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

IOTC–2016–WPEB12–INFO4

Blue Shark catches reported to the IOTC Secretariat, and a review of current estimation procedures

IOTC Secretariat[1]

Purpose

To provide an overview of the IOTC Secretariat's published catch estimates for Blue Sharks (*Prionace glauca*), including a summary of the status for each of the main fleets, data quality issues affecting the reliability of catch estimates, and details of the estimation processes, following the request from the Working Party on Ecosystems and Bycatch in 2015:

> *Para 23. WPEB11. NOTING that where there are serious issues with nominal catch data reported by CPCs the IOTC Secretariat provides estimates of total catches using alternative sources to obtain the best possible information to use for scientific advice, the WPEB **REQUESTED** the IOTC Secretariat describe these estimation processes (at a sufficient level of detail to allow reproduction of the results) prior to the next meeting in a reference document (Information Paper) to assist all scientists utilising the nominal catch series.*

Blue shark: IOTC total (nominal) catches

For each IOTC species, including sharks, the IOTC Secretariat routinely publishes total annual catch estimates (in live weight) by fleet, IOTC Area (East/West Indian Ocean), species, and gear.

Catches of blue sharks in the IOTC database can be classified under three categories (**Fig.1**):

i. Reported data: 'official' catches reported from the flag countries, or reports from other countries on the catches of foreign vessels operating within its Economic Exclusive Zone or based in ports within its territory, according to the reporting standards of IOTC Resolution 15/02.
Examples include: Tawain,China (LL), EU-Portugal (LL), Japan (LL).

[1] James Geehan (IOTC Fisheries Statistician, james.geehan@iotc.org); Lucia Pierre (IOTC Data Assistant, lucia.pierre@iotc.org).

ii. Partially estimated catches: Estimates carried out by the IOTC Secretariat, which may involve adjustments to officially reported catches (e.g., reports of aggregated catches of Sharks which are disaggregated by species and/or gear by the IOTC Secretariat),or estimates from alternative data sources (e.g., partial catch-and-effort data, FAO FishStat database, catches estimated by the IOTC from data collected through port sampling, or data published by other organizations such as ISSF, WWF).
Examples include: Indonesia (coastal fisheries), Sri Lanka (longline-gillnet fisheries).

iii. Fully estimated: catches fully estimated by the IOTC Secretariat due to, e.g., non-reporting fleets. Estimation techniques may include repeat of previous years catches, estimation of average catches per vessel, or applying a fixed ratio based on reported catches of other species (e.g., ratios of SWO:BSH by longliners targeting swordfish).
Examples include: Indonesia (fresh LL), India (LL).

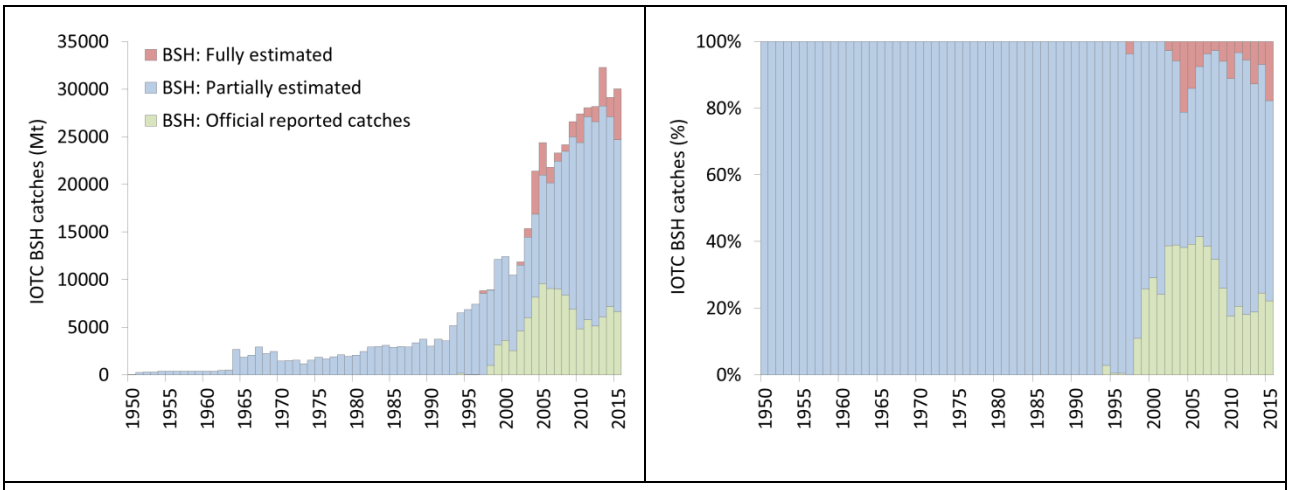

Fig.1. IOTC estimates of Blue Shark catches, including official reported catches, partially estimated and fully estimated catches.

Main data issues

While the number of fleets reporting catches of blue sharks has increased over time (**Fig.1**) – particularly in recent years since the adoption of CMMs by the Commission on sharks and other bycatch which require IOTC CPCs to collect and report more detailed statistics on bycatch species to the IOTC Secretariat – the majority of the catches of blue sharks in the IOTC database continue to require some level of adjustment or partial/full estimation by the IOTC Secretariat, for a number of reasons:

i.) Underestimates due to lack of reporting. Many CPCs still report zero catches of sharks – particularly in the case of small-scale or artisanal fisheries, as well as recreational fisheries, where there is little or no systematic data collection in place to monitor catches of species of sharks.

ii.) Other CPCs may only collect or report partial data on catches of sharks (e.g., retained catches), while bycatch, or discarded sharks are either not recorded or reported to the IOTC Secretariat.

iii.) A large proportion of catches of sharks continue to be reported to the IOTC Secretariat as species aggregates (e.g., 'Sharks'), due to issues of species identification.

iv.) Related to the previous point, species misidentification is also commonplace and which further confounds the reliability of catches which are reported by CPCs by species of shark.

Consequently, nominal catches of blue sharks in the IOTC database should be considered highly uncertain and it is generally accepted that official reported catches of blue sharks are negatively biased, and significantly underestimate actual catch levels.

Main fleets and estimation processes

Table 1 below lists the main fleets and fisheries important for catches of blue sharks (i.e., accounting for >90% of catches in the last ten years), and a summary of the main estimation methods used by the IOTC Secretariat.

Table 1. Main fleets and gears important for blue sharks and description of IOTC estimation procedures

Fleet/gear	% Blue shark catches (last 10 years)	Estimation method	Description
Indonesia - coastal longline	49%	Partially estimated	FAO total catches of shark species; broken by species and gear by IOTC Secretariat based on 2012 IOTC review of historical time series
EU-Spain - LL (targeting swordfish)	13%	Reported data	Official reported data
Taiwan,China - LL (deep-freezing)	6%	Reported data (data downloaded from official statistics website)	Downloaded data; broken by area (East/West Indian Ocean) by IOTC Secretariat using time area catches reported by catch-and-effort
Taiwan,China - LL (fresh)	6%		
Japan - LL (deep-freezing)	5%	Reported data	Official catches reported by Japan; disaggregated by area (East/West Indian Ocean, prior to 2006) by IOTC Secretariat using time area catches reported by catch-and-effort
Indonesia - gillnet	4%	Partially estimated	FAO total catches of shark species; broken by species and gear by IOTC Secretariat based on 2012 IOTC review of historical time series
Indonesia - LL (fresh)	4%	Partially estimated	Catches estimated using average catch (by species and gear) using proxy fleet (i.e., Taiwanese LL fleet)
EU-Portugal - LL (targeting swordfish)	4%	Reported data	Official reported data
EU-UK	1%	Reported data	Official reported data
All fisheries above (sub-total)	93%		

Indonesia: catch estimates of blue sharks

Given the importance of Indonesia to the total catches of blue sharks (i.e., ≈49% of catches in the last ten years) the following section is dedicated to detailing the methodology for estimation of blue sharks for Indonesia.

Rationale for estimation of catches

Despite ranking first in terms of catches of IOTC species in the Indian Ocean – including catches of blue sharks – substantial gaps exist in the information available to the IOTC for Indonesia's fisheries:

- Indonesia first began publishing catches by species of tuna in 2004, while no catch-and-effort or length frequency data has been reported to the IOTC Secretariat for industrial or coastal fisheries since the 1980s. The situation is partly due to the challenges of data collection arising from the geographic complexity of the country, with over 95,000 km of coastline and several thousand landing sites.
- More serious are concerns raised with the quality of the current data collection and reporting systems. Since the early-2000s Indonesia has reported large – and mostly unexplained – fluctuations in total catches between years, as well as abrupt changes in catches by species that suggest fundamental problems with the data collection and reporting systems.

Indonesia's official catches reported to the IOTC Secretariat remain highly uncertain, while compliance with IOTC's data-related Resolutions remains poor, partly due to deficiencies in the data collection.

For a number of years the IOTC Secretariat has disseminated their own catch estimates for Indonesia due to on-going issues with the reliability of officially reported data. The current IOTC methodology is based on a 2012 review of Indonesia's historical catch series (starting from the 1970s), conducted by an independent IOTC consultant and approved by the IOTC Scientific Committee in 2012 (Moreno, 2012), and which combines information from a number of data sources including IOTC, IPTP[2] and DGCF[3]. Current nominal catches for Indonesia (including catches of blue sharks) published by the Secretariat for the IOTC Working Parties are produced using this method.

[2] Indo-Pacific Tuna Development and Management Programme.

[3] Directorate General of Capture Fisheries, Indonesia.

The aim is to ensure greater consistency in the Indonesia catch-by-species over time, and that changes to Indonesia's fishery – including the introduction of new gears, changes in fleet composition, or changes in targeting of species – are reflected more accurately in the revised data series.

Indonesia: catch reconstruction methodology

i.) Revisions to the catch series for blue sharks included the complete catch reconstruction from 1950 onwards, based on total (aggregated) catches of sharks reported by FAO for Indonesia.

ii.) Catches by species of shark, by gear, were then estimated using information from IPTP and DGCF for the following time periods, coinciding with known changes in the fishery (i.e., development of the coastal longline fisheries in the mid-1980s):

- 1950-1972
- 1973-1984
- 1985 onwards

In practical terms, the procedure means applying a series of fixed ratios to allocate catches by species and gear, according to the time periods defined above, to coincide with the introduction of new gears or fisheries by Indonesia.

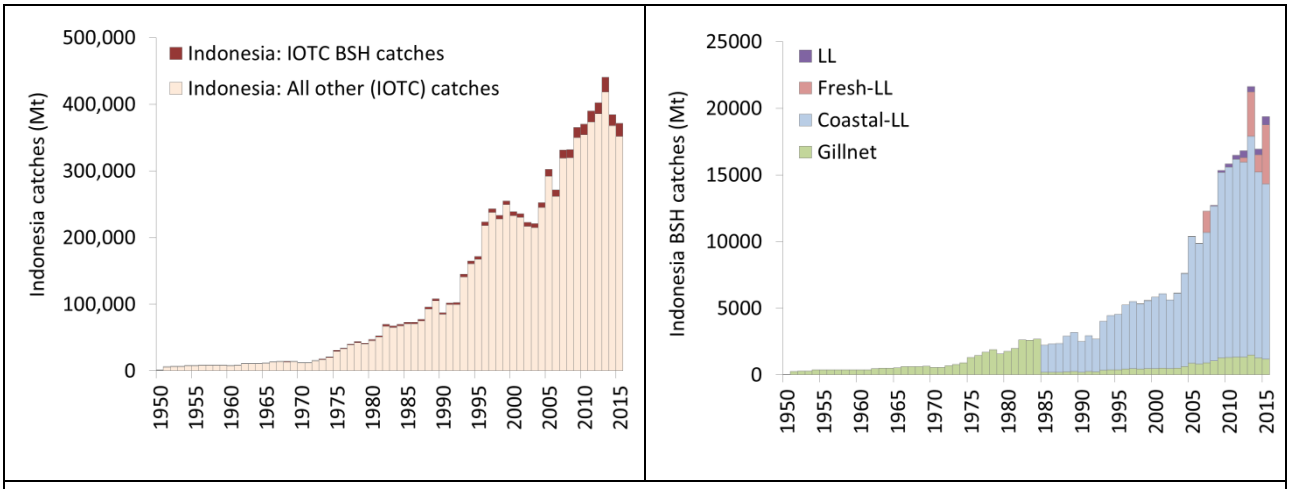

Fig.2(a-b). (Left) IOTC estimates of Indonesia catches of Blue Shark and all other IOTC species. (Right) IOTC estimates of Indonesia catches of Blue Sharks, by gear.

Results

The methodology estimates that catches of blue sharks have accounted for a relatively stable proportion of ≈3% to 5% of total catches of Indonesia since the 1950s (**Fig.2(a.)**). However catches of blue sharks, by gear, have been estimated to change significantly over time – notably the shift from gillnet to coastal longline in the mid-1980s, and also the development of the fresh-tuna longline fishery since 2010 (**Fig.2(b)**).

Limitations of the current methodology

While IOTC estimates of Indonesia's catches considered an improvement over official catches reported by DGCF, the approach is grounded on a number of assumptions of changes in the fishery – mostly driven by the introduction of new gears – which in turn are occasionally based on conflicting data sources.

Secondly, as previously stated, the methodology uses fixed ratios to allocate catches by species and gear, according to defined time periods coinciding with the development of new gears. In doing so, the approach inadvertently creates artificial breaks in catches-by-gear, as catches are assigned to different gears or target species (**Fig.2(b)**) – rather than gradual changes in the fisheries which are more realistic to expect with the introduction of new gears or changes in fishing strategies. In the case of blue sharks, this can create an abrupt (and unrealistic) change in the catches by gear – notably the development of the coastal longline fleet in the mid-1980s which coincides with a sharp reallocation in catches from the gillnet fisheries.

Thirdly, IOTC's estimates for Indonesia are still heavily dependent on DGCF data and therefore any errors reported by DGCF in terms of overestimation or underestimation of total catches will also be reflected in the catch-by-species (including catches of blue sharks) estimated by the IOTC Secretariat. The methodology implicitly assumes that total catches are reliable – in the absence of alternative information – however the limitations of the current data collection and reporting systems suggest that this may not necessarily be the case.

Ultimately, while the current IOTC methodology is considered an improvement over official catches reported by Indonesia, IOTC estimates should not be considered an adequate substitute for improvements required in the data collection; for example, based on sample-based monitoring of catches. Since 2014, the IOTC Secretariat has provided technical and financial assistance for a pilot project sampling catches from artisanal fisheries, however the scope of the project (i.e., sampling eight landing sites in North

Sumatra and West Sumatra, and focused on sites/gears important for landings of juvenile tunas) means that the project is of limited value in terms improving the quality of catch estimates for shark species.

Summary:

- Total catches of blue sharks in the IOTC database are considered to underestimate actual catches, with negative bias particularly in the case of small-scale, artisanal fisheries and recreational fisheries which may omit or substantially under-report catches of sharks.
- Information of shark discards, and also bycatch data, is equally poor if not worse – and for the few data that are reported, catches are also likely to be highly underestimated.
- Of the main fleets/fisheries, Indonesia accounts for nearly half of the total IOTC estimates catches of blue sharks. While catches have been reconstructed in 2012 by an independent IOTC consultant, the new estimates are still considered highly uncertain. The current methodology also has some limitations – partly the result of the lack of historical information upon which the review was based on – which notably created break in the catch-by-gear time series coinciding with the development of new gears/fisheries.