Report of the Seventh Session of the IOTC Working Party on Temperate Tunas (Data Preparatory Session)

Kuala Lumpur, Malaysia, 14–17 January 2019

DISTRIBUTION:

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ACRONYMS

ALB	Albacore
ASAP	Age structured assessment program
ASPIC	A Stock-Production Model Incorporating Covariates
ASPM	Age-structured production model
B	Biomass (total)
BBDM	Bayesian biomass dynamics model
B_{MSY}	Biomass which produces MSY
BSPM	Bayesian State-Space Production Model
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
F	Fishing mortality; F_{2011} is the fishing mortality estimated in the year 2011
F_{MSY}	Fishing mortality at MSY
HBF	Hooks between floats
HCR	Harvest control rule
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
LL	Longline
LRP	Limit reference point
M	Natural mortality
MPF	Meeting participation fund
MSE	Management strategy evaluation
MSY	Maximum sustainable yield
n.a.	Not applicable
PS	Purse-seine
SC	Scientific Committee of the IOTC
SB	Spawning biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock biomass which produces MSY
SS3	Stock Synthesis III
SST	Sea surface temperature
TAC	Total allowable catch
TRP	Target reference point
VB	Von Bertalanffy (growth)
WPTmT	Working Party on Temperate Tunas of the IOTC

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 7th Session (Data Preparatory) of the Indian Ocean Tuna Commission's (IOTC) Working Party on Temperate Tunas (WPTmT07(DP)) was held in Kuala Lumpur, Malaysia, from 14–17 January 2019. A total of 19 participants (29 in 2016 and 27 in 2014) attended the Session.

The following a subset of the complete list of recommendations from the WPTmT06 to the Scientific Committee, which are provided in Appendix 7.

Review of data available at the Secretariat for temperate tuna species

WPTmT07(DP).01 (para 20) **NOTING** that observer data for the Taiwanese deep-freezing longline fleet in the period 2012-2017 has been submitted to the IOTC Secretariat as highly aggregated *observer trip reports*, and **ACKNOWLEDGING** that no length-frequency information is available within said data, the WPTmT **RECOMMENDED** (see Resolution 11-04) Taiwan,China to provide more detailed information (as per IOTC ROS specifications) to its earliest convenience, as this data is considered of particular importance for the validation and understanding of recent changes detected in the length-frequency of albacore tuna (among others) reported by the Taiwanese fleet and could contribute to explain the decline in the proportion of smaller fish sampled for lengths by this same fleet.

WPTmT07(DP).02 (para 23) **ACKNOWLEDGING** that the levels of coverage for length frequency data reported by Japan for its longline fleet exceed – in recent years – the minimum threshold of one sampled fish per metric ton (as per IOTC Resolution 15/02) the WPTmT also **NOTED** that length frequency data for years prior to 2008 were reported by Japan as 10x20 degrees grids, which is well below the minimum resolution of 5x5 degrees grids, and therefore further **RECOMMENDED** Japan to ensure that historical data to the expected level of resolution is provided to the IOTC Secretariat in the near future.

Biological indicators, including age-growth curves and age–length keys

WPTmT07(DP).03 (para 45) The WPTmT **NOTED** that the new LW relation derived by Dhurmeea et al (2016) is likely biased due to lack of small size data, thus the LW relation by Penny (1994) (South Atlantic) should be used again as a base case for stock assessments. As for the sensitivity, other LW relations including official IOTC observer data will be explored and the results provided by the middle of February 2019. These data, which are sourced from the Japanese observer program, cover a wider range of fish sizes and have larger sample sizes. The WPTmT **RECOMMENDED** that CPCs submit length-weight data to the IOTC secretariat, so that they may compile a database that represents spatial, seasonal, and sex-based variability in LW.

1. Opening of the meeting

1. The 7th Session (Data Preparatory) of the Indian Ocean Tuna Commission's (IOTC) Working Party on Temperate Tunas (WPTmT07(DP)) was held in Kuala Lumpur, Malaysia, from 14–17 January 2019. A total of 19 participants (29 in 2016 and 27 in 2014) attended the Session. The list of participants is provided at Appendix 1. The meeting was opened by a representative of the Department of Fisheries Malaysia, and the Chairperson, Dr Jiangfeng Zhu (China), who welcomed participants to Kuala Lumpur, Malaysia.

2. Adoption of the agenda and arrangements for the session

2. The WPTmT **ADOPTED** the Agenda provided at Appendix 2. The documents presented to the WPTmT07 are listed in Appendix 3.

3. The IOTC process: outcomes, updates and progress

3.1 Outcomes of the 21st Session of the IOTC Scientific Committee

3. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–03 which outlined the main outcomes of the 19th , 20th and 21st Sessions of the Scientific Committee, specifically related to the work of the WPTmT.

4. The WPTmT **RECALLED** that the SC adopted a set of standardised *IOTC Working Party and Scientific Committee reporting terminology*, contained in Appendix IV of the SC16 Report (para. 23 of the SC16 Report), and **AGREED** that the terminology (which is provided in the opening pages of this WPTmT06 Report) will provide greater clarity and remove some of the ambiguity in the way advice is provided to the next level in the Commission's structure.

5. The WPTmT **NOTED** that the majority of requests made by the SC over the past few years in relation to the WPTmT have been with regards to Taiwanese length frequency information (Driftnet and deep-freezing longline fleets) which will be addressed in Section 4. Other requests related mainly to the MSE process.

3.2 Outcomes of the 22nd Session of the Commission

6. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–04 which outlined the main outcomes of the 22nd Session of the Commission, specifically related to the work of the WPTmT and **AGREED** to consider how best to provide the Scientific Committee with the information it needs, in order to satisfy the Commission's requests, throughout the course of the current WPTmT meeting.

7. The WPTmT **NOTED** the 10 Conservation and Management Measures (CMMs) adopted at the 22nd Session of the Commission (consisting of 10 Resolutions and 0 Recommendation):

IOTC Resolutions

- Resolution 18/01 *On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock in the IOTC Area of Competence*
- Resolution 18/02 *On management measures for the conservation of blue shark caught in association with IOTC fisheries*
- Resolution 18/03 *On establishing a list of vessels presumed to have carried out illegal, unreported and unregulated fishing in the IOTC Area of Competence*
- Resolution 18/04 *On bioFAD experimental project*
- Resolution 18/05 *On management measures for the conservation for the conservation of billfish, striped marlin, black marlin, blue marlin and Indo-Pacific sailfish*
- Resolution 18/06 *On establishing a programme for transhipment by large-scale fishing vessels*
- Resolution 18/07 *On measures applicable in case of non-fulfilment of reporting obligations in the IOTC*
- Resolution 18/08 *Procedures on a fish aggregating devices (FADs) management plan, including a limitation on the number of FADs, more detailed specifications of catch reporting from FAD sets, and the development of improved fad design to reduce the incidence of entanglement of non-target species*
- Resolution 18/09 *On a scoping study of socio-economic indicators of IOTC fisheries*
- Resolution 18/10 *On vessel chartering in the IOTC Area of Competence*

IOTC Recommendations

- Nil

8. The WPTmT **RECALLED** the importance of standardising the way in which the subsidiary bodies of the Commission provide advice. Recommendation 14/07, adopted at the 18th Session of the Commission, details a range of options for further standardising the way in which advice may be presented in the IOTC Executive Summaries.

3.3 Review of Conservation and Management Measures (CMMs) relevant to temperate tunas

9. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–05 which aimed to encourage participants at the WPTmT07 to review existing Conservation and Management Measures (CMM) related to temperate tunas, noting the CMMs contained in document IOTC–2019–WPTmT07(DP)–04; and as necessary to 1) provide recommendations to the Scientific Committee on whether modifications may be required; and 2) recommend whether other CMMs may be required.

10. The WPTmT **NOTED** that Resolution 13/09 *On the conservation of albacore caught in the IOTC area of competence*, requires the Scientific Committee to assess the coverage and the quality of catch and effort data made available by CPCs targeting albacore, and to advise the Commission before the end of 2014 on target and limit reference points (LRPs, TRPs) which may be used when assessing the albacore stock status and when evaluating potential management measures. In addition, the Scientific Committee, through its Working Parties on Temperate Tunas (WPTmT) and on Methods (WPM), is required to examine and evaluate potential management measures which would allow the achievement of the conservation and optimal utilization of the albacore stock.

11. The WPTmT **NOTED** Resolution 15/10 *On target and reference points and a decision framework*, introduces amendments to Resolution 13/10 by including a possibility for the IOTC Scientific Committee to use possible alternatives to MSY-based reference points when they are considered as insufficiently robust. The proposal refers to B0-based reference points, where B0 is generally considered either as the historical biomass before the beginning of the fishing activities or as the biomass under the assumption of a termination of any fishing activities. In addition, considering these reference points, the Resolution introduces management objectives and a work program which would allow the IOTC Scientific Committee to discuss projections and outlooks associated to possible management options, more particularly when implementing Management Strategy Evaluations.

12. The WPTmT **NOTED** Resolution 16/09 *On establishing a Technical Committee on Management Procedures* aims at enhancing the dialogue and mutual understanding between the Scientific Committee and the Commission on matters relating to management procedures, and the decision making response of the Commission in relation to management procedures, The Resolution addresses the priorities identified in Resolutions 14/03 On enhancing the dialogue between fisheries scientists and managers, and 15/10 On target and limit reference points and a decision framework or any subsequent resolutions addressing Management Strategy Evaluation and Management Procedures. This Resolution supersedes Resolution 14/03 On enhancing the dialogue between fisheries scientists and managers..

3.4 Progress on the recommendations of WPTmT06

13. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–06 which provided an update on the progress made in implementing the recommendations from the previous WPTmT meeting which were endorsed by the Scientific Committee, and **AGREED** to provide alternative recommendations for the consideration and potential endorsement by participants as appropriate given any progress. A summary of the status of the previous meeting's recommendations is provided in Appendix 4.

14. The WPTmT **REQUESTED** that the IOTC Secretariat continue to prepare a paper on the progress of the recommendations arising from the previous WPTmT, incorporating the final recommendations adopted by the Scientific Committee and endorsed by the Commission.

4. Review of the data available at the Secretariat for temperate tuna species

15. The WPTmT **NOTED** paper IOTC-2019-WPTmT07(DP)-07 which summarises the standing of a range of information received by the IOTC Secretariat for albacore, in accordance with IOTC Resolution 15/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*, for the period 1950–2017. The paper also provided a range of fishery indicators, including catch and effort trends, for fisheries catching albacore in the IOTC area of competence. A summary of the supporting information for the WPTmT is provided in Appendix 5.

16. The WPTmT **NOTED** the main albacore data issues, by type of dataset and fishery, that are considered to negatively affect the quality of the statistics available at the IOTC Secretariat and that are provided in Appendix 6, and **REQUESTED** that the CPCs listed in the Appendix make efforts to remedy the data issues identified and to report back to the WPTmT at its next meeting.

17. **RECALLING** that no size samples were available in the IOTC database for the Taiwanese driftnet fishery which operated in the mid-1980s to early-1990s and was known to have targeted juvenile albacore, the WPTmT **ACKNOWLEDGED** that such information was recently (December 2018) recovered and provided to the IOTC Secretariat, **NOTING** that although originally lacking geo-spatial information, it was successfully incorporated within the IOTC database using the spatial information extracted from the catch-and-effort dataset for the same strata as a replacement.

18. The WPTmT **NOTED** that the overall distribution of albacore length frequencies recorded by the Taiwanese driftnet fishery is only partially confirming the assumption that the fishery was mainly catching juvenile tunas, as the average length of all measured fish is shown to be around 75 cm (i.e. 10 cm less than the average length of fish recorded in the same strata by the longline fishery of Taiwan,China).

19. The WPTmT further **NOTED** the positive effects on the average weight, overall length distribution and catch-at-age information that the inclusion of length-frequency data from the Taiwanese driftnet introduces in the estimations produced by the IOTC Secretariat, and **RECOGNIZED** that what pursued represents the best possible approach given the limited information available.

20. **NOTING** that observer data for the Taiwanese deep-freezing longline fleet in the period 2012-2017 has been submitted to the IOTC Secretariat as highly aggregated *observer trip reports*, and **ACKNOWLEDGING** that no length-frequency information is available within said data, the WPTmT **RECOMMENDED** (see Resolution 11-04) Taiwan,China to provide more detailed information (as per IOTC ROS specifications) to its earliest convenience, as this data is considered of particular importance for the validation and understanding of recent changes detected in the length-frequency of albacore tuna (among others) reported by the Taiwanese fleet and could contribute to explain the decline in the proportion of smaller fish sampled for lengths by this same fleet.

21. The WPTmT **NOTED** that there still is uncertainty about the proper length-weight relationships to be adopted for albacore in the Indian ocean, and that these relationships are a fundamental pre-requisite to ensure that Taiwan,China and other CPCs could provide, in the future, individual fish weights in place of length measurements (as the former are considered easier to collect).

22. Also, the WPTmT **NOTED** that the determination of length-weight relationships is influenced by the condition of the fish and by the area of capture, to the point that ideally multiple length-weight relationships should be determined to account for these distinct influencing factors, and eventually *averaged* for scientific purposes.

23. **ACKNOWLEDGING** that the levels of coverage for length frequency data reported by Japan for its longline fleet exceed – in recent years – the minimum threshold of one sampled fish per metric ton (as per IOTC Resolution 15/02) the WPTmT also **NOTED** that length frequency data for years prior to 2008 were reported by Japan as 10x20 degrees grids, which is well below the minimum resolution of 5x5 degrees grids, and therefore further **RECOMMENDED** Japan to ensure that historical data to the expected level of resolution is provided to the IOTC Secretariat in the near future.

24. The WPTmT **ACKNOWLEDGED** that the issue with the number of active vessels exceeding the number of authorized vessels for the longline fisheries of Indonesia in the years between 2010 and 2013 was also discussed during the 21st session of the Scientific Committee, and that Indonesia are further looking forward to identify the source of this problem and eventually provide revised information to the IOTC Secretariat.

25. Also, the WPTmT **NOTED** marked increases in average catch per vessel per year in 2016 and 2017 as determined for the longline fleet of Indonesia, and **ACKNOWLEDGED** that these can negatively affect the estimation, by the IOTC Secretariat, of Indonesian nominal catches in recent years.

26. For this reason, the WPTmT **SUGGESTED** that Indonesia continue liaising with the IOTC Secretariat with the purpose of improving the reporting and clarify the information pertaining to their authorised and active vessels as per IOTC requirements.

27. **NOTING** that logbook derived catch-and-effort data for the four major species in 2017 have been submitted by Indonesia to the IOTC Secretariat in 2018, the WPTmT **ACKNOWLEDGED** that the information provided could not be incorporated into the IOTC database due to a number of factors that include, among others, the need of properly split the reported information for the two distinct components (deep-freezing vs. fresh) of the Indonesian longline fleet.

28. The WPTmT **ACKNOWLEDGED** that Indonesia is using VMS data to cross-check the information collected through logbooks and **NOTED** that an e-logbook system, expected to improve the quality of the data reported to the IOTC Secretariat, is in the process of being implemented by Indonesia in 2019.

5. NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENTAL DATA RELATING TO TEMPERATE TUNAS

5.1 Review new information on the biology, stock structure, their fisheries and associated environmental data

- **Catch data**

Status of Malaysian Longliners

29. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–09 which provided a review of the status of Albacore Fishing by Malaysian Tuna Longliners in the Southwest of Indian Ocean, including the following abstract provided by the author:

"*Malaysian tuna fisheries began with tropical tuna fishing in 2005 to 2011. In 2012, Malaysia tuna longline vessels shifted their operation from tropical tuna to albacore tuna fishing. A total of 5 tuna longline fishing vessels and 1 carrier are currently operating under Malaysian flag and they mainly operated in the southwest of Indian Ocean. The range of areas covered by the fishing operation of the Malaysia tuna longliners extended from 10° S in the north to 39° S toward the south and longitude from 40°E to 70°E. This paper was based on the data extracted from fishing logbooks which were sent to Department of Fisheries Malaysia. In 2017, the total catch of albacore increased significantly by 17% to 1,607 tons from 1,330 tons in 2016. Catches of albacore tuna by Malaysian tuna fishing vessels ranged from 2.74 – 277.59 tons with the average of 96.94 ± 64.38 tons. The average monthly catches for 5 years showed that there were two peaks seasons for albacore fishing; from May – August and October – January.*"

30. The WPTmT **THANKED** the authors for the important information provided in the document.

31. The WPTmT **NOTED** that all of the vessel used by Malaysian tuna longliners are above 24 meter in LOA.

32. The WPTmT **NOTED** that although Malaysia has operated a tuna fishing fleet since 2005, ALB were only targeted after 2012 as previously the fleet had only fished for YFT.

- **Catch and effort**

Indonesian Catch and Effort data

33. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–10 which provided a updated information on catch and effort of albacore tuna (*Thunnus alalunga*) from Indonesian tuna longline fishery, including the following abstract provided by the authors:

34. *"Albacore tuna (Thunnus alalunga) is one of the main targets for Indonesian tuna longline fishery in the Eastern Indian Ocean. The fishery has begun since early 1980's, when deep longline introduced. There were two types of data used in this study; first was the skipper's "logbook" data from the state-owned commercial tuna longline vessels based in Benoa Port (1978-1995), and the later was the scientific observer data conducted by Research Institute for Tuna Fisheries (RITF) from 2005 to 2017. Both then combined to produce nominal catch-per-unit-of-effort (CPUE) (no. fish/100 hooks). The result showed that the catch rates of albacore tuna was very low at the start of the series (1978-1995) which below 0.2/100 hooks, but higher at the recent decade (2005-2017), which around 0.2-0.4/100 hooks. Efforts were geographically distributed within the area bordered by 5 – 35oS and 75 – 130oE. High CPUE mainly occurred in sub area between 25oS and 35oS. We are still in progress of completing the skipper's "logbook" data entry in a hope of presenting the appropriate standardized CPUE in the future."*

35. The WPTmT **THANKED** the authors for their presentation and data described in the paper.

36. The WPTmT **NOTED** that the percentage of ALB caught prior to 1995 was very low due to YFT targeting, but that there was some increase after 2006 as more vessels operated in the south.

37. The WPTmT **NOTED** that most of the ALB landed in Indonesia are frozen without processing, therefore it is difficult to acquire biological samples such as otoliths and gonads

38. The WPTmT **ACKNOWLEDGED** the effort made to re-enter the skipper logbook data for a period of 30 years (1979-2008) and **NOTED** that this information will likely be used for scientific purposes only (e.g. CPUE standardization) and not to re-estimate the current Indonesia catch series.

Catch and effort data for Korean LL

39. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–11 which provided a review of catch and effort for albacore tuna by Korean tuna longline fishery in the Indian Ocean (1965-2017), including the following abstract provided by the authors:

"This paper describes the fishing characteristics of Korean tuna longline fishery, with a focus on catch and CPUE trends for albacore tuna in the Indian Ocean from 1965 to 2017. The number of active fishing vessels showed the highest value in the mid-1970s, after that sharply decreased to 7 vessels in 2011 and 2012, while a slight increasing to 13 or 14 vessels in recent years. The albacore tuna catch peaked at about 10 thousand ton in 1974 and sharply decreased thereafter. Since 2009 it showed an increasing over 600 ton in 2013 and 2014 but decreased again in 2016. The CPUE of albacore tuna had a big jump in the early 1970s and showed a steady trend at a low level from 1980s to the early 2000s. However, it started to increase after 2003 and sharply increased from 2011 to 2014, but again decreased in 2016. And the main fishing ground of albacore tuna by Korean longline fishery was formed between 25°S and 45°S of the western Indian Oceans off South Africa and the eastern Indian Ocean off the Western Australia."

40. The WPTmT **NOTED** that this paper was presented in conjunction with paper IOTC–2019–WPTmT07(DP)–15 and therefore the discussion of this information is provided in Section 6 (below).

- **Biological indicators, including age-growth curves and age–length keys**

41. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–12 which provided a review of Indian Ocean albacore biological parameters for stock assessments, including the following abstract provided by the authors:

"We reviewed the stock structure and seven biological parameters of ALB (albacore) for IOTC stock assessments by Stock Synthesis (SS3), Statistical-Catch-At-Size (SCAS) etc. to be conducted in July 2019 during WPTmT07 in Japan. Seven types of biological parameters are (1) sex ratio, (2) LW relation, (3) growth equation, (4) life span, (5) natural mortality, (6) fecundity and (7) maturity-at-age. In this review, we referred to parameters used in ISC and three RFMOs (ICCAT, WCPFC and IOTC) in the past. New biological information in the western Indian Ocean derived by Dhurmeea et al (2016) is included for reviews and discussions. During this data preparatory meeting for WPTmT07 in January 2019 in Kuala Lumpur, Malaysia, we will evaluate and select the most feasible parameters for IOTC ALB stock assessments as a base case and a sensitivity. We suggest candidates but the final decision will be made by this data preparatory meeting"

42. The WPTmT **THANKED** the authors for compiling this vital information and presenting it in a clear format for discussion by the participants.

43. The WPTmT **NOTED** that the new biological study in the western Indian Ocean by Dhurmeea et al (2016) (sex ratio, LW relation and maturity-at-size) and Farley et al (2019) (growth equation) did not cover smaller sizes of albacore (< 65cm) and thus results are likely biased.

44. The WPTmT further **NOTED** that less than 1% (0.84%) of the fish for which fork length measurements exist in the IOTC database (over 4.6 million fish) is recorded as having a length of 50 cm or less, and that the majority of these are reported by fresh and deep-freezing longliners from Taiwan,China in the years between 2012 and 2017 (for FLL) and between 1980 and early 2000s (for LL).

45. The WPTmT **NOTED** that the new LW relation derived by Dhurmeea et al (2016) is likely biased due to lack of small size data, thus the LW relation by Penny (1994) (South Atlantic) should be used again as a base case for stock assessments. As for the sensitivity, other LW relations including official IOTC observer data will be explored and the results provided by the middle of February 2019. These data, which are sourced from the Japanese observer program, cover a wider range of fish sizes and have larger sample sizes. The WPTmT **RECOMMENDED** that CPCs submit length-weight data to the IOTC secretariat, so that they may compile a database that represents spatial, seasonal, and sex-based variability in LW.

46. The WPTmT **NOTED** that the maximum life span of around 15 years is plausible and should be used for stock assessments. The WPTmT further **NOTED** that longer life span may need to be considered.. The WPTmT further **NOTED** that the plus group of 15 years may be appropriate for stock assessment purposes.

47. The WPTmT **NOTED** that if there is no strong evidences to change natural mortality from the last stock assessment in 2016, the same (three) M vectors should be used. Then if the most plausible M vectors can be effectively determined, that M should be used as the base case for the final stock assessment runs.

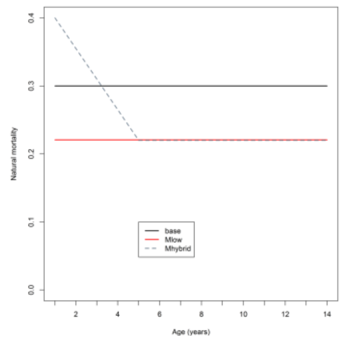
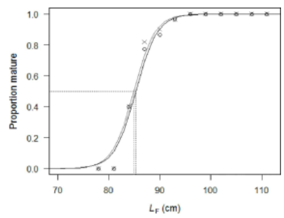
48. The WPTmT **NOTED** that Maturity-At-Length should be used in the stock assessments in order to maintain accuracy when using different growth curves. The ogive developed by Farley et al (2014) for the South Pacific was proposed as the base case, because the L50 is not significantly different from the Dhurmeea et al (2016) L50 but the ogive may be more accurate because fish were measured at 1cm rather than 3cm bins. The maturity ogive

is also estimated at a population level by accounting for seasonal and spatial variation together with population density, which affect the shape of the ogive. As a sensitivity analysis, it was suggested to use the Maturity-At-Size developed by Dhurmeea et al (2016).

49. WPTmT **AGREED** on the stock structure and seven biological parameters listed in Table 1, which will be used for stock assessments in July this year.

Table 1 Summary of agreed stock structure and seven biological parameters (base case and sensitivities) to be used for 2019 ALB stock assessments in the Indian Ocean

(note) (*) same as in the last stock assessments in 2016

Parameters	Base case	Sensitivity
Stock structure	Single (*)	Optional (to be explored)
Biological parameters		
(1) Sex ratio at birth	1:1	
(2) LW relation	Penny (1994) (South Atlantic) (*) $W = (1.3718 \times 10^{-5}) * L^{3.0973}$	*To be explored intersessionally (including JPN LL ROS data for 2012-2016 as currently available to the IOTC Secretariat) by Dr Kitakado by the middle of February 2019*
(3) Growth equation	Farley et al (2019) based on Von Bertalanffy ♂ $L(t)=110.06\ [1-e^{-0.34\ (t+0.87)}]$ ♀ $L(t)=103.80\ [1-e^{-0.38\ (t+0.86)}]$	Growth equation estimated by SS3
(4) Life span	Age 15+ (equivalent quarterly age for SS3) (*)	
(5) M by age	Base case (*): three M vectors (i) 0.2207 by Lee and Liu (1992) (Indian Ocean), (ii) 0.3 by Watanabe et al (2006) (North Pacific) and (iii) age specific M (M=-0.03586*Age+0.4) (i.e., Age 0=0.4, Age 1=0.36414, Age 2=0.32838, Age 3=0.29242 and Age 5=0.2207) (or equivalent quarterly M for SS3) 	
(6) Fecundity	Fecundity is proportional to female weight at age (*)	
(7) Maturity schedule at length	Farley et al (2014) (South Pacific) Maturity-at-age will be converted by the growth equation by Farley et al (2019)	Dhurmeea et al (2016) (Western Indian Ocean)  Maturity-at-age will be converted by the growth equation by Farley et al (2019)

50. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–21 which provided information on growth of albacore tuna (*Thunnus alalunga*) in the western Indian Ocean using direct age estimates, including the following abstract provided by the authors:

"This paper describes a study to estimate the age and growth of albacore tuna in the western Indian Ocean using otoliths. A total of 600 otoliths were selected for analysis. Females ranged in length from 74 to 108 cm fork length (FL) and males from 67 to 115 cm FL. Otolith morphometric data indicate sex and regional (ocean) differences in otolith growth. Annual age was estimated following protocols developed and validated for South Pacific albacore. Decimal (fractional) age was estimated using count of opaque zones in the otolith, an assumed birth date, capture date and the state of completion of the marginal increment (otolith edge classification). A final age was estimated for 574 fish, ranging from 2.0 to 16.0 years for females and 2.4 to 14.0 years for males. Growth differed between the sexes with males growing faster than females after ~85 cm FL and reaching larger mean asymptotic length. Albacore in the western Indian Ocean appear to grow slightly faster than in the Pacific. However, this may be partly due to the absence of small fish in our samples resulting in higher estimated length-at-age for young fish. Additional age data for small fish (particularly <75 cm FL in temperate latitudes) and from the south and eastern Indian oceans would improve this study. Further work is required to examine the timing of increment formation and refine the age algorithm. Direct validation of the age estimation methods for the Indian Ocean are also recommended. A preliminary estimate of the proportion of females mature at age was also estimated, although the result should be considered preliminary given the lack of data on small/young fish in the growth and maturity analysis. Age at 50% maturity was estimated at 3.2 years."

51. The WPTmT **WELCOMED** this study by the authors and **ACKNOWLEDGED** that it provides a first growth estimation for the Indian Ocean Albacore population. This is important as previous assessments used growth analyses from other Oceans, which may not be applicable to the Indian Ocean.

52. The WPTmT **NOTED** that the stock assessment can be sensitive to the growth curve, particularly the asymptotic length, and the new estimate of asymptotic length is not affected by the limited data for small fish. For this reason it was suggested that the new growth curve should be used in the stock assessment. Nevertheless, the shape of the growth curve at smaller sizes is likely to be biased by the lack of small fish in the samples. It was therefore suggested that stock assessment scientists should explore alternative estimates for the other growth parameters. The WPTmT suggested estimating the growth curve within the model, potentially including the age-at-length data in the model in a way that accounts for the length selectivity of the fisheries from which the samples were obtained

53. The WPTmT **NOTED** that for assessment purposes, the age-specific variation in growth as well as the standardized residual plots are required. The WPTmT also **NOTED** that the full data set regarding the estimated ages and lengths of the samples used in the study was required for input into the assessment models. As such, the secretariat was asked to request this information from the authors

6. Review of new information on the status of temperate tunas

6.1 Nominal and standardised CPUE indices

CPUE Standardisations

Area definitions for CPUE standardisation were those defined during the IOTC joint CPUE analysis in 2018 ("regA4", Figure 1), which are similar to the regions used in the last stock assessment..

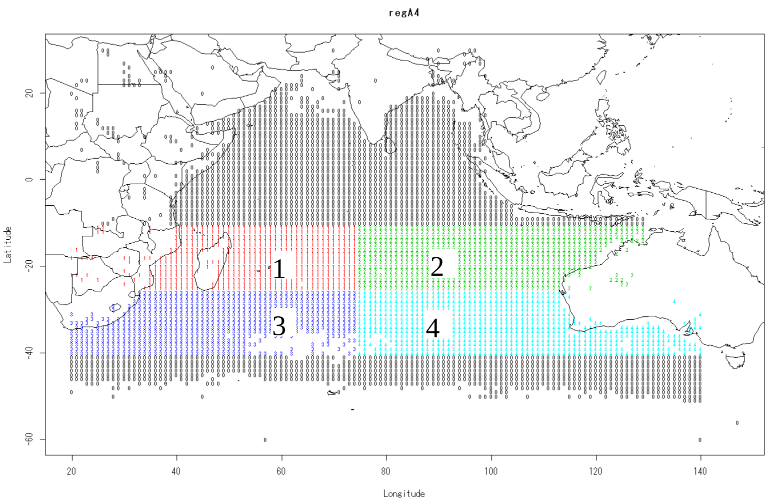


Figure 1: Map of the regional structure used to estimate albacore CPUE indices

Taiwanese LL – Catch-per-unit-effort (CPUE)

54. The WPTmT **NOTED** paper IOTC–2017–WPTmT07(DP)–14 which provided data analysis and CPUE standardization of albacore caught by Taiwanese longline fishery in the Indian Ocean, including the following abstract provided by the authors:

"*This paper described the historical trends of fishing operations and albacore catches of Taiwanese large scale longline fishery in the Indian Ocean. The cluster analysis was adopted to explore the targeting of fishing operations. In addition, the CPUE standardizations were conducted using generalized linear model and generalized linear mixed model for examining the influence of treating the vessel ID as fixed and random effects on the CPUE standardizations*."

55. The WPTmT **NOTED** that the comparability of model selection statistics should be considered because the CPUE standardizations were conducted using GLM, which incorporated only fixed effects, and GLMM, which incorporated fixed and random effects.

56. The WPTmT also **NOTED** that model selection statistics for CPUE data are unreliable and overly sensitive because the data are pseudo-replicated. Dependence between consecutive sets by the same vessel is not accounted for by the model. This problem also affects confidence intervals. The problem can be addressed by using generalized estimating equations, but GEE models are not easy to implement.

57. The WPTmT **SUGGESTED** that the number of vessels by clusters should be added into the boxplot when exploring the characteristics of fishing operations between and within clusters.

58. The WPTmT further **SUGGESTED** that the year-quarterly standardized CPUE can be estimated based on the estimates of interaction between year and quarter effects. However, this approach may not be appropriate to the data for every fleet because data may not be available for every year and quarter.

59. For purpose of stock assessment and comparison among fleets, the WPTmT **REQUESTED** the CPCs to conduct CPUE standardizations to produce the annual and year-quarterly trends of standardized CPUE series. The WPTmT further **ASKED** for clarification as to whether to derive annual indices using imputation

60. The author **NOTED** that biased estimates of standardized CPUE might result from sparse fishing information for albacore in region 2Indian Ocean in recent years. Thus he suggested excluding the standardized CPUE in region 2 after 2012 when conducting stock assessments.

Korean - Catch-per-unit-of-effort (CPUE)

61. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–15 which described CPUE standardization of albacore tuna caught by Korean tuna longline fishery in the Indian Ocean (1977-2017), including the following abstract provided by the authors:

"*In this study we standardized CPUE of albacore tuna caught by Korean tuna longline fishery in the Indian Ocean using Generalized Linear Models (GLM) with operational data. The data used for the GLMs were catch (number), effort (number of hooks), number of hooks between floats (HBF), fishing location (5° cell), and vessel identifier by year, quarter, and region. We applied cluster analysis to address concerns about the changes of target species through time which can affect CPUE indices. The CPUE was standardized using lognormal constant and delta lognormal approaches, considering with vessel effects and without vessel effects, and the main indices was estimates from delta lognormal approach.*"

62. The WPTmT **NOTED** that the model incorporating interactions between year and quarter effects, is not appropriate for Korean data because the Korean vessels target albacore seasonally, resulting in missing estimates for many quarters.

63. The authors **SUGGESTED** that the data in the early 1970s should be excluded for CPUE standardization because of the low coverage of operational data.

64. The WPTmT **SUGGESTED** that it may be useful to present the time series of standardized estimates of the proportion of non-zero catches.

65. The WPTmT **NOTED** the high variability of the estimates, due to sparse data.

Japan – Catch-per-unit-of-effort (CPUE)

66. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–16 which provided information on the standardization of albacore CPUE by Japanese longline fishery in the Indian Ocean, including the following abstract provided by the authors:

"*Standardization of albacore CPUE by Japanese longline fishery in the Indian Ocean was conducted using the Generalized Linear Model (GLM) with log-normal error structure (LN model). Operational level catch and effort data as well as environmental factor (sea surface temperature) were used for standardization. Area definition is the same as that for longline joint CPUE. All CPUEs sharply declined in the early period* *(until around 1970). CPUE in the north area was comparatively constant after that. CPUE in the south area increased after early 2000s. Some difference of CPUE trend was observed between the present study and CPUE with 'new' method (with cluster analysis and vessel effect)".*

67. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–17 which provided information on the standardization of albacore CPUE by Japanese longline in the Indian Ocean which includes cluster analysis, including the following abstract provided by the authors:

"*Standardizations of Japanese longline CPUE for albacore in the Indian Ocean regions were conducted. The models incorporated fishing power based on vessel ID where available, and used cluster analysis to account for targeting. The variables year-quarter, vessel ID, latlong5 (five degree latitude-longitude block), cluster and number of hooks were used in the standardization. The numbers of clusters selected varied among regions, but in all cases were either 4 or 5. Dominant species differed by cluster. The effects of each covariate differed depending on region. The CPUEs trends were decreasing during the early period, and constant or increasing after that."*

68. The WPTmT **NOTED** that both papers were presented together and that they should be discussed simultaneously. As such, the discussions recorded below are reflective of both documents.

69. The WPTmT **NOTED** that incorporating SST may be confounded with the longitude-latitude effect and this may therefore be problematic in the standardisation process. Subsequent analyses indicated that SST could have an important effect on the standardisation of the CPUE series and should be explored in the future.

70. The WPTmT **SUGGESTED** that diagnostic plots would be useful to compare the results obtained from the current and previous models.

71. The WPTmT **NOTED** that models can be fitted either for separate regions, or for the entire Indian Ocean using time-region interaction terms. It was noted that there are advantages to estimating covariates independently by region, since covariates may have different relationships with catch rate by region, given spatial variation in oceanography. It was also noted that regions are defined to match fisheries, and that fish availability at size differs among regions, as do the error distributions.

ASPIC simulations and considerations for joint CPUE analysis

72. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–18 which provided a preliminary stock assessment of Indian Ocean albacore based on ASPIC and consideration on the specification of joint longline CPUE:

"*Preliminary analysis of Indian Ocean albacore was conducted based on ASPIC. The objective is to see the results based on each CPUE including CPUE fit. Also, available CPUE indices were reviewed and examined. The trend of CPUE differed among fleets. Results of ASPIC seem much more reasonable with the CPUE of Taiwanese longline. Recent increase in Japanese longline CPUE seems to be affected by the change in fishing strategy, and so may not be a good indicator. Therefore, it may be better to eliminate catch and effort data for Japanese longline in recent period.*"

73. The WPTmT **NOTED** that the authors suggested that the stock assessment should not use the Japanese standardized CPUE series in recent years in region 4 because unreliable indices might result from the substantial change in fishing strategy of Japanese fleets and these changes are not yet fully understood.

74. The WPTmT **NOTED** that Standardized CPUE for albacore by Japanese longline in region 4 (southeast region) shows a steep increase during the mid to late 2000s (Fig. 2) The WPTmT expressed concern that this issue is due to the fact that the incorporation of targeting based on a cluster analysis may have not worked well.

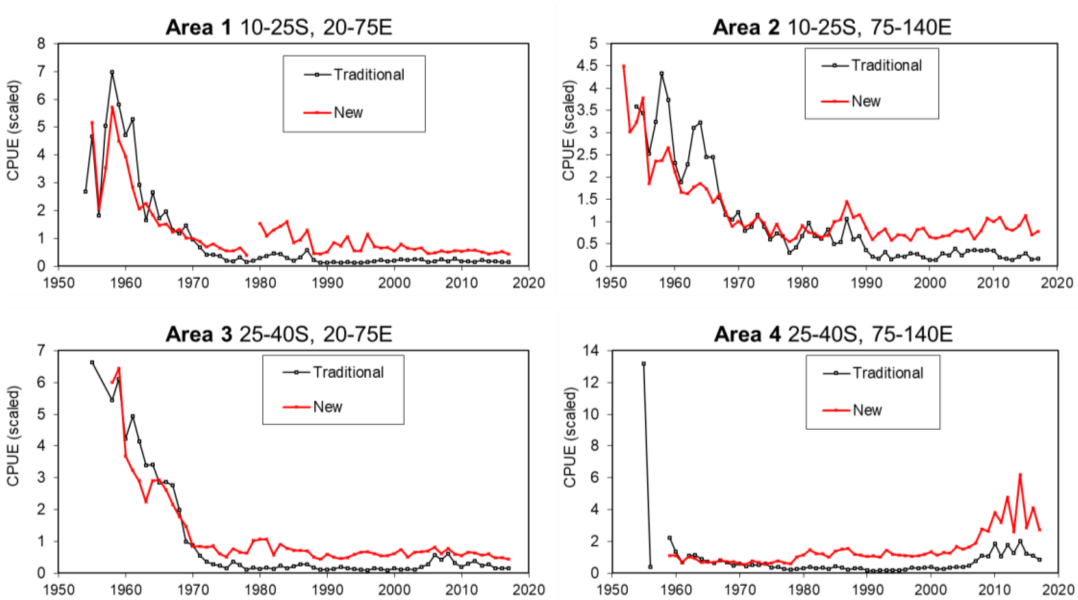


Fig.2. Standardized albacore CPUE for Japanese longline fishery. 'Traditional' and 'new' mean that the method by Japanese scientist's own and the method same as that for joint CPUE, which incorporates vessel effect and cluster analysis. (Note the use of the term area in this case is equivalent to the term region for other CPUE series)

75. The WPTmT **NOTED** that at the previous albacore stock assessment, joint longline CPUE (Japanese, Korean and Taiwanese longline), which didn't remove Japanese longline catch and effort data for this period and region, was used for stock assessment. At that time the solution was to use time varying q after 2006 in the SS3 model, which meant that CPUE in this period was down-weighted. This approach was not available for other models.

76. The WPTmT **ACKNOWLEDGED** that the details of recent fishing strategies of Japanese longliners are not clear, but albacore targeting in the Indian Ocean by Japanese longliners is not reported by the industry. However, after 2005 Japan's TAC for southern bluefin tuna decreased substantially. Also, during the late 2000s fishing operations in the northern Indian Ocean region were severely constrained by the effects of piracy. Together, these may have changed the fishing strategies of the Japanese longline fleet, and albacore may have become more important than before.

77. The WPTmT **NOTED** that cluster analysis is used in the CPUE standardization to account for changes in targeting strategy. However, the approach was not effective in this case. Cluster analysis identified an albacore targeting cluster, but there was a substantial increase in albacore catch rates in the cluster after 2005, particularly in the southern latitudinal band of region 4 (Figure 3). Before this increase the catch rates were much less than the catch rates by the Taiwanese fleet, but the increase brought the Japanese catch rates up to a similar level. The species composition in the albacore cluster both before and after 2005 is predominantly albacore. The reason for the increased catch rate is unclear, but the Taiwanese fleet does not show a similar increase in catch rate.

78. The WPTmT therefore **ACKNOWLEDGED** that, the sharp increase in albacore CPUE by Japanese longline during the mid to late 2000s may not fully reflect the abundance of the stock. The WPTmT considered it advisable to prevent this change in targeting from affecting the joint longline CPUE for stock assessment, and agreed to remove the Japanese catch and effort data after 2005 in region 4.

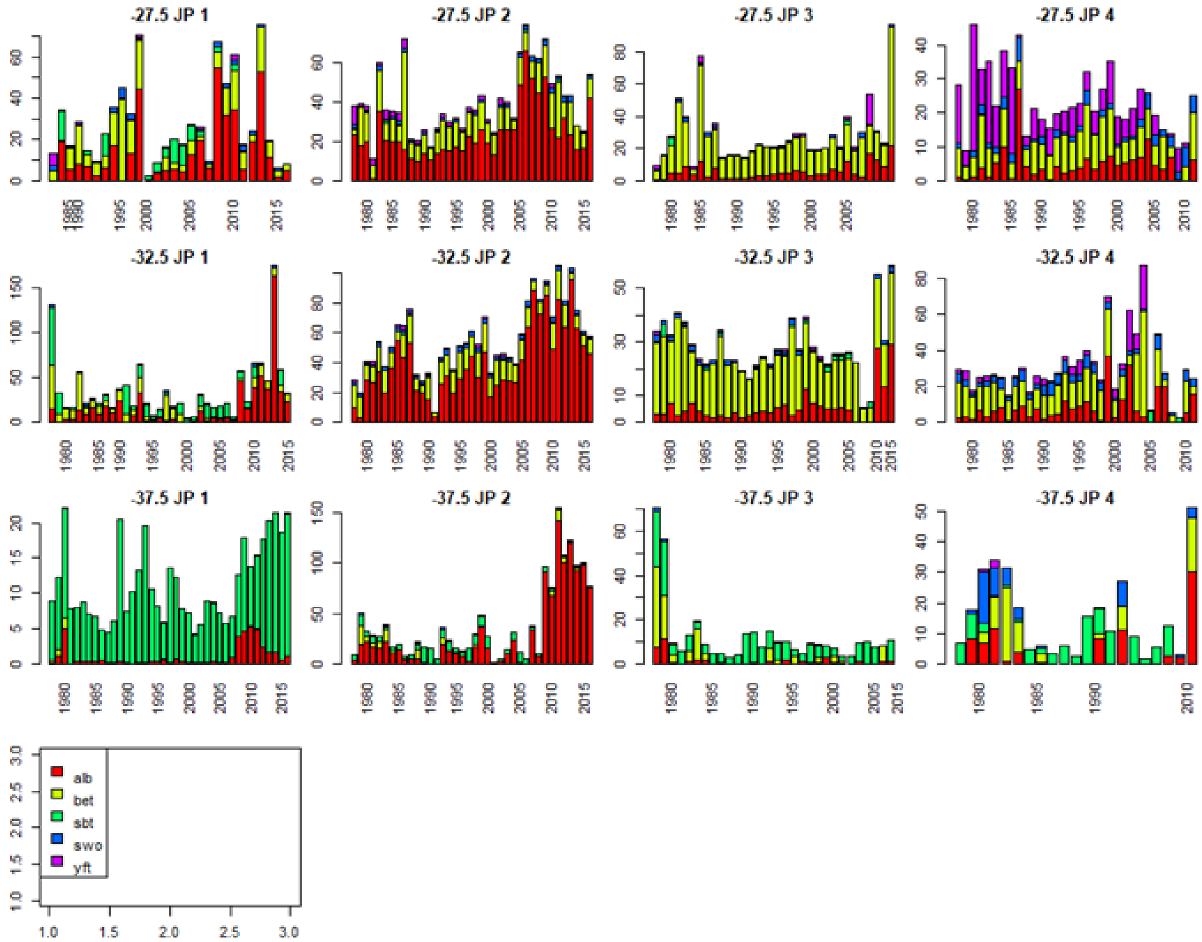


Fig. 3: Average catch per set by latitude (rows), cluster (columns), species (colours of barplot) and year for the Japanese longline fleet in Region 4.

Regional Scaling factors

79. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–13 which provided information on regional scaling factors for Indian Ocean albacore tuna, including the following abstract provided by the authors:

"Indian Ocean tuna assessments may be spatially structured, and CPUE indices developed for different regions often indicate different trends through time. In this situation it is useful to determine the relative abundances by region, so that we may either apply regional scaling in a multi-region assessment, or appropriately combine the separate indices into a single index of abundance. Regional scaling, which has been used since 2005 in tuna assessments, estimates the abundance distribution from regional catch rates and areas. We describe the method and explore potential impacts on albacore abundance scaling of changes to the approach previously applied to yellowfin and bigeye tuna. Supported improvements included using cell ocean areas in scaling calculations; adjusting statistical weights in the standardization model based on the density of samples; including fleet effects in the standardization model; and using a region-season interaction term in the standardization model rather than a year-season term".

80. The WPTmT **NOTED** that regional scaling factors calculated based on operational data is likely more appropriate than those from other data sources.

81. The WPTmT **WELCOMED** this study and **ACKNOWLEDGED** its utility for appropriately scaling CPUEs when generating single region indices (such as for ASPIC). In that case, it is necessary to join together individual indices and this requires appropriate scaling.

Joint CPUE analysis

82. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–19 which provided information on a collaborative study of albacore tuna CPUE from multiple Indian Ocean longline fleets in 2019, including the following abstract provided by the authors:

"In May and June 2018 a collaborative study was conducted between national scientists with expertise in Japanese, Korean, Seychelles, and Taiwanese longline fleets, an independent scientist, and an IOTC scientist. The meetings

addressed Terms of Reference covering several important issues related to yellowfin and albacore tuna CPUE indices in the Indian Ocean. The study was funded by the Indian Ocean Tuna Commission (IOTC).” – See paper for full abstract

83. The WPTmT **NOTED** that it is not necessary for all scientists to conduct CPUE standardizations using the same models, and that CPCs may develop their own appropriate models for conducting CPUE standardization, to account for the fact that fishery characteristics may be varied among CPCs.

84. As explained previously, the WPTmT **NOTED** that Japanese fleets may have changed their targeting from southern bluefin tuna to albacore which may have resulted in an increase in catch rate for albacore that does not represent the abundance trend.

85. The WPTmT **REQUESTED** that Japan investigate the changes in strategy in consultation with their fishing industry and provide a scientific explanation for the apparent change in fishing strategy.

86. The WPTmT was presented with a revision to the joint indices, which were re-estimated by removing Japanese data from the southeastern region 4 after 2005.

87. The WPTmT **NOTED** that the effect of this revision on the CPUE trend in region 4 was to substantially reduce the sharp increase after 2005, resulting in relatively stable catch rates. The trends were also similar to those obtained in the Taiwanese CPUE for that region.

CPUE discussion summary

88. The WPTmT **DISCUSSED** the appropriateness of the various CPUE series for use in the assessment models. After deliberation, it was **NOTED** that the joint CPUE analysis includes all the information from the individual series, and showed similar trends to the other major indices and therefore was the most appropriate for use in the assessment models. All CPUEs are presented in Figure 4. All detailed CPUE series outputs are available on the meeting website.

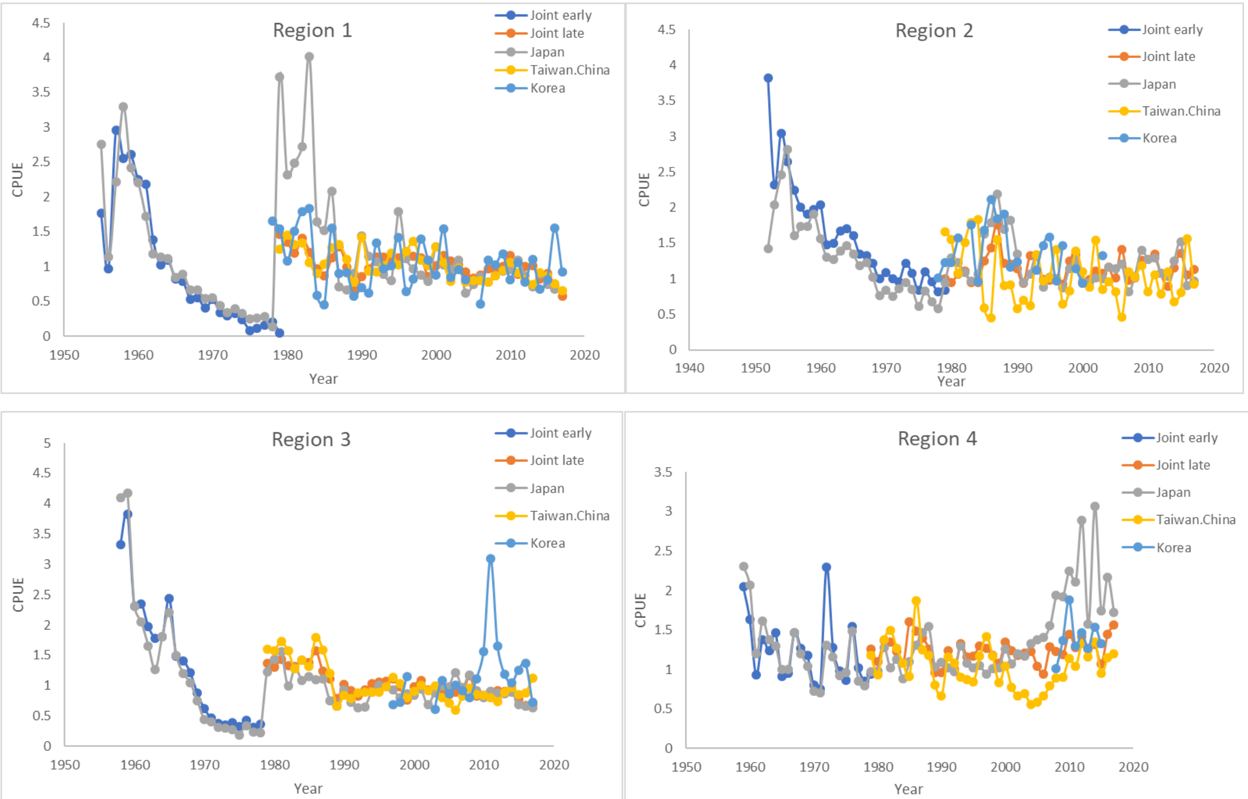


Figure 4. CPUE series per region

7. Albacore stock assessment

7.1 Discussion on albacore assessment models to be developed and their specifications

89. The WPTmT **NOTED** paper IOTC–2019–WPTmT07(DP)–20 which was to provide an outline of ALB stock assessment by SCAS (Statistical-Catch-At-Size), was withdrawn. The authors, however, provided a very short explanation orally, as to what they had attempted, but which was unavailable at the time of the WPTmT07(DP) meeting.

90. The authors **NOTED** that a Statistical-Catch-At-Age (SCAA) or Age-Structured-Production-Model (ASPM) has been applied in past IOTC stock assessments (YFT, BET, ALB and SWO) as an alternative to Stock Synthesis and to back up the SS results. The SCAA and ASPM are based on Catch-at-Age (CAA). However CAA provided by the Secretariat is estimated by applying an age slicing method, which may include classification errors across ages. To improve this, the authors attempted to estimate CAA using a probability method. However, catch are affected by gear selectivity, thus it created more biases (uncertainties) and was therefore not successful.

91. The authors **NOTED** that to solve this problem, the authors decided to change to SCAS (a size based application of SCAA) utilising the original size frequency data, which does not require a generated CAA, thus the problems in CAA should be eliminated. Although the specification of SCAS is similar to SS, SCAS is much simpler, i.e., definition of fisheries (simpler structure), annual basis, no spatial components, sex aggregated and homogenous sex ratio. In addition, SCAS can be conducted more easily compared to SS3 due to its user friendly software.

92. The authors **NOTED** that the authors intend to use SCAS for the same purposes as the previous SCAA model, i.e., to provide results as a reference/backup to SS3 because differences in specification with SS3 might be potential sources of bias (uncertainties).

7.2 Identification of data inputs for the different assessment models and advice framework

93. The WPTmT **ACKNOWLEDGED** that one of the key purposes of the current data preparatory meeting is to discuss and decide on the model specifications to be used for the assessment.

94. The WPTmT **NOTED** the assumptions used in the previous assessment with regards to the input data as well as the assumed parameters. Taking into account updated studies and information, many of which are discussed under sections 4, 5 and 6 of this report, the WPTmT agreed on advisory base case and initial sensitivity specifications defined in Table 2. The fleet definitions were also revisited and the advisory decision on the base case definitions are provided in Table 3.

Table 2: Assessment models and specifications to be used for the 2019 IO ALB assessment.

	ASPIC	**SSPM**	**BSSPM**	**SCAS**	**SS3**
Scientists in charge	Matsumoto	Kitakado and Lee	Lee and Kitakado	Nishida and Kitakado	Consultant
Software availability	Public	Original (TMB)	Original (jags or stan)	Original (ADMB/TMB)	Public
Model characteristics	**ASPIC**	**SSPM**	**BSSPM**	**SCAS**	**SS3**
Age/sex	Aggregated	Aggregated	Aggregated	Age&(sex?)-structured	Age&sex-structured
Observation/model error for CPUE	Yes	Yes	Yes	Yes	Yes (CV of CPUE fixed at 0.2?)
Process error	No	Yes	Yes	In recruitment	In recruitment
Temporal step in population dynamics	Annual	Annual	Annual	Annual	Quarterly
Spatial structure	No	No	No	Single region but accounted by definition of fisheries with different selectivity patterns	Single region but accounted by definition of fisheries with different selectivity patterns
Stock structure	Single	Single	Single	Single	Single
Other information	Fox	PT/Fox	PT/Fox		
Specification for the initial year	**ASPIC**	**BDPM**	**BSPM**	**SCAS**	**SS3**
Initial year	(1) First year of catch series available (1950) (2) First year of CPUE series available (19xx)	(1) First year of catch series available (1950) (2) First year of CPUE series available (19xx)	(1) First year of catch series available (1950) (2) First year of CPUE series available (19xx)	1950	1950
Status in the initial year	(1) Depleted (B/K=0.9)	Initial depletion to be estimated	Initial depletion to be estimated	Initial depletion to be estimated	Initial depletion to be estimated

	(2) Depleted (B/K=xx, yy)				
Biological information needed (see more details in Table xx under Item 5)	**ASPIC**	**BDPM**	**BSPM**	**SCAS**	**SS3**
Sex ratio at birth	1:1 (implicitly)	1:1 (implicitly)	1:1 (implicitly)	1:1	1:1
Length-Weight				Penny (1994) from S. Atlantic as in 2016 assessment; New estimates will be given based on JPN LL ROS data for 2012-2016 as currently available to the IOTC Secretariat , which will be dealt with as a sensitivity test	Penny (1994) from S. Atlantic as in 2016 assessment; New estimates will be given based on JPN LL ROS data for 2012-2016 as currently available to the IOTC Secretariat , which will be dealt with as a sensitivity test
Plus group age				15+	15+
Growth formula				Sex-specific curve in Farley et al. (2019) to be used as a base case; As a sensitivity test, growth as estimated by SS3 sensitivity case CV by age will be investigated within the model (or using the data)	Sex-specific curve in Farley et al. (2019) to be used as a base case; As a sensitivity test, to be estimated [age-length data are available] CVs in young/old will be given by developers
Natural mortality				3 base case scenarios	3 base case scenarios
Fecundity				Proportional to female weight at age	Proportional to female weight at age
Maturity				Estimates of maturity-at-size estimated in S. Pacific Ocean (Farley et al 2014) (converted using the growth formula above) Sensitivity – estimates from Dhurmeea et al (2016)	Estimates of maturity-at-size estimated in S. Pacific Ocean (Farley et al 2014) Sensitivity – estimates from Dhurmeea et al (2016)
Recruitment				BH (h=0.7, 0.8, 0.9) as 3 base case scenarios	BH (h=0.7, 0.8, 0.9) as 3 base case scenarios
Fishery and data					
Fishery definition	Single	Single	Single	11 fisheries as in 2016 stock assessment (see Table 3)	11 fisheries as in 2016 stock assessment (see Table 3)
Joint CPUE	Single annual spatially-aggregated CPUE	Single annual spatially-aggregated CPUE	Single annual spatially-aggregated CPUE	Annual by region	Quarterly by region
Catch-at-size	None	None	None	Annually by fishery	Quarterly by fishery

				(Removal of TWN size data to be decided by mid-Feb)	(Removal of TWN size data to be decided by mid-Feb)
Catchability change over time?	Base case: 0% Sensitivity case: 1%(/year)	Base case: 0% Sensitivity case: 1%(/year)	Base case: 0% Sensitivity case: 1%(/year)	Base case: 0% Sensitivity case: 1%(/year)	Base case: 0% Sensitivity case: 1%(/year)

Table 3: Fleet definitions for use in the 2019 IO ALB assessment.

Fishery	**Nationality**	**Gear**	**Area**
LL1	All	Longline	1
LL2	All	Longline	2
LL3	All	Longline	3
LL4	All	Longline	4
DN3	CN-TW	Drift net	3
DN4	CN-TW	Drift net	4
PS	All	Purse seine	1
Other1	All	Others	1
Other2	All	Others	2
Other3	All	Others	3
Other4	All	Others	4

95. The WPTmT **NOTED** that these specifications provide advisory approaches for the base case and identified sensitivity runs prior to the assessment meeting. It was further noted that there should be flexibility for the modellers to identify or modify the specifications in Tables 7.1 and 7.2 should the modelling results show a necessity to do so.

96. The WPTmT **NOTED** that the size frequency information from Taiwan.China had several problems. The WPTmT further **NOTED** that the Taiwan.China scientists would continue to investigate the data and should the issues be resolved by mid-February, the outcomes would be provided for potential use. Selectivity would be estimated using the size frequency information from Japan and Korea.

7.3 Other data or priorities relevant to the albacore stock assessment and preparation of the WPTmT07 stock assessment meeting

97. The WPTmT **NOTED** that during the 2018 Scientific Committee meeting, the importance of model diagnostics was highlighted. The WPTmT **ACKNOWLEDGED** that the SC requested that specific diagnostics, such as retrospective analyses should be conducted and presented for all species assessments. The WPTmT therefore **REQUESTED** that the assessment modellers provide this and other diagnostics (as appropriate) when presenting their results at the July Stock Assessment meeting.

98. The WPTmT **NOTED** that the specifications for projections should also be discussed and addressed prior to the Assessment meeting.

99. The WPTmT **ACKNOWLEDGED** that the current requirements include projecting the stock for short (3 years) and medium (10years) periods. It is also required that the projected catch should be conducted in +/-10% increments of the current catch up to +/-40% (i.e. +/- 0, 10, 20, 30 and 40% of the current catch). The WPTmT **NOTED** that the WPM had suggested that these increments should be finer (i.e. 5%) and it was **AGREED** that this could be considered in the future.

100. **ACKNOWLEDGING** that the submission of mandatory statistical data according to Resolution 15/02 for the year 2018 is expected by the end of June 2019, and therefore that it is unlikely that 2018 catch values will be available by the July assessment meeting, the WPTMT **AGREED** that current catch would be defined as the average catch of the previous 3 years (i.e. 2015, 2016 and 2017).

101. The WPTmT **ACKNOWLEDGED** that it is also important to take into consideration the multiple sources of uncertainty in the projections, especially with regards to recruitment. The WPTmT **DISCUSSED** that there are various ways of accounting for this uncertainty and these would be discussed and defined intersessionally by a small technical working group with a final decision to be taken by mid-May.

8. OTHER BUSINESS

8.1 Review of information relevant to the Albacore management strategy evaluation process

102. The WPTmT **NOTED** a brief update on the albacore management strategy evaluation process that was provided on behalf of the lead modeller. This update presented the latest iteration in the development of the operating model (OM) for Indian Ocean albacore tuna, constructed as a grid of Stock Synthesis (SS3) stock assessment runs. The base case is the model run conducted by WPTmT in 2016, and considers a number of sources of uncertainty, as identified by WPTmT and WPM, in the estimation of population trajectories and dynamics. Tuning of candidate management procedures, according to the objectives put forward by TCMP in 2018, has been carried out and the results show some of the trade-offs involved in achieving those objectives.

103. The WPTmT **WELCOMED** the progress that had been made on the MSE process and **NOTED** that this process is also being undertaken in the WPM.

104. The WPTmT **AGREED** that further discussion on this issues should take place at the July Assessment meeting, and that the update provided to the data preparatory meeting was informative.

8.2 Any other matters

105. The WPTmT **NOTED** an update provided by the secretariat with regards to a biological sampling programme for albacore to be conducted in the Indian Ocean. The WPTmT were informed that this work would be funded by an EU grant and that it has initially been planned as a port sampling exercise in Mauritius. The WPTmT **NOTED** that the original proposal had to be revised due to impediments in implementing the sampling in Mauritius.

106. The WPTmT **NOTED** that an alternative proposal was being developed, which focused on sampling by observers onboard vessels. It was further noted that the proposal consisted of two parts. An initial phase would be carried out to design the project and develop protocols for the data collection. Thereafter future work would entail the actual collection of the samples.

107. The WPTmT **NOTED** that a draft Terms of Reference for the project would be made available by the secretariat. The CPC scientists were then encouraged to read the proposal and provide comments to the secretariat (no later than 2 weeks after the completion of the WPTmT(DP) meeting) on how the proposal could be improved as well as the potential fleets that could be involved in the study.

9. REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 7TH SESSION OF THE WPTMT(DATA PREPARATORY)

108. The WPTmT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTmT07(DP), provided at Appendix 7.

109. The report of the 7th Session of the Working Party on Temperate Tunas (*IOTC–2017–WPTmT07(DP)–R*) was **ADOPTED** on the 17 January 2019.

APPENDIX 1
LIST OF PARTICIPANTS

Chairperson
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APPENDIX 2
AGENDA FOR THE 7TH WORKING PARTY ON TEMPERATE TUNAS

Date: 14 - 17 January 2019
Location: Kuala Lumpur, Malaysia
Venue: ParkRoyal Hotel
Time: 09:00 – 17:00 daily
Chair: Dr Dr. Jiangfeng Zhu (People's Republic of China); **Vice-Chair:** Dr Toshihide Kitakado (Japan)

1. **OPENING OF THE MEETING** (Chair)
2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION (**Chair**)**
3. **THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS**
4. **REVIEW OF THE DATA AVAILABLE AT THE SECRETARIAT FOR TEMPERATE TUNA SPECIES (**IOTC Secretariat**)**
5. **NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENAL DATA RELATING TO TEMPERATE TUNAS** (Chair)
   5.1 Review new information on the biology, stock structure, their fisheries and associated environmental data:
      - Catch data
      - Catch and effort
      - Observer data
      - Catch at size
      - Catch at age
      - Biological indicators, including age-growth curves and age–length keys
6. **REVIEW OF NEW INFORMATION ON THE STATUS OF TEMPERATE TUNAS** (Chair)
   6.1 Review of fishery dynamics by fleet (CPCs)
   6.2 Nominal and standardised CPUE indices
7. **ALBACORE STOCK ASSESSMENT** (Chair)
   7.1 Discussion on albacore assessment models to be developed and their specifications
   7.2 Identification of data inputs for the different assessment models and advice framework
   7.3 Other data or priorities relevant to the albacore stock assessment and preparation of the WPTmT07 stock assessment meeting
8. **OTHER BUSINESS** (Chair)
   8.1 Selection of Stock Status indicators
   8.2 Review of information relevant to the Albacore management strategy evaluation process
   8.3 Any other matters
9. **REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 7th SESSION OF THE WORKING PARTY ON TEMPERATE TUNAS (DATA PREPARATORY)** (Chair)

APPENDIX 3
LIST OF DOCUMENTS

Document	Title
IOTC–2019–WPTmT07(DP)–01a	Draft Agenda of the 7th Working Party on Temperate Tunas
IOTC–2019–WPTmT07(DP)–01b	Draft Annotated agenda of the 7th Working Party on Temperate Tunas
IOTC–2019–WPTmT07(DP)–02	Draft List of documents
IOTC–2019–WPTmT07(DP)–03	Outcomes of the 21st Session of the Scientific Committee (IOTC Secretariat)
IOTC–2019–WPTmT07(DP)–04	Outcomes of the 22nd Session of the Commission (IOTC Secretariat)
IOTC–2019–WPTmT07(DP)–05	Review of Conservation and Management Measures relevant to temperate tuna (IOTC Secretariat)
IOTC–2019–WPTmT07(DP)–06	Progress made on the recommendations of WPTmT06 (IOTC Secretariat)
IOTC–2019–WPTmT07(DP)–07	Review of the statistical data and fishery trends for albacore (IOTC Secretariat)
IOTC–2019–WPTmT07(DP)–08	Revision of the WPTmT Program of Work (2020–2024) (IOTC Secretariat)
IOTC–2019–WPTmT07(DP)–09	Status of Albacore Fishing by Malaysian Tuna Longliners in the Southwest of Indian Ocean (Faizal E M, Jamon S and Basir S)
IOTC–2019–WPTmT07(DP)–10	Updated information on catch and effort of albacore tuna (Thunnus alalunga) from Indonesian tuna longline fishery (Setyadji B and Fahmi Z)
IOTC–2019–WPTmT07(DP)–11_Rev1	Review of catch and effort for albacore tuna by Korean tuna longline fishery in the Indian Ocean (1965-2017) (Lee S-I)
IOTC–2019–WPTmT07(DP)–12_Rev2	Review of Indian Ocean albacore biological parameters for stock assessments (Nishida T and Dhurmeea Z)
IOTC–2019–WPTmT07(DP)–13	Regional scaling factors for Indian Ocean albacore tuna (Hoyle S)
IOTC–2019–WPTmT07(DP)–14_Rev1	Data analysis and CPUE standardization of albacore caught by Taiwanese longline fishery in the Indian Ocean (Weng S-P)
IOTC–2019–WPTmT07(DP)–15	CPUE standardization of albacore tuna caught by Korean tuna longline fishery in the Indian Ocean (1977-2017) (Lee S-I)
IOTC–2019–WPTmT07(DP)–16	Standardization of albacore CPUE by Japanese longline fishery in the Indian Ocean (Matsumoto et al.)
IOTC–2019–WPTmT07(DP)–17	Standardization of albacore CPUE by Japanese longline in the Indian Ocean which includes cluster analysis (Matsumoto et al.)
IOTC–2019–WPTmT07(DP)–18	Preliminary stock assessment of Indian Ocean albacore based on ASPIC and consideration on the specification of joint longline CPUE (Matsumoto et al.)
IOTC–2019–WPTmT07(DP)–19	Collaborative study of albacore tuna CPUE from multiple Indian Ocean longline fleets in 2019 (Hoyle S, Chassot E, Fu D, Kim D N, Lee S I, Matsumoto T, Satoh K, Wang S-P, Yeh Y-M, and Kitakado T.)
IOTC–2019–WPTmT07(DP)–20	Outline of ALB stock assessment by SCAS (Statistical-Catch-At-Size) (Nishida T and Kitakado T.)
IOTC–2019–WPTmT07(DP)–21_Rev1	Growth of albacore tuna (Thunnus alalunga) in the western Indian Ocean using direct age estimates (Farley J, Eveson P, Bonhommeau S, Dhurmeea Z, West W, Bodin N)
INFO Papers	
IOTC–2019–WPTmT07(DP)–INF01	Reproductive Biology of Albacore Tuna (Thunnus alalunga) in the Western Indian Ocean (Dhurmeea Z, Zudaire I, Chassot E. Cedras M, Nikolic N, Bourjea J, West W, Appadoo, C and Bodin N)
IOTC–2019–WPTmT07(DP)–INF02	Morphometrics of albacore tuna (Thunnus alalunga) in the Western Indian Ocean (Dhurmeeaa Z, Chassot E, Augustin E, Assan C, Nikolic N, Bourjea J, West W, Appadoo, C and Bodin N)
IOTC–2019–WPTmT07(DP)–INF03	Spatiotemporal distribution of albacore in relation to oceanographic variables in the Indian Ocean (Wang J, Zhu J and Chen X)

APPENDIX 4
PROGRESS MADE ON THE RECOMMENDATIONS OF WPTMT05

Extracts from IOTC–2019–WPTmT07(DP)–06

WPTmT05 Rec. No.	Recommendation from WPTmT05	SC1X Rec. No.	Recommendation adopted by the SC19 (2016)	Progress / Comments
WPTmT06.01	***Review of the data available at the Secretariat for Temperate Tuna Species*** (para 21) The WTmT **NOTED** that length frequency samples for the Taiwanese driftnet fishery were collected during the 1980s and published in a former IPTP paper, and **RECOMMENDED** that the IOTC Secretariat process the information to ensure the data is available for future stock assessments.	SC19 (Para. 38)	The WTmT **NOTED** that length frequency samples for the Taiwanese driftnet fishery were collected during the 1980s and published in a former IPTP paper, and **REQUESTED** that the IOTC Secretariat process the information to ensure the data is available for future stock assessments.	**Update:** The data has been provided to the IOTC Secretariat but unfortunately it currently lacks geospatial information. Further processing (including an approximation of the spatial distribution for the measured samples) is necessary for this information to be incorporated and made available for the upcoming WPTmT Data Preparatory meeting in January 2019.
WPTmT06.02	(para 22) **NOTING** changes in the length frequency distribution by the Taiwanese deep-freezing longline fleet since the early-2000s, and particularly the decline in the proportion of smaller sized fish sampled for lengths, the WPTmT **RECOMMENDED** that length frequency and biological data collected by Taiwanese observers be provided to the IOTC Secretariat in order to validate and better understand recent changes in the length frequencies collected by on-board sampling – including samples collected for albacore tuna, tropical tuna species, and swordfish. The WPTmT **NOTED** that all observer data submitted to the IOTC Secretariat is subject to Resolution 12/02 *Data confidentiality policy and procedures*.	SC19 (Para. 39)	**NOTING** changes in the length frequency distribution by the Taiwanese deep-freezing longline fleet since the early-2000s, and particularly the decline in the proportion of smaller sized fish sampled for lengths, the SC **REQUESTED** that length frequency and biological data collected by Taiwanese observers be provided to the IOTC Secretariat in order to validate and better understand recent changes in the length frequencies collected by on-board sampling – including samples collected for albacore tuna, tropical tuna species, and swordfish, **NOTING** that all observer data submitted to the IOTC Secretariat is subject to Resolution 12/02 *Data confidentiality policy and procedures*.	**Update**: Observer data from Taiwanese observers for 2012-2017 has been submitted to the IOTC Secretariat. Their incorporation within the IOTC databases requires further processing, as these come in the form of highly aggregated observer trip reports that are provided as PDF documents. Most likely, this information will be

				fully available in time for the assessment in July 2019.
WPTmT06.03	(para 23) The WPTmT **ACKNOWLEDGED** the importance of port sampling of albacore tuna unloaded in Port Louis, Mauritius, and **RECOMMENDED** that the IOTC Secretariat provide additional support to Mauritius on how to collect and report this information. The WPTmT **NOTED** that the IOTC Secretariat has proposed a mission to Mauritius in August 2016 in support of this capacity building activity	SC19 (Para. 40)	The SC **ACKNOWLEDGED** the importance of port sampling of albacore tuna unloaded in Port Louis, Mauritius, and **REQUESTED** that the IOTC Secretariat provide additional support to Mauritius on how to collect and report this information, **NOTING** that the IOTC Secretariat conducted a preliminary mission to Mauritius in August 2016 in support of this capacity building activity.	**Update**: A project proposal has been developed (EU DG-Mare funding). Terms of reference include: a.) Scoping study to describe the sampling design for biological sampling; b.) Develop a biological sampling pilot project in 1 or 2 CPCs (e.g., in Mauritius or Indonesia) to facilitate the routine collection of Indian Ocean specific biological information for albacore tuna. Although tentatively planned for 2019, there have been issues identifying suitable consultants with experience in albacore biology. The IOTC Secretariat requests that the WPTmT review the TORs and feasibility of the current activity within the time-frame of end-2019.

WPTmT06.04	***New information on biology, ecology, fisheries and environmental data relating to temperate tunas*** (para 47) **NOTING** the general paucity of biological indicators available from the Indian Ocean, and particularly the lack of age-specific maturity as a primary source of uncertainty in the stock assessment of albacore tuna, the WPTmT **RECOMMENDED** a study on the growth curve of albacore tuna in the Indian Ocean as a high priority in the WPTmT Program of Work.	SC19 (Para. 41)	**NOTING** the general paucity of biological indicators available from the Indian Ocean, and particularly the lack of age-specific maturity as a primary source of uncertainty in the stock assessment of albacore tuna, the SC **RECOMMENDED** a study on the growth curve of albacore tuna in the Indian Ocean as a high priority in the **SC** Program of Work.	**Update**: A consultant has been contracted through an EU grant to carry out this study and it will be presented at the WPTmT07(DP) meeting.
WPTmT06.06	***Date and place of the 7th and 8th Sessions of the WPTmT*** (para 125) The WPTmT **RECOMMENDED** that the SC consider rescheduling of future WPTmT meetings (currently held in July) to later in the year, e.g., August-early September, to enable the possibility of the latest years' data to be included in the assessment	SC19 (Para. 42)	The SC **CONSIDERED** rescheduling future WPTmT meetings (currently held in July) to later in the year, e.g., August-early September, to enable the possibility of the latest years' data to be included in the assessment.	**Update**: No progress
WPTmT06.07	(para 126) The WPTmT **RECOMMENDED** that future stock assessment cycle for albacore tuna should be conducted every three years (rather than two years), in line with the assessment of species covered by other IOTC Working Parties (e.g., WPTT, WPEB), and that the WPTmT should in addition convene during the year preceding the next stock assessment to focus on priority areas for improvement in the albacore assessment, such as the standardization of CPUE, or development of biological parameters.	Nil	Nil	**Update**: Although initially planned for 2018, a data preparatory meeting was finalised for January 2019 in preparation of the assessment to be conducted in July of 2019.

APPENDIX 5
SUMMARY OF DATA AVAILABLE AT THE IOTC SECRETARIAT

Extracts from IOTC–2019–WPTmT07(DP)–07

Albacore Fisheries and main catch trends

- Main fisheries: albacore tuna are currently caught almost exclusively using drifting longlines (accounting for over 90% of the total catches) (**Table 1; Fig.3**), with remaining catches recorded using purse seines and other gears. Catches from the longline fisheries are split between deep-freezing longliners, and fresh-tuna longliners:

  Deep-freezing longline fishery:

  - Deep-freezing longliners from Japan and Taiwan,China have been operating in the Indian Ocean since the early 1950s (Fig.3). Although the Japanese albacore catch ranged from 8,000 t to 18,000 t in the period 1959 to 1969, since the early-1970s catches rapidly decreased to around 1,000 t due to a change in the target species, mainly to southern bluefin tuna and bigeye tuna. Albacore became a bycatch species for the Japanese fleet with catches between 200 t and 2,500 t. In recent years the Japanese albacore catch has been around 2,000 to 4,000 t.
  - Catches by Taiwan,China deep-freezing longliners increased steadily from the 1950's to average around 10,000 t by the mid-1970s. Between 1998 and 2002 catches ranged between 20,000 t to 26,000 t, accounting for over 55% of the total Indian Ocean albacore catch. Since 2006 albacore catches by Taiwan,China deep freezing longliners have been between 1,500 and 5,000 t, with the lowest catches recorded in 2012.

  Fresh-tuna longline fishery:

  - Unlike deep-freezing longliners, catches of albacore for the fresh-tuna longline fishery of Taiwan,China have increased in recent years to over 15,000 t compared to less than 5,000 t in the mid-2000s, leading to a shift in the proportion of catches of albacore by deep-freezing and fresh-tuna longliners. Catches by fresh-tuna longliners currently account for between 80% - 90% of catches by Taiwanese longliners.
  - Catches of albacore reported for the fresh tuna longline fishery of Indonesia have also increased considerably since 2003, ranging between 3,000 t and 9,000 t in recent years.

- Main fleets (i.e., highest catches in recent years):

  In recent years nearly three-quarters of the total catches of albacore in the Indian Ocean are accounted for by Taiwan,China and Indonesia, followed by Japan – with the majority of catches reported by fresh-tuna longline, and deep-freezing fisheries (**Fig.2**).

- Main fishing grounds:

  While most of the catches of albacore have traditionally come from the southwest Indian Ocean (i.e., South of 20°S), in recent years a larger proportion of the catch has come from the southern and eastern Indian Ocean (**Table 2; Figs.4, 6 & 7**). The relative increase in catches in the eastern Indian Ocean since the early 2000's is mostly due to increased activity of fresh-tuna longliners from Taiwan,China and Indonesia.

  In the Western Indian Ocean, the catches of albacore mostly result from the activities of deep-freezing longliners and purse seiners. One consequence of Somali maritime piracy in the western tropical Indian Ocean in recent years has been the movement of part of the deep-freezing longline fleets from this area, for which the target species were tropical tunas or swordfish, to operate in southern waters of the Indian Ocean which has led to an increased contribution of albacore to the total catches of some longline fleets.

  Offshore gillnet vessels from I.R. Iran and Pakistan, as well as gillnet-longline vessels from Sri Lanka have extended their area of operation in recent years, and are now thought to operate on the high seas closer to the equator. However the lack of catch-and-effort data from these fleets makes it difficult to assess whether they are operating in areas where catches of juvenile albacore are likely to occur.

- Retained catch trends:

  Between the early 1960s until the mid-1980s, catches of albacore remained relatively stable at around 15,000 – 20,000 t, except for high catches recorded in 1973 and 1974 (**Table 1, Fig.3**). From the mid-1980s catches increased markedly due to the use of drifting gillnets by Taiwan,China, with total catches over 30,000 t, mostly targeting juvenile albacore in the southern Indian Ocean (30°S to 40°S). In 1992 the United Nations worldwide ban on the use of drifting gillnets effectively closed this gillnet fishery. Following the removal of the Taiwanese drifting gillnet fleet, catches dropped to less than 21,000 t by 1993 (**Fig.5**).

From 1993 catches increased to 46,000 t (in 2001) – the year in which the highest catches of albacore were reported – mostly as a result of increased fishing effort by the Taiwanese deep-freezing longline fleet. Since 2001, catches have been almost exclusively taken by deep-freezing longlines and fresh-tuna longlines.

- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

TABLE 1. Albacore: Best scientific estimates of the catches of albacore by gear and main fleets (or type of fishery) by decade (1950s–2000s) and year (2008–2017), in tonnes. Catches by decade represent the average annual catch. Data as of December 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
DN				5,823	3,735		0	0	0	0	0	0	0	0	0	0
LL	3,715	17,313	17,136	15,602	22,992	21,350	13,043	13,971	20,211	12,318	9,858	9,494	15,539	12,862	12,215	14,370
FLL			80	314	1,309	11,702	19,332	21,662	21,380	18,361	20,547	21,528	21,234	21,148	22,068	22,749
PS				194	1,682	912	1424	392	207	725	1,297	501	534	535	433	438
OT	20	33	94	485	754	1,375	2,091	2,181	2,337	2,498	1,654	1,168	1,108	1083	1,013	1,156
Total	**3,736**	**17,347**	**17,310**	**22,417**	**30,472**	**35,339**	**35,890**	**38,205**	**44,135**	**33,902**	**33,355**	**32,691**	**38,414**	**35,628**	**35,729**	**38,713**

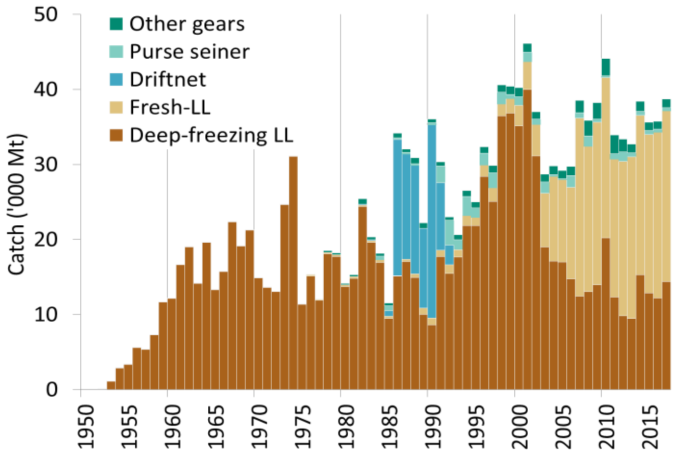
Fisheries: Driftnet (**DN**; Taiwan,China); Freezing-longline (**LL**); Fresh-tuna longline (**FLL**); Purse seine (**PS**); Other gears nei (**OT**).

TABLE 2. Albacore: Best scientific estimates of the catches of albacore by (stock assessment) fishing area by decade (1950s–2000s) and year (2008–2017), in tonnes[1]. Data as of December 2018.

	By decade (average)						By year (last ten years)									
	1950s	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1-NORTHWEST	1,092	5,453	4,720	3,488	5,472	7,162	4,255	6,582	10,353	7,824	7,320	9,449	8.275	6,177	6,406	7,865
2-NORTHEAST	2,292	3,010	3,607	2,918	3,972	7,537	13,371	6,996	9,934	5,910	4,750	2,920	2,520	3,025	2,116	2,432
3-SOUTHWEST	250	7,255	6,782	6,421	10,932	10,543	7,103	11,911	8,547	9,522	9,004	12,005	15,129	15,291	17,806	18,035
4-SOUTHEAST	101	1,629	2,201	9,591	10,096	10,097	10,811	12,716	15,301	10,647	12,281	8,317	12,491	11,135	9,402	10,381
Total	**3,736**	**17,347**	**17,310**	**22,417**	**30,472**	**35,339**	**35,890**	**38,205**	**44,135**	**33,902**	**33,355**	**32,691**	**38,414**	**35,628**	**35,729**	**38,713**

Areas: 1-NORTHWEST (North of 25S, West of 75 E); 2-NORTHEAST (North of 25S, East of 75 E); 3-SOUTHWEST (South of 25S, West of 75 E); 4-SOUTHEAST (South of 25S, East of 75 E)

[1] Catches exclude a small number of (artisanal) fisheries that were not included due to the paucity of information available in the IOTC database.



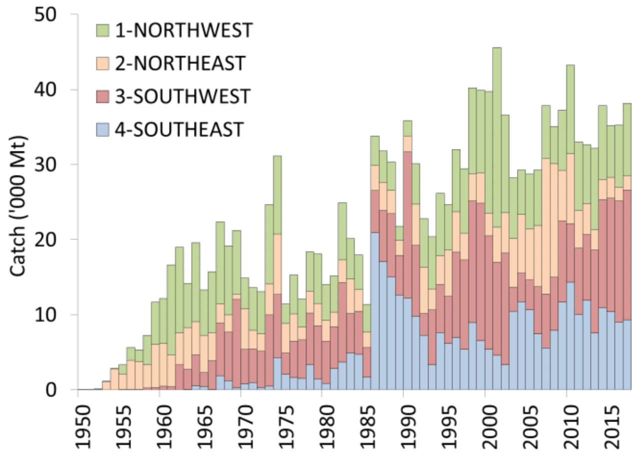


Fig.3. Albacore: catches by gear. Driftnet (DN; Taiwan,China); Freezing-longline (LL); Fresh-tuna longline (FLL); Purse seine (PS); Other gears NEI (OT).

Fig.4. Albacore: catches recorded in Stock Assessment Areas.

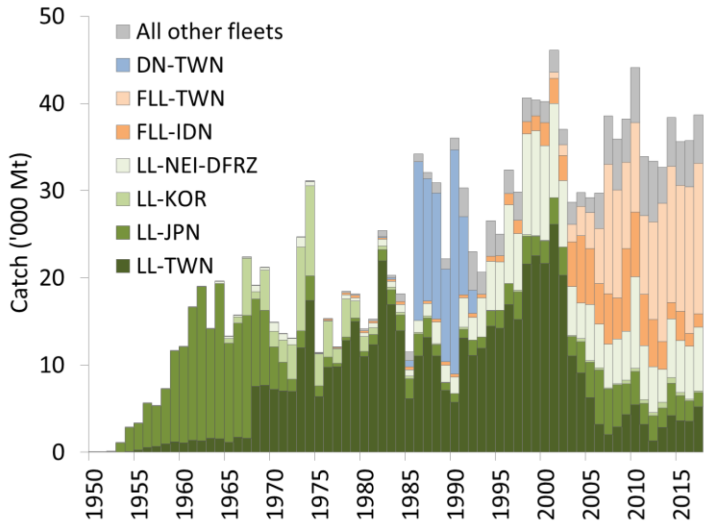


Fig.5. Albacore: Catches by fleet recorded in the IOTC Database (1950–2018). Data as of December 2018.

Freezing Longlines of Taiwan,China (LL-TWN), Japan (LL-JPN), Rep. of Korea (LL-KOR), and other nei fleets (LL-NEI-DFRZ); Fresh-tuna longlines of Indonesia (FLL-IDN), and Taiwan,China (FLL-TWN); Driftnets of Taiwan,China (DN-TWN); all other fleets combined (Other Fleets).

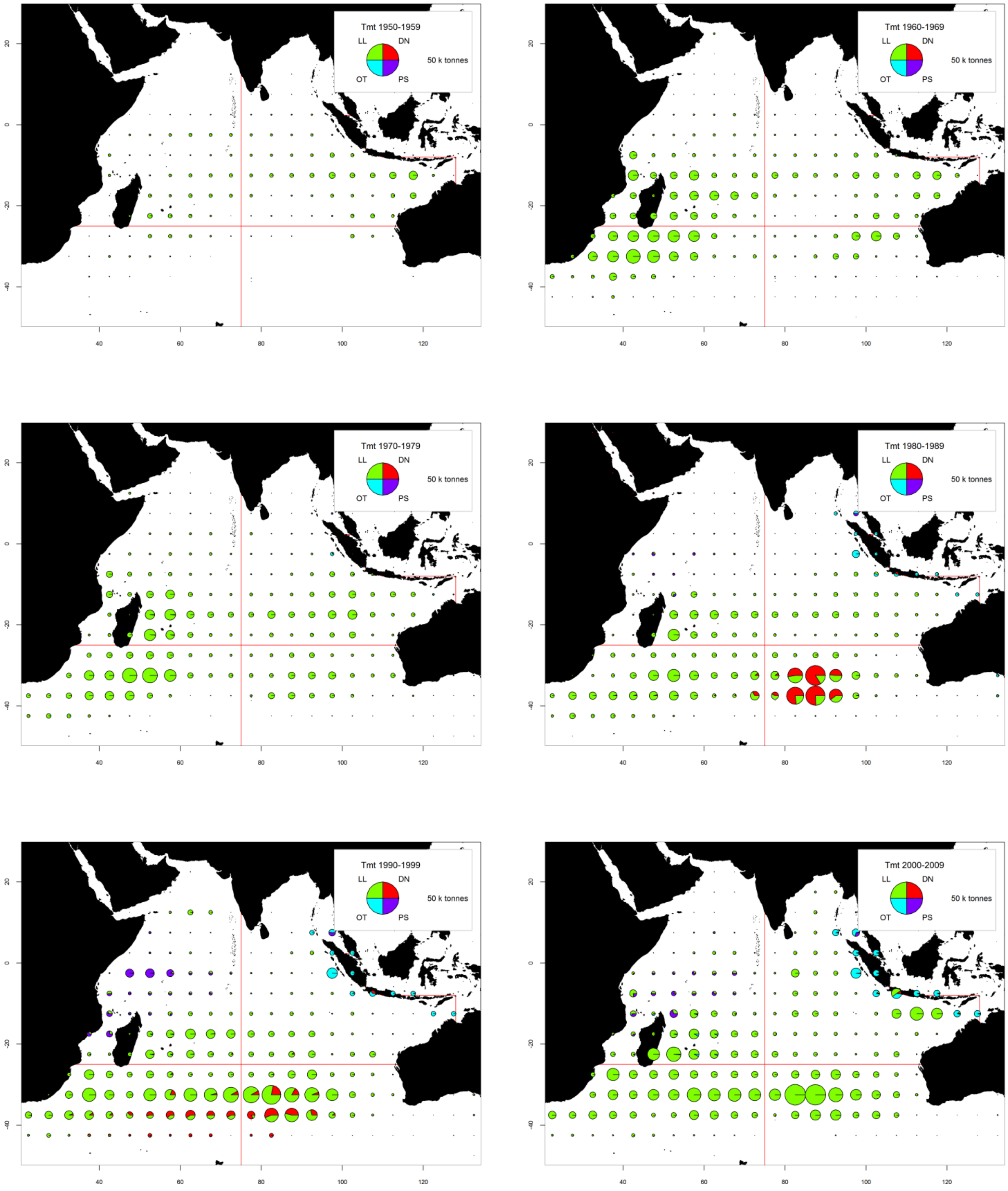


Fig.6a–f. Albacore: Time-area catches (total combined in tonnes) of albacore estimated for the period 1950-2009, by decade and type of gear. Albacore stock assessment areas shown in red.

Longline (**LL**, green), Driftnet (**DN**, red), Purse seine (**PS**, purple), Other fleets (**OT**, blue)

Time-area catches are not available for all fleets; catches for those were assigned by 5x5 square and month using information from other fleets. Data as of June 2016. Source: Catch-and-effort, raised to total nominal catches.

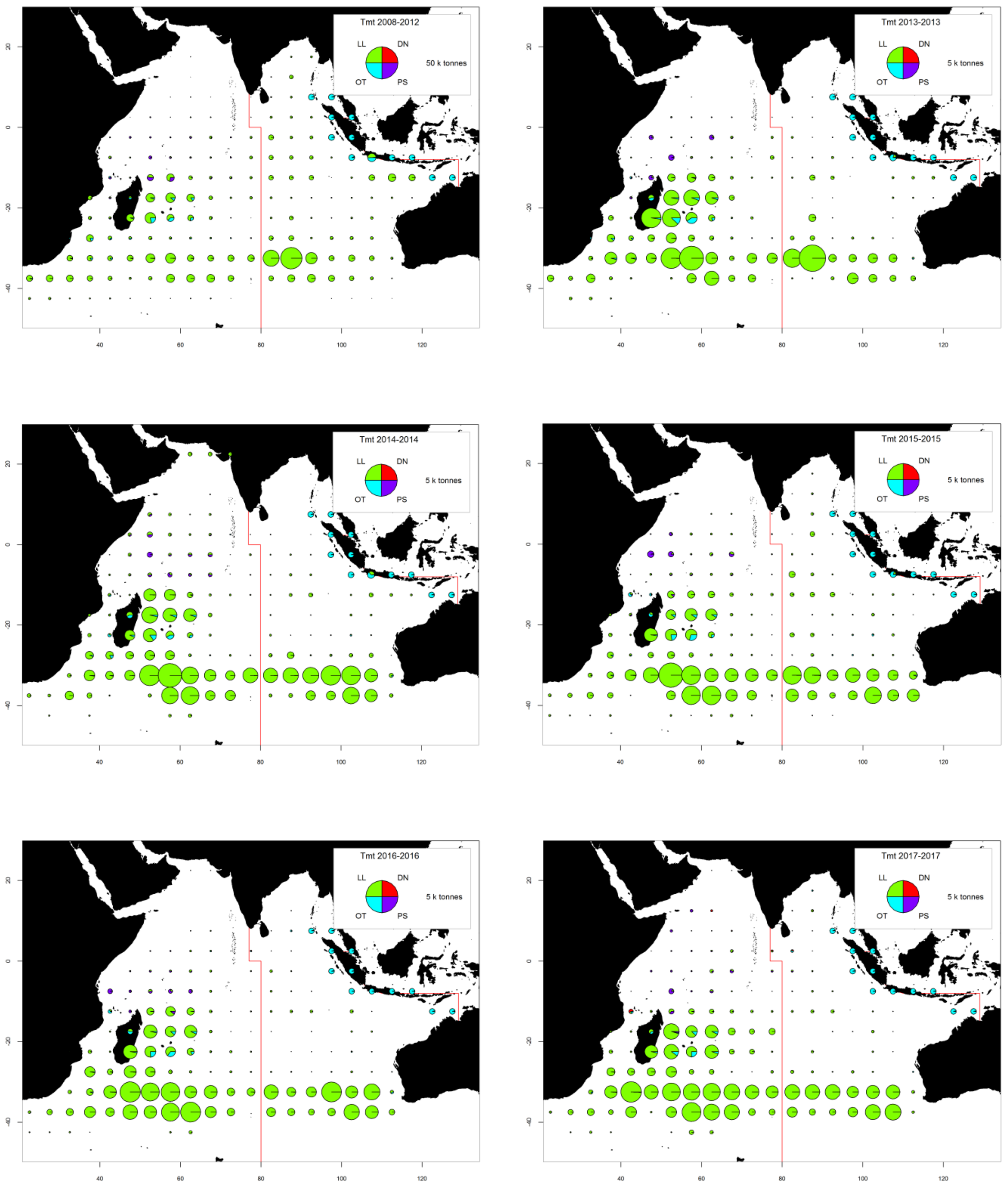


Fig.7a–f. Albacore: Time-area catches (total combined in tonnes) of albacore estimated for the period 2008–12 by type of gear and for 2013–17, by year and type of gear. Albacore stock assessment areas shown in red.

Longline (**LL**, green), Driftnet (**DN**, red), Purse seine (**PS**, purple), Other fleets (**OT**, blue)

Time-area catches are not available for all fleets; catches for those were assigned by 5x5 square and month using information from other fleets. Data as of June 2016. Source: Catch-and-effort, raised to total nominal catches.

- Discard levels: are thought to be low, although they are unknown for industrial fisheries other than European (EU) purse seiners (2003–07).

Changes to the catch series**:** there have been no major changes to the estimates of total catches of albacore tuna since the WPTmT meeting in 2016.

Albacore tuna – Catch-per-unit-effort (CPUE) trends

- Availability: Standardized catch-and-effort series are available from the various industrial fisheries (see below). Nevertheless, catch-and-effort reported to the IOTC Secretariat are not available from some fisheries or are considered to be of poor quality, especially during the last decade, for the following reasons (**Fig. 8d-f**):
  - uncertain data from significant fleets of longliners, including: India, Indonesia, Malaysia, Oman, and Philippines;
  - no catch-and-effort data for fresh-tuna longliners flagged as Taiwan,China, from 1990 (i.e., the start of the fishery) up to 2009;
  - non-reporting by industrial purse seiners and longliners (NEI).
- Main CPUE series available: Rep. of Korea (longline), Japan (longline), Taiwan,China (longline).

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

- Average fish weight: In general, the amount of catch for which size data is available for albacore before 1980 is very low (**Fig. 8g-i**). The deep-freezing longline fleets account for the majority of size data for albacore in the IOTC database. Size data are also available for industrial purse seiners flagged in EU countries and the Seychelles, however few data are available for all other fleets.

  Average fish weights can be assessed for several industrial fisheries although they are incomplete or of poor quality due to the issues identified below:

  i. Tawain,China longliners: size frequency data is available for the period 1980–2014. However, the length distributions of albacore available for Taiwan,China since 2003 are different than compared to earlier years (**Fig. 9**). Since 2003 higher average weights derived from length data have also been reported, compared to average weights from catch-and-effort (for the same time-periods and areas), which suggests changes in the sampling protocols of specimens measured for lengths – particularly the proportion of smaller sized fish measured for lengths.
  ii. Japan longliners: data for the Japanese longline fleet is available; however, the number of specimens measured per stratum has been decreasing since the early-1990s.

- Catch-at-Size(Age) table: are available but estimates are highly uncertain for some periods and fisheries, including:
  i. all industrial longline fleets before the mid-60s, from the early-1970s up to the early-1980s and most fleets in recent years, in particular fresh-tuna longliners;
  ii. no size samples from the driftnet fishery of Taiwan,China over the entire fishing period (1982–92);
  iii. lack of size data for some industrial fleets (Taiwan,China (fresh longline), NEI, India, Indonesia, and NEI fleets).

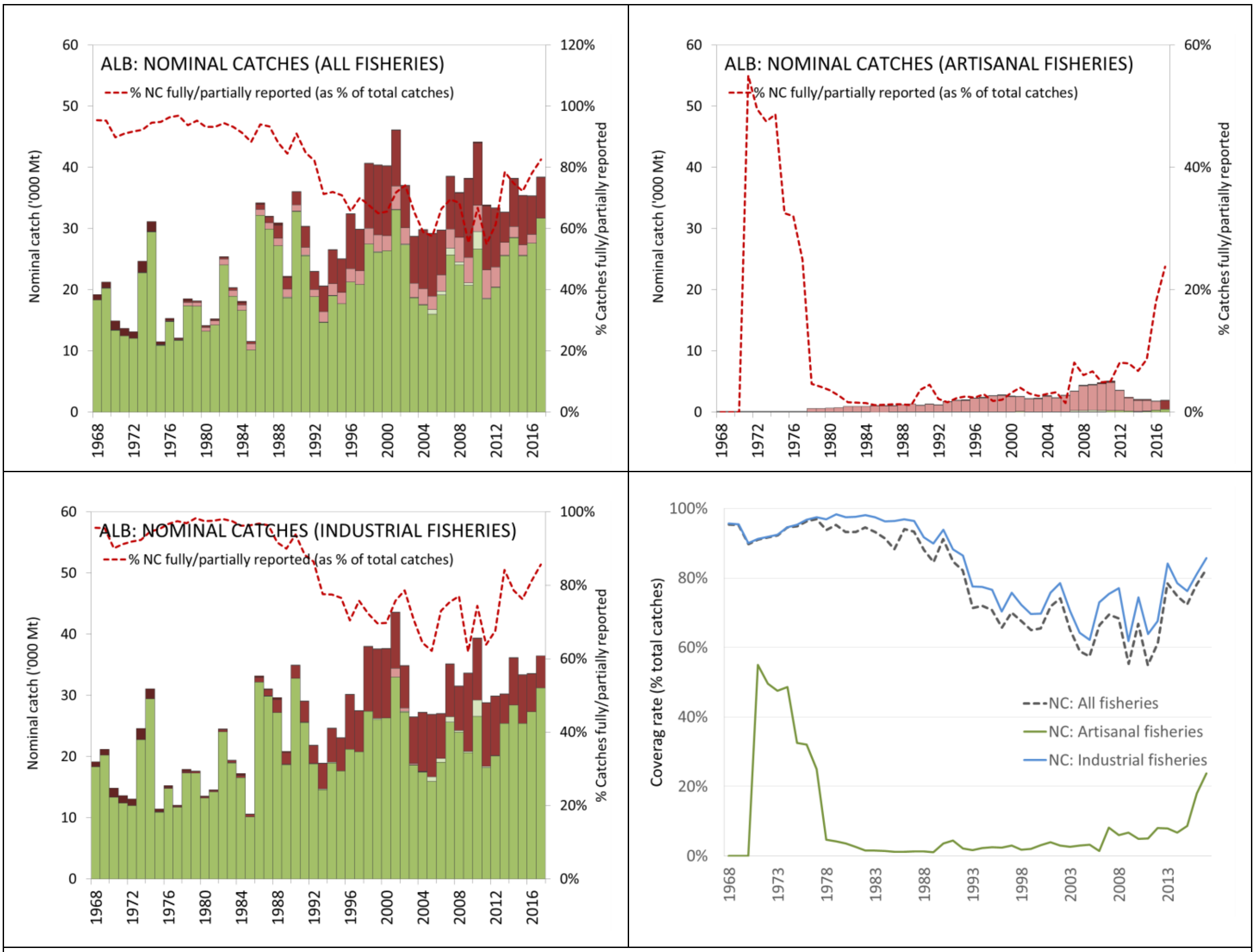


Fig. 8a-c. Albacore tuna: nominal catches data reporting coverage (1968–2017). Data as of December 2018.

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).

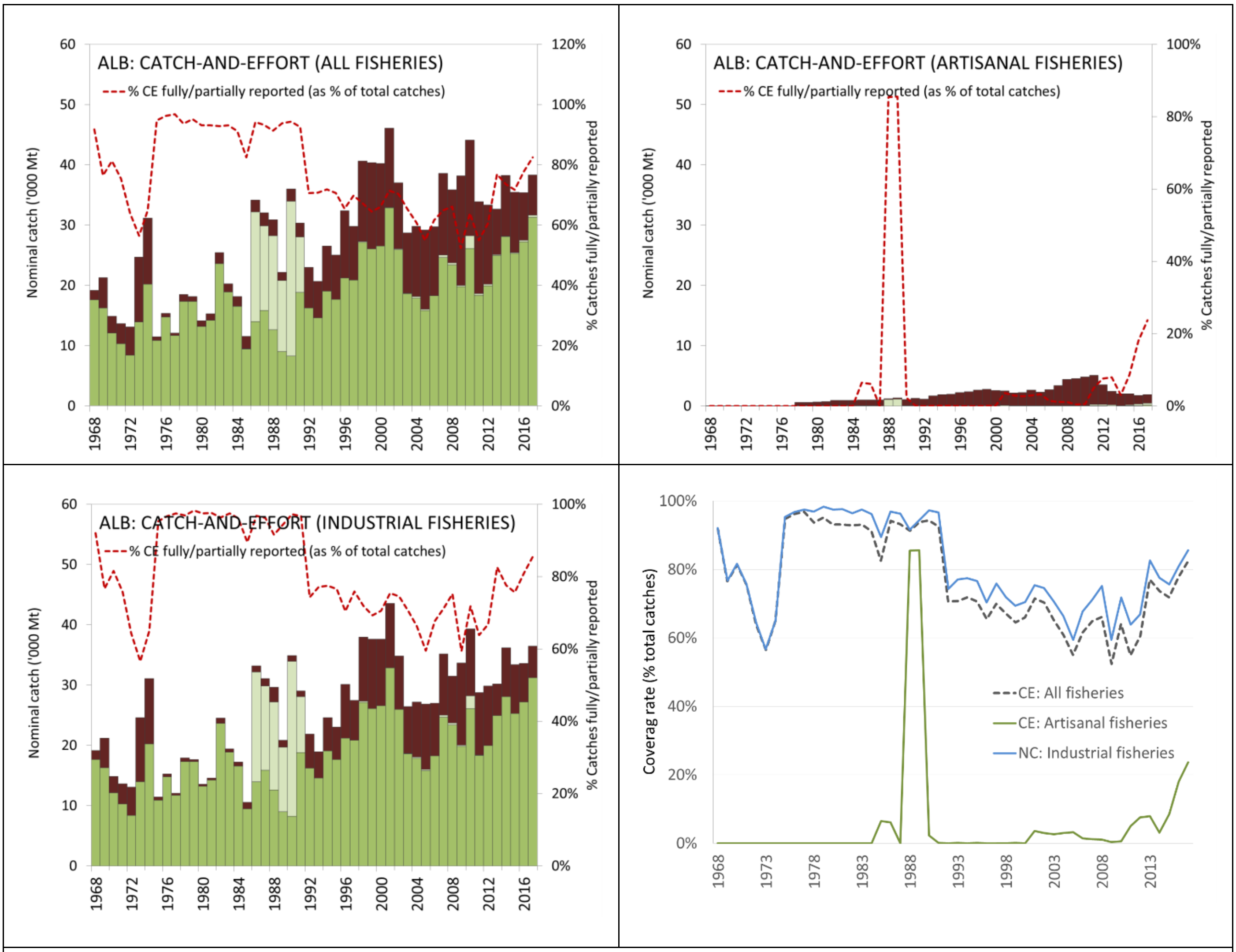


Fig. 8d-f. Albacore tuna: catch-and-effort data reporting coverage (1968–2017). Data as of December 2018.

Data reporting scores:

(green)	0
(light green)	2
(pink)	4
(red)	6
(dark red)	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).

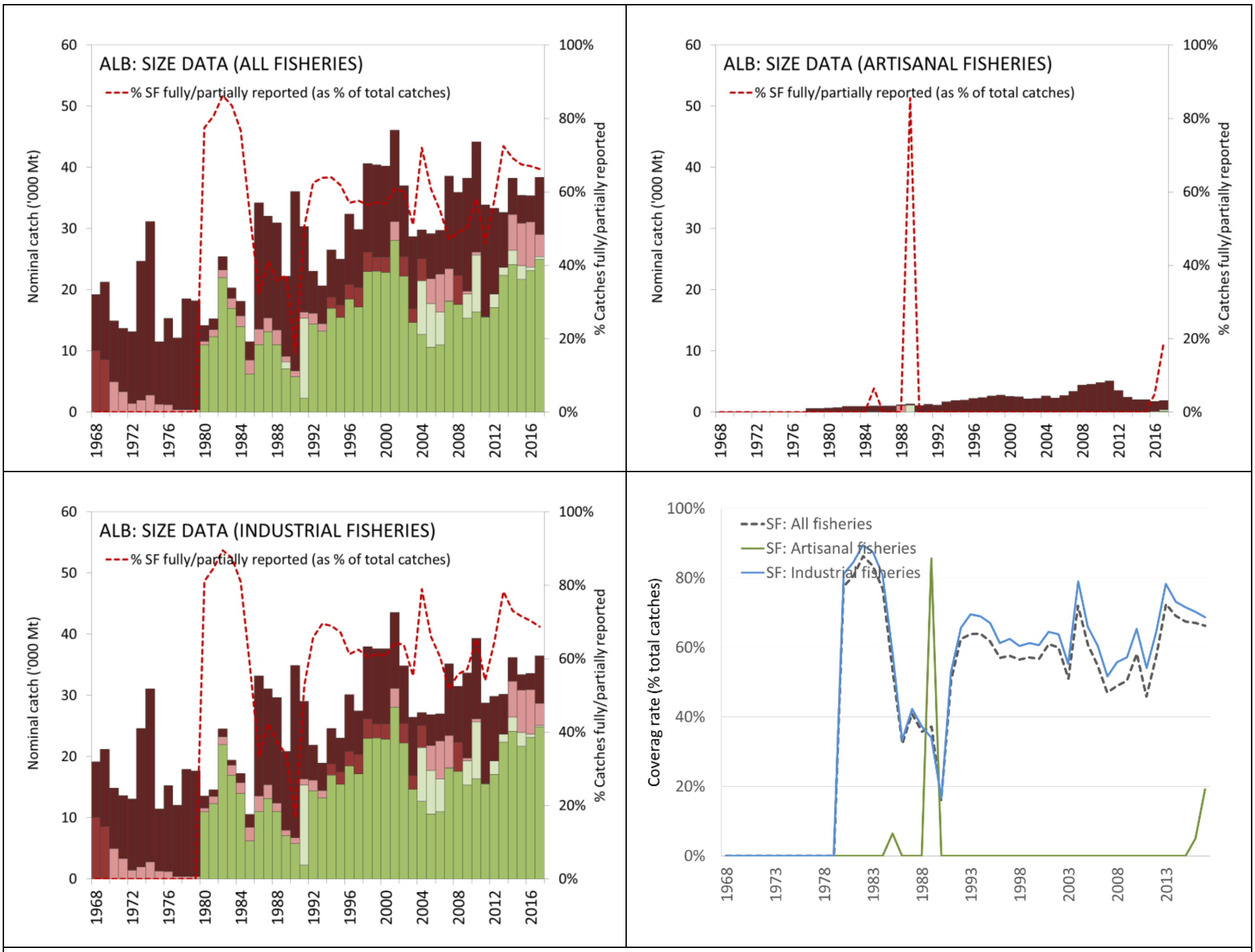


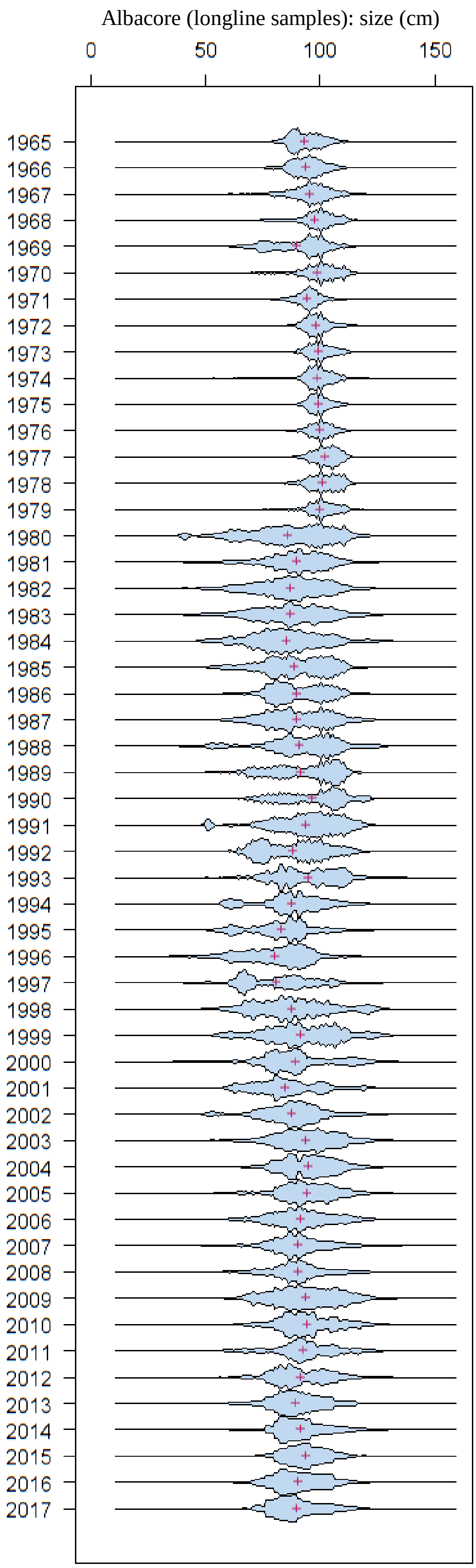
Fig. 8g-i. Albacore tuna: size frequency data reporting coverage (1968–2017). Data as of December 2018.

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).



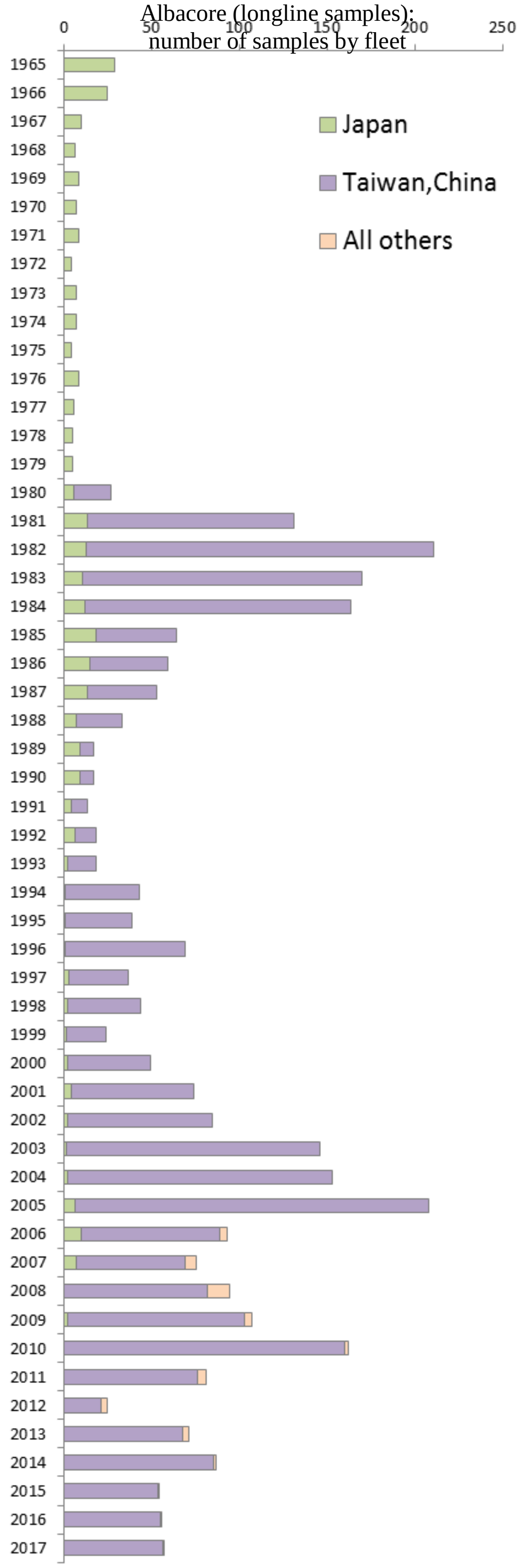


Fig. 9: **Left:** Albacore: Length frequency distributions (total amount of fish measured by 1cm length class) derived from the data available at the IOTC Secretariat for freezing longline fisheries, by year.
Right: Number of specimens sampled for lengths by main longline fleet.

APPENDIX 6
MAIN DATA ISSUES IDENTIFIED RELATING TO THE STATISTICS OF ALBACORE

Extract from IOTC–2019–WPTmT07(DP)–07

The following section provides a summary of the main issues that the IOTC Secretariat considers to negatively affect the quality of the statistics available at the IOTC for albacore tuna, by type of dataset.

Albacore tuna: estimation of total catches – data related issues

1. Nominal (retained) catches

Retained catches are considered to be fairly reliable until the early-1990s (**Fig. 8a-c**); since then the quality of catch estimates since then has been compromised due to poor catch reports from some fleets, in particular:

- Fisheries of Indonesia: Catches of albacore tuna for the fisheries of Indonesia – including fresh-tuna longliners and deep-freezing longliners and coastal fisheries – are estimated to account for around 20% of the total catches of albacore in the Indian Ocean in recent years (**Fig.2**). However the quality of the catch estimates is generally considered to be of relatively low quality.

  Following a recommendation from the IOTC Scientific Committee, in 2013 the Directorate General for Capture Fisheries of Indonesia (DGCF) and the IOTC Secretariat reviewed the estimates of albacore catches for Indonesia[2]. As a result of the review Indonesia submitted a revised catch series for albacore for the most recent years. While the new estimates are considered more reliable than previous catches reported by DGCF, the lack of catch-and-effort data available for the longline fishery data and issues with the monitoring of albacore landings in Indonesia compromises the ability of DGCF (and the IOTC Secretariat) to validate the new estimates which are still considered to be uncertain.

  Large fluctuations in total catches of albacore continued to be reported by Indonesia to the IOTC Secretariat, in addition to relatively large revisions between provisional and final catch estimates. The number of active longline vessels reported by Indonesia in previous years also remains highly uncertain, particularly prior to 2013. In 2018 the IOTC Secretariat revised the methodology for estimating the catches of Indonesia's fresh longline fleet, in collaboration with Indonesia. While catches for the most recent years are considered more reliable, catch estimates prior to 2013 continue to remain highly uncertain.

- Malaysia (longliners): In previous years, Malaysia has reported incomplete catches of albacore for its longline fleet, as monitoring of the fishery by Malaysia did not include the large component of the longline fleet that is based in ports outside Malaysia (e.g., in particular unloadings of albacore in Port Louis, Mauritius). In recent years Malaysia has reported around 5 longliners in the Indian Ocean, while catches of albacore range between nil and 2,000 t for the same period. To compensate the under-reporting of catches, an additional 500–2,000 t of albacore have been estimated in previous years for Malay longliners not based in Malaysia, unloaded in foreign ports (with catches instead reported as NEI longline fleet).

- Other longline fleets (e.g., India, Oman, and Philippines)**:** The catches of albacore for the longline fisheries of India, Oman, and Philippines appear to be only partially reported (i.e., compared to the number of active vessels operating), with current estimates accounting for 3% of the total catches of albacore in the Indian Ocean in recent years.

- Non-reporting industrial longliners (NEI): catches from longliners operating under flags of non-reporting countries (e.g., Malaysia, foreign unloadings) have been estimated by the IOTC Secretariat. While the catches were moderately high during the 1990s, they have not exceeded 3,000 t in recent years.

- Taiwan,China (fresh-tuna longliners): catches of albacore estimated for the fresh-tuna longline fishery of Taiwan,China are only available from 2001 onwards. Prior to 2001, catches for the Taiwanese fleet remain relatively uncertain.

2. Catch-and-Effort data from Industrial Fisheries:

- Indonesia (all fisheries): no catch-and-effort has been reported by Indonesia's industrial longline fishery. In 2015 an IOTC-OFCF mission was conducted to assist Indonesia with the reporting of catch-and-effort data, however to

[2] http://www.iotc.org/documents/report-review-catches-albacore-fisheries-indonesia

date, no information has been received. Submission of logbook data to DGCF also remains very low – at less than 10% for some years – raising concerns over the level of coverage.

- Taiwan,China (fresh-tuna longliners): catch-and-effort data for this fishery is only available since 2010, compared to nominal catches from 2001. Estimates of total catches, and time-area catches, prior to these periods therefore remains highly uncertain.
- Longline fisheries of India, Malaysia, Oman, and Philippines**:** Although catch-and-effort data are available for some of these fleets, they are usually incomplete and fall short of the IOTC data reporting standards of Resolution 15/02.

3. Size data from all Fisheries:

- Driftnets of Taiwan,China: No size data available over the entire period of activity of the fishery (1982–92).
- Indonesia (fresh-tuna longliners): has only reported size data for its fresh-tuna longline fishery for a limited number of years, during the mid-2000s. However samples, where available, cannot be fully disaggregated by month and fishing area (5x5 grid) and refer mostly to the component of the catch that is unloaded fresh. For this reason, the quality of the samples in the IOTC database are considered low quality.
- Taiwan,China (deep-freezing longliners): size data is available for the period 1980–2014. However, the length distributions of albacore available since 2003 are different than compared to earlier years. In addition, since 2003 higher average weights derived from length data have also been reported, compared to average weights from catch-and-effort (for the same time-periods and areas), which suggests changes in the sampling protocols of specimens measured for lengths – particularly the proportion of smaller sized fish measured for lengths.

  In 2010, the IOTC Scientific Committee noted several issues concerning the reliability size frequency statistics available for Japan and Taiwan,China, and which remain unresolved. In 2013 the IOTC Secretariat presented a paper to the Working Party on Tropical Tunas documenting the current data quality issues and inconsistences between the length frequency data and catch-and-effort reported in particular by Taiwan,China since the mid-2000s[3]. A consultancy has been planned for 2019 to address a number of longstanding issues with the longline size data – with an update to be provided at subsequent WPTmT meetings.
- Taiwan,China (fresh-tuna longliners): size data of albacore has been provided since 2010, however the levels of coverage remain very low, and well below the minimum sampling coverage recommended by the IOTC (1 fish per Mt of catch).
- Japan (deep-freezing longliners): data for the Japanese longline fleet is available; however, the number of specimens measured per stratum has been decreasing since the early-1990s, and since 2000 the number of samples has been very low.
- Longline fisheries of India, Malaysia, Oman, and Philippines**:** To date, none of these countries have reported size frequency data of albacore.

***4. Biological data*:**

- Industrial longline fisheries, in particular Taiwan,China, Indonesia, and Japan: the IOTC Secretariat has used length-age keys, length-weight keys, and processed weight-live weight keys for albacore from other oceans due to the general lack of biological data available from the fisheries indicated.

Albacore (ALB) – Estimation of catches of non-reporting fleets (NEI)

The estimates of catches of non-reporting fleets were updated by the IOTC Secretariat in 2018 (for 2017 catches). The high number of non-reporting fleets operating in the Indian Ocean since the mid-1980's has led to a large increase in the amount of catch that needs to be estimated by the IOTC Secretariat. This reduces confidence in the catch estimates for albacore.

- **Purse seine**: Catches for the six former Soviet Union purse seiners, currently under the Thailand flag, were estimated for January–August 2005 and those for the remaining purse seiner (Equatorial Guinea) for 2005–06. Total catches were estimated using the number of vessels available, the average catches of the former Soviet Union purse seiners in previous years, and average catches available for other fleets for 2005-06. Total catches were assigned to species and type of school fished according to data available for Thailand purse seiners during

[3] See IOTC Secretariat, IOTC-2013-WPTT15-41 Rev_1, for more details.

the same period (2005–06). The amount of catch that the Secretariat has to estimate for this fleet has decreased considerably in recent years. It is thought that there are no longer purse seiners operating under flags of non-reporting countries. The catches of albacore estimated for this component have never been above 170 t.

- **Deep-freezing longline** (Fig. 10): The catches by large longliners from several non-reporting countries[4] were estimated using IOTC vessel records and the catch data from Taiwan,China, Japanese or Spanish longliners, on the assumption that most of the vessels operate in a way similar to the longliners from these countries. The number of vessel operating since 1999 has decreased and this has led to a marked decrease in catch levels. The reason for this decrease in the number of vessels (and catches) operating in the Indian Ocean is not fully explained. Nevertheless, this decrease is somewhat proportional to an increase in the number of vessels recorded under other flags, such as Philippines, Taiwan,China, the Seychelles and, recently, Oman, India, Malaysia and Indonesia. However the catches recorded for India and Philippines are considered uncertain and probably do not account for all the albacore caught by vessels operating under these flags.

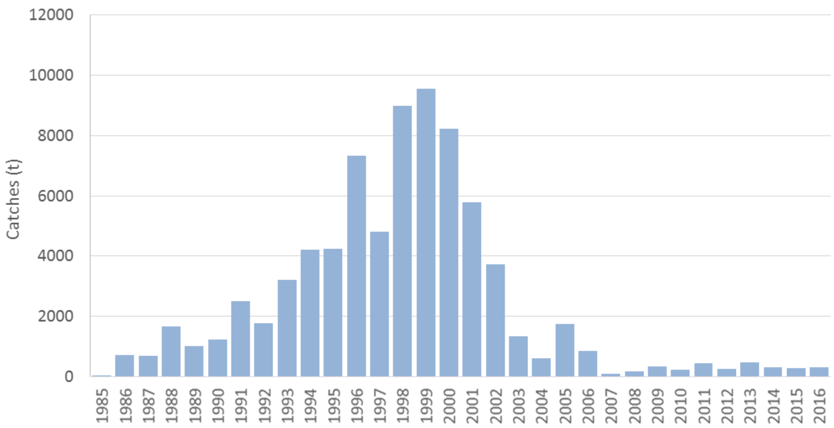


Fig. 10. Albacore: Catches of NEI deep-freezing longline vessels in the Indian Ocean estimated in 2018 (1973–2016).

- **Fresh tuna longline**: Fresh tuna longline vessels, mainly from China, Taiwan,China, India, Malaysia, Belize, India and Indonesia, have been operating in the Indian Ocean since the early 1970's. The catches of some of these fleets were, up to 2006, estimated by the IOTC Secretariat by using information from the following four sources:
    1. Catches reported from the flag countries: Although China reported total catches for its longline fleet, before 2006 catches were not reported by gear (i.e., fresh-tuna longline or deep-freezing longline). The Secretariat estimated the catches of fresh-tuna longliners for this period by using the total catches reported, the numbers of fresh-tuna longline vessels provided by China and catch rates for fresh-tuna and deep-freezing longlines available from other fleets.
    2. Information on catches and vessel activity collected through several catch monitoring schemes implemented in the main ports of landing for these vessels, involving the IOTC-OFCF Project[5] and/or institutions in the countries where the fleets are based and/or foreign institutions (Fig. 15). This applies to Indonesia (2002 - 2009), Thailand (1998 – to-date), Sri Lanka (2002–03), Malaysia (2000-06), Oman (2004–05) and Seychelles (2000–02).
    3. Information available on the number of fresh-tuna longline vessels operating in other ports or on the activity (e.g. the number of vessel unloadings) or catches of those vessels, as reported by third parties. This applies to ports in India (2004–10), Indonesia (1973–2001), Thailand (1994–97), Sri Lanka (1990–2001; 2004–05), Malaysia (1989–99), Singapore, Maldives and Yemen (recent years). The catches in

[4] For example Bolivia, Togo, Honduras, Equatorial Guinea, Tuvalu, Mongolia, Cambodia, Kiribati, plus countries like Belize, Indonesia, Oman, Tanzania which are considered to under report catches.

[5] Overseas Fisheries Cooperation Foundation of Japan

these ports and years were estimated from the known/presumed levels of activity of the vessels and the average catches obtained in ports covered through sampling.

4. Market data, including exports of frozen Albacore recorded in Indonesia and imports of Albacore for canning, provided through ISSF (from 2008 to date). These data are used to compare with the catches reported by Indonesia and Malaysia.

In 2006 Taiwan,China provided total catches for its longline tuna fleet operating in the Indian Ocean for the period 2001 to 2005. Since then, Taiwan,China has provided catches regularly on an annual basis. The catches provided by Taiwan,China are higher than those previously estimated by the IOTC Secretariat for most years, which were replaced in the IOTC database. The rationale for replacing the catch estimates was the assumption that vessels from Taiwan,China have been operating in ports from non-reporting countries and their catches have not been accounted for in previous IOTC estimates.

APPENDIX 7
CONSOLIDATED RECOMMENDATIONS OF THE 7TH SESSION OF THE WORKING PARTY ON TEMPERATE TUNAS (DATA PREPARATORY SESSION)

Review of data available at the Secretariat for temperate tuna species

WPTmT07(DP).01 (para 20) **NOTING** that observer data for the Taiwanese deep-freezing longline fleet in the period 2012-2017 has been submitted to the IOTC Secretariat as highly aggregated *observer trip reports*, and **ACKNOWLEDGING** that no length-frequency information is available within said data, the WPTmT **RECOMMENDED** (see Resolution 11-04) Taiwan,China to provide more detailed information (as per IOTC ROS specifications) to its earliest convenience, as this data is considered of particular importance for the validation and understanding of recent changes detected in the length-frequency of albacore tuna (among others) reported by the Taiwanese fleet and could contribute to explain the decline in the proportion of smaller fish sampled for lengths by this same fleet.

WPTmT07(DP).02 (para 23) **ACKNOWLEDGING** that the levels of coverage for length frequency data reported by Japan for its longline fleet exceed – in recent years – the minimum threshold of one sampled fish per metric ton (as per IOTC Resolution 15/02) the WPTmT also **NOTED** that length frequency data for years prior to 2008 were reported by Japan as 10x20 degrees grids, which is well below the minimum resolution of 5x5 degrees grids, and therefore further **RECOMMENDED** Japan to ensure that historical data to the expected level of resolution is provided to the IOTC Secretariat in the near future.

Biological indicators, including age-growth curves and age–length keys

WPTmT07(DP).03 (para 45) The WPTmT **NOTED** that the new LW relation derived by Dhurmeea et al (2016) is likely biased due to lack of small size data, thus the LW relation by Penny (1994) (South Atlantic) should be used again as a base case for stock assessments. As for the sensitivity, other LW relations including official IOTC observer data will be explored and the results provided by the middle of February 2019. These data, which are sourced from the Japanese observer program, cover a wider range of fish sizes and have larger sample sizes. The WPTmT **RECOMMENDED** that CPCs submit length-weight data to the IOTC secretariat, so that they may compile a database that represents spatial, seasonal, and sex-based variability in LW.

WPTmT07(DP).04 (para 108) The WPTmT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTmT07(DP), provided at Appendix 7.