Report of the 22nd Session of the IOTC Working Party on Tropical Tunas, Data Preparatory Meeting

Microsoft Teams Online, 22 - 24 June 2020

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ACRONYMS

aFAD	anchored Fish aggregating device
ASAP	Age-Structured Assessment Program
ASPIC	A Stock-Production Model Incorporating Covariates
ASPM	Age-Structured Production Model
B	Biomass (total)
BDM	Biomass Dynamic Model
BET	Bigeye tuna
B_{MSY}	Biomass which produces MSY
CE	Catch and effort
CI	Confidence Interval
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
CPCs	Contracting parties and cooperating non-contracting parties
CPUE	Catch per unit of effort
current	Current period/time, i.e. $F_{current}$ means fishing mortality for the current assessment year.
EEZ	Exclusive Economic Zone
ENSO	El Niño–Southern Oscillation
EU	European Union
F	Fishing mortality; F_{2011} is the fishing mortality estimated in the year 2011
FAD	Fish aggregating device
FOB	Floating object
F_{MSY}	Fishing mortality at MSY
GLM	Generalised linear model
HBF	Hooks between floats
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
IWC	International Whaling Commission
K2SM	Kobe II Strategy Matrix
LL	Longline
M	Natural Mortality
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
MSY	Maximum sustainable yield
n.a.	Not applicable
PS	Purse seine
q	Catchability
ROS	Regional Observer Scheme
RTTP-IO	Regional Tuna Tagging Project in the Indian Ocean
RTSS	RTTP-IO plus small-scale tagging projects
SC	Scientific Committee, of the IOTC
SB	Spawning biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock biomass which produces MSY (sometimes expressed as SSB_{MSY})
SCAA	Statistical-Catch-At-Age
SKJ	Skipjack tuna
SS3	Stock Synthesis III
Taiwan, China	Taiwan, Province of China
VB	Von Bertalanffy (growth)
WPTT	Working Party on Tropical Tunas of the IOTC
YFT	Yellowfin tuna

STANDARDISATION OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE REPORT TERMINOLOGY

SC16.07 (para. 23) The SC **ADOPTED** the reporting terminology contained in Appendix IV and **RECOMMENDED** that the Commission considers adopting the standardised IOTC Report terminology, to further improve the clarity of information sharing from, and among its subsidiary bodies.

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

Level 1: From a subsidiary body of the Commission to the next level in the structure of the Commission:
RECOMMENDED, RECOMMENDATION: Any conclusion or request for an action to be undertaken, from a subsidiary body of the Commission (Committee or Working Party), which is to be formally provided to the next level in the structure of the Commission for its consideration/endorsement (e.g. from a Working Party to the Scientific Committee; from a Committee to the Commission). The intention is that the higher body will consider the recommended action for endorsement under its own mandate, if the subsidiary body does not already have the required mandate. Ideally this should be task specific and contain a timeframe for completion.

Level 2: From a subsidiary body of the Commission to a CPC, the IOTC Secretariat, or other body (not the Commission) to carry out a specified task:
REQUESTED: This term should only be used by a subsidiary body of the Commission if it does not wish to have the request formally adopted/endorsed by the next level in the structure of the Commission. For example, if a Committee wishes to seek additional input from a CPC on a particular topic, but does not wish to formalise the request beyond the mandate of the Committee, it may request that a set action be undertaken. Ideally this should be task specific and contain a timeframe for the completion.

Level 3: General terms to be used for consistency:
AGREED: Any point of discussion from a meeting which the IOTC body considers to be an agreed course of action covered by its mandate, which has not already been dealt with under Level 1 or level 2 above; a general point of agreement among delegations/participants of a meeting which does not need to be considered/adopted by the next level in the Commission's structure.
NOTED/NOTING: Any point of discussion from a meeting which the IOTC body considers to be important enough to record in a meeting report for future reference.

Any other term: Any other term may be used in addition to the Level 3 terms to highlight to the reader of and IOTC report, the importance of the relevant paragraph. However, other terms used are considered for explanatory/informational purposes only and shall have no higher rating within the reporting terminology hierarchy than Level 3, described above (e.g. **CONSIDERED**; **URGED**; **ACKNOWLEDGED**).

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EXECUTIVE SUMMARY

The 22nd Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Tropical Tunas (WPTT), Data Preparatory Meeting was held online using the Microsoft Teams online platform from 22 - 24 June 2020. The meeting was opened by the Chairperson, Dr Gorka Merino (EU, Spain) who welcomed participants and Vice-Chair, Dr M. Shiham Adam (Maldives). A total of 62 participants attended the Session (cf. 68 in 2019, 57 in 2018, and 49 in 2017). The list of participants is provided at Appendix I.

The report of the 22nd Session of the Working Party on Tropical Tunas Data Preparatory Meeting (IOTC–2020–WPTT22(DP)–R) was **ADOPTED** intersessionally via correspondence

1. OPENING OF THE MEETING

1. The 22nd Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Tropical Tunas (WPTT), Data Preparatory Meeting was held online using the Microsoft Teams online platform from 22 - 24 June 2020. The meeting was opened by the Chairperson, Dr Gorka Merino (EU, Spain) who welcomed participants and Vice-Chair, Dr M. Shiham Adam (Maldives). A total of 62 participants attended the Session (cf. 68 in 2019, 57 in 2018, and 49 in 2017). The list of participants is provided at Appendix I.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

2. The WPTT **ADOPTED** the Agenda provided in Appendix II. The documents presented to the WPTT22(DP) are listed in Appendix III.

3. The WPTT **NOTED** papers:

    - IOTC–2020–WPTT22(DP)–03: Outcomes of the 22nd Session of the Scientific Committee (IOTC Secretariat)
    - IOTC–2020–WPTT22(DP)–05: Review of Conservation and Management Measures relevant to tropical tuna (IOTC Secretariat)
    - IOTC–2020–WPTT22(DP)–06: Progress made on the recommendations of WPTT21 (IOTC Secretariat)
    - IOTC–2020–WPTT22(DP)–07: Outcomes of the 3rd Technical Committee on Management Procedures (IOTC Secretariat)

4. Due to time constraints during the meeting, these papers were not presented. In addition it was noted that due to the postponement of the 24th Session of the IOTC Commission to November 2020 and the cancellation of the TCMP04, there was no update/comment from the Commission and no additional guidance from the TCMP provided prior to the meeting.

3. NEW INFORMATION ON FISHERIES AND ASSOCIATED ENVIRONMENTAL DATA RELATING TO TROPICAL TUNAS

3.1 Review of the statistical data available for tropical tunas

5. The WPTT **NOTED** paper IOTC–2019–WPTT22(DP)–08 which provided a review of the statistical data and fishery trends for tropical tunas received by the IOTC Secretariat, in accordance with IOTC Resolution 15/02 on Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs), for the period 1950–2018. The paper also provided a range of fishery indicators, including catch and effort trends for fisheries catching tropical tunas in the IOTC area of competence. It covers data on nominal catches, catch-and-effort, size-frequency and other data, in particular mark-recapture (tagging) data. A summary of supporting information for the WPTT is provided in Appendix IV.

6. The WPTT **ACKNOWLEDGED** that the information presented in this paper is still based on the statistical data available for the previous reference year (2018) and that the major updates included within since the last WPTT are the revision of historical catch series from Pakistani gillnetters (1987-2018), the inclusion of nominal catch data not originally provided by the deadline (EU,ITA PS) and the routine updates to longline data reported at the end of 2019.

7. The WPTT **NOTED** that the revision of Pakistan catch series substantially affects the catch levels of yellowfin tuna from year 2000 onwards, with yearly differences ranging from 8,000 to 20,000 t. Skipjack tuna is only marginally affected by the revision while Bigeye tuna continues to be not reported at all by the fishery.

8. The WPTT **NOTED** that the total catch levels for all tropical tunas combined in 2018 almost reached the same levels as in pre-piracy years (over 1.1 million t) and that this was mainly due to an increase in the catch of skipjack tuna, with catches of Yellowfin tuna and Bigeye tuna remaining around the same levels recorded over the last five years.
9. Also, the WPTT **ACKNOWLEDGED** that the sharp increase in catches of skipjack tuna detected for 2018 comes prevalently from industrial purse seine fleets, some of which (EU) confirmed that the provided data for the tropical tunas still has to be considered as provisional and therefore might be subject to revisions in the future.
10. The WPTT **NOTED** that catches of tropical tunas on free-schools have reached an all-time low in 2018, although recorded trends in log-school and free-school catches in recent years show recurring oscillations in the proportions of catches reported for the two fishing modes for both Yellowfin and Bigeye tunas. For what concerns skipjack tuna, the proportion of catches coming from free-school sets has become basically negligible in recent years.
11. The WPTT **NOTED** that in 2018 the EU PS fleet has reported unraised ("raw") size frequency data for one of its components, and that while this is perfectly feasible and in accordance with the requirements of Res. 15/02, it introduces a discontinuity with previous years that might affect the estimation processes adopted for the production of standard stock assessment inputs.
12. For this reason, the WPTT **CONSIDERED** the possibility of recommending the provision of both raw and raised size frequency data in the future, **NOTING** that for some CPCs this might not be always feasible.
13. Furthermore, the WPTT **NOTED** that due to the CoViD-19 pandemic crisis, almost no size sample has been collected since March 2020 in Port Victoria for the Seychelles and EU purse seine fleets, so the processing for 2020 purse seine data might prove to be particularly difficult and require estimation procedures relying on alternative strata (substitution scheme), and that this situation might be common to other fleets and fisheries as well.
14. **RECALLING** that the re-estimation of tropical tuna catches performed at the WPTT21 due to possible issues detected in the species composition reported by EU,ESP for 2018 led to an alternative catch series to be used for the bigeye tuna assessment and management purposes, the WPTT **AGREED** that, for the planned skipjack tuna assessment due this year, it would be beneficial to maintain the original catch data as provided by the respective data owners as it appears to be more stable compared to the other two species, and also because the potential re-estimation introduces negligible changes that are likely not to produce any effect on the assessment.
15. The WPTT **NOTED** with concern that a number of problems with non-reporting and late reporting by several CPCs still persist, and this is problematic for stock assessments.
16. For this reason, the WPTT strongly **ENCOURAGED** all CPCs to report their data in accordance with Resolution 15/02, and **NOTED** that the IOTC Secretariat is liaising with several CPCs (e.g. Pakistan, Oman and I.R. Iran among others) to ensure that all information available at national level is timely and accurately reported in the future.
17. The WPTT **NOTED** that underreporting was very likely to have occurred in earlier years of the time series (1950s-1970s) and that confidence around older data is still low for some species and fisheries.

4. NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENTAL DATA RELATING TO SKIPJACK TUNAS

4.1 Tagging information

18. The WPTT **NOTED** paper IOTC–2020–WPTT22(DP)–10 which provided a review of the tag data processing for IOTC tropical tuna assessments, including the following abstract provided by the authors”

    “*IOTC maintains a database for the tagging data collected from the Indian Ocean Regional Tuna Tagging Programme, and the tag release/recapture observations have played a critical role in the stock assessments of the IO tropical tuna species. This report summarises how the tagging dataset were processed for incorporation into the recent Stock Synthesis assessments for yellowfin, bigeye, and skipjack tuna. The procedures and processes are very similar among the species/assessments (they generally included filtering of dubious records, correction for potential tag loss, and adjustment for under-reporting of recaptures), but there are some differences or inconsistency due to historical reasons (evolvement of individual assessments overtime, different researchers being involved in the analysis, etc). The report documents the assumptions and criteria being applied to ensure the reproducibility and transparency, and thus provides a basis for establishing a unified and consistent procedure for the processing of the tagging data for future assessments of IO tropical tuna species*.”

19. The WPTT **NOTED** that it was not possible for tag recovery dates and location to be identified using logbook data, as most of the tags were recovered during unloading and the well location may relate to several sets. The tag recovery date and location information are assigned to a larger spatio-temporal stratum used in the stock assessment.

20. The WPTT **NOTED** that for tagging induced mortality, the estimates presented during the 2019 WPTT (Hoyle et al., 2015) are relative to those for the best tagger but the best tagger fishing induced mortality (about 7.5%) was not precisely estimated. The WPTT further **NOTED** that the results of the Hoyle model presented in 2019 were accepted for bigeye but the figures used in previous assessments for yellowfin/skipjack should be revisited. Hoyle et al. (2015) did not find any differences in tagging induced mortality between species in the Indian Ocean, although in the Pacific (with more data) tag mortality was estimated to be lower for skipjack tuna. Chronical tag loss for the three species of tropical tunas estimated by Gaertner and Hallier (2009) are being used in the stock assessments which were estimated using a double-tag experiment.

21. The WPTT **ACKNOWLEDGED** that reporting rates can be different between fisheries and can vary with time. The reporting rates for purse seine were estimated based on a tag shedding experiment carried out between 2005-2008. The reporting rates for skipjack was applied differently from yellowfin and bigeye. In the case of skipjack, the reporting rates were applied separately for tags recovered at sea (assumed 100 reporting rates for PS) and for tags recovered at unloading.

22. The WPTT **NOTED** that YFT/BET recovered fish for which the fishing mode is unknown are assigned to Free or FAD sets based on size information while most of skipjack tuna are assigned to FAD sets. The WPTT further **NOTED** that large yellowfin/bigeye could also be caught in FAD sets, however, as a requirement for SS3 to estimate tag return rates to different fisheries, different assumptions and expert knowledge are used to assign tag recovery to fisheries based on size information. The WPTT **SUGGESTED** the impact of these reassignments in the stock assessment should be explored in the future.

5. Review of New Information on Stock Status of Skipjack Tunas

5.1 Nominal and Standardised CPUE indices

- ***Maldives Pole and Line***

23. The WPTT **NOTED** paper IOTC-2020-WPTT22(DP)-11 on Bayesian Skipjack and Yellowfin Tuna CPUE Standardisation Model for Maldives Pole and Line 1970-2019 including the following abstract provided by the authors:

    "*An abundance index for skipjack and juvenile yellowfin tuna from 1970 to 2018 has been developed from Maldives pole and line catch and effort data. The index was derived from multiple datasets with differing level of detail over the period. Solutions for missing data were a random effects component used to account for missing mechanization information on the fleet 1974-1979 (Medley et al. 2017a) and the reconstruction of vessel length information using a vessel survival regression (described in Medley et al. 2017c). Fishing power effects related to vessel length are explained using a segmented regression that accounts for different classes of vessel*." – see document for full abstract.

24. The WPTT **CONGRATULATED** the authors for the progress made in the development of the abundance index time series for skipjack and yellowfin tuna from the Maldivian pole and line fishery including the work to extend to time series back to the 1970s. The WPTT **NOTED** that the Maldivian Pole and line CPUE is essential for the skipjack tuna assessment which could benefit from a longer time series to reduce model uncertainty.

25. The WPTT **NOTED** that the separate recording of yellowfin and skipjack tuna in the Maldives officially began in 1970 but that this may have taken some time to be effective in the entire country.

26. The WPTT **NOTED** that there was therefore some potential issue in the composition of the catch skipjack with yellowfin, and possibly bigeye, in the early years of the time series and that this could bias the CPUE trend observed during 1970-1980 for both yellowfin and skipjack.

27. The WPTT **NOTED** that the catch may have been reported for aggregated trips (i.e. >1 day) in some cases in the early years of the fishery and that this may affect the CPUE through a bias in the quantification of the fishing effort.

28. The WPTT **NOTED** that the outputs of the model suggest a substantial decline in the abundance index during 1970-1980 when the Indian ocean skipjack fishery was not much developed, which could potentially result in some inconsistent stock dynamics by the assessment model when reconciling the large decline with the relatively small catches.

29. The WPTT **AGREED** that the major decline observed in the 1970s is more likely to reflect local depletion rather than represent changes in abundance of the skipjack tuna for the whole Indian Ocean.

30. The WPTT **SUGGESTED** that the time series covering 1995-2018 are probably more reliable and could be considered for the configuration of a base model. However, the WPTT **AGREED** that the utility of the full time series should be explored in the assessment taking into account the uncertainty associated with the early part of the series and a final decision for the base model taken on reviewing diagnostics for the model fits.

31. The WPTT **NOTED** that the removal of the extremely high CPUEs observed from small vessels in the early period (and fixed constant fishing power for this size class) might result in some bias in the model estimates and that it would be useful to remove all the vessels of the small size class over the whole period to assess the robustness of the results. The WPTT **NOTED** that this would

exclude the aggregated IPTP data and therefore could only be carried out for the 1995-2018 period.

- ***EU Purse Seine***

32. The WPTT **NOTED** document IOTC-2020-WPTT22(DP)-12 on the skipjack CPUE series standardization by fishing mode for the European purse seiners operating in the Indian Ocean including the following abstract provided by the authors:

    "*The time series of EU purse seine fleet catches per unit effort (CPUE) of skipjack tuna from the Indian Ocean were standardized using the new development of the Delta-lognormal generalised linear mixed model adopted in ICCAT. The aim was to depict the trend in abundance for skipjack tuna by fishing mode, i.e. in free school (FSC) or under drifting fishing aggregating device (dFAD). The originality of this work relied on the inclusion of i) null sets in the total number of schools detected (i.e., considered as presence of skipjack tuna FSC), ii) fishing days without set, considered as absence of FSC and iii) dFAD density and support vessel assistance*." – see document for full abstract.

33. The WPTT **NOTED** that the purse seine catch on free schools has been very small in recent years and that they might not be representative of the stock.

34. The WPTT **NOTED** that it would be important to consider the effects of fishing power creep in the estimation of purse seine CPUE (e.g. annual 1% increase since 1995 in the catchability considered in the previous skipjack tuna stock assessment) and that some work focusing on the power component related to the use of echosounder buoys will be presented at the next WPTT.

35. The WPTT **NOTED** that some skippers may have reduced the time at sea of their own FADs before fishing on them in recent years to reduce the risks of setting by other purse seiners and that this could result in a decrease of the CPUE when expressed in catch per set.

36. The WPTT **NOTED** that the model includes a vessel effect but that the influence of the skipper could be explored for a subset of the data.

37. The WPTT **NOTED** that the increase in the number of satellite-tracked FADs may affect the catch per set by increasing the information provided to the fishermen and then enable the selection of the best FOBs but also possibly by fragmenting the biomass between FOBs. The WPTT however **NOTED** that information on all FOBs at sea is not available and cannot be included in the model.

38. The WPTT **NOTED** that some analysis showed that the increasing use of FADs may have resulted in increased searching time but that such analysis was conducted before the advent of echosounder buoys (from the early 2010s) and should be revisited as recent data indicate that fishermen tend to primarily target their own FADs when they have more buoys and as such reduce searching time.

5.2 Other abundance indices

Abundance indices for tuna populations associated with floating objects

39. The WPTT **NOTED** paper IOTC-2020-WPTT22(DP)-13 on assessing tropical tuna populations from their associative behaviour with floating objects: A novel abundance index for skipjack tuna (*Katsuwonus pelamis*) in the Western Indian Ocean including the following abstract provided by the authors:

    "This work presents a new behaviour-based modelling approach for providing direct estimates of tropical tuna populations based on their associative dynamics with floating objects (FOBs) and acoustic data collected from fisher's echosounder buoys. This new approach combines the residence and absence times of tuna individuals at FOBs with the

dynamics of FOBs occupancy by tuna aggregations in order to construct abundance indices for tropical tuna populations and their associated and non-associated components. Based on the case study of skipjack tuna (Katsuwonus pelamis), the approach was implemented to field data to provide time series of abundance of this species in the western Indian Ocean, over the period 2011 to 2019. The sensitivity of this novel approach to different association dynamics parameters and FOB numbers was assessed."

40. The WPTT **NOTED** that there might be differences in size between associated and non-associated tunas and that no size-dependent process is included in the model for the CRT (average continuous residence times) but that preliminary results suggest that the variability in CRT might be small.

41. The WPTT **NOTED** that the variability in the model outputs is not yet fully explicit but that some variability of the model components such as the number of FOBs has been accounted for.

42. The WPTT **NOTED** that the model does not account for the spatio-temporal variability in CAT (average continuous absence times), CRT, and numbers of FOBs and that this could be explored with a simulation model.

43. The WPTT **NOTED** that the model does not account for the effects of fishing.

Abundance indices for skipjack tuna using Echosounder Buoys

44. The WPTT **NOTED** paper IOTC-2020-WPTT22(DP)-14 on a Novel index of abundance of skipjack in the Indian Ocean derived from echosounder buoys including the following the abstract provided by the authors:

    "The collaboration with the Spanish vessel-owners associations and the buoy-providers companies, has made it possible the recovery of the information recorded by the satellite linked GPS tracking echosounder buoys used by the Spanish tropical tuna purse seiners and associated fleet in the Indian Ocean since 2010. These instrumental buoys inform fishers remotely in real-time about the accurate geolocation of the FAD and the presence and abundance of fish aggregations underneath them. Apart from its unquestionable impact in the conception of a reliable CPUE index from the tropical purse seine tuna fisheries fishing on FADs, echosounder buoys have also the potential of being a privileged observation platform to evaluate abundances of tunas and accompanying species using catch-independent data." – see document for full abstract

45. The WPTT **NOTED** that the two methodologically distinct approaches based on acoustic signals from echosounder buoys provide very different trends in skipjack relative abundance and that the reasons for this remain difficult to explain although the indices developed in IOTC-2020-WPTT22(DP)-13 used information from FAD and free schools whereas this study only used information from the echosounder buoys. It was further **NOTED** that the FAD set index from the paper IOTC-2020-WPTT22(DP)-13 showed similarities to the index derived in this study.

46. The WPTT **NOTED** that the environmental conditions in the Western Indian Ocean have varied over time. A period of low productivity noted during the period 2007-2014 was followed by an unusually high productivity until 2016 before stabilising until 2018. This change in productivity could be driving the increasing trend in skipjack abundance estimated in this model.

47. The WPTT **NOTED** the strong but necessary assumption of linear proportionality between population abundance and the biomass estimated from the acoustic signal and that some preliminary analysis based on catch showed some significant positive relationships but with a small variance explained likely due to the noise in both catch and acoustic data.

48. The document references catches on FAD sets and the WPTT **NOTED** that no official definition has been adopted by the IOTC as to what constitutes a FAD set. It was further NOTED that this

issue is being addressed by the FAD working group based on discussions between the tuna RFMOs.

49. The WPTT **NOTED** that echo-sounder buoys increased the catch of the purse seine fishery but that this would not affect the abundance index derived from acoustic data which are independent of the catch biomass.

50. The WPTT **NOTED** that the echosounder data used in the study are owned by the purse seine fishing companies and not currently publicly available.

6. SKIPJACK STOCK ASSESSMENT

6.1 Discussion on skipjack assessment models to be developed and their specifications

51. The WPTT **NOTED** the summary provided by the Secretariat on the model structure and input data from the 2017 assessment of skipjack tuna, as the basis for the discussion of the 2020 assessment planning. The WPTT further **NOTED** the set of biological parameters agreed to be used in assessment of skipjack tuna (see Table 9 from IOTC–2017–WPTT19) and that catch data until 2019 will be included in the model.

52. The WPTT discussed other options for the natural mortality and steepness values. With regard to the natural mortality, the WPTT **NOTED** that a Lorenzen type of natural mortality curve was explored in the previous assessment which did not yield very different results to the base model. With regard to steepness, the WPTT **NOTED** that the species is spawning year-round and is highly productive therefore the base value of 0.8 was probably not high enough. However, it was suggested that the perception that steepness should be higher for skipjack is not well supported as recent literature suggests that longer lived species tend to have higher steepness (Munyandorero 2020 and Zhou et al 2020). The WPTT further **NOTED** that IATTC commonly assumed a steepness of 1 (no stock-recruitment relationship) in their tropical tuna assessments but are currently revising their analysis to include different steepness options.

53. The WPTT **NOTED** that the 2017 assessment assumed a 1% annual increase of catchability for the Purse seine CPUE time series. The WPTT discussed whether this assumed catchability increase is consistent with the adoption of measures that limit the efficiency of PS in recent years or at least for some components of the fleet. It was suggested that the current limits on FADs may not be enough to limit effort creep and the restrictions on support vessel are now becoming quite restrictive. The WPTT further **NOTED** that the Purse seine CPUE indices have accounted for FAD densities and BAI indices are fishery independent, and thus suggested that the issue of effort creep for the Purse seine CPUE may need to be revisited.

54. The WPTT **NOTED** the caveats of using the longer time period of Maldivian indices as an abundance of the whole Indian Ocean. The WPTT suggested that the Maldivian index may be more appropriate as a regional abundance index. However, the WPTT **NOTED** that a spatially structured model previously explored for skipjack tuna did not work very well as there is lack of information to link the abundance across the regions.

55. The WPTT **NOTED** that the results of the 2020 assessment (if endorsed by the WPTT and SC) are expected to be used as the input to the skipjack HCR to determine the catch limit for 2021-2023. The WPTT **AGREED** that while it is important to maintain some level of continuity in-between assessments to avoid drastic changes in management advice, the new assessment should adequately consider new data input and improved knowledge of the fishery and stocks. The WPTT further **NOTED** that IOTC is currently undertaking a study to evaluate the skipjack harvest control rule and its potential revision to be a fully specified MP, which could provide a resolution to address the issue of the assessment continuity.

56. The WPTT suggested that the grid approach is appropriate for characterising the uncertainty for the skipjack assessment. The WPTT **AGREED** that adequate diagnosis such as hind-casting, jittering, and retrospective analysis should be conducted to help the selection of model grid. The WPTT agreed to set-up a small group to work intersessionally to guide the process of model diagnosis and selection, utilising recent progress in the development of methodology for model selection and weighting.

7. OTHER MATTERS

Revision of the WPTT Program of Work (2021-2025)

57. The WPTT **NOTED** paper IOTC-2020-WPTT22(DP)-09 on Revision of the WPTT Program of Work (2021-2025).

58. The WPTT **NOTED** that revisions to the Workplan will be very dependent on decisions made during the WPTT22 assessment meeting so was not discussed in detail here. The WPTT **NOTED** that this Program of Work has been accepted by the Scientific Committee but it needs to be updated by a year after the WPTT22 assessment meeting.

59. The WPTT **NOTED** that the Workplan has become very large and not very useful and the Secretariat will work with Chairs of the WPTT and SC to provide a more streamlined Workplan for discussion.

60. The WPTT **AGREED** to establish a small working group to coordinate skipjack stock assessment work going forward under the leadership of WPTT-Chair, and various aspects of preparatory work were assigned to key participants the Group

Review of size data from Indian Ocean Longline fleets

61. The WPTT **NOTED** presentation IOTC-2020-WPTT22(DP)-INF07 on a Review of size data from Indian Ocean longline fleets, and its utility for stock assessment.

62. The WPTT **THANKED** the authors for the presentation.

63. The WPTT **NOTED** there had been a delay in accessing all the size data for this project and, during this period, the data sharing agreements with Japan and Korea have expired. The WPTT **REQUESTED** that the Secretariat coordinate an extension of these data sharing agreements intersessionally, to ensure that the project can deliver results for the WPTT meeting in October 2020..

64. The WPTT **NOTED** issues that IATTC and ICCAT have with the identification of length data in their databases and **NOTED** the presentation of a recent paper from Korean scientists examining differences between observer data and data collected by crew onboard vessels (2020 IATTC document SAC-11 INF-K). The WPTT **NOTED** that there may be value in extending the examination of such data issues to all RFMOs.

65. The WPTT **NOTED** issues with length composition data from longline fleets and their impact on the assessment model for yellowfin tuna. The WPTT **REQUESTED** the author pays particular attention to the issue of the length composition data in all fleets. The author confirmed he will investigate these data fully and coordinate with the Secretariat specifically related to length compositions in assessment models.

Update on Yellowfin tuna

66. The WPTT **NOTED** that no new data have been presented for Yellowfin Tuna assessments. The WPTT **NOTED** that during the WPTT21 meeting there were no agreements made related to

aspects of the assessment model including growth curves and natural mortality values. The WPTT **NOTED** the plan to present the finalised grid at the WPTT22 assessment meeting.

67. The WPTT **NOTED** work that is being done by members of the group to modify growth curves and determine the best way to weight characteristics based on diagnostic analyses. These results will be presented at the WPTT22 assessment meeting.

8. Review of the draft, and adoption of the Report of the 20th Session of the WPTT

68. The report of the 22nd Session of the Working Party on Tropical Tunas Data Preparatory Meeting (IOTC–2020–WPTT22(DP)–R) was **ADOPTED** intersessionally via correspondence.

APPENDIX I
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APPENDIX II
AGENDA FOR THE 22ND WORKING PARTY ON TROPICAL TUNAS DATA PREPARATORY MEETING

Date: 22 - 24 June 2020
Location: Microsoft Teams
Venue: Virtual
Time: 12:00 – 15:00 (Seychelles time)
Chair: Dr Gorka Merino (European Union); **Vice-Chair:** Dr Shiham Adam (IPNLF)

1. **OPENING OF THE MEETING** (Chair)

2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chair)

3. **REVIEW OF THE DATA AVAILABLE AT THE SECRETARIAT FOR TROPICAL TUNA SPECIES** (IOTC Secretariat)

4. **NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENAL DATA RELATING TO SKIPJACK TUNAS** (Chair)

    4.1. Review new information on the biology, stock structure, their fisheries and associated environmental data for skipjack tuna:

    - Tagging information

5. **REVIEW OF NEW INFORMATION ON THE STATUS OF SKIPJACK TUNAS** (Chair)

    5.1. Nominal and standardised CPUE indices
    - Maldives Pole and Line
    - EU Purse Seine

    5.2. Other abundance indices

6. **SKIPJACK STOCK ASSESSMENT** (Chair)

    6.1. Discussion on skipjack assessment models to be developed and their specifications

7. **OTHER MATTERS** (Chair)

8. **REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 22ND SESSION OF THE WORKING PARTY ON TROPICAL TUNAS (DATA PREPARATORY) (Chair)**

APPENDIX III
LIST OF DOCUMENTS FOR THE 22ND WORKING PARTY ON TROPICAL TUNAS DATA PREPARATORY MEETING

Document	Title
IOTC–2020–WPTT22(DP)–01a	Draft: Agenda of the 22nd Working Party on Tropical Tunas (Data Preparatory Meeting)
IOTC–2020–WPTT22(DP)–01b	Draft: Annotated agenda of the 22nd Working Party on Tropical Tunas (Data Preparatory Meeting)
IOTC–2020–WPTT22(DP)–02	Draft: List of documents for the 22nd Working Party on Tropical Tunas (Data Preparatory Meeting)
IOTC–2020–WPTT22(DP)–03	Outcomes of the 22nd Session of the Scientific Committee (IOTC Secretariat)
IOTC–2020–WPTT22(DP)–05	Review of Conservation and Management Measures relevant to tropical tunas (IOTC Secretariat)
IOTC–2020–WPTT22(DP)–06	Progress made on the recommendations of WPTT21 (IOTC Secretariat)
IOTC–2020–WPTT22(DP)–07	Outcomes of the 3rd Session of the Technical Committee on management Procedures (IOTC Secretariat)
IOTC–2020–WPTT22(DP)–08	Review of the statistical data and fishery trends for tropical tunas (IOTC Secretariat)
IOTC–2020–WPTT22(DP)–09	Revision of the WPTT Program of Work (2021–2025) (IOTC Secretariat)
IOTC–2020–WPTT22(DP)–10	Tag Data Processing for IOTC Tropical Tuna Assessments (IOTC Secretariat)
IOTC–2020–WPTT22(DP)–11	Bayesian Skipjack and Yellowfin Tuna CPUE Standardisation Model for Maldives Pole and Line 1970-2019 (Medley P, Ahusan M and Shiham Adam M)
IOTC–2020–WPTT22(DP)–12	Skipjack CPUE series standardization by fishing mode for the European purse seiners operating in the Indian Ocean (Guery, L., Aragno, V., Kaplan, D., Grande M., Baez , J.C., Abascal, F., Urunga J., Marsac, F., Merino, G. and Gaertner, D.)
IOTC–2020–WPTT22(DP)–13	Assessing tropical tuna populations from their associative behaviour with floating objects: A novel abundance index for skipjack tuna (*Katsuwonus pelamis*) in the Western Indian Ocean (Baidai Y, Dagorn L, Amande M.J. ,Kaplan D., Gaertner D., Deneubourg J.L. and Capello M.)
IOTC–2020–WPTT22(DP)–14	A Novel Index of Abundance of Skipjack in the Indian Ocean Derived from Echosounder Buoys (Santiago J, Uranga J, Quincoces I, Grande M, Murua H, Merino G, Urtizberea A, Zudaire I and Boyra G)
IOTC–2020–WPTT22(DP)–INF01	Development Status of the New Tropical Tunas Treatment (T3) Software (DuParc A et al.)
IOTC–2020–WPTT22(DP)–INF02	Review of Japanese fisheries and tropical tuna catch in the Indian Ocean. (Matsumoto T)
IOTC–2020–WPTT22(DP)–INF03	Japanese longline CPUE for bigeye tuna in the Indian Ocean standardized by GLM. (Matsumoto T)
IOTC–2020–WPTT22(DP)–INF04	Japanese longline CPUE for yellowfin tuna in the Indian Ocean standardized by generalized linear model. (Matsumoto T)
IOTC–2020–WPTT22(DP)–INF05	Unprecedented Decrease In Landings Of Tropical Tuna In Pakistan During 2019 (Moazzam M)
IOTC–2020–WPTT22(DP)–INF06	CPUE standardization of yellowfin tuna, *Thunnus albacares* (Bonnaterre, 1788) from Indonesian tuna longline fishery in the north-eastern Indian Ocean (Setyadji B, Hartaty H, Fahmi Z)
IOTC–2020–WPTT22(DP)–INF07	Review of size data from Indian Ocean longline fleets, and its utility for stock assessment (Hoyle S, Chang S-T, Fu D, Geehan J, Kim D-N, Lee S-I, Matsumoto T, Yeh Y-M and Wu R-F.).

APPENDIX IVA

STATISTICS FOR TROPICAL TUNAS

(Extracts from IOTC–2020–WPTT22(DP)–08)

Fisheries and catch trends for tropical tuna species

- Main species: Skipjack tuna accounts for 48.5% of total catches of tropical tunas, followed closely by yellowfin tuna (42.2%), while catches of bigeye tuna account for the remaining 9.3% of catches (**Fig. 1d**).

- Main fishing gear (2014-18): Purse seiners account for 43% of total catches of tropical tunas, with important catches also reported by handlines and trolling (18%), gillnets (18%), pole-and-line (11%), and longliners (9%), with catches occurring in both coastal waters and the high seas.

  Tropical tunas are the target species of many industrial and artisanal fisheries throughout the Indian Ocean, although they are also a bycatch of fisheries targeting other tunas, small pelagic species, or other non-tuna species.

- Main fleets (i.e., highest catches in recent years): Tropical tunas are caught by both coastal countries in the Indian Ocean and distant water fishing nations (**Fig. 2**).

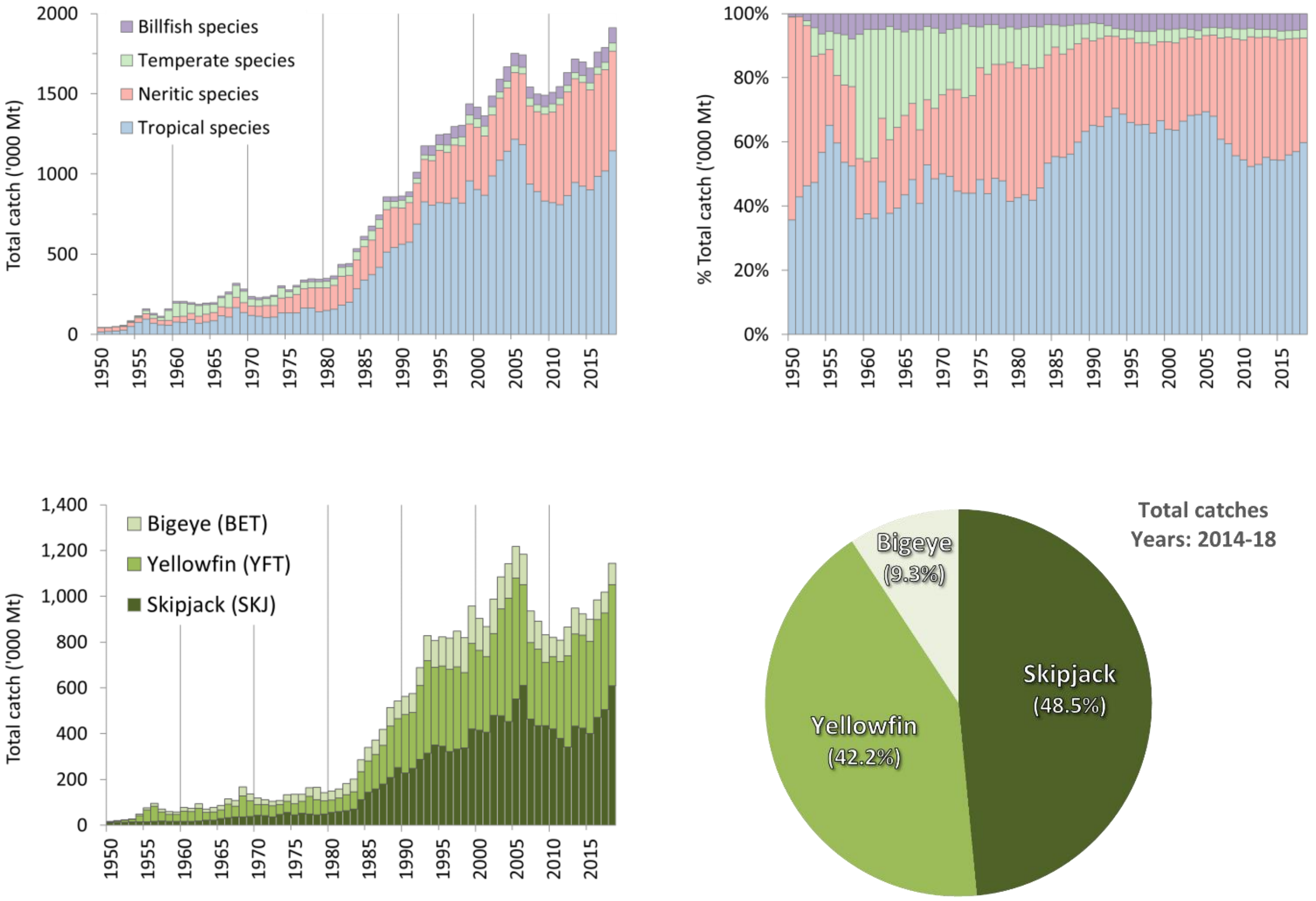
  In recent years the coastal fisheries of five countries (Indonesia, Maldives, Sri Lanka, I.R. Iran, and India) have accounted for 51% of the total catches of tropical tuna species in the Indian Ocean, while the industrial purse seiners and longliners flagged as EU-Spain, Seychelles and EU-France reported a further 33% of total catches of these species.

- Retained catch trends: The importance of tropical tunas to the total catches of IOTC species in the Indian Ocean has changed over the years (Figs. 1a-b.), in particular following the arrival of industrial purse seine fleets to the Indian Ocean in the early-1980s targeting tropical tunas. With the onset of piracy in the late-2000s, the activities of fleets operating in the north-west Indian Ocean have been displaced or reduced – particularly the Asian distant-water longline fleet – leading to a relative decline in the proportion of catches from tropical tunas (i.e., currently around 59% of total catches of all IOTC species, compared to ≈68% over the (pre-piracy) period 1950-2008).

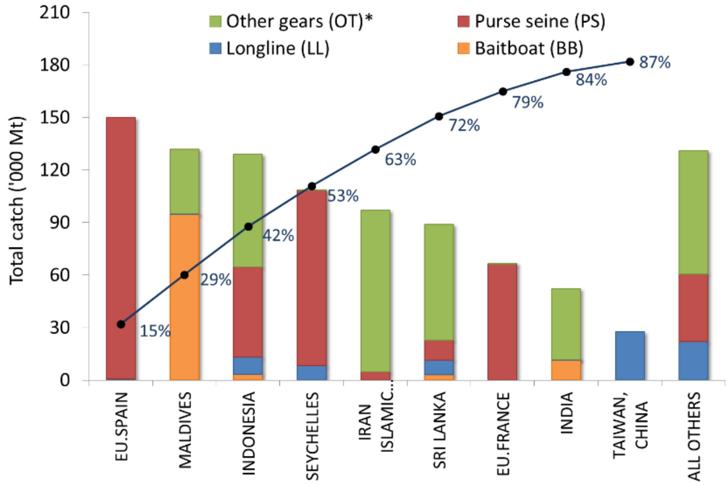
  Since 2012 catches of tropical tunas appear to show signs of recovery – in particular catches from the distant water longline fleets (e.g., Taiwan,China) – as a result of the reduction of the threat of piracy and return of fleets and to the north-west Indian Ocean.

  Total catches of tropical tunas have increased from ≈820,000t during the years of piracy in the late 2000s, to ≈940,000t in 2013 and ≈1,000,000t and over in 2017 and 2018.

- Economic markets: The majority of catches of tropical tuna species are sold to international markets, including the sashimi market in Japan (large specimens of yellowfin tuna and bigeye tuna in fresh or deep-frozen condition), and processing plants in the Indian Ocean region or abroad (small specimens of skipjack tuna and, to a lesser extent, yellowfin tuna and bigeye tuna). A component of the catches of tropical tunas, in particular skipjack tuna caught by some coastal countries in the region, is sold in local markets or retain by the fishermen for direct consumption.



Figs. 1a-d. Top: Contribution of the three tropical tuna species under the IOTC mandate to the total catches of IOTC species in the Indian Ocean, over the period 1950-2018 (a. Top left: total catch; b. Top right percentage, same colour key as Fig. 1a); **Bottom:** Contribution of each tropical tuna species to the total combined catches of tropical tunas (c. Bottom left: nominal catch of each species, 1950-2018; d. Bottom right: share of tropical tuna catch by species, 2014 – 18)



** Other gears includes handline, gillnet, gillnet-longline, trawling.*

Fig. 2. All tropical tunas: average catches in the Indian Ocean over the period 2014 – 18, by country. Countries are ordered from left to right, according to the importance of catches of tropical tunas reported. The dark line indicates the (cumulative) proportion of catches of tropical tunas for the countries concerned, over the total combined catches of species reported from all countries and fisheries.

APPENDIX IVB

MAIN STATISTICS OF SKIPJACK TUNA

(Extracts from IOTC–2020–WPTT22(DP)–08)

Fisheries and main catch trends

Main fishing gear (2014–18)

Skipjack tuna are mostly caught by industrial purse seiners (≈49%), gillnet (≈18%) and pole-and-line (≈16%) (**Table 4; Fig. 10**).

Main fleets (and primary gear associated with catches)

<u>Percentage of total catches (2014–18)</u>: the five main fleets catching skipjack tuna are EU-Spain (purse seine): 17%; Indonesia (coastal purse seine, troll line, gillnet): 17%; Maldives (pole-and-line): 17%; Seychelles (purse seine): 11% and Sri Lanka (gillnet-longline): 10%; (**Fig. 12**).

Main fishing areas

Primary: Western Indian Ocean (West R2), in waters off Somalia (**Table 5; Fig.11**)

- In recent years catches of skipjack in this area have dropped considerably as fishing effort has been displaced or reduced due to piracy – particularly catches from industrial purse seiners and fleets using driftnets flagged under I.R. Iran and Pakistan.

Secondary: Maldives (Area R2b)

- Since the mid-2000s decreases in skipjack catches have also been reported by the Maldivian pole-and-line fishery (although the reasons remain unclear) but may possibly be related to a change in targeting to yellowfin tuna.

Retained catch trends

<u>Purse seine fisheries</u>:

The increase in catches of skipjack tuna in the last 30 years have largely been driven by the arrival of purse seiners in the early 1980s, and the development of the fishery in association with Fish Aggregating Devices (FADs) since the 1980s. In recent years, well over 90% of the skipjack tuna caught by purse seine vessels are taken from around FADs.

Annual catches peaked at over 600,000t in 2006 with the constant increase in catches and catch rates of purse seiners until that year believed to be associated with increases in fishing power and also an increase in the number of FADs (and technology associated with them) used in the fishery.

Since 2006 total catches (across all fisheries) have declined to around 340,000t in 2012 – the lowest catches recorded since 1998 – although since 2013 catches have increased sharply and in 2018 reached again a level of 600,000t (around 100,000t more than in 2017) mostly driven by the purse seine (log-school) fisheries.

<u>Pole-and-line fisheries</u>:

The Maldivian pole-and-line fishery effectively increased its fishing effort with the mechanisation of its fleet since 1974, including an increase in boat size and power, as well as the use of anchored FADs since 1981. Skipjack tuna represents around 80% of the total catch of Maldives, where catches of skipjack tuna increased regularly between 1980 and 2006 – from around 20,000t to over 130,000 t.

Catches of skipjack tuna reported by Maldives pole-and-line have since declined in recent years to as low as 55,000t - less than half the catches taken in 2006 - although the reasons for the decline remain unclear. One explanation may be improvements in the data collection with the introduction of logbooks and more accurate, albeit lower, estimates of skipjack landed; while the introduction of handlines and a shift in targeting from skipjack tuna to yellowfin tuna may also be a contributing factor. In 2018 catches from this fishery reached again 100,000t, with the majority of these catches (over 80%) being caught in offshore waters.

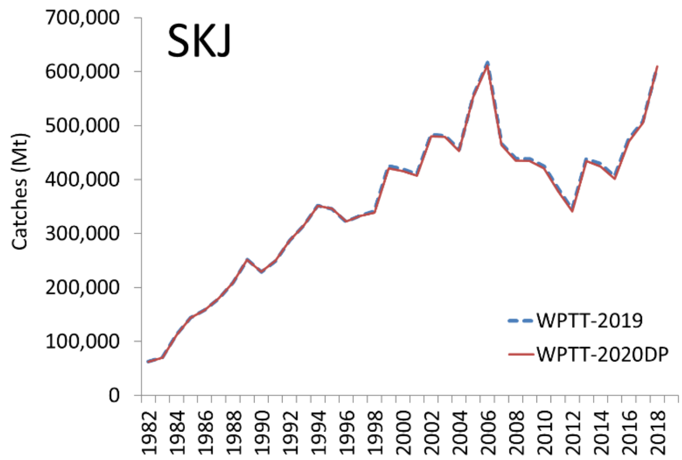
Gillnet fisheries:

Several fisheries using gillnets have reported large catches of skipjack tuna in the Indian Ocean, including the gillnet/longline fishery of Sri Lanka, driftnet fisheries of I.R. Iran and Pakistan, and gillnet fisheries of Indonesia. In recent years gillnet catches have represented as much as 20% to 30% of the total catches of skipjack tuna in the Indian Ocean. Although it is known that vessels from I.R. Iran and Sri Lanka have been using gillnets on the high seas in recent years, reaching as far as the Mozambique Channel, the activities of these fleets are not fully understood, as time-area catch-and-effort series have been made available for those fleets only in recent years.

Discard levels

Low, although estimates of discards are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–07.

Catch series



Total Skipjack catches in the years 1987-2018 have been relatively impacted by the revisions introduced to the official catch series submitted in late 2019 by Pakistan for its gillnet fisheries, with revised catches being now 69,244 MT lower (in total) during considered years.

Table 4. Skipjack tuna: Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) by gear and main fleets (or type of fishery) by decade (1950–2009) and year (2009–2018), in tonnes. Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery. Data as of May 2020.

Fishery	By decade (average)						By year (last ten year)									
	1950s	1960s	1970s	1980s	1990s	2000s	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BB	9,000	12,800	19,275	35,459	67,760	100,496	65,018	71,585	52,489	51,134	72,583	67,301	68,965	68,712	88,617	99,886
FS	0	0	0	13,658	25,197	24,342	9,498	8,708	8,930	2,924	5,625	6,467	7,535	6,560	5,735	5,763
LS	0	0	0	30,673	107,845	153,298	135,797	139,770	120,115	77,992	117,046	118,856	118,785	175,716	195,201	276,124
OT	6,014	14,066	27,642	50,330	118,328	194,845	224,122	200,632	196,916	208,880	238,582	231,435	205,388	219,199	215,933	227,383
Totals	**15,014**	**26,866**	**46,918**	**130,121**	**319,130**	**472,982**	**434,436**	**420,695**	**378,450**	**340,930**	**433,836**	**424,059**	**400,673**	**470,187**	**505,486**	**609,156**

Gears: Pole-and-Line (**BB**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Other gears nei (**OT**) (e.g., troll line, handline, beach seine, Danish seine, liftnet). Background colour intensity is proportional to the catches by fishery and category (i.e. decade, year)

Table 5. Skipjack tuna: Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) by area (as used for the assessment) by decade (1950–2009) and year (2009–2018), in tonnes. Catches by decade represent the average annual catch. Data as of May 2020.

Area	By decade (average)						By year (last ten year)									
	1950s	1960s	1970s	1980s	1990s	2000s	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
R1	4,524	9,951	19,330	34,877	80,744	118,318	151,486	154,434	153,882	155,406	171,217	149,052	131,236	116,968	114,413	123,041
R2	1,491	4,116	8,313	59,784	170,626	254,168	217,931	194,676	172,079	134,391	190,036	207,705	200,476	284,507	302,456	386,229
R2b	9,000	12,800	19,275	35,459	67,760	100,496	65,018	71,585	52,489	51,134	72,583	67,301	68,965	68,712	88,617	99,886
Totals	**15,014**	**26,866**	**46,918**	**130,121**	**319,130**	**472,982**	**434,436**	**420,695**	**378,450**	**340,930**	**433,836**	**424,059**	**400,676**	**470,187**	**505,486**	**609,156**

Areas: East Indian Ocean (**R1**); West Indian Ocean, (**R2**); Maldives baitboat (**R2b**). Background colour intensity is proportional to the catches by area and category (i.e. decade, year)

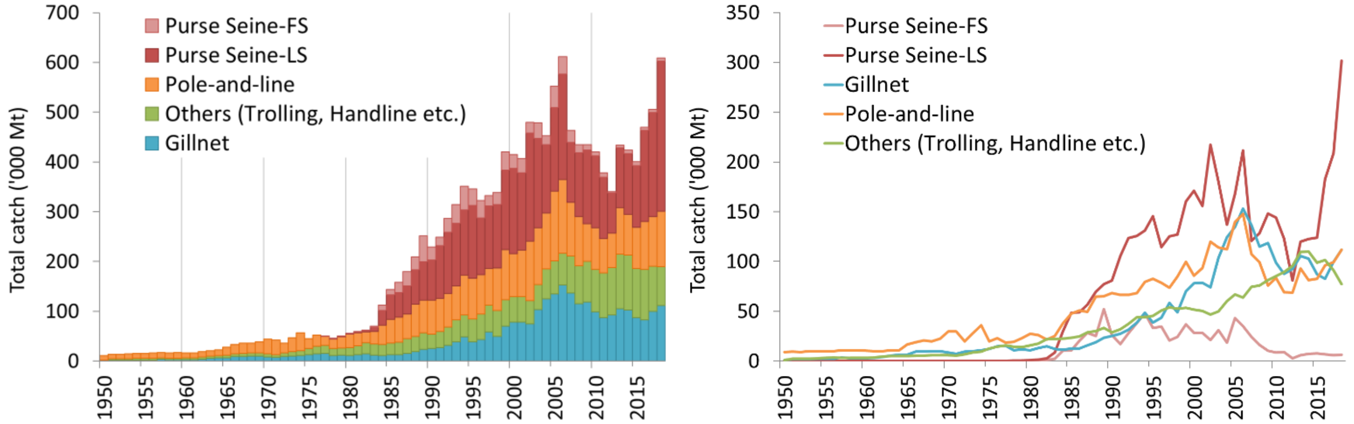


Fig. 10. Annual catches of skipjack tuna by gear (1950–2018). Data as of May 2020.

Gear definitions: Pole-and-Line (**BB**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Other gears nei (**OT**) (e.g., troll line, handline, beach seine, Danish seine, liftnet).

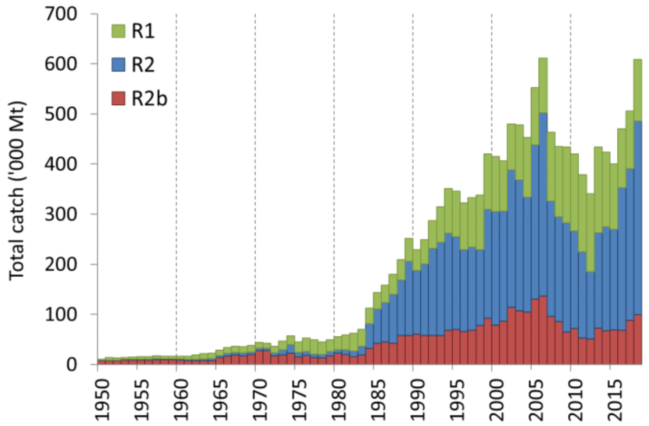


Fig. 11. Skipjack tuna: Catches of skipjack tuna by area by year estimated for the WPTT (1950–2018).
Areas: East Indian Ocean (**R1**); West Indian Ocean (**R2**); Maldives baitboat (**R2b**). Data as of May 2020.

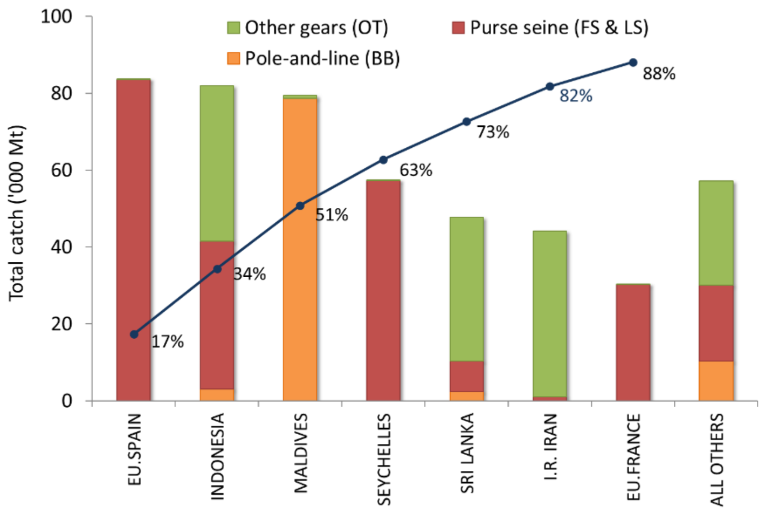


Fig. 12. Skipjack tuna: average catches in the Indian Ocean over the period 2014 – 18, by country. Countries are ordered from left to right, according to the importance of catches of skipjack reported. The dark line indicates the (cumulative) proportion of catches of skipjack for the countries concerned, over the total combined catches of this species reported from all countries and fisheries. Data as of May 2020.

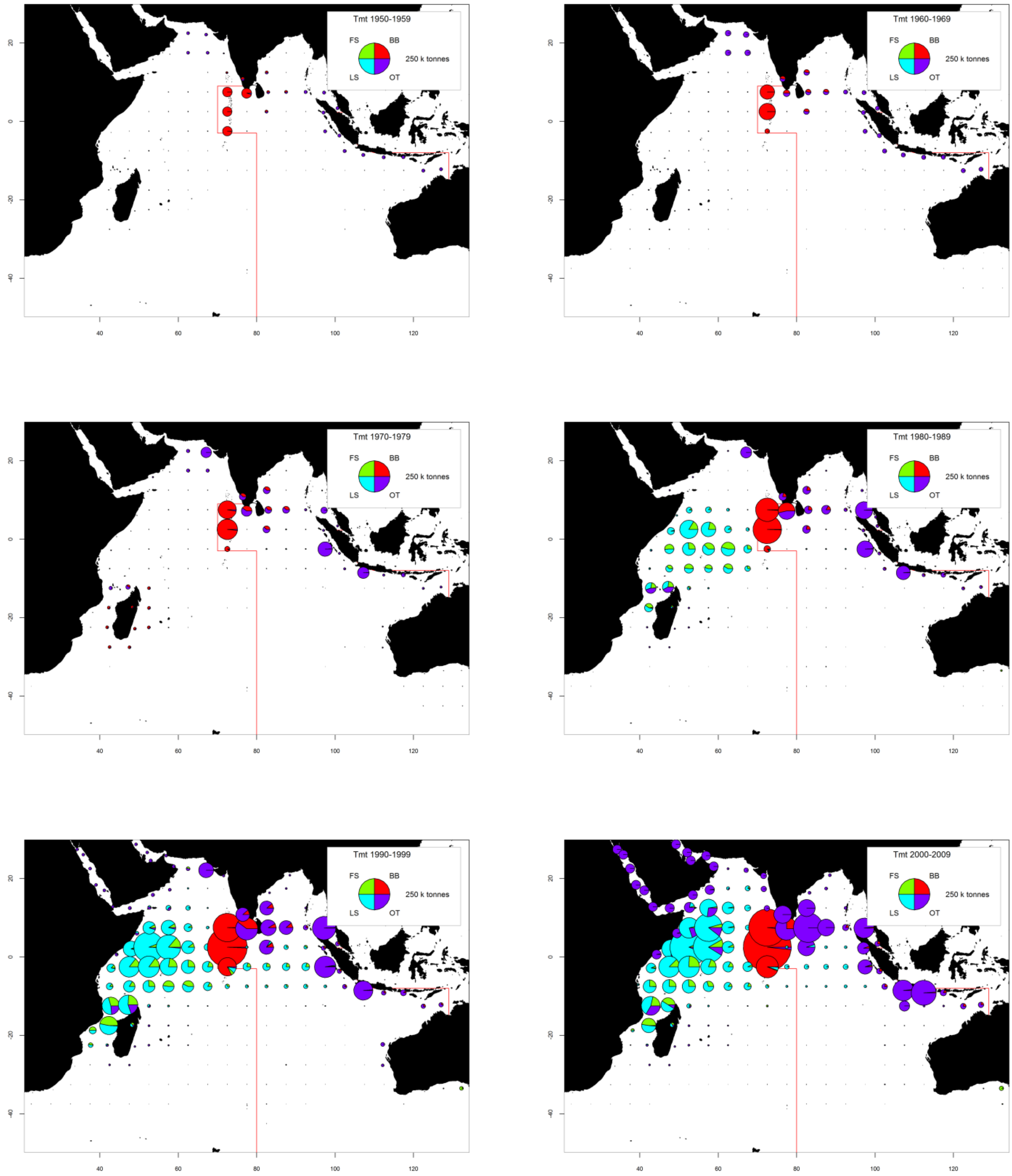


Fig. 13(a-f). Skipjack tuna: Time-area catches (total combined in tonnes) of skipjack tuna estimated for the period 1950–2009, by decade and type of gear. Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including longline, drifting gillnets, and various coastal fisheries.

Note that the catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded using the estimated areas from the CAS data set. This is particularly true for the driftnets of I.R. Iran, gillnet and longline fishery of Sri Lanka, and longline and coastal fisheries of Indonesia (OT).

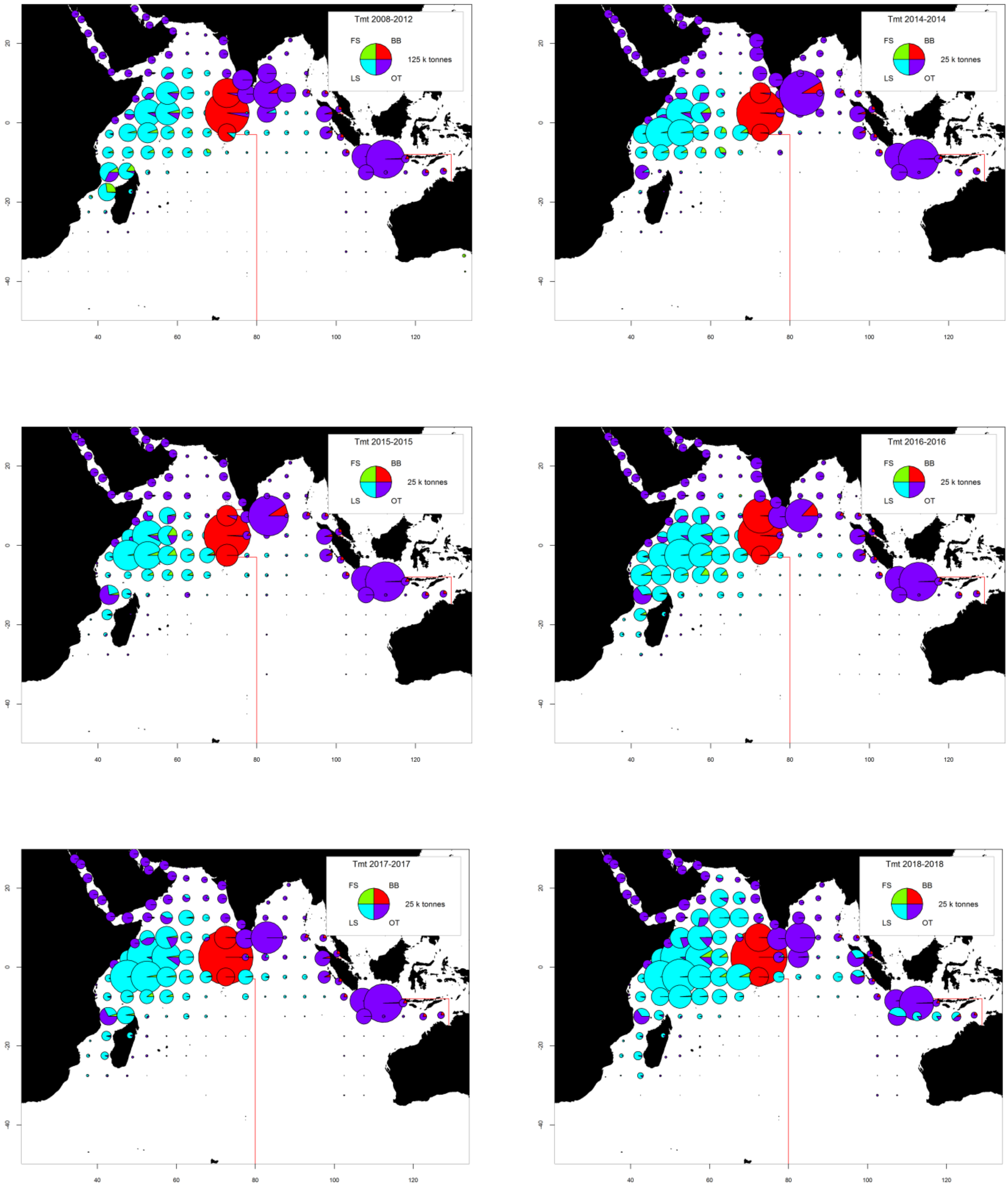


Fig. 14(a-f). Skipjack tuna: Time-area catches (total combined in tonnes) of skipjack tuna estimated for the period 2008–12 by type of gear and for 2013–17, by year and type of gear. Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including longline, drifting gillnets, and various coastal fisheries.

Note that the catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded using the estimated areas from the CAS data set. This is particularly true for the driftnets of I.R. Iran (years before 2007), gillnet and longline fishery of Sri Lanka, and longline and coastal fisheries of Indonesia (OT).

Data availability and related data quality issues

Retained catches

- Retained catches are considered to be generally well known for the major industrial fleets, with the proportion of catches estimated, or adjusted, by the IOTC Secretariat relatively low (**Fig. 15a**). Catches are less certain for many artisanal fisheries for a number of reasons, including:
  - catches not fully reported by species;
  - uncertainty in the catches from some significant fleets including the Sri Lankan coastal fisheries, and coastal fisheries of Comoros and Madagascar.

Catch-per-unit-effort (CPUE) trends

- Catch-and-effort series are available for the various industrial and artisanal fisheries (e.g., Maldives pole-and-line fishery, EU-France purse seine).

  However for a number of other important fisheries catch-and-effort are either not available (**Fig. 15b**), or are considered to be of poor quality, notably:
  - insufficient data available for the gillnet fisheries of I.R. Iran (before 2007) and Pakistan;
  - poor quality effort data for the gillnet-longline fishery of Sri Lanka. In previous years catch-and-effort has not been reported fully by area, or disaggregated by gear (i.e., gillnet-longline) according to the IOTC reporting standards – however, since 2014 detailed information by EEZ area (for coastal fisheries) and grid area (for offshore fisheries) and gear started being submitted to the IOTC Secretariat;
  - no catch-and-effort data are available for important coastal fisheries using hand and/or troll lines, in particular Indonesia, India and Madagascar. Time-area catches for handline and troll line fisheries of Indonesia were received in 2018 for the first time.

Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Average fish weight: trends in average weights cannot be assessed before the mid-1980s and are also incomplete for most artisanal fisheries, namely hand lines, troll lines and many gillnet fisheries (e.g., Indonesia) (**Fig. 15c**).
- Catch-at-Size (Age) table: are available but the estimates are uncertain for some years and fisheries due to:
  - a general lack of size data before the mid-1980s, for all fleets/fisheries;
  - lack of size data available for some artisanal fisheries, notably most hand lines and troll line fisheries (e.g., Madagascar) and many gillnet fisheries (e.g., Indonesia, Sri Lanka) – although from 2014 Sri Lanka reported size information for its offshore fisheries.

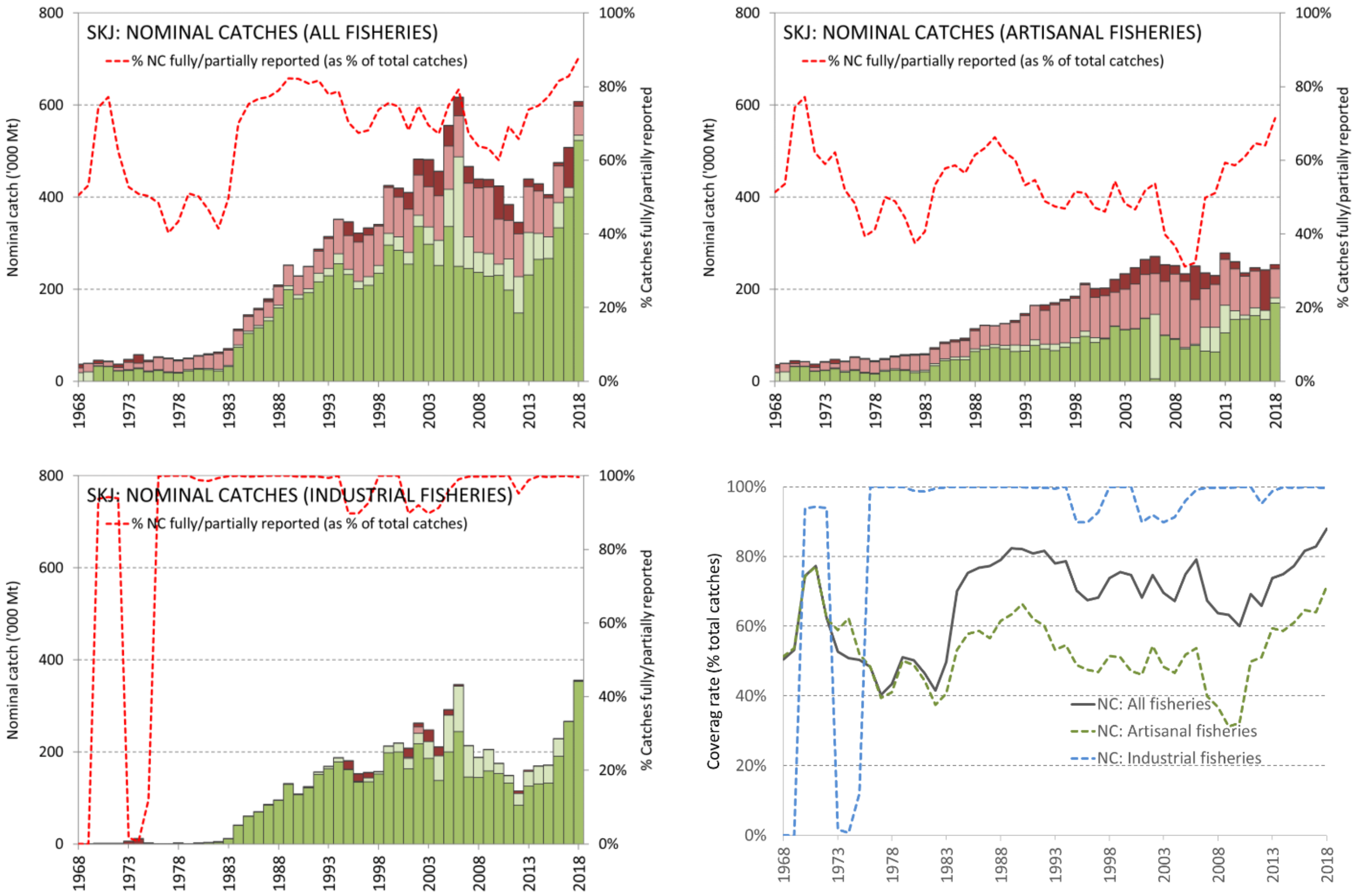


Fig. 15a-c. Skipjack tuna: nominal catches data reporting coverage (1968–2018). Data as of May 2020.

Data reporting scores:

	0
	2
	4
	6
	8

Each IOTC dataset (nominal catch, catch-and-effort, and size data) are assessed against IOTC reporting standards, where:

- **Score: 0** indicates the amount of nominal catch associated with each dataset fully reported according to IOTC standards.
- **Score: 2 – 6** indicates the amount of nominal catches associated with each dataset partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat or for any of the other reasons provided in the document).
- **Score: 8** indicates the amount of nominal catches associated that is fully estimated by the IOTC Secretariat (i.e., nominal catches) or data that is not available (i.e., catch-and-effort or size data).

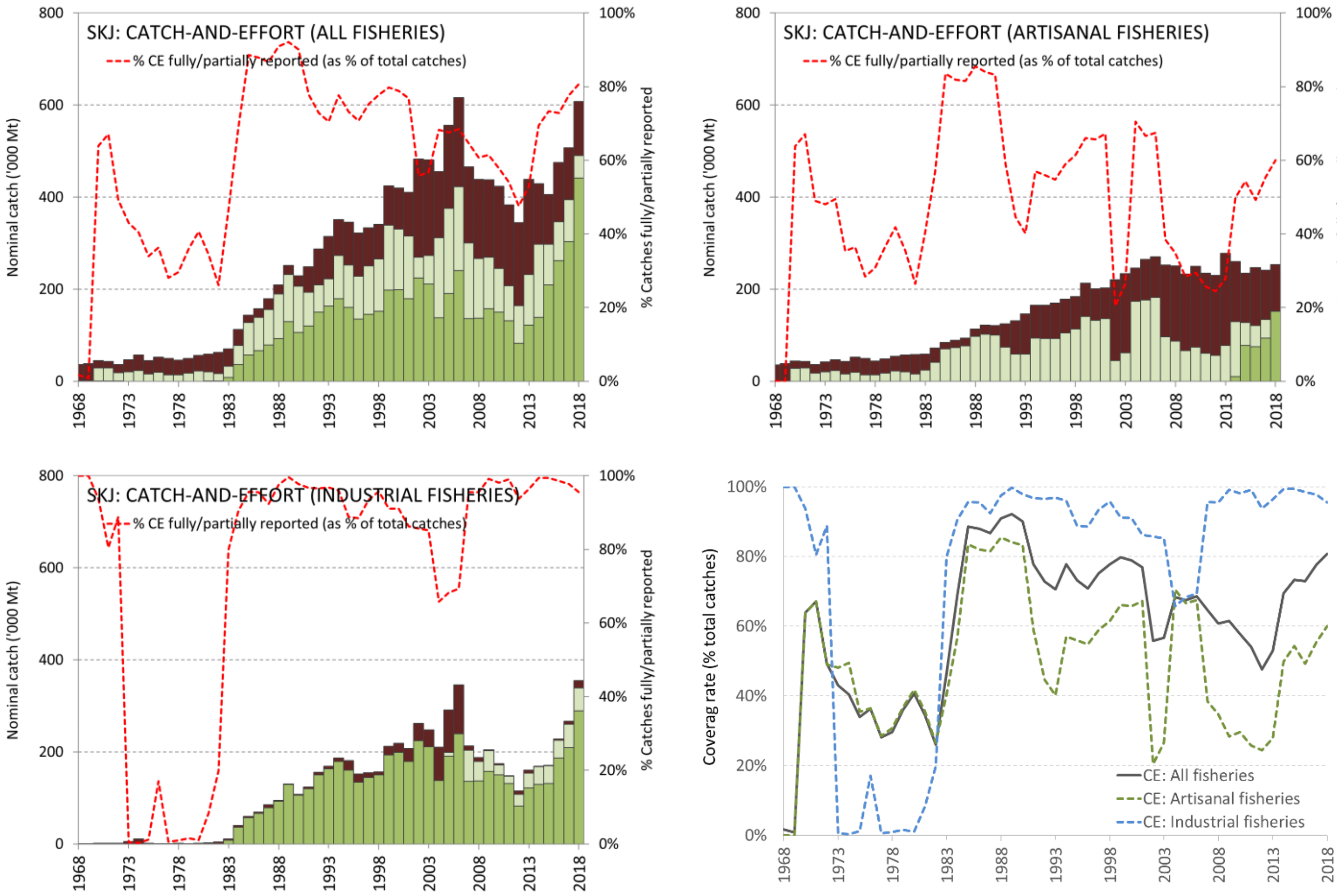


Fig. 15d-f. Skipjack tuna: catch-and-effort data reporting coverage (1968–2018). Data as of May 2020.

Data reporting scores:

	0
	2
	4
	6
	8

Each IOTC dataset (nominal catch, catch-and-effort, and size data) are assessed against IOTC reporting standards, where:

- **Score: 0** indicates the amount of nominal catch associated with each dataset fully reported according to IOTC standards.
- **Score: 2 – 6** indicates the amount of nominal catches associated with each dataset partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat or for any of the other reasons provided in the document).
- **Score: 8** indicates the amount of nominal catches associated that is fully estimated by the IOTC Secretariat (i.e., nominal catches) or data that is not available (i.e., catch-and-effort or size data).

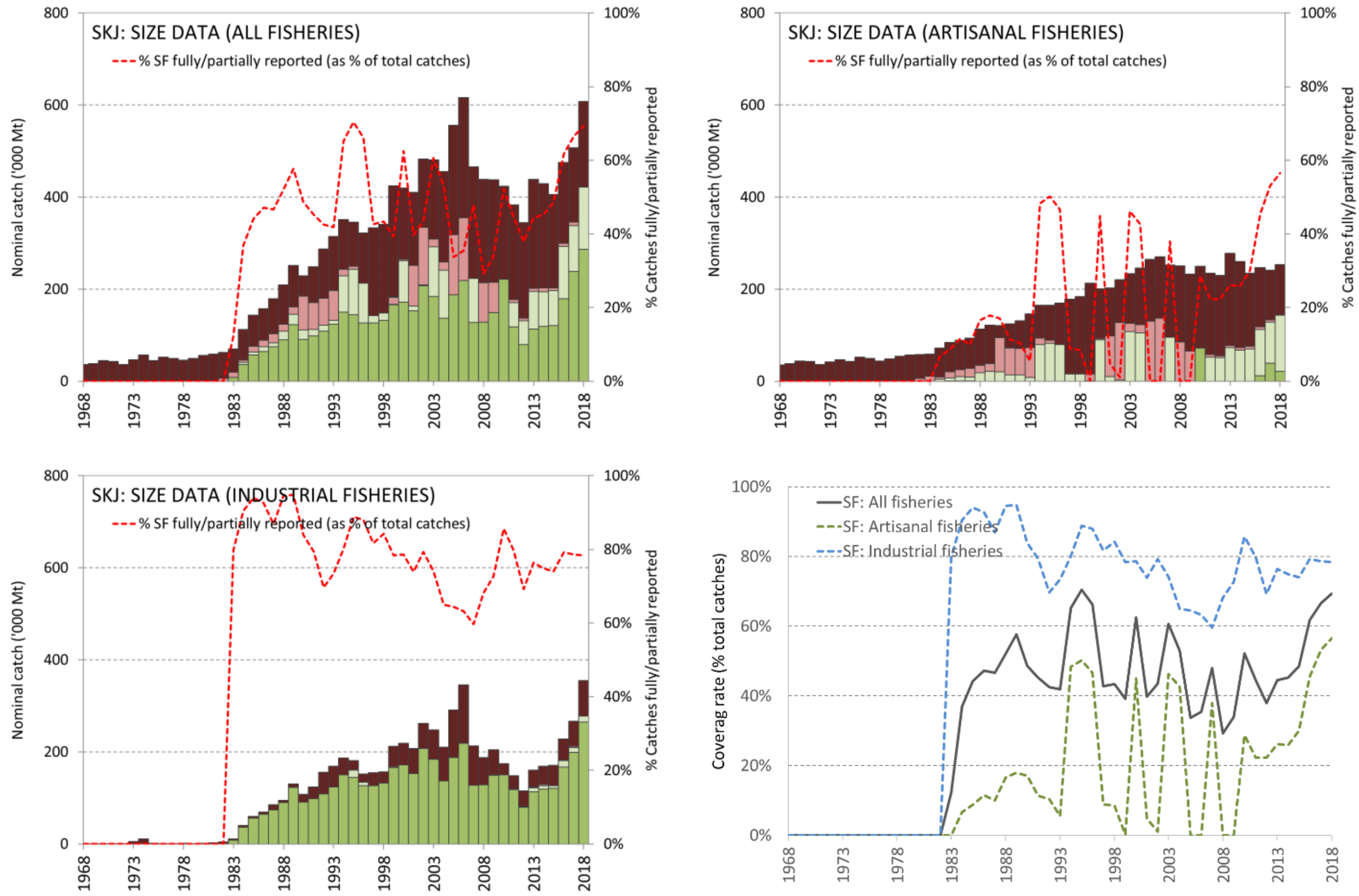


Fig. 15g-i. Skipjack tuna: size frequency data reporting coverage (1968–2017). Data as of September 2018.

Data reporting scores:

	0
	2
	4
	6
	8

Each IOTC dataset (nominal catch, catch-and-effort, and size data) are assessed against IOTC reporting standards, where:

- **Score: 0** indicates the amount of nominal catch associated with each dataset fully reported according to IOTC standards.
- **Score: 2 – 6** indicates the amount of nominal catches associated with each dataset partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat or for any of the other reasons provided in the document).
- **Score: 8** indicates the amount of nominal catches associated that is fully estimated by the IOTC Secretariat (i.e., nominal catches) or data that is not available (i.e., catch-and-effort or size data).

Skipjack tuna: Tagging data

- A total of 115,693 skipjack (representing 53% of the total number of fish tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP), of which ≈68% were released during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) around Seychelles, in the Mozambique Channel and off the coast of Tanzania, between May 2005 and September 2007 (**Fig. 16**). The remaining were tagged during small-scale tagging projects, and by other institutions with the support of IOTC around the Maldives, India, and in the south west and the eastern Indian Ocean.
- To date, 17,669 specimens (15% of releases for this species), have been recovered and reported to the IOTC Secretariat. Around 70% of the recoveries were from the purse seine fleets operating from the Seychelles, and around 29% by the pole-and-line vessels mainly operating from the Maldives. The addition of the data from the

past projects in the Maldives (in 1990s) added 14,506 tagged skipjack tuna to the databases, or which 1,960 were recovered mainly in the Maldives.

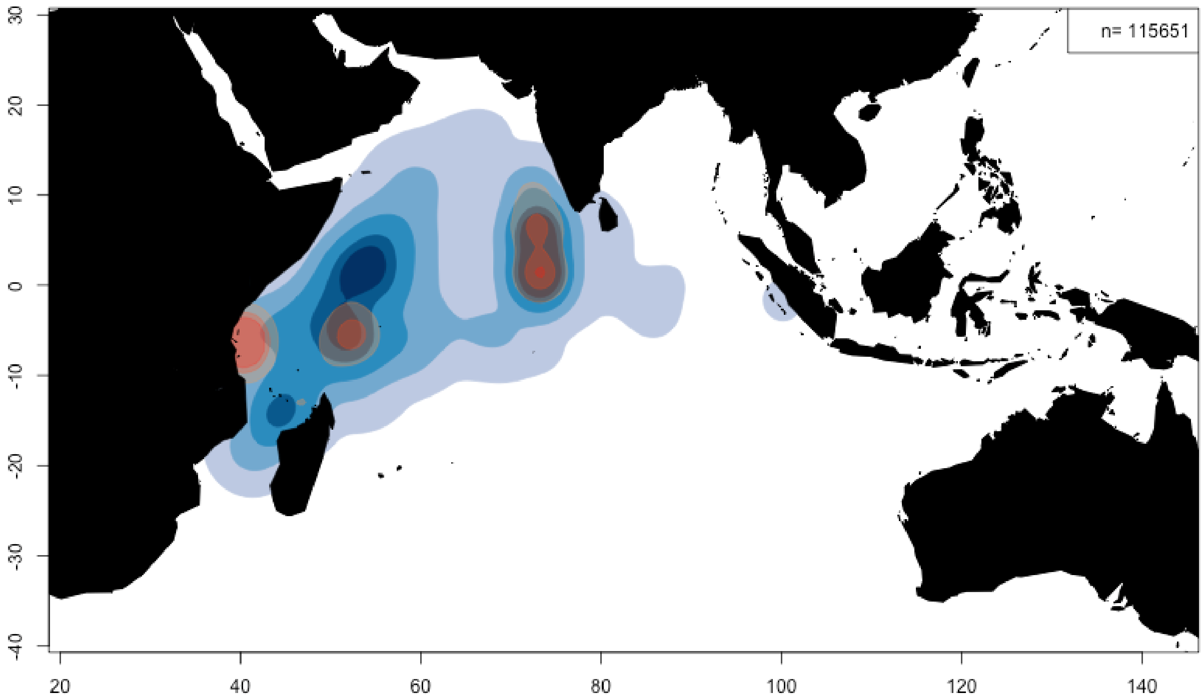
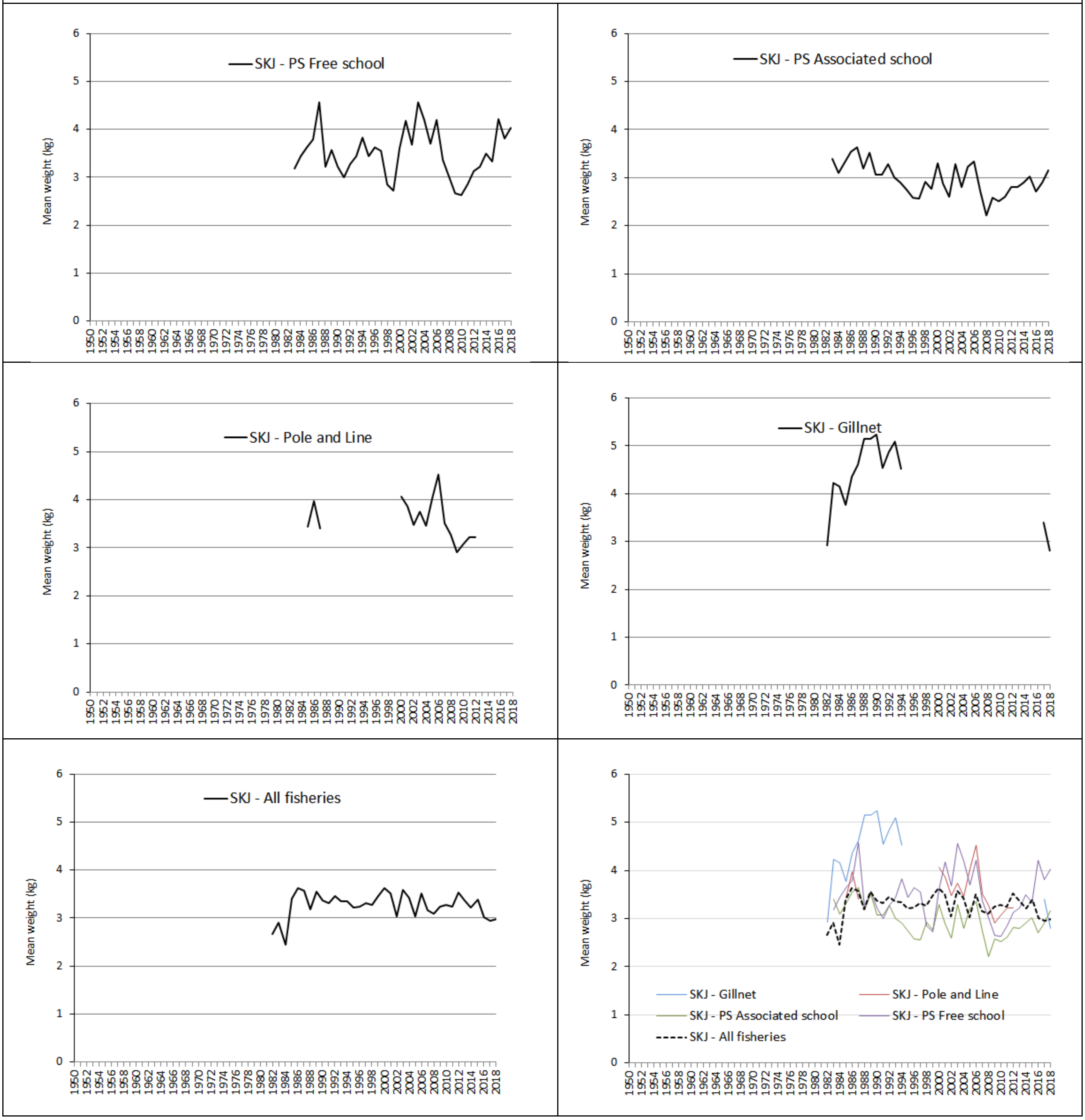


Fig. 16. Skipjack tuna: Densities of releases (in red) and recoveries (in blue). Includes specimens tagged during the IO and also Indian Ocean (Maldivian) tagging programmes during the 1990s.

Skipjack tuna (SKJ)

Fig. 17. Average weight of skipjack tuna (SKJ) taken by:

- Purse seine on free (top left) and associated (top right) schools,
- Pole-and-line from Maldives and India (second row left), and gillnets from Sri Lanka, Iran, and other countries (second row right)
- All fisheries (bottom row left), and all fisheries and main gears (bottom row left)



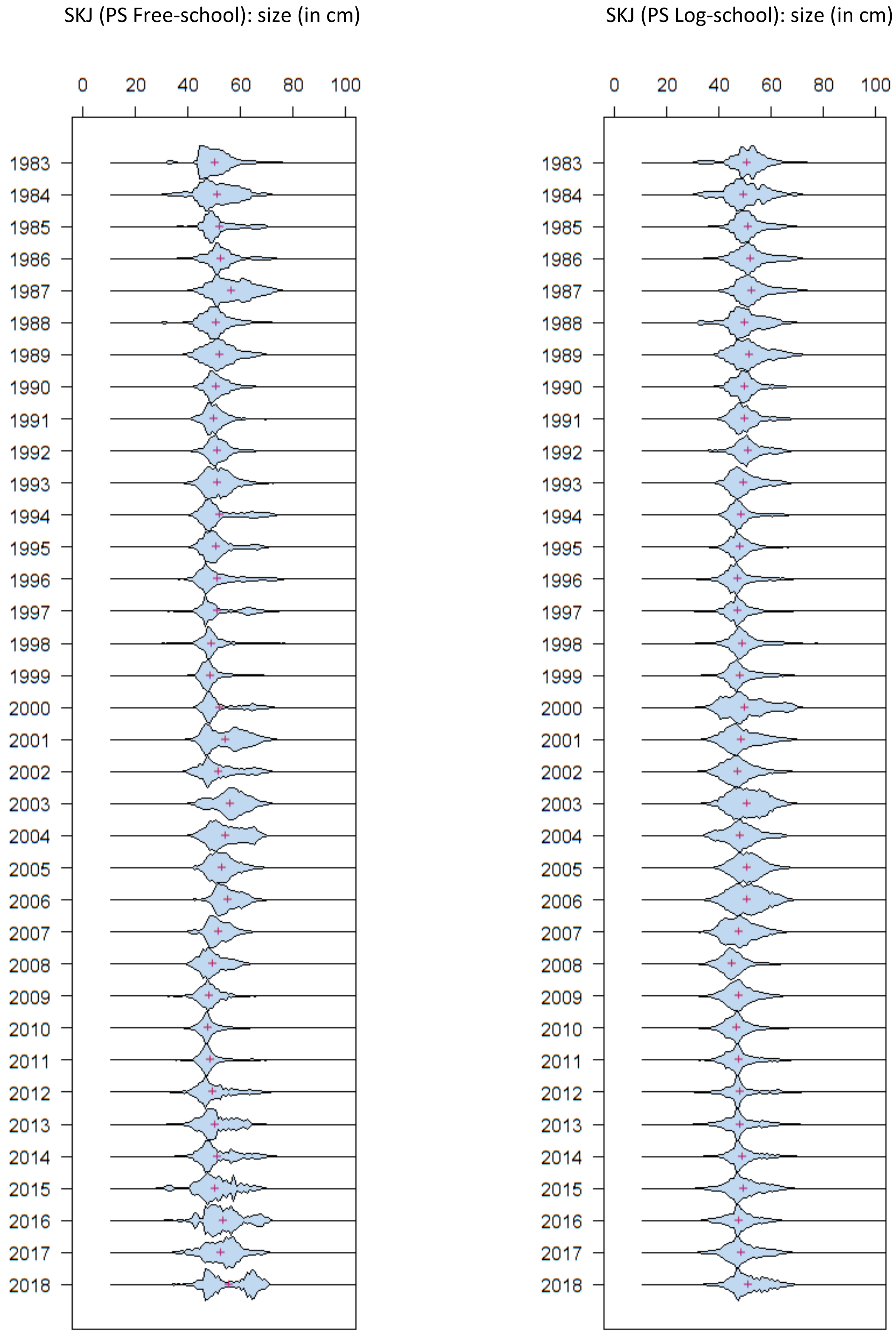


Fig. 18. Skipjack tuna (purse seine): Left: length frequency distributions for SKJ PS Free school fisheries (by 2 cm length class). Right: Length frequency distributions for SKJ PS Associated (log) school fisheries (by 2 cm length class). Source: IOTC database.