2016: REPORT ON THE AVAILABILITY, COMPLETENESS AND QUALITY OF CATCH DATA FOR ALL FLEETS IN THE IOTC DATABASE

PURPOSE

To provide information to the Technical Committee on Allocation Criteria (TCAC) that would allow it to determine if the statistics available at the IOTC Secretariat are reliable enough to derive historical time series of catches for albacore, bigeye tuna, skipjack tuna, yellowfin tuna and swordfish, that could be used in an allocation. Information is provided as:

- Time series estimates of total annual catches by country and species, including:
  - Coastal fisheries (Box 1): estimates of annual catches by country and species;
  - Surface and longline fisheries (Box 1): estimates of annual catches by country, area and species, in particular total catch within Economic Exclusive Zones (EEZ) and high seas.
- Estimates of total catches by country, species, and month, in close-to-real time.

BACKGROUND

At its first Session in 2011, the TCAC made the following statement: "*Noting that historical catch data is likely to be an important component of the baseline calculation for the allocation system, the Technical Committee agreed that the Secretariat prepares, for the next meeting, a document on the availability, completeness and quality of data for all fleets in IOTC database.*" (para. 34, of the TCAC01 Report).

Box 1: Definition of coastal, surface, and longline fisheries

IOTC Resolution 15/02 (Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties, collectively termed CPCs) calls for IOTC CPCs to report data on IOTC species for their fisheries, including catches for surface, longline and coastal fisheries. However, no definition exists in the IOTC context for the above fisheries. Considering that the terms coastal and artisanal are used indistinctly by the IOTC, as opposed to industrial, and taking into account that the IOTC uses the term industrial to refer to vessels in the IOTC Record of Authorized Vessels (IOTC Resolution 14/04), the following definitions are used in this paper:

- **Coastal fisheries**: Fisheries carried out by vessels having an overall length of less than 24 meters and which only operate within the EEZ of the flag country.
- **Surface** and **longline fisheries**: Fisheries carried out by vessels having an overall length of 24 meters or greater; or by vessels having an overall length of less than 24 meters which operate, partially or fully, beyond the EEZ of the flag country.

Compilation and review of catch estimates

IOTC Resolution 15/02 contains provisions calling for CPCs to report statistics on IOTC species in a given format, including the following data relevant to the present study:

- *Total catch data:* refers to estimates of total annual catches, and quarterly if possible, in live weight or numbers by gear type, species and IOTC basin (Eastern or Western Indian Ocean), including discards;
- *Catch-and-effort*: refers to catch and effort data reported according to the following standards:
  - **Surface fisheries**: refers to fisheries undertaken by tuna purse seiners, baitboats, and gillnetters in the IOTC record of authorized vessels. Data to be reported include catches in live weight per year, month, gear type, fishing mode, and species, as derived from fishing logbooks completed onboard fishing vessels, reported aggregated by 1 degree square areas.
  - **Longline fisheries**: refers to fisheries undertaken by longliners in the IOTC record of authorized vessels. Data to be reported include catches in live weight per year, month, gear type, and species, as derived from fishing logbooks completed onboard fishing vessels, reported aggregated by 5 degree square areas.

The two above apply to fisheries undertaken by fishing vessels in the IOTC Record of Authorized vessels (see Box 1), including tuna purse seine, baitboat, driftnet, longline, or any other fisheries with vessels in the record.

o **Coastal fisheries**: refers to fisheries undertaken by fleets operating in coastal waters, all year round within the EEZ of their flag countries (not in the IOTC Record of Authorized Vessels). Data to be reported include catches in live weight per year, month, gear type, and species, as collected at the landing place through sampling, interviews, or by other means, reported aggregated by area, for areas that are representative of the fisheries concerned.

In addition to the above, IOTC Resolution 15/01 *On the recording of catch and effort data by fishing vessels in the IOTC area of competence*, contains provisions for IOTC coastal States to collect and report catch-and-effort data for foreign vessels fishing within their EEZs, by flag country. All countries have to report statistics each year, no later than 1st July the following year.

In order to complete and verify the information reported to the Commission, the IOTC Secretariat also collects alternative information, including (i) catch data published by the FAO, as provided by flag states; (ii) catch data published through web pages, documents, or by other means; (iii) data collected in the field by the IOTC Secretariat (IOTC–OFCF Project, Pilot Project, etc.); (iv) reports from third parties (e.g. landings of foreign vessels, export statistics, and catches processed in canning factories).

Each year, the IOTC Secretariat contacts all parties fishing for IOTC species in the Indian Ocean, including CPCs or other countries known to have fished in the IOTC area of competence, to remind them of the type of data that must be reported and the deadlines that apply in each case. All data received are processed and transferred to the IOTC Database. In the event of catches not reported by the flag country, the IOTC Secretariat raises estimates of catch, using alternative information. This process is summarized in the flow chart presented in **Fig. 1**.

The preliminary estimates of catches obtained from the above process are presented to the IOTC Working Parties and Scientific Committee (SC) each year and, once adopted by the SC, are considered to represent the best scientific estimates of catch, and are used for the assessments of IOTC and associated species.
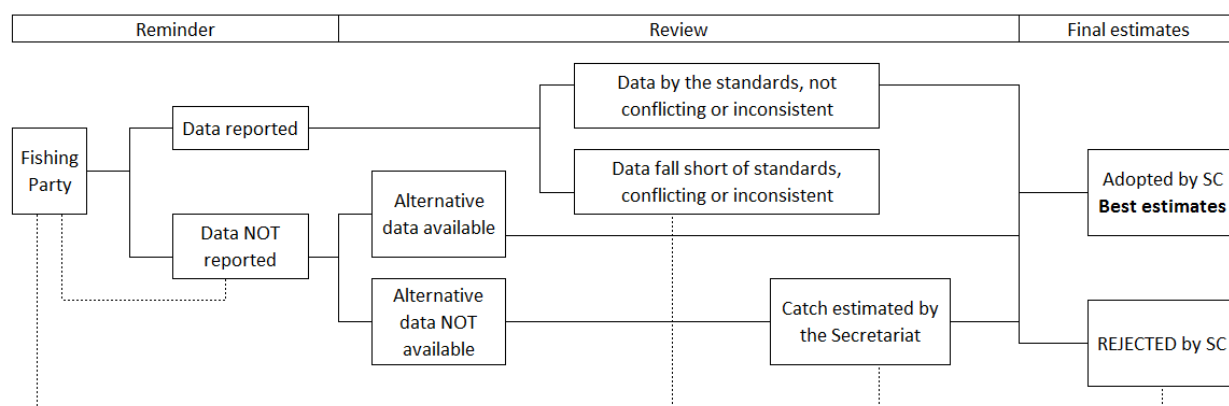
Fig. 1. Flow chart showing the process leading to the production of best estimates of catch for IOTC species. Continuous lines are used to represent flow from left-to right while dotted lines refer to backward flow.

DISCUSSION

Completeness and quality of catch data (albacore, bigeye tuna, skipjack tuna, yellowfin tuna and swordfish)

Estimates of total annual catches: The total combined catches for the main market species (i.e., the five species listed above) are presented in **Fig. 2a** by type of fleet (Box 1), as adopted at the 14th Session of the IOTC Scientific Committee (SC14, December 2011). **Fig. 2b–f** present best estimates of catch in the IOTC area of competence for yellowfin tuna (YFT), skipjack tuna (SKJ), bigeye tuna (BET), albacore (ALB) and swordfish (SWO).

The quality of the catches estimated varies depending on the country, fishery, time-period, and species. The main issues identified for albacore, tropical tunas and swordfish, are summarised in Appendix A, including: (i) The main issues identified; (ii) time-period; (iii) fleets concerned; (vi) details on whether it was possible to raise estimates of catch or not; and (v) the importance of the estimates as a potential source of uncertainty in the total catch estimates, by species.

The same information is summarised in **Fig. 3a–d**, expressed as the amount of catch that has been further revised and adjusted by the IOTC Secretariat, due to it being incomplete or inaccurate, by type of fishery, including: (i) catches

officially reported or from alternative sources which conformed to the validation criteria used by the IOTC Secretariat; (ii) catch officially reported or from alternative sources which had to be adjusted for species or gear composition, due to disaggregation or species mis-identification; and (iii) catches not available, estimated by the IOTC Secretariat, for example using levels of activity from the fleets and catches from other fleets or time periods (also called the Not Elsewhere Indicated (NEI) component).
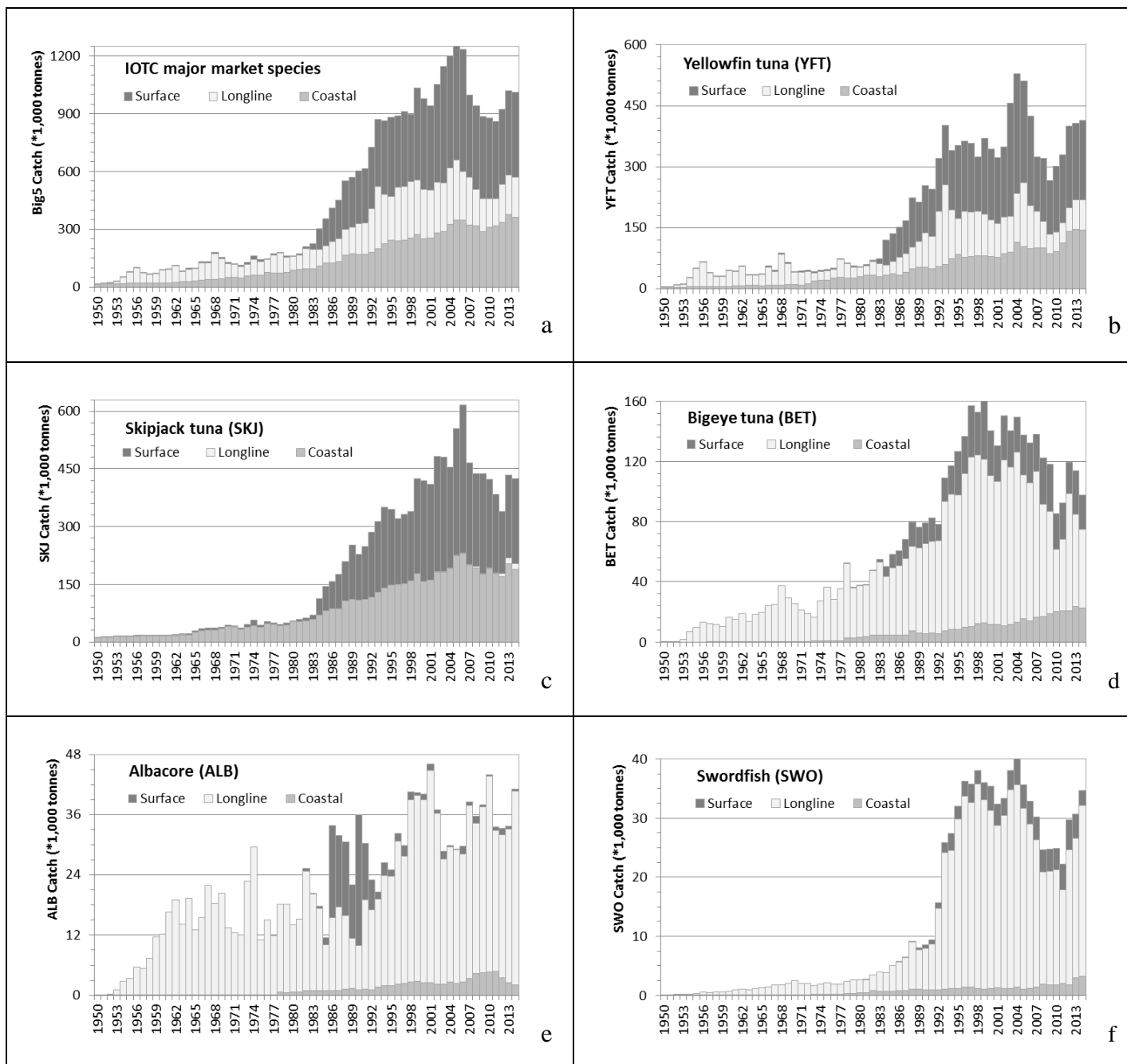
Fig. 2a–f. Best estimates of catches in live weight (1000s of tons) for the five species requested by the Commission for information and total catches for all five species, by type of fleet (Box 1). *Note: Surface fisheries include all industrial tuna purse seine fleets, and fleets using driftnets (I.R. Iran, Pakistan, Sri Lanka). Longline fisheries include all deep-freezing, fresh tuna, and swordfish longline fleets. Coastal fisheries include all baitboat, hook-and-line (other than longline), coastal gill and seine nets, and other gears operated in coastal waters (e.g., lift nets, Danish seines, beach seines, traps, etc.).*

A summary of the information presented in Appendix A and **Fig. 3a–d** is provided below:

- Around 28% of the total catches of the main market species in the IOTC database have been estimated, or partially estimated, by the IOTC Secretariat since 1950 onwards (**Fig. 3a**) The majority of estimates involve the revision of original catch reports to adjust catches by species or gear, while in other cases catches are fully estimated using information from other fleets or time periods (e.g., catches recorded under the NEI category).

- **Coastal fisheries** are, by far, the major contributor to the uncertainty in the estimates of catches for the main market species in the Indian Ocean - particularly tropical tuna species (**Fig. 3d**). Most of the uncertainty can be attributed to insufficient monitoring of the fisheries, with data systems not producing reliable estimates due to limited data collection or poor identification of IOTC species (Appendix A). The relatively high proportion of catches considered of better quality (i.e., classified as 'No change') in **Fig. 3d** before the mid-1980s is misleading, and is more related to the fact that there is little information available on the fisheries or catches before that time and therefore reports cannot be validated properly. In addition, during the mid-1980's fisheries in IOTC coastal countries underwent substantial development, including mechanization and introduction of fiberglass vessels in many countries, and development of new fisheries directed at tunas. The statistical systems in some of the countries concerned, however, were not updated and monitoring of tuna fisheries remains deficient in many cases – including some CPCs which account for significant proportions of catches from coastal fisheries (e.g., Indonesia, India, Sri Lanka).

- **Longline fisheries** undertaken by fleets using flags of convenience or under flags of coastal countries in the IOTC Area do not report statistics to the IOTC Secretariat which are considered accurate. In addition, catch data for the fresh-tuna longline fleet of Taiwan,China is thought to be less accurate between 1989 and 1998, as the fleet was not monitored during that period (Appendix A). In the majority of the cases detailed above, the IOTC Secretariat has fully estimated the catch series by species (**Fig. 3c**). The estimation procedure affects the of catch history of albacore, bigeye tuna and yellowfin tuna, especially between the mid-1980's and the late 1990's. In addition, the amounts of tuna and swordfish discarded by longline fisheries are not included in the estimates of catch, even though they are considered substantial for some of the IOTC longline fleets, especially those using surface longlines in tropical areas where depredation by marine mammals is considered high by the Scientific Committee.

- **Surface fisheries** using industrial tuna purse seines are thought to produce good catch statistics by species in most cases (**Fig. 3b**), especially in recent years where activities are limited to a small number of fleets. The only issues relevant to these fisheries are the lack of reporting of catch data from a fleet of Russian-owned purse seiners during the 1990's, the fact that catch statistics do not contain discard levels for most of the time-series (1977–2002), and that they are derived from non-validated logbook reports for some fleets, in particular catch by species (Appendix A). On the other hand, the catches of bigeye tuna for driftnet fisheries are considered to be less reliable due to species identification issues – in particular the catches from Pakistan driftnet vessels are considered to be very unreliable as the fishery is not adequately monitored (Appendix A). The problems associated with these fisheries primarily affect the accuracy of catches recorded for bigeye tuna and swordfish. In the case of swordfish, catches are often aggregated with those of other billfish species (e.g., I.R. Iran driftnet vessels).
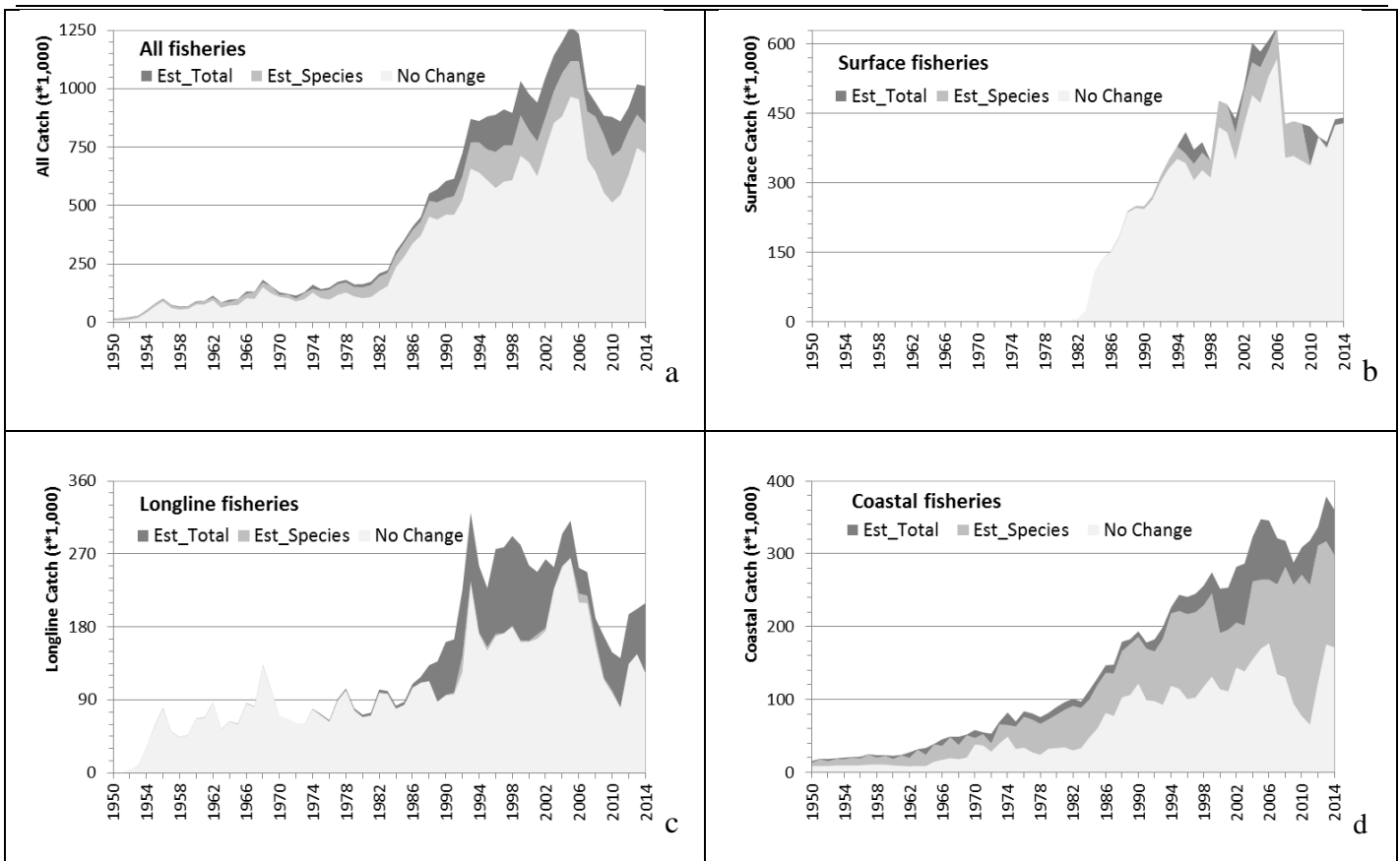
Figure 3a–d. Total combined catches (1000s of tonnes) of major market species in the IOTC Area for a) all species and fisheries combined; b) surface fisheries; c) longline fisheries; and d) coastal fisheries. Data classified according to the type of data processing required to derive the catches. No change = Catch data derived directly from official reports or alternative sources, with no changes made to the original datasets. Est_Species = Catch data derived from official reports or alternative sources; catch by species re-estimated using alternative information. Est_Total = Catch data neither reported officially or available from alternative sources; total catches and species/gear breakdown estimated. *Note: Surface fisheries include all industrial tuna purse seine fleets, and fleets using driftnets. Longline fisheries include all deep-freezing, fresh tuna, and swordfish longline fleets. Coastal fisheries include all baitboat, hook-and-line (other than longline), coastal gill and seine nets, and other gears operated in coastal waters (e.g. lift nets, Danish seines, beach seines, traps, etc.).*

Estimates of catches by fishing area: The IOTC Secretariat estimates catches by species, time-period, and fishing area using the following information: (i) estimates of total catch by species, type of fishery, and year; (ii) time-area catches available from reports of catch-and-effort data, or from alternative sources. As indicated above, the minimum standards that apply to the reporting of catch-and-effort data are different for coastal (representative areas), longline (5 degrees square areas), and surface (1 degree square areas) fleets.

As in the case with total annual catch data, catch-and-effort data are not available from all fleets and, where available, levels of coverage and data quality can vary considerably depending on the fleet and time period concerned. In terms of estimating catches within and outside the EEZs of countries in the IOTC Area, generally speaking it can be assumed that all coastal fisheries operate within the EEZs of their respective flag countries all year round, while most surface and longline fisheries operate both inside countries EEZs, and on the high seas. Figures 4a–f shows the levels of coverage of time-area catches for the main market species, as per the IOTC standards, for all longline and surface fleets combined, as well as individually, as derived from the catch-and-effort data available in the IOTC database. The following issues can be highlighted:

- Since the early 1990's, about 25% of the catches have been assigned by area using information from alternative sources, as they are not reported by the flag countries (**Fig. 4a**). Catches by area, on the contrary, are available for most fleets before the mid-1980's. The main reason for the deterioration of data quality since the mid-1980's is the increase in the amount of fleets using purse seines, longlines, and driftnets operating in the IOTC area, for which the flag countries have consistently failed to provide, or have provided poor quality, time-area catch data series, including: (i) an increase in the activities of longline and purse seine vessels using flags of convenience; (ii) the arrival of fleets of fresh-tuna longliners from the Pacific; (iii) the construction or reflagging of longline and driftnet vessels in several coastal countries.

- As regards to time-area catches by species: (i) the catches of skipjack tuna (**Fig. 4c**) have to be assigned by area for all driftnet fleets; (ii) the time-area catches of yellowfin tuna (**Fig. 4b**), and swordfish (**Fig. 4f**) are affected by the lack of catches by area from fleets using driftnets and fleets of longliners; (iii) the catches of bigeye tuna (**Fig. 4d**) have to be assigned by area for the same longline fleets indicated for yellowfin tuna; (iv) time-area catches for albacore (**Fig. 4e**) have to be estimated for Indonesian fresh-tuna longliners.

Once the available time-area catches have been raised to represent total catches, catches by EEZ and on the high seas for each fleet can be estimated by year, species, and grid (1 degree or 5 degrees square). However, the catches estimated are not precise as they are often derived from large areas which may overlap two or more EEZs, or EEZs and the high seas, and therefore need to be assigned to an area. Estimates are also generally more precise for surface than longline fleets, as the former report time-area catches by 1 degree square area. This is represented in **Fig. 5a–b**, which show the amount of catches recorded in one/five degree(s) square grids that fall entirely within the EEZ of countries versus those recorded in one/five degree square(s) grids that overlap an EEZ and the high seas.

An additional problem is that, at present, the process of assigning catches ignores the licensing history of the fleets concerned and may involve the allocation of catches to EEZ areas where the fleet has never operated. This problem could be overcome if the provisions of IOTC Resolutions 15/01 are implemented as they call for IOTC CPC's to collect and report operational catch and effort data on foreign fleets operating in their EEZs and report this information to the IOTC Secretariat annually.

Estimates of catches by month in close-to-real time: The ability of coastal countries and distant-water fishing nations in the IOTC area to estimate catches of tunas by month in close-to-real time is discussed in document IOTC–2011–SC14–38, which was presented to the IOTC Scientific Committee in 2011 and is summarized in paper IOTC–2012–TCAC02–04.
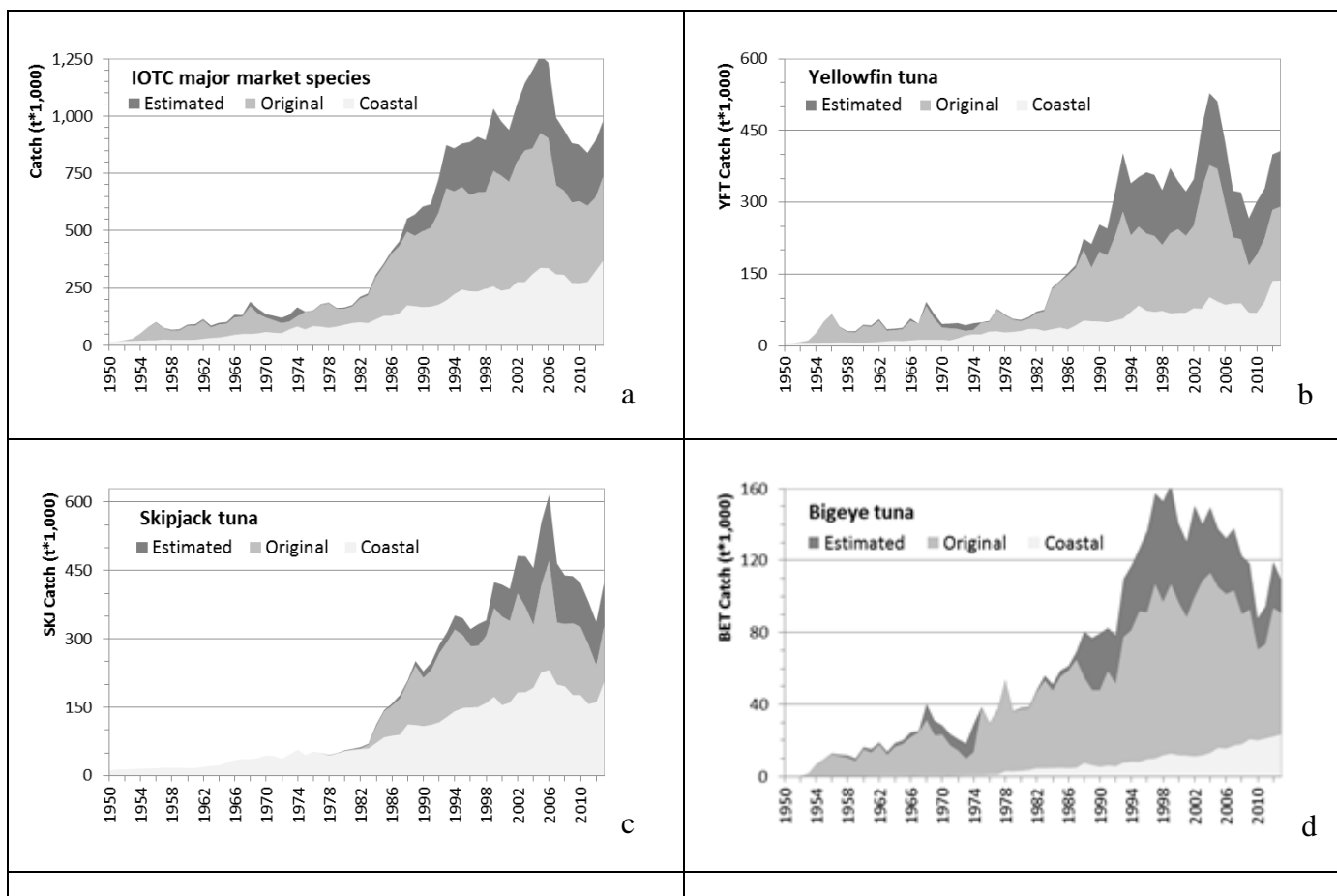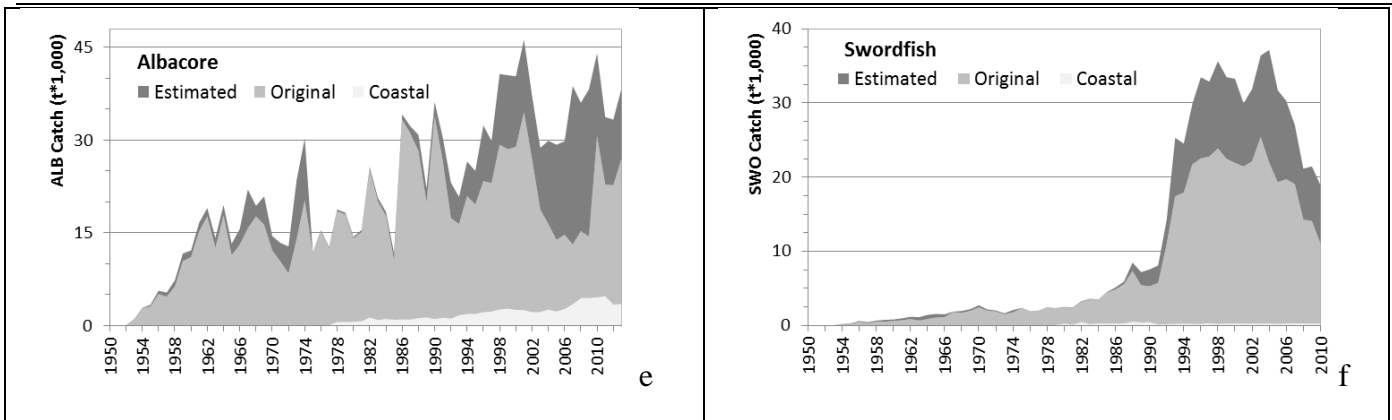
Figures 4a–f. Amount of catch for surface and longline fleets for which time-area catches had to be estimated (Estimated), versus catches for which time-area catches were available (Original), as per the IOTC standards; and the amount of catches recorded for a) coastal fleets for all species combined; and by species, b) yellowfin tuna; c) skipjack tuna; d) bigeye tuna; e) albacore; and f) swordfish.

Note: Surface fisheries include all industrial tuna purse seine fleets, and fleets using driftnets (Iran, Pakistan, Sri Lanka). Longline fisheries include all deep-freezing, fresh tuna, and swordfish longline fleets. Coastal fisheries include all baitboat, hook-and-line (other than longline), coastal gill and seine nets, and other gears operated in coastal waters (e.g. lift nets, Danish seines, beach seines, traps, etc.).
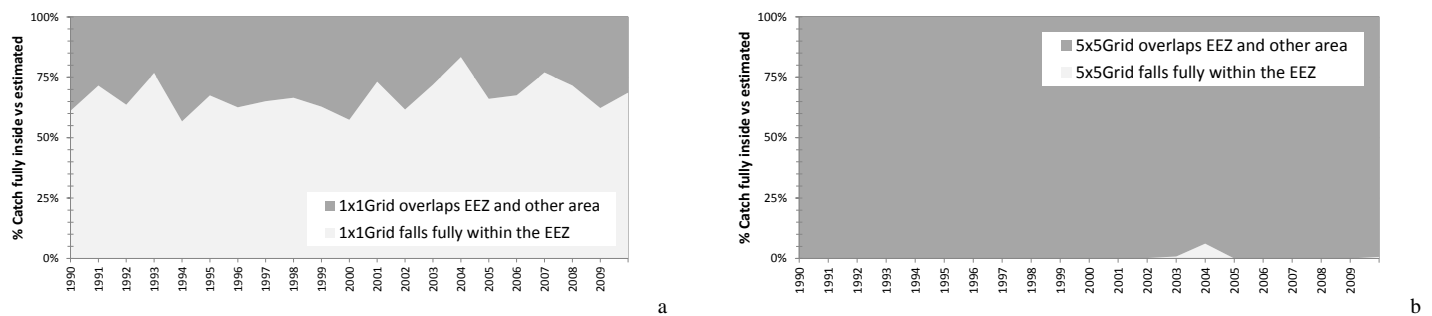
Figure 5a–b. Amount of catch recorded in grid areas which fall fully within countries EEZs or on the high seas versus catches recorded in grid areas that overlap EEZs and the high seas, when a) one degree or b) five degrees square grids are used. The time-area catches available for purse seiners under flags of EU countries are used for the comparison, for the period 1990–2009.

Conclusion

In general, all types of fishery catch statistics (e.g., nominal catches, and time-area catches) are obtained, to various degrees, through sampling schemes and are therefore by definition 'estimates'. Such catch estimates will always have uncertainty associated with them, however the level of uncertainty is dependent on the sampling design, type of fishery and the amount of catch and effort that are sampled by the CPC. The same applies to the catches that the IOTC Scientific Committee adopts each year as the best scientific estimates, which are the product of data reviews and further estimation by the IOTC Secretariat, including estimation of catches which are not reported by the flag countries concerned.

The time-series of catches presented in this document cover all known fishing activities in the Indian Ocean and for this reason, represent the best estimates of catches for the species under consideration. Although some of the issues identified are likely to compromise the quality of the estimates to some degree, the final estimates of catch are not thought to be substantially affected by these issues.

It should be noted, however, that the accuracy of future estimates of catches can and should be improved, if CPCs address the issues identified in Appendix A as a matter of priority.

RECOMMENDATION/S

That the Technical Committee on Allocation Criteria (TCAC) **NOTE** the report by the IOTC Secretariat on the availability, completeness and quality of data for all fleets in IOTC database.

APPENDICES

Appendix A: Evaluation of the quality of the best estimates of total catch for major market species in the IOTC area, by species, type of fishery and time period.

APPENDIX A

EVALUATION OF THE QUALITY OF THE BEST ESTIMATES OF TOTAL CATCH FOR MAJOR MARKET SPECIES IN THE IOTC AREA, BY SPECIES, TYPE OF FISHERY AND TIME PERIOD

Time period	Issue	Fleets concerned	Estim	YFT	BET	SKJ	ALB	SWO
Coastal fisheries								
1950–1979	Most countries did not have statistical systems in place; catch reports cannot be validated; the majority of catches taken from the FAO FishStat Database, not by gear; catches disaggregated by gear by the IOTC Secretariat	Most fleets	Y	M	L	H	L	L
Whole time series	Insufficient data collection; lack of statistical systems or, where data collection systems do exist, catch of tunas not recorded or highly aggregated (e.g., all marine fish species combined), or catch estimates are unreliable (e.g., insufficient sampling coverage or poor data management)	Many fleets	Y	M	L	H	L	L
Whole time series	Underreporting of catch of juvenile tuna, especially on fishing sets around anchored Fish Aggregating Devices (pole-and-line, liftnets, gillnets, seine nets)	Fleets catching juvenile tunas	N	H	H	M	L	L
Most years	Data insufficient to raise estimates of catch; data not reported; or alternative data not available	Many fleets	N	L	L	L	L	L
Longline fisheries								
2002-2010	Significant underreporting of catch; poor monitoring of commercial longline fishery; very low logbook returns; insufficient monitoring of vessel activities		Y	H	M	L	L	M
1985-2010	Catches not reported (NEI-deep freezing longline); fleets not monitored by the flag countries; number of vessels operated reported by third parties	Flags of Convenience (FoC)	Y	M	M	L	H	M
1973-2000	Catch not reported (NEI-fresh tuna); fleets not monitored by the flag countries; landing statistics collected from third parties		Y	H	H	L	M	M
2002-2010	Likely underreporting of catches of albacore and swordfish; poor sampling of frozen component of the catch; lack of logbook system (recently implemented)		Y	L	L	L	H	M
Whole time series	Discards not reported; discards not recorded in the logbooks; discard levels not monitored through observers; predation rates not estimated	All fleets	N	L	L	L	L	L
Whole time series	Underreporting of catches in weight; processed weights occasionally reported as live weights	Some fleets (unknown)	N	L	L	L	L	L
Surface fisheries								
1989-2010	Likely mis-identification of bigeye tuna and swordfish; bigeye tuna mis-reported as yellowfin tuna, and swordfish reported as Indo-Pacific sailfish		Y	L	M	L	L	H
1977-2010	Catch by species likely to be imprecise (i.e., catch by species as reported in logbooks), and not corrected using samples		N	L	L	L	L	L
1996-2003	Catch not reported for NEI purse seine fleets; catches not monitored by flag countries; catch and effort statistics collected by third parties	FoC and other	Y	L	L	L	L	L
1996-2006	Catch not reported for NEI purse seine fleets; catches not monitored by flag countries; catch and effort statistics collected by third parties or estimated by the Secretariat	FoC	Y	M	M	M	L	L
1977-2002	Discards not reported; discards not recorded in the logbooks; discard levels not monitored through observers	All fleets	N	M	M	M	L	L

Albacore (ALB), bigeye tuna (BET), skipjack tuna (SKJ), yellowfin tuna (YFT) and swordfish (SWO). Details on whether it was possible to raise estimates of catch (Y), or not (N; catch remains unknown); and importance of the estimates as a potential source of uncertainty in the total catch estimates, by species, including low importance (L), medium importance (M), and high importance (H).