of 22 October 2018, slightly less than 30,000 sharks from 2005-2017 are represented in the database, and none are recorded using any of the codes that pertain to finning activities.

3.2.3 Transhipment Observer Programme (ROP)

The other key dataset available to the Commission and potentially informative regarding shark finning activities in the IOTC is the transhipment database. These data are currently collected under Res. 18/06 (and previously under other superseded resolutions) and pertain to at-sea transhipment activities between large-scale tuna longline fishing vessels and carrier vessels. The IOTC transhipment database contains records for 2009-2018[4] from the transhipment observers (n=5,315) and vessels (n=4,165), with each record in both datasets describing the species, the product type and the product weight. Product types include dressed weight, round weight, gilled and gutted, head off, number, fillet, belly meat, other and shark fins.

A recent study attempted to use shark product quantities in the transhipment database to calculate the live weight of sharks represented in order to obtain a better understanding of the quantity of sharks caught in the IOTC (Martin et al. (2013)). The results for the live weight of sharks calculated from the transhipment data accounted for only ~10% of the total recorded shark catch in the IOTC. The paper suggested that this may be because the IOTC transhipment database does not capture transhipment occurring in port or by fishing vessels at sea other than longliners.

Using the IOTC transhipment database to determine whether shark finning is occurring is similarly constrained to large-scale tuna longline fishing vessels only. Furthermore, some of the issues that arose in the Martin et al. (2013) study involving conversion factors are also problematic for a shark finning analysis. Foremost amongst these is uncertainty arising from converting to live weight from a variety of product types for various shark species including those that are not identified.

Despite these drawbacks, fin and carcass quantities recorded in the transhipment database were compared through applying the conversion factors assumed in Martin et al. (2013)[5]. This analysis shows that the quantity of shark fins transhipped, as recorded both by observers and by vessels, has declined from maximum values in 2010-2011 to consistently lower values in recent years (Figure 2). This trend may reflect a downturn in the global shark fin market beginning in 2012 (Eriksson & Clarke 2015).

[4] Only records contained in the database as of 22 October 2018 were reviewed for this study

[5] Live weights were calculated from recorded shark fin quantities assuming that the fins were dried (i.e. 2% of live weight). Recorded quantities of sharks in round weight were summed with converted quantities of sharks as fillets (all species combined) and in various dressed forms (four conversion factors applied for blue, mako, other Carcharhinid and other sharks).

The analysis also shows that 86% of the unique transhipment events[6] recorded by observers and 96% of the unique transhipment events recorded by the vessels appear to contain more fins than would be expected given the quantities of other shark products transhipped in the same event (Figure 2). However, there are several critical points to consider when interpreting this result. First, the conversion factors are highly uncertain. Small data sets were used to construct them, species-specific recording is lacking for most shark products (70% of observer records and 86% of vessel records), and product weights including fins are likely to vary considerably between vessels even if produced from the same species.

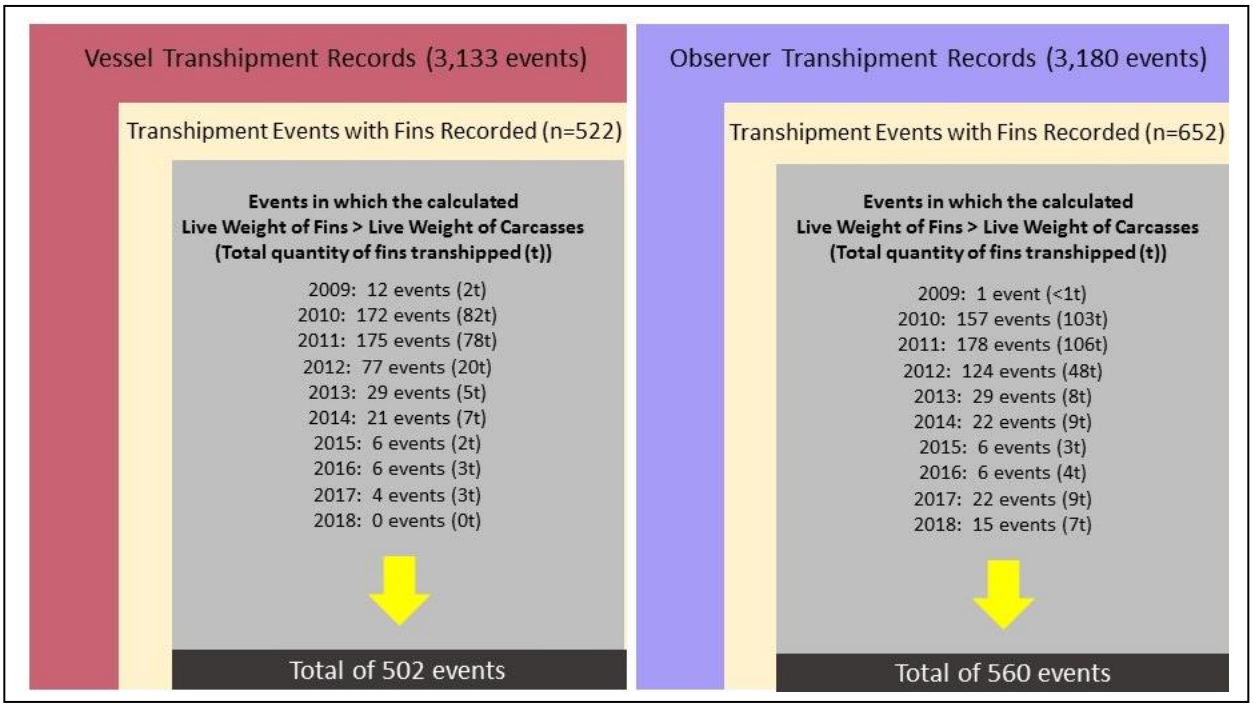

Figure 2. Summary of the number of unique transhipment events, the number of those events which recorded shark fins, and the number of those events for which the live weight of sharks calculated from fin weights is greater than the live weight of sharks calculated from the sum of all other recorded shark products, held by the Secretariat as of 22 October 2018.

Second, and more importantly, there is no requirement for vessels to offload shark fins in the same transhipment event as other shark products. This is because Res. 17/05 (and Res. 05/05 before it) allows for CPCs that currently do not require fins and carcasses to be offloaded together at the point of first landing to ensure compliance with the 5% ratio through other means. As described in Section 3.1, there is no requirement for CPCs exercising this option to report on it to the IOTC. It is possible that none of the events identified in Figure 2 involved shark finning, rather they simply arose because the fins were offloaded in separate transhipment events from the carcasses. In fact, it is quite possible to imagine that fins and carcasses would follow different trade pathways which might diverge as early as the first transhipment event off of the fishing vessel.

It might be possible, with full access to the transhipment database (i.e. including vessel identifiers not provided for this analysis due to data confidentiality restrictions), to identify

[6] Note that the number of records is not equal to the number of unique transshipment events because each event may transship one or more species' products and each species-product combination is one record.

particular vessels which are consistently offloading more shark fins than carcasses (as opposed to this analysis which treated each transhipment as an independent event because vessel identity was unknown). However, even this method would be problematic as a means of identifying shark finning as some products may not be transhipped at all, i.e. they could be carried back to port at the end of the trip. Furthermore, complexities arising from conversion factors and the possibility of replenishment through fishing between transhipment events would also likely render such an analysis equally inconclusive.

In summary, the IOTC transhipment database a) is limited in its coverage to large-scale tuna longline vessels; b) cannot be reliably and precisely converted to live weights for the purpose of reconciling fin and carcass product quantities; and c) was not designed to match or tally product quantities over an entire vessel-trip and even if so would not account for quantities remaining onboard. For these reasons, the IOTC transhipment database has substantial limitations as a tool for assessing the incidence of shark finning and at present does not provide any definitive evidence that finning has occurred.

4 Request to the Scientific Committee

The Commission's May 2018 request to the Scientific Committee calls for specific suggestions to improve data quality for sharks (see Section 2). Progress has been made in recent years with preparing stock status indicators and assessments for some sharks frequently caught in association with fisheries targeting IOTC species, but available data remain limited and are often uncertain. As reflected in the request, opportunities to improve species-specific catch (and discard) records, including complementary information from trade-based sources, as well as life history and other biological information, should be pursued. In fact, the Scientific Committee has repeatedly considered these issues and over the years made many recommendations for data collection (Table 2). While some of the recommendations have been adopted, many have not, presumably due to operational constraints, costs or other non-scientific factors.

As these issues have been discussed in detail in the context of the IOTC for many years, this section compiles and presents past recommendations of the Scientific Committee and the Working Party on Ecosystems and Bycatch for renewed consideration. For a few of the topics, supplemental points have been added to cover evolving and emerging issues.

Table 2. Data improvements for sharks recommended by the Thirteenth Session of the Scientific Committee of the IOTC (IOTC 2010).

Data / information / work required	Fishery	Major fleets involved
Retained catches:		
Historical catch-and-effort information	Fresh-tuna and/or deep-freezing longliners	Taiwan,China, Indonesia, Japan, China, Seychelles, Malaysia, Oman, Philippines, South Korea and India.
	Longliners targeting swordfish	EU-Spain, Seychelles
	Artisanal fisheries with large catches of pelagic sharks	Sri Lanka, Pakistan, Iran, Indonesia, Yemen
Historical catch level estimates by species and year	Fresh-tuna and/or deep-freezing longliners	Taiwan,China, Indonesia, Japan, South Korea
	Purse seine	EC and the Seychelles (before 2003)
Logbook coverage set to produce acceptable levels of precision (CV to be initially set at less than 20%) in the catch-and-effort statistics for the main species of sharks.	All industrial fleets	
Research on identification of shark species from fins and processed body parts.	All fleets	
Discard levels:		
Implementing levels of observer coverage as requested by the Commission (*i.e.* 5% of the fishing events on Industrial fisheries and 5% of the fishing trips on artisanal fisheries).	All fleets	
Estimates of historical discard levels for sharks by species and year	All industrial fleets	
Size frequency data:		
Collecting and reporting size frequency information for the main shark species caught by their fisheries, including all historical data available	All industrial fleets, notably longline fleets	
Observers collecting size frequency data for main shark species, including discards	All industrial fleets	
Biological data:		
Collecting data that can be used to derive length-weight keys (where appropriate by season and sex), ratios of fin-to-body weight, non-standard measurements-fork length keys and processed weight-live weight keys.	All fleets	
Research required while fins are unloaded detached from carcasses:		
Identification of sharks through fins validated by using DNA techniques The use of shark fins to derive catch estimates in weight by species/species group and fishery. The use of shark fins to derive length frequencies by species.	All fleets	

4.1 Recommendations to Improve Estimates of Shark Mortality

Accurate annual estimates of shark mortality, i.e. the amount of total removals from the population, are necessary for reliable stock assessments. These estimates are informed by logbook and observer-based catch estimates as well as post-release mortality estimates. Recommendations to improve these estimates are described below.

4.1.1 Catch and Catch Rate

- Expand logbook reporting requirements

  Logbook reporting requirements for sharks have expanded over the years through continuous consideration and debate by the WPEB and SC. The current logbook reporting requirements for sharks and rays are contained in Res. 15/01. A number of options considered by the WPEB and SC in past sessions could be given further consideration by the Commission as follows:

  - Move the optionally reported species to the mandatory reporting species list as species identification tools improve and CPCs become more competent at species identification (based on discussions at SC13 in 2010 to have all listed species reported on a mandatory basis).

  - Require that species groups containing multiple species with different life history characteristics and levels of conservation concern be recorded in more discrete, and if possible species-specific categories; specifically, add shortfin mako, longfin mako, scalloped hammerhead, smooth hammerhead, great hammerhead, bigeye thresher[7], pelagic thresher[7], manta ray and devil ray (based on ecological risk assessments identifying certain species as vulnerable, and needing species-specific information for stock assessments (discussed at SC16 in 2013); and the recommendation from WPEB14 in 2018 to improve catch reporting for mobulid rays).

  - Review the list of most vulnerable species from the ecological risk assessment against available observer data to determine whether any of these species commonly occur in any of the gear types covered by Res. 15/01; if so add these species to the list of mandatory reporting species (discussed at SC16 in 2013).

  - Consider allowing CPCs with sufficient observer coverage (≥20%) to opt-out of logbook reporting for these species by providing observer-based catch estimates (discussed at SC13 in 2010).

  - Renew efforts to scope, fund and initiate data mining exercises to construct historical catch series of the most commonly caught shark species (discussed at SC14 in 2011 and SC16 in 2013).

  - Update the discard reporting form (Form 1DI) to include seasonal (month) and spatial information (5x5 or 1x1 degree resolution) in a similar format to the catch and effort data reporting forms (discussed at WPEB13 in 2017).

[7] Retention of this species is prohibited under IOTC Res. 12/09.

- Expand ROS observer coverage and reporting of ROS observer data to the Secretariat

  Observer programmes often provide the most reliable and detailed data on shark catches and catch rates. However, low levels of coverage and lack of timely and efficient provision of these data can hamper assessment and management. Fundamental recommendations for improvements have been discussed by WPEB and SC for many years including:

  - Ensure all major fleets are covered by the Regional Observer Scheme and that levels of coverage provide estimates of total catch at an acceptable precision, including those for rare species (discussed at WPEB2 in 2006; "sufficient" coverage defined at SC13 in 2010 as ≥20%).
  - Encourage all members to collect biological information on all the significant species caught in their fisheries, notably through observer programmes, and provide this information and the raw data to the Secretariat (discussed at SC9 in 2006).
  - Actively investigate means of enabling all CPCs to meet the existing observer coverage requirements (discussed at WPEB14 in 2018).
  - Re-double efforts by CPCs and the Secretariat to transfer, quality-check and load all available observer data (discussed at WPEB14 in 2018), including fields that are mandatory or recommended for collection but not required to be reported.

- Improve species identifications

  Reliable identification of catches is critical for both logbook and observer records. Publication of a new guide for pelagic sharks and rays of the Western Indian Ocean (FAO 2014) provides substantial support for species identification activities but further work may be necessary such as:

  - Task the Secretariat to interview national data managers and observer coordinators to determine shark and ray species identification needs (i.e. materials (guides, posters, digital keys) or training), and develop proposals to provide these (this topic was discussed at SC18 in 2015).

4.1.2 Post-release mortality

IOTC adopted no-retention measures for thresher sharks (Res. 12/09), whale sharks (Res. 13/05), and oceanic whitetip sharks (Res. 13/06) in order to reduce the impacts of fishing on these vulnerable shark species. In theory, prohibiting retention of these sharks would allow a proportion of them to survive their interaction with the fishery and thus reduce the fishing mortality on the population. The proportion surviving is likely to vary by species and fleet and to date is poorly understood. Therefore it is recommended to:

- Continue and expand support for post-release mortality tagging studies underway in IOTC fisheries (discussed at WPEB14 in September 2018; at that time three of 54 tags had been attached to bigeye thresher and two of 35 tags had been attached to oceanic whitetip sharks).

4.2 Recommendations to Improve Shark Biological Parameters

Reliable data on basic shark biology and population structure is essential for accurate stock assessments. The Scientific Committee, appreciating that such data are deficient for most shark species, developed and endorsed a multi-year shark research program entitled the Indian Ocean Shark Year Program in 2013 (IOTC 2013). It is recommended to:

- Revisit the Indian Ocean Shark Year Plan updating it where necessary with new information and data needs (discussed at SC16 in 2013) and scoping and costing specific projects;
- Commit a modest amount of Commission funds to supporting elements of the Shark Year Program on an annual basis;
- Actively seek CPC or external investments in shark data improvement activities included in the Shark Year Program (discussed at SC18 in 2015);
- Encourage CPCs to collect basic information on size frequencies (length or weight) and conversion factors (length-weight, size-age and whole-processed) as part of standard operating procedures with or without observers (discussed at SC9 in 2006 and at SC14 in 2011).

4.3 Other Recommendations

- Generate data to verify that shark finning is not occurring

The WPEB and SC have considered this issue in detail and have made several recommendations to the Commission in past years. These recommendations do not reflect any disagreement about the undesirability of shark finning. Rather, the following selection of key recommendations over the years, some of which were introduced in Section 1, illustrates an ongoing difference of opinions regarding whether fins must remain naturally attached in order to verify that finning did not take place:

- "*the best way to guarantee that sharks are fully utilised is to require that the trunks be landed with the fins attached, and if fully implemented, this would facilitate the collection of data that would be highly beneficial in shark stock assessments*" (SC11 in 2008);
- "*operational factors (e.g. storage methods and product processing) are likely to make a requirement for the natural attachment of fins to the shark carcass difficult for some operators to apply*" (SC11 in 2008)
- "*current scientific evidence clearly indicates that percentage fins:body weight varies widely among species, fin types used in calculations, the type of carcass weight used (whole or dressed), and the method of processing used to remove the fins (fin cutting technique)*" (SC11 in 2008)
- "*recognized there was a need to collect more biological information on sharks and more detailed species composition information, and agreed with the*

principle that shark fins should be matched to a specific carcass for such biological research" (SC12 in 2009);

- "*the best way to encourage full utilisation of sharks, to ensure accurate catch statistics, and to facilitate the collection of biological information, is to revise the IOTC Resolution 05/05 concerning the conservation of sharks caught in association with fisheries managed by IOTC such that all sharks must be landed with fins attached (naturally or by other means) to their respective carcass. However, such an action would have practical implementation and safety issues for some fleets and may degrade the quality of the product in some cases*" (SC18 in 2015).

Res. 05/05 has now been superseded by Res. 17/05 but the issues with the use of the 5% ratio (versus fins naturally attached) continue to be unresolved for fleets landing frozen sharks (see Section 3). In theory there are three scenarios for fleets retaining shark products: 1) fins remain naturally attached to carcasses; 2) fins do not remain naturally attached to carcasses but finning is not occurring; and 3) fins do not remain naturally attached to carcasses and some finning is occurring. Given the existing text of the measure (Res. 17/05) the compliance programme is not empowered to call for the reporting or data to distinguish between the second and third scenarios (see Section 3).

One potential solution is to require all CPCs to practice Scenario 1 and provide a limited amount of reporting and data to verify it. Little oversight by the compliance process would be required as the practice is easy to verify at landing. Another potential solution is to allow CPCs to choose Scenario 2 but to place an additional burden of proof to provide verification systems to clearly demonstrate that Scenario 3 does not occur. As circumstances in different fleets may vary, each fleet could establish mechanisms for fulfilling the burden of proof associated with the removal of fins at sea at their own discretion. Oversight would be provided by the IOTC by requiring the burden of proof mechanisms to generate data that flows to the Secretariat and is considered in the compliance process.

Either of the solutions described above would require amendment of the current measure (Resolution 17/05). Continuation of the current measure allows all three scenarios above to continue, including the non-compliant Scenario 3.

- Catch documentation for sharks

IOTC's second performance review highlighted the importance of further consideration of development of a catch documentation scheme (CDS) for high value target species (IOTC 2016). Although sharks are likely not considered to be target species by many of the fleets fishing in the IOTC area, they are nevertheless of potentially high value for their fins. Furthermore, many markets utilizing shark products are growing increasingly concerned about the potential for illegal activities in the source fisheries, including shark finning, and are calling for catch documentation schemes or other traceability systems[8]. A catch documentation scheme (or similar) could respond to these concerns while also potentially

[8] For example, see a CITES-EU study on shark product traceability (Lehr 2016), and press releases by WWF (http://wwf.panda.org/?300950/better%2Dtraceability%2DSingapore%2Dworlds%2Dsecond%2Dlargest%2Dshark%2Dfin%2Dtrader) and Shark Trust (https://www.sharktrust.org/en/shark_threats).

improving species-specific estimates of catches and serving as a curb and check on finning practices. It is thus recommended to:

- Consider including sharks in the development of the CDS to be discussed in the upcoming Workshop Relating to the Studies on MCS and CDS in February 2019.

The following box briefly summarizes the scientific recommendations introduced above:

Recommendations to Improve Estimates of Shark Mortality

Catch and catch rate

Logbook

- Report all sharks listed in Res. 15/01 on a mandatory basis
- Report all sharks listed in Res. 15/01 in species-specific categories
- Add any shark species which are vulnerable and commonly caught
- Allow sufficient observer coverage (≥20%) to substitute for logbook shark recording
- Renew efforts to construct historical catch series
- Update discard reporting formats for higher resolution

ROS Observers

- Ensure statistically adequate coverage for catch and catch rate
- Collect biological data and provide to the Secretariat
- Assist CPCs to meet existing coverage requirements
- Transfer, quality-check and load all available observer data

Species identification

- Determine needs for materials or training; develop proposals to provide

Post-release mortality

- Continue and expand support for post-release mortality tagging studies

Recommendations to Improve Shark Biological Parameters

- Revisit and update the Indian Ocean Shark Year Plan
- Invest in shark data improvement activities from the Commission budget
- Actively seek CPC or external investments in shark data improvement
- Improve size and conversion factor data through CPC initiatives

Other Recommendations

Generate data to verify that shark finning is not occurring

- Require fins to remain naturally attached to carcasses until landing – OR-
- Require CPCs removing fins at sea to submit verification data for review by the compliance process to demonstrate finning is not occurring

Catch documentation schemes for sharks

- Consider including sharks in the ongoing IOTC CDS development

5 Conclusion

Assessing the practice of shark finning in IOTC fisheries is complicated by the fact that the past and current resolutions (Res. 05/05 and 17/05) do not require CPC reporting at a level that is sufficient to determine how shark fins and carcasses are handled. As a result, the IOTC compliance process is unable to verify the extent to which shark finning may be taking place. It would be possible to document shark finning in observer records, but the coverage is low and at present the data are simplified when loaded such that information on the retention of fins while discarding of carcasses is not compiled. At the time of writing, there is no evidence of shark finning in the IOTC scientific observer (ROS) database. Similar to the ROS, the transhipment database is limited in coverage and does not contain the information necessary to match or tally shark products over an entire vessel trip. At present it also does not provide any definitive evidence that finning has occurred.

In considering how to improve the data available for managing the shark resources of the Indian Ocean, the IOTC may wish to revisit some of the data improvement recommendations of its Scientific Committee over the past few years. In addition, with regard to shark finning in particular, improving the data to verify that finning is not taking place will likely require amendment of the current conservation and management measure (Res. 17/05). Options include requiring shark fins to be naturally attached for all CPC fleets, or requiring those which choose to remove fins from carcasses at sea to fulfil a higher burden of proof that finning is not occurring. This analysis supports the conclusion that continuation of the current measure would perpetuate a situation in which finning may be occurring undetected.

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