INTERNATIONAL COMMISSION
for the
CONSERVATION of ATLANTIC TUNAS

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for biennial period, 2018-19
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INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS

CONTRACTING PARTIES

(at 31 December 2019)

Albania, Algeria, Angola, Barbados, Belize, Brazil, Cabo Verde, Canada, China (People's Rep.), Côte d'Ivoire, Curaçao, Egypt, El Salvador, Equatorial Guinea, European Union, France (St. Pierre & Miquelon), Gabon, Ghana, Grenada, Guatemala, Guinea (Rep.), Guinea Bissau, Honduras, Iceland, Japan, Korea (Rep.), Liberia, Libya, Mauritania, Mexico, Morocco, Namibia, Nicaragua, Nigeria, Norway, Panama, Philippines, Russia, Sao Tomé & Principe, Senegal, Sierra Leone, South Africa, St. Vincent and the Grenadines, Syria, The Gambia, Trinidad & Tobago, Tunisia, Turkey, United Kingdom (Overseas Territories), United States, Uruguay, Vanuatu, Venezuela

COMMISSION OFFICERS

Commission Chairman	*First Vice Chair*	*Second Vice Chair*
R. DELGADO, PANAMA (since 21 November 2017)	S. DEPYPERE, EU (since 17 November 2015)	Z. DRIOUICH, MOROCCO (since 21 November 2017)

Panel No.	***PANEL MEMBERSHIP***	***Chair***
-1- Tropical tunas	Angola, Belize, Brazil, Cabo Verde, Canada, China (P.R.), Côte d'Ivoire, Curaçao, El Salvador, Equatorial Guinea, European Union, France, Gabon, Ghana, Guatemala, Guinea (Rep.), Guinea-Bissau, Honduras, Japan, Korea (Rep.), Liberia, Libya, Mauritania, Mexico, Morocco, Namibia, Nicaragua, Nigeria, Panama, Philippines, Russian Federation, Sao Tomé & Principe, Senegal, Sierra Leone, South Africa, St. Vincent and Grenadines, Trinidad & Tobago, United Kingdom (Overseas Territories), United States of America, Uruguay and Venezuela.	Côte d'Ivoire
-2- Temperate tunas, North	Albania, Algeria, Belize, Brazil, Canada, China (P.R), Egypt, European Union, France (St. Pierre and Miquelon), Iceland, Japan, Korea (Rep.), Libya, Mauritania, Mexico, Morocco, Namibia, Norway, Panama, Russian Federation, Senegal, St. Vincent and the Grenadines, Syria, Tunisia, Turkey, United States, and Venezuela.	Japan
-3- Temperate tunas, South	Belize, Brazil, China (P.R.), European Union, Japan, Korea (Rep.), Namibia, Panama, Philippines, South Africa, United States and Uruguay.	South Africa
-4- Other species	Algeria, Angola, Belize, Brazil, Cabo Verde, Canada, China (People's Republic), Côte d'Ivoire, Egypt, Equatorial Guinea, European Union, France (St. Pierre & Miquelon), Gabon, The Gambia, Guatemala, Guinea Bissau, Guinea (Rep.), Honduras, Japan, Korea (Rep.), Liberia, Libya, Mauritania, Mexico, Morocco, Namibia, Nigeria, Norway, Panama, Sao Tomé & Principe, Senegal, Sierra Leone, South Africa, St. Vincent and the Grenadines, Trinidad and Tobago, Tunisia, Turkey, United States of America, Uruguay, and Venezuela.	Brazil

SUBSIDIARY BODIES OF THE COMMISSION

	Chair
STANDING COMMITTEE ON FINANCE & ADMINISTRATION (STACFAD)	H. A. ELEKON, Turkey (since 21 November 2017)
STANDING COMMITTEE ON RESEARCH & STATISTICS (SCRS) Sub-Committee on Statistics: G. DÍAZ (United States), Convener Sub-Committee on Ecosystems: A. DOMINGO (Uruguay), A. HANKE (Canada), Conveners	G. MELVIN, Canada (since 5 October 2018)
CONSERVATION & MANAGEMENT MEASURES COMPLIANCE COMMITTEE (COC)	D. CAMPBELL, United States (since 25 November 2013)
PERMANENT WORKING GROUP FOR THE IMPROVEMENT OF ICCAT STATISTICS AND CONSERVATION MEASURES (PWG)	N. ANSELL, European Union (since 21 November 2017)
STANDING WORKING GROUP TO ENHANCE DIALOGUE BETWEEN FISHERIES SCIENTISTS AND MANAGERS (SWGSM)	R. DELGADO, Panama (since 21 November 2017)

ICCAT SECRETARIAT

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FOREWORD

The Chairman of the International Commission for the Conservation of Atlantic Tunas presents his compliments to the Contracting Parties of the International Convention for the Conservation of Atlantic Tunas (signed in Rio de Janeiro, May 14, 1966), as well as to the Delegates and Advisers that represent said Contracting Parties, and has the honor to transmit to them the ***"Report for the Biennial Period, 2018-2019, Part II (2019)"***, which describes the activities of the Commission during the second half of said biennial period.

This issue of the Biennial Report contains the Report of the 26th Regular Meeting of the Commission (Palma de Mallorca, Spain, 18-25 November 2019) and the reports of all the meetings of the Panels, Standing Committees and Sub-Committees, as well as some of the Working Groups. It also includes a summary of the activities of the Secretariat and the Annual Reports of the Contracting Parties of the Commission and Observers, relative to their activities in tuna and tuna-like fisheries in the Convention area.

The Report is published in four volumes. ***Volume 1*** includes the Proceedings of the Commission Meetings and the reports of all the associated meetings (with the exception of the Report of the Standing Committee on Research and Statistics-SCRS). ***Volume 2*** contains the Report of the Standing Committee on Research and Statistics (SCRS) and its appendices. ***Volume 3*** includes the Annual Reports of the Contracting Parties of the Commission. ***Volume 4*** includes the Secretariat's Report on Statistics and Coordination of Research, the Secretariat's Administrative and Financial Reports, and the Secretariat's Reports to the ICCAT Conservation and Management Measures Compliance Committee (COC), and to the Permanent Working Group for the Improvement of ICCAT Statistics and Conservation Measures (PWG). All Volumes of the Biennial Report are only published in electronic format.

This Report has been prepared, approved and distributed in accordance with Article III, paragraph 9, and Article IV, paragraph 2-d, of the Convention, and Rule 15 of the Rules of Procedure of the Commission. The Report is available in the three official languages of the Commission: English, French and Spanish.

RAÚL DELGADO
Commission Chairman

REPORT OF THE STANDING COMMITTEE ON RESEARCH AND STATISTICS (SCRS)
(Madrid, 30 September-4 October 2019)

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REPORT OF THE
2019 STANDING COMMITTEE ON RESEARCH AND STATISTICS (SCRS)

(Madrid, Spain – 30 September to 4 October 2019)

1. Opening of the meeting

The 2019 Meeting of the Standing Committee on Research and Statistics (SCRS) was opened on Monday, 30 September, at the Weare Chamartín Hotel in Madrid by Dr Gary Melvin, Chair of the Committee. Dr Melvin welcomed all the participants to the annual meeting.

The ICCAT Executive Secretary, Mr. Camille Jean Pierre Manel, addressed the meeting and welcomed all the participants to Madrid. He noted that 2019, as with previous years, has been very busy for both the SCRS and the Secretariat, with many ICCAT scientific meetings being held during the year. He then reiterated that the Secretariat is always committed to assisting the SCRS in its work and expressed his certainty that the work during the week would meet the high expectations of the Contracting Parties. He congratulated all the scientists and the Secretariat staff who contributed to the work of the SCRS throughout 2019. Finally, the Executive Secretary reminded the Committee of his note from 2018, when he noted the fact that under the current increasing complexity and number of requests from the Commission, it would be important for the Committee to discuss other ways to organize its work in such a manner that would reduce the current workload of scientists and the Secretariat. Mr. Manel expressed his expectation to hear some news in this regard during the meeting, as the current workload for the Secretariat is not in line with the available human resources. In addition, Mr. Manel put forward a number of possible solutions for the SCRS to address his concerns, such as: i) reduction the number of SCRS meetings; ii) SCRS documents and data to be provided according to the deadlines established by the SCRS; and, iii) improve coordination within the different Species/Working Groups to enhance intersessional work. The Opening Address of the Executive Secretary is attached as **Appendix 1**.

The Chair of the SCRS, welcomed the Executive Secretary and thanked him and the Secretariat for their cooperation and work throughout 2019 and their permanent support for the SCRS.

2. Adoption of Agenda and arrangements for the meeting

The Tentative Agenda was revised and adopted with minor changes (**Appendix 2**). Full assessments were carried out this year on white marlin (WHM) and yellowfin tuna (YFT), and an update on the projections was conducted for the shortfin mako shark. Additionally, intersessional meetings were held for small tunas (SMT) and swordfish (SWO), the Sub-committee on Ecosystems and the Working Group on Stock Assessment Methods (WGSAM). Additionally, several meetings of the bluefin tuna MSE technical group were also held, as well as a intersessional meeting of Panel 2 that involved a high number of SCRS delegates.

The following scientists served as rapporteurs of the various species sections (agenda item 9) of the 2019 SCRS Report.

YFT - Yellowfin tuna	S. Cass-Calay
BET - Bigeye tuna	D. Die
SKJ - Skipjack tuna	J. Amandé (East), P. Travassos (West)
ALB - Albacore	H. Arrizabalaga (Atlantic), J. Ortiz de Urbina (Med.)
BFT - Bluefin tuna general	G. Melvin (Coordinator), J. Walter (West), A. Gordoa (East)
BIL - Billfishes	F. Ngom Sow
SWO - Swordfish	R. Coelho (Coord. and North), D. Parker (South), G. Tserpes (Med.)
SMT - Small tunas	F. Lucena-Frédou
SHK - Sharks	E. Cortés
SBF - Southern bluefin	

The Secretariat served as rapporteur for all other Agenda items.

3. Introduction of Contracting Party delegations

The Executive Secretary introduced the 30 Contracting Parties present at the 2019 meeting: Algeria, Brazil, Cabo Verde, Canada, China (P.R.), Côte d'Ivoire, Egypt, El Salvador, European Union, Gabon, Ghana, Honduras, Japan, Korea (Rep.), Liberia, Mauritania, Mexico, Morocco, Namibia, Nicaragua, Nigeria, Norway, Russian Federation, Senegal, South Africa, Tunisia, Turkey, United Kingdom (O.T.), United States and Uruguay. The List of Participants at the Species Groups Meetings and the Plenary Sessions is attached as **Appendix 3**.

4. Introduction and admission of observers

Representatives from the following Cooperating non-Contracting Party, Entity, or Fishing Entity (Chinese Taipei), inter-governmental organizations (Commission sous-régionale des pêches sub-regional fisheries – CSRP, Food and Agricultural Organization – FAO) and non-governmental organizations (Federation of Maltese Aquaculture Producers – FMAP, International Seafood Sustainability Foundation – ISSF, Marine Stewardship Council – MSC, Pew Charitable Trusts – PEW, The Ocean Foundation, The Shark Trust and World Wild Fund – WWF) were admitted as observers and welcomed to the 2019 meeting of the SCRS (see **Appendix 3**).

5. Admission of scientific documents

The Secretariat informed the Committee that 179 scientific papers and 77 scientific presentations had been submitted to the 2019 intersessional meetings. In 2015 a deadline of seven days before the beginning of the species groups meetings was established for submitting the full documents. The objective of this deadline is to facilitate the work of the rapporteurs in preparing the meeting. Taking into account the limited time that the groups have to complete their work, adherence to deadlines greatly contributes to improving the work of the SCRS.

Besides the scientific documents, there are 12 reports of intersessional and regular species groups meetings, 45 Annual Reports from the Contracting Parties, and non-Contracting Cooperating Parties, Entities and Fishing Entities, as well as various documents by the Secretariat. The List of SCRS Documents and Presentations is attached as **Appendix 4.**

6. Report of Secretariat activities on research and statistics

The Secretariat summarized its activities, data reported, publications, website updates, and other information contained in the 2019 Secretariat Report on Research and Statistics related to fisheries and biological data submitted for 2018, which included revisions to historical data. The activities and information included in this report refer to the period between 1 October 2018 and 16 September 2019 (the reporting period).

Regarding the activities conducted by the Secretariat in the most recent years, in addition to the normal activities on statistics, publications, data funds management and others, the Secretariat dedicated a lot of additional work to the preparation and attendance of the SCRS meetings. Moreover, it participated extensively in stock assessment activities, and conducted extensive work related to coordination and management of external support to the SCRS data collection and research programmes and activities. The Secretariat's participation in these programmes mainly consisted in both administrative and scientific support, including the coordination of research proposals, calls for tenders, database management, fund administration, and oversaw auditory and accounting responsibilities, as well as IT support for each programme. As in the past, during 2019 the Secretariat actively participated in all data collection and research programmes components. Finally, the Secretariat highlighted the effort being made on the supervision and partial contribution to the development of the ICCAT Integrated Online Management System (IOMS), a system designed to manage online all the ICCAT data requirements in the future. This is a long-term project intended to replace entirely the current ICCAT data reporting system. Two new senior software developer experts, were hired for one year to work full-time on the IOMS implementation.

A total of 58 ICCAT CPCs (53 Contracting Parties (CP), plus five Cooperating non-Contracting Parties, Entities, Fishing Entities (NCC)) have reporting obligations to ICCAT. For statistical purposes, this corresponds to a total of 76 flag related CPCs (51 CP + 1 CP [16 EU Member States] + 1 CP [4 UK Overseas Territories Member States] + 5 NCC) who have reported information to ICCAT in recent years. The term "flag CPC" was adopted here to refer to those 76 flags. The Secretariat reiterated to the CPCs the Commission's requirement of using the most recent standard electronic forms for data submission and complete all the information requested.

The Secretariat has continued the series of periodic publications developed throughout the history of ICCAT, which includes: 75 (issues 6 to 8) and volume 76 (already published 6 issues) of the *ICCAT Collective Volume of Scientific Papers*; *Part I of the Biennial Period 2018-2019*, corresponding to Volume I (Commission meeting report), Volume II (SCRS Plenary meeting report), Volume III (Annual Reports) and Volume IV (Secretariat reports); and Volume 45 of the Statistical Bulletin. The Secretariat continued to work on developing processes which facilitate editing work undertaken by the Secretariat to maintain the current quality standard of the publications. A new template for authors of ICCAT Collective Volume of Scientific Papers has been made available.

In June 2018, the Secretariat concluded the development and released the new ICCAT web site, which uses HTML5 technology and CSS3 style. With a new structure, the ICCAT web site can be accessible and can be used in a more user-friendly mode from different mobile devices, tablets and portable computers. A search engine for ICCAT documents is being developed for the webpage in 2019.

In 2012, the SCRS approved a protocol to use the Data Fund and other ICCAT funds. This protocol defines a broad structure for use of the funds which includes improvement of statistics, training and support of SCRS work, including attendance at meetings. The protocol also includes the criteria to be followed for allocation of funds. In 2019 the funds managed by the Secretariat have been used in support of the following SCRS activities:

- Participation in SCRS meetings: 58 scientists from Algeria, Brazil, Cabo Verde, Côte d'Ivoire, Egypt, Gabon, Ghana, Liberia, Mauritania, Mexico, Namibia, Nigeria, São Tomé and Príncipe, Senegal, Sierra Leone, Tunisia, Uruguay and Venezuela, were funded to attend SCRS scientific meetings.

- Improvement of statistics: Training course to build the capacity of data collection in the industrial and artisanal fisheries in Gabon, Namibia (to be held in November 2019) and Angola (to be scheduled) and rebuilding of the statistical and fisheries data collection system in Liberia (supported by JCAP); Capacity building courses aiming to enhance participation of managers in MSE processes - training workshops in MSE development to be conducted in the margins of the 2019 Annual meeting of the Commission.

- SCRS activities funded the following:
  - Short-term contract for ICCAT collection of biological samples for the study of growth of billfish in the eastern Atlantic;
  - Short-term contract on Atlantic blue marlin Gulf of Mexico reproductive biology study (to be signed);
  - Short-term contract for ICCAT SMTYP for the biological samples collection for growth, maturity and genetics studies;
  - Short-term contract for ICCAT swordfish biological samples collection for growth, reproduction and genetics studies;
  - Short-term contract for modelling approaches: support to ICCAT North Atlantic swordfish MSE process;
  - Short-term contract for Mediterranean swordfish data recovery;
  - Swordfish workshop on sampling and processing protocols aiming at growth and reproduction studies;
  - Short-term contract for the addition of swordfish distribution model to the longline simulator study (contract expected to be signed soon);
  - Short-term contract for improvement of the North Atlantic albacore management strategy evaluation (MSE) framework;

- Collaborative analysis using longline operational data to standardized Atlantic yellowfin tuna CPUE indices;
- Electronic PSAT tagging of Atlantic swordfish, northern albacore and Atlantic pelagic sharks;
- Study on genetic stock structure of shortfin mako shark based on mitochondrial analysis;
- Study on the reproduction of northeastern Atlantic porbeagle;
- Experts workshop to evaluate the impact of fishing on seabirds;
- Attendance of intersessional SCRS meetings (e.g. seabird expert).

The ICCAT-Japan Capacity-Building Assistance Project (JCAP) has been dedicated to assisting developing CPCs to effectively implement ICCAT measures including those related to the monitoring, control and surveillance of tuna fishing activities as well as the improvement of data collection, analysis and reporting. In 2019 JCAP supported training courses to build the capacity of data collection onboard industrial vessels fishing for tropical tunas in Gabon and longliners in Namibia (to be held in November 2019). Another training course is planned for Angola on the collection of fisheries and biological data from the local artisanal fisheries. The rebuilding of the statistical and fisheries data collection system in Liberia has also been supported by JCAP, as well as the GBYP scientific activities in Africa (e.g. biological sampling, otolith and genetic analysis and development of tagging expertise for bluefin tuna).

Discussion

The Committee noted its appreciation for the efforts of the Secretariat in managing all this information and making it available to the SCRS and ICCAT in general. Several questions arose after the presentation. These included three important observations/questions: i) Concern about data incompleteness and how to improve the quality and completeness of the information on fleet characteristics (form ST01-T1FC), ii) what was the quality of the information on FADs reported on form ST08, and iii) on if the proposed form for the National Observer Program data could be used in order to estimate undersized discards (with a focus on Mediterranean swordfish stock). The Secretariat responded that:

i. This form collects information on active vessels from previous years (registered vessels are on the ICCAT positive list). Active vessels in a year, can be characterized with an indicator of effort to differentiate them from registered ones. For instance, higher completeness can be achieved by requesting historical omissions.

ii. Due to the variable nature of the form and reporting, the data provided are not fully comparable between CPCs. It is expected that the new adopted form (ST08) will facilitate the submission of these data by all CPCs involved in tropical tuna fisheries.

iii. The data collected in the National Observer Program had information on the proportion of fish in the catch that were undersized that could be used to scale up the total number of undersized discards provided that the size data reported were representative and complete. It was noted that the provision of size data in the ST09C subform is optional. Those CPCs that decide not to provide this information should indicate this to the Secretariat. It was noted that ST01 also has place to report undersized discards.

The Committee discussed how the observer data could be used to estimate undersized discards in a way that could be used for stock assessment. Several options were discussed, including having CPCs make these estimates using their own observer data and submit the estimates or alternatively having the Secretariat make these estimates based on the data reported in National Observer Program data.

It was noted that debates about the use of National Observer data have taken place for a long time with particular regard to low reporting rates and data privacy issues. In that (long) time, there has been little progress resolving them. It was proposed that the SCRS provide the Commission options on paths forward including what would be analysed using these data, for what purpose, and which parties (Secretariat and/or individual CPCs) would be responsible for doing these analyses. At this point in the discussions, the Committee did not agree to any resolution or proposals.

In relation to the IOMS implementation, the Committee also requested an explanation of the way the IOMS system will handle alerts and notifications. The Secretariat explained that the IOMS will contain a very flexible notification system (requirement, reminders, alert procedures, etc.) focused on efficiency and transparency.

The SCRS Chair and CPCs welcomed the outcome of the activities carried out this year within ICCAT/JCAP and expressed their gratitude for the support provided by the Government of Japan toward capacity building of the developing CPCs. In response, Japan remarked that taking into account that this project is very much welcomed by the CPCs, and that the five-year term of the JCAP will end in November 2019, they will make effort to develop a new programme (JCAP-2) starting from December 2019 for continuous contribution to developing CPCs. The SCRS and the Secretariat expressed their appreciation to Japan.

7. Review of national fisheries and research programs

In accordance with the Revised Guidelines for the preparation of Annual Reports (ICCAT Ref. 12-13), only information relative to new research programs (Part I of the Annual Report) was presented to the Committee. The Committee considered the need to include information of interest for its work, separating it from the Annual Report which, with its current structure, is more geared to providing information to the Commission on compliance. The Committee reiterated the need to follow the Revised Guidelines for the preparation of the Annual Reports including the Summary Tables.

Algeria

The national catches of tuna and tuna-like species recorded in 2018 are around 528 t for swordfish from a quota of 533.49 t, 1,299.994 t for bluefin tuna including 3,720 kg of dead individuals recorded during the live tuna fishing campaign by tuna purse seiners and 2,073.801 t for small tunas. Catch data have been collected on three species of shark taken as bycatch: around 7.476 t of blue shark (*Prionace glauca)* and 0.902 t of thresher shark (*Alopias vulpinus*). In 2018, 14 Algerian-flagged tuna purse seiners, with a length of between 21.8 m and 40 m, have participated in the live bluefin tuna fishing campaign. This campaign was divided into two (2) joint fishing groups. As a result of these fishing activities, 1,299.994 t of bluefin tuna were caught from an adjusted quota of 1,306 t that had been allocated to Algeria's national fleet, and which includes a quota of 6 t for bycatch. In accordance with legislation and the national regulation, only vessels with a fishing permit are authorised to fish for bluefin tuna. As such, the quota of 6 t has not been fished. 48 dead individuals of bluefin tuna, weighing 3,720 kg, were taken onboard tuna purse seine vessels during the 2018 fishing campaign. Biological information on swordfish (*Xiphias gladius*) has been collected within the framework of the national sampling programme, including sampling for size and weight which has been carried out at landing ports. 476 specimens were sampled for size, which ranged from 85 cm and 250 cm.

Brazil

In 2018, the Brazilian fleet fishing for tunas and tuna-like fish consisted of 434 fishing boats, including about 300 artisanal and small-scale boats. The Brazilian catch of tunas and tuna-like fish, including marlins, sharks and other species of less importance (e.g. wahoo, dolphinfish, etc.) was 50,435.1 t (live weight), presenting a decrease of 7.3% in relation to the catches reported in 2017, when 54,450.6 t were landed. Most of the catches were taken by the handline fishery (23,618.5 t; 46.8%), in associated schools, targeting tropical tunas, mainly YFT (15,159.1 t). The baitboat fishery accounted for the second largest catch in 2018, representing 31.5% (15,880.4 t) of the total tuna and tuna like-fish caught this year, with SKJ being the most abundant species (14,885.9 t). Longline catches reached 8,497.5 t, representing 16.8% of the total, being made up mainly of BSH (2,867.9 t), SWO (2,686.87 t), BET (1,096.15 t), and YFT (831 t). About 51% of all Brazilian catches of tunas and tuna-like fish came from artisanal and small-scale boats (10 to 20 m LOA), based predominantly in the southeast and northeast region and targeting YFT, BET, SKJ, DOL, plus a variety of small tuna species, with various fishing gears, including mainly handline, troll and other surface gears. Support provided by the Secretary of Aquaculture and Fisheries (SAP) of the Ministry of Agriculture, Livestock and Supply (MAPA) to the Scientific Subcommittee of the Standing Committee for the Management of the Tuna Fisheries in Brazil, allowed several scientific activities to be re-established in 2018, such as the collection of biological data, including size distribution of the fish caught and research on the bycatch of seabirds and sea turtles in the longline fishery, including the development of measures to avoid their catches. Research on the bycatch of seabirds and sea turtles in the longline fishery, however, has continued, including the development of measures to prevent these catches.

Canada

In 2018, the Canadian fishing year for bluefin tuna was changed from a calendar year to run annually from June 24 to June 23 of the following year. The adjusted Canadian quota for 2018 was 621.889 t which includes a 73.98 t transfer from Mexico. A total of 480 licensed fishermen were active (i.e. licenses that had landings) in the directed bluefin fishery using rod and reel, handlines, tended lines, electric harpoon and trap nets to harvest 418.4 t. An additional 131.6 t was harvested as bycatch in the pelagic longline fleet in the swordfish and other tunas fishery. There were 4.0 t of observed dead discards in 2018. The swordfish fishery in Canadian waters takes place from April to December. Canada's adjusted swordfish quota for 2018 was 2070.2 t with landings reaching 782.0 t. The tonnage taken by longline gear was 748.2 t while 33.7 t were taken by harpoon. Of the 77 licensed swordfish longline fishermen, 44 were active in 2018. Only 45 of 1,138 harpoon licenses reported swordfish landings in 2018. The other tunas (albacore, bigeye and yellowfin) are at the northern edge of their range in Canada and are harvested from May through October. In 2018, other tunas accounted for approximately 17%, by weight, of the commercial large pelagic species landed in Atlantic Canada. The Canadian Atlantic statistical systems provide real time monitoring of catch and effort for all fishing trips targeting pelagic species. At the completion of each fishing trip, independent and certified Dockside Monitors must be present for off-loading to weigh out the landing, and verify log record data. Canada continues to actively support scientific research such as: the reprocessing of acoustic data from the Gulf of St. Lawrence herring survey for bluefin tuna targets was completed and yielded a new relative (fishery independent) index of abundance that is updated annually. Similarly, the reprocessing of acoustic data from the German Bank (NAFO Area 4X) herring survey for bluefin tuna targets was initiated in 2017 and may yield a fishery independent index of relative abundance in a second region in the near future. Tagging of bluefin tuna that addresses questions related to mixing, migration and the distribution within the Canadian EEZ plus the short term survival and behaviour of BFT caught and released from the Canadian recreational charter fishery; the collection of bluefin tuna otoliths and spines which will contribute to a mixing analysis, diet analysis and lipid analysis. In 2018 Canada helped to establish an international biological sampling research program for swordfish in the Atlantic Ocean aiming to improve the knowledge of the stock distribution, age and sex of the catch, growth rate, age at maturation, maturation rate, spawning season and location and diet. 10 new or updated gender specific length-weight conversions for North and South Atlantic swordfish were produced to support Task I and II data and stock assessment. Canada led this analysis using data from Canada, Portugal and Chinese Taipei. To develop indicators of swordfish stock status in non-assessment years, DFO in 2018 began testing the use of length frequency and animal growth models. These emerging methods will be applied to swordfish data to estimate size at maturity and the spawning potential ratio of the stock for each of the three stocks. For sharks, recent research has been focused on a conventional tagging program for incidental captures of blue, porbeagle and shortfin mako shark caught by charter and recreational fishermen, short-term archival satellite tags were deployed on shortfin mako and porbeagle to assess the post-release mortality associated with the Canadian pelagic longline fleet and the porbeagle abundance index derived from the fixed-station longline survey for large pelagic sharks in 2017 showed no evidence of population increase. Analyses are ongoing to account for changes in oceanic conditions affecting availability of porbeagle to the survey.

China (P.R.)

The Bureau of Fisheries (BOF), Ministry of Agriculture and Rural Affairs of China is in charge of management of distant water fisheries including tuna fishing activities in ICCAT waters. And China Overseas Fisheries Association (COFA) assists BOF with coordination of tuna fisheries activities. China attaches great importance to the ICCAT tuna fishery and priorities were set to abide by the Recommendations and Resolutions adopted by ICCAT. China had set up a series of domestic MCS to implement ICCAT Recommendations by transferring those Recommendations into domestic regulation. China established a monitoring, control and surveillance system, e.g. annual review of each fishing vessel performance, sanction scheme, fishing license system, VMS, logbook, monthly catch report (weekly report for BFT), national observer program, by-catch regulation, CDS and market-related measures, compliance training. We set a catch limit for each vessel on target and by-catch stocks, strictly in accordance with the respective ICCAT Recommendations. Fishing vessels that violate management measures will be subject to severe sanctions, including fines, suspension or termination of fishing license, cancelation of qualification to conduct fishing activities and so on. In addition, China holds meetings at national level each year, in which all companies involved in the tuna fisheries must participate. During the meeting, we circulate the new ICCAT Recommendations that come into force after translating them into Chinese. We also reiterate key compliance issues, such as catch limit, VMS, observer deployment, logbook, by-catch, transshipment and so on. Non-compliance by tuna fishing vessels will be punished. Furthermore, I wish to inform that China is now in the process of revising the Fisheries Law and Distant Water Fishing Management Regulation which will require that fishery development should follow the precautionary approach, and it will also establish a blacklist for vessel owners that violate both domestic and RFMOs measures. Right now the revision process is almost finished and will hopefully enter into force at the end of this year or the beginning of next year. More severe sanctions and fines will be imposed on vessel captains and vessel owners than before. In 2018, we organized a training course for all the Chinese tuna fishing companies regarding the most updated t-RFMO conservation and management measures and to strengthen their compliance capacity and capacity-building. At the beginning of this year, the General Office of the Ministry of Agriculture and Rural Affairs issued a circular titled Circular issued by the General Office of the Ministry of Agriculture and Rural Affairs on further strict compliance with the conservation and management measures adopted by tuna RFMOs, which updated all the conservation and management measures adopted by tuna-RFMOs last year, including measures in relation to vessel registration, logbook, catch limit/quota, fishing area closure and fishing gear restriction, minimum catch size, VMS, by-catch, marine environment protection and access agreements.

Côte d'Ivoire

In 2018, vessels flying the Côte d'Ivoire flag and artisanal vessels landed the total quantities of 2,772.5 t of tuna, 264 t of sharks and 282 t of billfish. The catches for all categories of species have been much lower than those obtained in 2017. Skipjack, yellowfin, Atlantic black skipjack and sailfish are the dominant species and no quota overage has been observed for the different species subject to limitation. Côte d'Ivoire actively encourages its vessels to engage in responsible fishing practices and also closely monitors compliance with recommendations.

Egypt

In the 2019 season, Egypt had one BFT vessel operating actively *SAFINAT NOOH* under ICCAT reg. No. AT000EGY00010 with national registration in the Alexandria area in Alexandria Port. Egypt kept the same strategy of capacity reduction for our tuna fishing vessels. Egypt has completed its 2019 BFT fishing season 2019, according to the Egyptian fishing plan. The 27th edition of the fishing statistical yearbook has been recently published by the General Authority for Resources and Development (GAFRD). Tuna and tuna-like species, mainly *Scomberomorus* spp and *Euthynnus alletteratus*, were caught by purse seiners, longliners and trammel fishing vessels in coastal fisheries within territorial waters. Also swordfish fishing was monitored and recorded small quantities as bycatch taken in territorial waters by the longliners and purse seiners in the coastal area. It is prohibited to catch dolphin and sharks in Egypt. The total catches of tuna-like species in 2013 and 2017 were 1327.508 t and 1808.50 t, respectively.

El Salvador

The Republic of El Salvador has fished in the area of the International Commission for the conservation of Atlantic Tuna (ICCAT) since 2015. El Salvador regulates fishing and aquaculture through implementation of the General Law on Fisheries and Aquaculture Management and Promotion, which was approved by Legislative Decree number 637, and published in Official Daybook Number 240, Volume 353 of 19 December 2001, and has been in force since 26 December 2001. The institution responsible for the fisheries and aquaculture is the Centre for Fisheries and Aquaculture Development, which is a Directorate attached to the Ministry of Agriculture and Livestock. In order to complete the Law on Fisheries, the Regulation on Satellite Control and Monitoring System of Vessels entered into force in November 2018. The purpose of this legal instrument is to fight against illegal, unreported and unregulated fishing. In 2018, four purse seiners engaged in fishing activities, carrying out a total of 38 fishing trips, and taking a reported total catch - according to fishing logbooks - of 26,427 t of tropical tunas, which breaks down as follows: 17,072 t of SKJ, 5,574 t of YFT, 2,634 t of BET, and 1,157 t of frigate tuna (*Auxis thazard*), in 1206 sets. 48.50% of the catches were taken in international waters and 51.50% in the exclusive economic zones of countries that have granted fishing licences to Salvadoran vessels, including: Angola, Cabo Verde, Côte d'Ivoire, Gabon, Guinea-Bissau, Guinea (Rep.), Liberia, Mauritania, Sao Tomé and Prince, and Sierra Leone.

European Union

This report presents the fishing activity performed by the EU fleet in the ICCAT Convention area in 2018.

The EU Member States with fleets actively fishing in the ICCAT Convention area in 2018 were the following: Croatia, Cyprus, France, Greece, Ireland, Italy, Malta, the Netherlands, Portugal, Spain, and the United Kingdom.

The EU fleet is composed of 3,289 commercial vessels. Within the EU, there is a great diversity of active vessels and fleets in terms of vessel length and fishing gears involved in the fishery. The EU fleet uses a wide range of fishing gears including purse seine, longline, pole-and-line, handline, mid-water trawl, troll, baitboat, trap, harpoon, and sport and recreational fishing gears.

Most of the species and stocks regulated by ICCAT are targeted by the EU vessels: Atlantic and Mediterranean bluefin tuna (BFT), Atlantic swordfish, Mediterranean swordfish (Med-SWO), tropical tuna (skipjack, yellowfin and bigeye tuna), Atlantic albacore, Mediterranean albacore, blue and white marlins, sharks and small tuna species (bullet tuna, Atlantic bonito, frigate tuna, little tunny and dolphinfish). Some of these species are caught as bycatch.

The total reported EU catches for the main species regulated by ICCAT in the Atlantic Ocean and Mediterranean Sea amounted to 251,802 t in 2018. Compared to the previous year (250,845 t), the amount remains roughly the same (1% decrease). Nearly 55% of these catches correspond to tropical tunas (yellowfin, bigeye and skipjack), 20% to sharks, and 11% to albacore.

As for ICCAT managed resources, changes in the EU fishing patterns in the ICCAT Convention area were not significant in 2018. SKJ, BSH, YFT, ALB, BET, SWO, and BFT continued to be the most important resources exploited by the EU fishing fleet.

The EU has earmarked financial resources for the funding of studies and research activities in the context of the RFMOs of which it is a member. Research activities related to ICCAT fisheries are also carried out at national level by the EU Member States.

Gabon

At national level, the tuna caught by the local fleet are considered bycatch, since they are not a target species and the volume of catches is low. In 2018, 86.6 t catches of tuna were taken. In addition, despite the absence of tuna fleets, measures have been taken by the fisheries administration to better manage tuna resources. For this purpose, the grant of fishing licenses to foreign purse seiners is essentially subject to a reduction in the number of FADs per vessel and limitation of the number of support vessels. During this year, collection of historical data on national fishing has continued. The fisheries administration has also been involved in the ICCAT research programmes.

Ghana

In reporting year 2018, 37 vessels i.e. 20 baitboats and 17 purse seiners were registered in the ICCAT database. These fleets exploited mainly skipjack, yellowfin and bigeye tuna in the Atlantic Ocean. Other tuna and tuna-like species exploited were Atlantic black skipjack, Atlantic bonito, frigate mackerel and Atlantic sailfish. Total landings in the year were 94,908 t. This comprised 66,786.5 t of skipjack tuna, 24,041.50 t of yellowfin, 3,571 t of bigeye and 1,391 t of other tuna-like species. Purse seiners had a total catch of 82,154 t whilst baitboats had 17,207.50 t. About 85% of the fishing of both fleets were on FADs. The moratorium on fishing on FADs was observed during the months of January and February with no observed infractions. Sampling of fish at port has improved in recent years in addition to more information from logbooks of all fleets. Beach sampling of billfishes continued off the western coastline of Ghana from artisanal drift gill net operators with catches of swordfish and decreased landings of sailfish. No white marline species were observed in 2018, as in 2017. Sharks when caught in purse seiners during observer missions were released live; estimates of sharks from the artisanal fishery were obtained from the western shelf of Ghana. Drift nets are also used in capturing sharks which are consumed locally with no bycatch and discards in the fishery. A five (5) year pilot project (ABNJ-EMS) sponsored by ISSF/WWF and executed by FAO is implementing video footages to help improve observance of fishing activities for prompt analysis for compliance and scientific purposes aimed at effectively managing the tuna fishery.

Honduras

The Republic of Honduras has not carried out any positive fishing activity in the Convention area in the last 5 years, and hence compliance with the obligation to provide data on zero catches and fishing inactivity. Despite entry into force on 25 August 2017 of the new Law on Fisheries and Aquaculture, which enables fisheries management to be adapted to the requirements of modern management practices, given their complex implementation process which has involved professionalisation of the operative and logistic frameworks, at the date of this report, a fleet has not been active in the area of the Commission.

Japan

The Fisheries Agency of Japan (FAJ) has set catch quotas for western and eastern Atlantic bluefin tuna as well as for southern albacore, northern and southern Atlantic swordfish, blue marlin, white marlin, spearfish and bigeye tuna, and has required all tuna vessels operating in the Atlantic Ocean to submit logbook and, for bluefin tuna, daily catch information. All Japanese longline vessels operating in the Convention area are equipped with satellite tracking devices onboard. In accordance with ICCAT recommendations, FAJ has taken necessary measures to comply with its minimum size regulations, time area closures and so on by Ministerial Order. A statistical or electronic catch document program has been conducted for several species (swordfish, bigeye tuna and bluefin tuna). Records of fishing vessels larger than 20 meters in length overall (LSFVs) have been established. One patrol vessel was dispatched to the North Atlantic in 2018 to monitor and inspect Japanese tuna vessels catching bluefin tuna and also observe fishing activities of fishing vessels from other nations. FAJ also inspected landings of Japanese fishing vessels at Japanese ports to enforce the catch quotas and minimum size limits. A prior authorization from FAJ is required in the case that Japanese tuna longline vessels transship tuna or tuna products to carriers at foreign ports or at sea.

Korea (Rep. of)

In 2018, Korea only had a longline fishery for tunas and tuna-like species in the Atlantic Ocean, and data reporting coverage was 100%. 11 Korean longline vessels engaged in fishing in this area, and fishing effort (fishing days) was 1,892 days. Total catch of tunas and tuna-like species was 3,210 t, which is an increase of 13% compared to 2017. The catches of bigeye tuna, yellowfin tuna and bluefin tuna were 623 t (19.4%), 455 t (14.2%) and 208 t (6.5%), respectively. All Atlantic bluefin tuna were caught north of 55°N, and catches of all species except Atlantic bluefin tuna and blue marlin were higher south of 0°S compared to 2017. The incidental catch of seabirds was 56 and for turtles, for 3 individuals. Three satellite tags were used for Atlantic bluefin tuna tagging activity as a part of ICCAT GBYP tagging activities and biological studies. The observer coverage in 2018 was 22% (No. of sets).

Liberia

Nominal catches were reported for the period under review to ICCAT on August 2, 2019. Some management measures have been put in place to ensure proper management of Liberia's tuna fisheries such as: more comprehensive access agreement guidelines for foreign tuna fishing fleets, an effective Monitoring Control and Surveillance Unit, VMS requirement for all tuna fishing vessels and a minimum of 15% observer coverage for all tuna companies and daily reporting of catches and logbook by individual vessel to NaFAA through the Research and Statistics Division.

Mauritania

In Mauritania, high seas tuna species are only targeted by foreign fleets operating under bilateral agreements and free licence arrangements. The fleets of these Contracting Parties, which comprised some 47 tuna vessels in 2018, landed their products in foreign ports. Coastal tuna species were taken as bycatch by small pelagic high seas vessels. According to the statistics, bycatch of high seas tuna taken by the high seas fishery in 2018 amounted to 10,107 t (i.e. a decrease of almost 13% as compared with 2017) and essentially comprised *Sarda sarda* (58%), compared to *Euthynnus* sp (30%) and *Auxis thazard* (12%). Catches landed by the artisanal fishery and coastal fishery increased slightly (16%) in 2018. It should be noted that landings of tuna by purse seine in Mauritania are generally carried out at night, and are not covered by the current monitoring system. A monitoring programme for these fisheries should be envisaged to strengthen data collection on small tunas and tropical tunas during the times not covered by the Artisanal and Coastal Fishery Monitoring System (SSPAC). Finally, several research programmes focussed on the study of some tuna species were launched by the IMROP in 2016 and 2017 with financial support from ICCAT; in particular, a programme to collect available data and information on the presence of bluefin tuna in the area of Mauritania in 2016 and another programme to collect biological data in order to study size structures and growth parameters and to develop approaches to recover catches of these species from 2000 to 2016. Since 2018, the delegation of Mauritania to ICCAT has petitioned ICCAT regarding increased monitoring of the fisheries and bycatch of these tuna species.

Mexico

The report describes the characteristics of the longline yellowfin tuna (*Thunnus albacares*) fishery in the Gulf of Mexico as well as the species that make up the by-catch, while highlighting compliance with national regulations and/or implementation of the recommendations and resolutions adopted by the International Commission for the Conservation of Atlantic Tunas (ICCAT). It should be noted that fishing for yellowfin tuna in the Gulf of Mexico is carried out by midwater longline vessels. In addition to the target species, other species are also taken as bycatch such as: skipjack (*Katsuwonus pelamis*), bigeye tuna (*Thunnus obesus*), Atlantic bluefin tuna (*Thunnus thynnus*), shark and swordfish, among others. The legal framework that regulates this fishery in Mexico includes the General Law on Sustainable Fisheries and Aquaculture (LGPAS), and the Official Mexican Standard NOM-023-SAG/PESC-2014 which governs exploitation of tuna species by longline vessels in waters of Federal Jurisdiction of the Gulf of Mexico and Caribbean Sea, and which is updated periodically for the purpose of incorporating the regulations adopted by ICCAT. The Secretariat of Agriculture and Rural Development (SADER), through the National Commission of Aquaculture and the Fisheries (CONAPESCA) is the national authority in charge of implementing policies, programmes and regulations that facilitate the competitive and sustainable development of Mexico's fisheries and aquaculture sector. For its part, the National Fisheries and Aquaculture Institute (INAPESCA) is responsible for carrying out scientific research and compiling statistics on the longline tuna fishery in the Gulf of Mexico.

Morocco

The tuna and tuna-like species fishery attained a production of 15,680 t in 2018 compared to 9,563 t in 2017, which is an increase in volume of 64%. In 2018, the bluefin tuna quota allocated by ICCAT was fully exhausted. The major species caught off the coasts of Morocco are bluefin tuna, swordfish, bigeye tuna, yellowfin tuna, skipjack tuna, small tunas, and pelagic sharks. Collection of statistical data on fishing and effort is carried out virtually exhaustively through the fisheries administrative structures (Department of Maritime Fisheries and the National Fisheries Office), located along Morocco's Atlantic and Mediterranean coasts. A subsequent control is also carried out by the Exchange Office on exports of fishing products. In terms of science, the National Institute of Fisheries Research (INRH), through its 6 Regional Centres, which cover the entire Moroccan coastline, has strengthened collection of biological data on the major species (bluefin tuna and swordfish). The Regional Centre of the INRH in Tangier coordinates the collection and analysis of all these data. In recent years, monitoring of other species has started, in particular, the tropical species (bigeye tuna, among others), small tunas, and pelagic sharks especially in the areas to the south of Morocco. There has been significant progress in collection of statistical and biological data, as evidenced by the series of scientific papers, and the Task II data, submitted by Moroccan researchers to the different SCRS scientific meetings, for the purposes of tuna stock assessments.

Namibia

Namibia, as a member of ICCAT, strives to fully implement all ICCAT conservation and management measures. Foreign fishing vessels entering Namibian ports are thoroughly inspected to ensure that they have not contravened national laws and regulations of Namibia or those of other States, as well as conservation and management measures adopted by ICCAT and any other RFMOs or International Organization. In addition, monitoring measures are in place to ensure that all products coming from licensed tuna fishing vessels, when entering or leaving Namibia, are accompanied by the necessary documents. In 2018, Namibia continued to undertake research on all ICCAT species caught by boats operating in Namibian waters. Data obtained from log sheets supplied to fishing vessels, as well as data collected by Fisheries Inspectors deployed at all landing points and those data collected by Fisheries

Observers onboard fishing vessels were analysed and the results were submitted to ICCAT in July 2019 (Task I and Task II). The landings for some species, namely, albacore (ALB), bigeye tuna (BET), shortfin mako (SMA), Longfin mako (LMA), blue shark (BSH), and oil fish (OIL) have significantly decreased in 2018, while those of swordfish (SWO), have increased in 2018 when compared to 2017. Fisheries observers were also deployed on board large pelagic vessels to observe and monitor the activities of fishing vessels at sea and report any violations for possible action to be taken against the offenders. Furthermore, Namibia had deployed Fisheries Inspectors both at sea onboard Fisheries Patrol vessels and in the harbours, to ensure strict compliance with the country's rules and regulations related to the exploitation of marine living resources, including those adopted by Namibia as part of its obligations to RFMOs and International Organizations. Namibia also ratified in June 2017 the FAO Port State Measures agreements.

Nigeria

The tuna fisheries situation in Nigeria remains the same as reported in 2018. Nigeria has not licensed any tuna fishing boat in her territorial waters and Exclusive Economic Zone (EEZ). Nigeria also has no Access Agreement with any country on ICCAT species and other fisheries. All registered vessels in Nigeria are targeting shrimps mainly in the inshore waters. The type of gear deployed is bottom trawling. No tuna quota is allocated to Nigeria. The nominal catches reported are bycatch from the shrimp trawlers. The current status of the tuna fisheries resources in Nigeria is unknown as there is no recent assessment to determine the state of the fisheries. There is a problem of accurate data collection especially from the coastal artisanal fisheries due to insufficient manpower and technical knowledge in area of tuna species identification. Nigeria has reviewed its data collection and reporting procedures with regards to ICCAT requirement. Serious efforts are being made to improve the quality of data collection and reporting procedures from the fisheries inspectors. To that effect our data formats have been redesigned and upgraded to cover the coastal artisanal fisheries sub sector. Nigeria has conservation and management regulations in place for other fisheries such as sharks, sea turtles and other marine mammals. The trawl nets are fitted with Turtles Excluder Devices (TEDs) for the purpose of conserving sea turtles, sea mammals and other endangered species. Other Bycatch Reduction Devices (BRDs) are also installed on shrimp trawl nets. The Catch Certification Scheme is being implemented to deter IUU fishing. It is mandatory for all fish and fisheries products caught in the marine waters for export to other countries to be backed by Catch Certificates. The Vessel Monitoring System is also in place to check the fishing activities of the inshore shrimping vessels. Shark fining and discarding of fish at sea is prohibited as stipulated in the Nigerian fisheries laws and regulations.

Norway

Norway was allocated a quota of 104 t for eastern bluefin tuna (*Thunnus thynnus*) for 2018. Due to bad weather conditions, the quota was not exhausted. Numerous observations of bluefin tuna were made along the coast and in offshore waters of Norway from 57° N to 76° N from July to December 2018. Norway put a lot of effort into obtaining biological and ecological data and genetic samples from all individual Atlantic bluefin tuna caught in 2018. Norway continues to work on present and historical data related to tuna and tuna-like species and aims to incorporate the data on these species into an ecosystem perspective. Norway participated at Management Strategy Evaluation (MSE) related meetings on bluefin tuna and at the SCRS annual science meeting in 2018.

Russia

Fishery. In 2018 and 2019, a specialized (purse-seine) tuna fishery fleet flying the Russian flag did not carry out any operations. In 2018 trawl vessels caught 1,195 t of 4 tuna species and 364 t of Atlantic bonito as bycatch in the Eastern-Central Atlantic. Trawl vessels caught 47 t of frigate tuna, 130 t of Atlantic black skipjack, 59 t of oceanic skipjack and 209 t of Atlantic bonito as bycatch in the South-East Atlantic.

In the first half of 2019, trawl vessels caught 183 t of 4 tuna species and 97 t of Atlantic bonito.

Research and statistics. In 2018 observers of the Atlantic branch of VNIRO (AtlantNIRO) collected biological and fishery materials on tuna species onboard trawl vessels in the Eastern-Central Atlantic (area SJ71 according to the ICCAT classification). Fish length and weight were measured, fish sex, gonads maturity stages and degree of stomach fullness were determined. Species of the small tunas group occurred in trawls as bycatch, from one individual specimen or up to a few tons. Material was collected from frigate tuna, bullet tuna, Atlantic black skipjack, oceanic skipjack and Atlantic bonito for weight measurements (5,249 specimens) and biological analyses (2040).

Implementation of ICCAT conservation and management measures. In the trawl fishery, in the areas where tuna and tuna-like species occurred in the catches as bycatch, the ICCAT requirements and recommendations concerning compliance with restrictions on the tuna fishery and the ban on fishing for quoted species were applied.

Senegal

In 2018, the Senegalese industrial tuna fleet fishery comprised six (6) baitboat vessels and seven (7) purse seiners that exploited mainly Atlantic tropical tunas, in particular yellowfin (*Thunnus albacares*), bigeye (*Thunnus obesus*) and skipjack (*Katsuwonus pelamis*), and six (6) longline vessels and three (3) small cord boats targeting swordfish. However, part of the artisanal fisheries using fishing gears such as handline, troll, purse seine and nets, catch billfish (marlins and sailfish), small tunas (Atlantic black skipjack, mackerel, Atlantic bonito, frigate tuna, etc.) and shark. In 2018, total catches of tropical tunas taken by Senegalese baitboats and purse seiners amounted to some 36,118 t. The total catch of the six (6) Senegalese baitboats is estimated at 1,542 t in 2018 (3,349 t in 2017), with 1,086 t of skipjack, 290 t of yellowfin, 240 t of bigeye, and 8 t of frigate tuna. Catches of tropical tunas taken by Senegalese purse seiners are estimated at 34,574 t (28,702 t in 2017), with 87% made off floating objects (FADs). The fishing effort deployed in 2018 by the industrial tuna fleets was 787 fishing days and 915 days at sea for baitboats, and 1,543 fishing days and 1,590 days at sea for Senegalese purse seiners. The total catch of all species combined of the fleets targeting swordfish amounted to 183 t in 2018, with 92 t of swordfish taken by longliners and 44 t by small cord boats using line. It should be noted that there has been a 56% decrease in catches, compared to 2017 (375 t). For the artisanal small tunas and associated species fisheries, catches are estimated to be 6,546 t i.e. an increase of 22% compared to 2017 (5,346 t).

South Africa

South African large pelagic fisheries comprise a baitboat fleet (tuna pole-line) and a pelagic longline fleet (large pelagic longline). In 2018, the baitboat fleet comprised 92 active vessels of an average length of 16 m overall (LOA). The total baitboat effort of 3,751 catch days within the ICCAT Convention area represents an increase of 23% compared to 2017 and also resulted in an substantial increase in albacore catches to 2353 t (+43%), while yellowfin tuna increased very little to 235 t (+3%). In 2018, 15 active longline vessels fished in the Atlantic. These were exclusively South African flagged vessels, with all three active joint-venture (Japanese) vessels having fished exclusively in the Indian Ocean since 2014. After having seen a notable increase from 924 thousand hooks in 2016 to 1,380 thousand hooks in 2017, effort has increased further to 1,537 thousand hooks in 2018. The 2018 longline catches of swordfish (189 t), yellowfin tuna (147 t), bigeye tuna (269 t) and blue shark (403 t) were very similar to 2017, whereas albacore (220 t) increased by 50% and shortfin mako shark (244 t) decreased further by around 20%. Strategies to reduce shark targeting to direct effort towards improved tuna and billfish catch have been included in the Large Pelagic Longline Fishery Policy and the measures have been implemented since January 2017. In 2018, the number of observed trips could be further increased to 24 trips, while total observer coverage of hooks set remained similar to 2017 (8.4%) due to a higher proportion of trips covering also smaller vessels with typically less sea days. South African government scientists are working independently and in collaboration with scientists from other CPCs and NGOs to carry out research related to large pelagic fisheries. Key research activities in 2018/2019 included collaborations on modelling bird bycatch rates from observer data and collaborative work on additional ICCAT stock assessment applications of the Bayesian Surplus Production modelling software 'JABBA'.

Tunisia

The tuna and tuna-like management and conservation plans are essentially governed by the provisions of Law No. 94-13 of 31 January 1994 and its implementing texts. In 2018, as for previous years, these plans were supported by implementation of all the control programmes (onboard observer programme) and the at-sea and in-port inspection programmes, in particular, during the periods of prohibition on fishing for bluefin tuna and swordfish. In preparation for the 2018 bluefin tuna fishing campaign, Tunisia adjusted its fishing capacity in accordance with the methodology adopted by ICCAT (Recs. 14-04 and 17-07). Based on this methodology, Tunisia established a fishing plan, allocating individual quotas to 37 vessels to fish for bluefin tuna in 2018. In this context and within the framework of improvement of collection of bluefin tuna catch statistics and monitoring of implementation of action taken to mitigate bycatch and discards in the tuna and swordfish fisheries, the competent authority, in addition to catch documentation, has attained a scientific observer coverage of 5% of the tuna and artisanal fisheries. Allocation of quotas for bluefin tuna fishing and fine-tuning of gears targeting swordfish have greatly reduced bycatch; in 2018, there was no bycatch of sea turtles, sea birds or sea mammals reported by the national and scientific observers programme. Total catches of bluefin tuna in 2018 amounted to 2,102.93 t, with 2,092.043 t taken by purse seine vessels authorised to fish for bluefin tuna. Regarding its contribution to the scientific research programme, Tunisia carries out different research activities on bluefin tuna, swordfish and small tunas. These activities are defined taking into account ICCAT recommendations and SCRS priorities.

Turkey

The amount of total catch of marine species of Turkey was 314,093.8 t during the year 2018. The portion of tuna and tuna-like fish in total catch was 33,652.5 t including Mediterranean swordfish. In 2017, the amounts of catch of bluefin tuna, swordfish, albacore, bullet tuna, Atlantic bonito and little tunny were 1,283.7 t, 427.0 t, 37.8 t, 367.0 t, 30,920.4 t and 616.6 t, respectively. Most bluefin tunas were caught by purse seiners, with an overall length 30-62 meters. Fishing operations were conducted intensively off Antalya Bay in the south of Turkey and in the Eastern Mediterranean region. Catches of bluefin tuna started at the end of May and finished at the end of June. Conservation and management measures on the swordfish and bluefin tuna fisheries as well as farming are regulated by national legislation through notifications, taking into account related ICCAT regulations.

United Kingdom – OTs

The United Kingdom (Overseas Territories) 2018 annual report provides information for the United Kingdom Overseas Territories (UKOTs) of Bermuda, St Helena (including Ascension Island and Tristan da Cunha), Turks and Caicos Islands and the British Virgin Islands. The fishing fleets associated with the UKOTs are small-scale and deploy limited effort compared to other nations. Most fishing is conducted within close proximity to shore, with some activity operating over seamounts within the EEZs. The typical fishing gears utilised are pole-and-line, trolling, rod-and-reel and handlines which reduce issues with incidental capture of non-target bycatch species more typically associated with longline and purse-seine fishing techniques. Catches across the UKOTs were low, with 386 t landed in total (St Helena; 260 t and Bermuda; 126 t). The UKOTs of Turks and Caicos Islands and British Virgin Islands remain interested in developing and diversifying offshore fisheries to support their economic development, but no commercial landings were reported in 2018 for these territories. A successful tagging programme is currently in operation at St Helena. In 2018, 1,993 tunas or tuna-like species have been tagged as part of scientific research to study the movement, growth and habitat use of pelagic species in the St Helena EEZ (under the AOTTP and Blue Belt Program).

United States

Total (preliminary) reported U.S. catch of main tunas (YFT, SKJ, BET, ALB, BFT) and swordfish, including dead discards, in 2018 was 6,104 t, a decrease of about 12% from 6,908 t in 2017. Swordfish catches (including estimated dead discards) decreased from 1,438 t in 2017 to 1,275 t in 2018, and provisional landings from the U.S. fishery for yellowfin tuna decreased in 2018 to 2,700 t from 3,372 t in 2017. U.S. vessels fishing in the northwest Atlantic caught in 2018 an estimated 1,028 t of bluefin tuna, an increase of about 31 t compared to 2017 (997 t). Provisional skipjack tuna landings decreased by about 121 t to 78 t from 2017 to 2018, bigeye tuna landings increased by 85 t compared to 2017 to an estimated 921 t in 2018, and albacore landings decreased from 2017 to 2018 by 135 t to 103 t.

U.S. government (NOAA) and university scientists, working independently or in collaboration (including collaborations with scientists from other CPCs), conducted research in 2018 involving a variety of ICCAT and bycatch species. Such research included larval surveys, the development of abundance indices, electronic and conventional tagging to investigate movements, habitat usage and post-release mortality, and the collection and analysis of biological samples to study topics such as age, growth, stock structure, spawning areas, fecundity, and genetics (including direct estimates of stock size). Additional topics included the influence of environmental factors on distribution and catch rates, and the development of stock assessment models and operating models as part of management strategy evaluations.

Uruguay

In 2018, the Uruguayan tuna fleet did not carry out any activity. So far in 2019 several projects have been submitted to DINARA for inclusion of new vessels in the large pelagic resources fishery. A recovery in the sector is therefore expected at the end of this year. The analysis continued of historical catch and effort statistics of the species of interest to the Commission. A research campaign aimed at large pelagic resources was carried out onboard DINARA's research vessel. During this campaign, the catch was recorded, sampling for size and sex was carried out, biological samples were taken, and the Conventional Tagging Programme and the Satellite Tagging Programme (*Thunnus albacares, Isurus oxyrinchus* and *Sphyrna lewini*) continued. Uruguay participated in the ICCAT AOTTP and SRDCP programmes, tagging tropical tunas and shark onboard of DINARA's research vessel. In addition, experiments were carried out to evaluate bycatch mitigation measures. Uruguay participated in and contributed papers to several SCRS meetings, including the Bigeye Tuna Data Preparatory Meeting, the Intersessional Meeting of the Shark Species Group, and the Intersessional Meeting of the Sub-committee on Ecosystems. The work to control third party vessels in port continued, having started in 2009. Port inspections were carried out to determine which species had been landed, their origin and to control formal aspects of vessel documentation. All ICCAT Recommendations adopted at the 2018 Commission meeting have been implemented into Uruguayan law, and are currently in force through decree.

- Cooperating Non-Contracting Parties, Entities and Fishing Entities

Chinese Taipei

In 2018, the number of our authorized fishing vessels in ICCAT waters was 85, with 56 targeting bigeye tuna and 29 targeting albacore, and the total catch of tuna and tuna-like species was about 27,735 t. Albacore was the most dominant species, which accounted for 44% of the total catch in weight, followed by bigeye tuna with catch accounting for 42% of the total catch. In general, Chinese Taipei fully implemented ICCAT conservation and management measures in 2018. All longline vessels operating in the ICCAT Convention area have been equipped with satellite tracking devices (Vessel Monitoring System, VMS) on board to automatically transmit a message of vessel position to our Fisheries Monitoring Center every 4 hours, and every hour since 30 January 2018. Captains of Chinese Taipei-flagged fishing vessels were required to completely and accurately fill in the catch logbooks and electronic logbooks. In order to comply with the catch limit set by ICCAT, individual quota management was conducted by the Fisheries Agency for Atlantic bigeye tuna, blue marlin and white marlin/spearfish, northern and southern Atlantic albacore and swordfish. The catches of those species were well below catch limits allocated by ICCAT for 2018. Regarding the requirements of ICCAT shark recommendations, Chinese Taipei has taken several measures, including data collection and the prohibition of retaining, transshipping, landing, storing, or selling bigeye, thresher sharks, hammerhead sharks, oceanic whitetip sharks, silky sharks, and North Atlantic shortfin mako. We have carried out a scientific observer program for the tuna fishery in ICCAT waters since 2002. In 2018, 19 observers were deployed on fishing vessels operating in the Atlantic Ocean, and the observer coverage rate was 6.56% and 11.67% for albacore and bigeye tuna fleets, respectively. The research programs conducted by scientists in 2018-2019 included the researches on CPUE standardizations and assessments of yellowfin tuna, white marlin, bigeye tuna, albacore, swordfish and sharks; the impact of climatic change on major tuna stocks; studies of shark bycatch and abundance index; the age and growth of sharks; and the research on incidental catch of ecological related species. The research results were presented at the intersessional working group meetings and regular meetings of the SCRS. As for the reporting obligation, the related statistical information and information required by ICCAT Recommendations was submitted to the ICCAT Secretariat within the required timeframe.

8. Report of intersessional SCRS meetings

The reports of the intersessional meetings held in 2019 were presented.

8.1 Intersessional Meeting of the Bluefin Species Group

The Intersessional Meeting of the Bluefin Tuna Species Group was held in Madrid, Spain, 11-15 February 2019. The main objectives of this meeting were to approve the final set of Operating Models (OMs)[1], to review progress on Candidate Management Procedure (CMP)[2] development, and to provide input to the SCRS Chair on the MSE presentation to the Intersessional Meeting of Panel 2. The Group discussions focused on reviewing the contents and structure of the OMs developed by the Bluefin Tuna MSE Technical Group, including data used for conditioning and Trial Specification Document. Various concerns were raised on the use of data, fleet structure, master index, and unrealistic outcomes in the OMs. Although changes in conditioning the OMs and additional coding activity were conducted, a final set of conditioned OMs was not adopted. The Group developed lists of sensitivity runs and diagnostics for acceptability of OMs, and agreed to conduct further review of input data and evaluation of sensitivity runs intersessionally. Due to time constraints, initial review of CMP results was postponed. The Group prepared a list of priorities of information and materials for the Panel 2 meeting.

Given the delays encountered in the MSE process, the Group adjusted the bluefin MSE roadmap and considered two options for planning the 2021 bluefin tuna TAC advice: (a) to continue with the MSE development process as outlined in the roadmap, and (b) to begin planning for a 2020 bluefin tuna stock assessment. The Group will make a decision on these options at the species groups meeting in September 2019.

The detailed report was presented (Anon. 2019a).

During the Bluefin Tuna Species Group meeting in September, through the work conducted by the Bluefin MSE Technical Group (see Section 8.2), the Group has concluded that it cannot yet recommend a final reference set of OMs. Therefore, it was recommended to move to “option B”, extending the MSE process for another year with a goal of completing the MSE process, and to provide a simple update of the 2017 stock assessment in 2020 as the basis for 2021 TAC advice of East and West stocks (**Appendix 5**).

The Bluefin Tuna Species Group workplan for 2020 is attached as **Appendix 13**.

Discussion

The discussion of this item was made together with that of the following agenda Item 8.2.

8.2 Bluefin MSE Technical Group meetings

In 2018 the SCRS approved a workplan for 2019 that included two meetings of the Bluefin Tuna MSE Technical Group. However, in response to the recommendations from the Intersessional Meeting of the Bluefin Tuna Species Group, an additional meeting of the MSE Technical Group was scheduled for July 2019. All meetings were funded by the GBYP. The main objectives were to propose a final reference set of OMs with acceptable conditioning and to review the progress on CMPs development.

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[1] An Operating Model (OM) is a mathematical–statistical model used to describe the fishery dynamics in simulation trials, including the specifications for generating simulated resource monitoring data when projecting forward in time. Multiple models will usually be considered to reflect the uncertainties about the dynamics of the resource and fishery.

[2] A Management Procedure (MP) is formally specified, and is a combination of monitoring data, analysis method, harvest control rule and management measure that has been simulation tested to demonstrate adequately robust performance in the face of plausible uncertainties about stock and fishery dynamics. CMP refers to a candidate Management Procedure (i.e. proposed but not as yet adopted).

The first meeting was held in Madrid, Spain, February 7-9, 2019, and dealt with the detailed behaviour of OMs reconditioned since the Bluefin Tuna Species Group in 2018. The Group reviewed the outputs of the ABFT MSE R package (version 4.2.15) carefully, and discovered several specific issues including a problem with the code that read in the operating model results to the ABFT MSE R package but not with the operating model code itself. This required revising the plotted results of the OMs brought to the meeting. The corrected outputs were reviewed further during the meeting, and the Group then summarized additional problems of the OMs.

The detailed report was presented (Anon. 2019b).

At the second meeting, held in St. Andrews, Canada, July 23-27, 2019, the Group reviewed the outputs from the revised OMs (version 5.2.4). The Group acknowledged that substantial progress had been made in developing OMs, addressing data and coding issues, and further development of CMPs. However, the Group also identified problems with OMs' selectivity assumptions for several fleets. Despite efforts to revise the OM further during the meeting, satisfactory result could not be obtained in the time available, and further work needed was identified. In consequence, the Group recommended moving to "Option B (Initiate process for stock assessment)" to the bluefin tuna Species Group for developing advice for 2021 TACs and extending the MSE process by one year.

The detailed report was presented (Anon. 2019c).

The third meeting of the MSE Technical Group was held in Madrid, Spain, September 19-21, 2019. The Group reviewed the outputs from the revised OMs (version 5.4.X), and based on recommendations from the second MSE Technical Group meeting. Various investigations were made in conditionings of OMs, and additional OM results were provided during and after the meeting. Major changes on OMs were agreed to incorporate newly developed vectors of the seasonal distribution of spawning fish in western and eastern spawning grounds to reflect better migratory behaviour, and to add one new component in the interim grid for the recent east stock trend. The Group updated a workplan, and lists of further conditioning evaluations and major robustness trials.

The detailed report was presented (Anon. 2019d).

Discussion

The rapporteurs of the Bluefin Tuna Species Group reported on the progress on MSE made in the course of the different intersessional meetings. They also presented the bluefin MSE roadmap, including a proposal for the stock assessment in 2020. The Committee requested the Bluefin Tuna Species Group to consider an additional plan to provide TAC in 2021 and the following years in case the Group is not able to adopt the final reference set of operating models (OMs) at the 2020 April meeting.

The Committee also discussed a number of issues related to the bluefin MSE. These are addressed under item 15.1 of this report.

Finally, the Committee noted that the Intersessional Meeting of the Bluefin Tuna Species Group before the Bluefin Tuna Species Group session in September 2020 is scheduled for 3 days, and that all the discussions above were reflected in the revised roadmap.

8.3 Intersessional Meeting of the Swordfish Species Group

In 2018 the SCRS elaborated a work plan for 2019 that included an intersessional meeting for the Swordfish Species Group, with the major focus on the progress of the swordfish biological and stock structure projects, and the development of the North Atlantic Swordfish MSE process. The meeting was held in Madrid, Spain, between 25-28 February 2019. Several documents were discussed during the meeting related to the development of the work on North Atlantic Swordfish MSE that started in 2018, namely regarding: the reference set of OMs and completing their conditioning; and, beginning testing candidate management procedures. With regards to other work in the swordfish workplan, several documents were presented on: Life history (Atlantic and Mediterranean stocks; PSAT tagging (Atlantic and Mediterranean stocks; Size/Sex distribution study; Weight-length relationships). Finally, the Swordfish Species Group revised the available fisheries indicators for the Mediterranean stock and agreed on the intersessional work to be done aimed at the September meeting of the species group.

The detailed report was presented (Anon. 2019e).

The Swordfish Species Group workplan for 2020 is attached as **Appendix 13**.

Discussion

The Coordinator of the Swordfish Species Group provided a summary of activities completed by the Group in the last year. These included: the main meetings that occurred, data availability and quality for northern and southern swordfish stocks, stock status for these stocks, progress on the swordfish research on biology and stock structure and plans for future sampling activities, progress on Species Distribution Modeling, and progress on MSE.

In addition, the Committee discussed the effects of different (deep and surface) longline fleet types and the importance of being able to discriminate (including the development of new gear codes) between these fleet types for conducting swordfish stock assessment. On this point, the Secretariat noted that a project was initiated two years ago to discriminate these different effort types within Task II (catch-and-effort and size data). It will take some time to complete this initiative and that there were many data still missing. The Committee discussed if the SCRS could provide specific recommendations to submit the data (including observer data) that are missing in order to complete this analysis. By way of response, it was noted that the species composition and set information that are available with the observer program data could help support this work. Further to the matter of data limitation with the more recent data, it was noted that data recovery of historical data of this nature might also improve the assessment and management of the stocks. The Secretariat noted that some type of preliminary results on this will be available by the 2020 SCRS meeting.

The Committee further inquired about why observers are not reporting discards of undersized Mediterranean swordfish. The rapporteur responded that the work could only partially be finished but that the data needed review by the whole species group in a data preparatory meeting. With respect to why observers cannot record undersized fish, the Chair responded that regulations prohibited even catching undersized swordfish. So in theory, undersized fish could not even be brought aboard the vessel. The Committee debated how it was that these undersized fish could not be captured within the 5% tolerance for undersized fish or if the apparent absence of reporting of undersized fish could be explained by changing of fishing practices and the rapporteur noted that unreporting of undersized swordfish could well exceed 5%. The Committee renewed its proposal to the Commission for a change in the recommendation that would allow sampling of these undersized fish.

8.4 Meeting of the ICCAT Working Group on Stock Assessment Methods (WGSAM)

The meeting was held in Madrid, Spain, 8-12 April 2019. The Group discussions focused mainly on Data Limited methods for stock assessment and how to efficiently characterize uncertainty in stock assessment results. The Group recognized that several of the ICCAT species assessed are in "data limited" situations and recommended a series of Data Limited Workshops for robust stock assessments. The Group also discussed updates of the longline simulation study on developing best practices for CPUE standardization and supported the continuation of this study. Furthermore, the Group reviewed and approved the ICCAT score card developed by the Secretariat, and agreed to include in the ICCAT stock assessment software catalogue the Bayesian surplus production model JABBA ("Just Another Bayesian Biomass Assessment"). Finally, the Group reviewed the progress on Management Strategy Evaluation (MSE) Processes ongoing in ICCAT and recommended a common Independent Peer Review team (1-3 reviewers) for all ICCAT species MSE approaches.

The detailed report was presented (Anon. 2019f).

The WGSAM workplan for 2020 is attached as **Appendix 13**.

Discussion

The WAGSAM rapporteur presented the report. The Committee recommends a system/programme of longline data loggers to collect necessary information for the CPUE standardization study (depth of gear, temperature around hook) be established. Data from data loggers could be stored within the ICCAT database capabilities.

In response to a comment regarding the review of the Independent Peer Review reviewing individual MSEs, it was clarified that an Independent Peer Review team would provide advice on the overall ICCAT MSE process and not on individual MSE efforts.

The Committee considered the recommendation from the convener of the Sub-committee of Ecosystems regarding facilitating access to stock assessment results, and it was suggested to store those data in the ICCAT Software catalogue.

The Committee recommended that the WGSAM review methodology and guidelines on how to quantify changes in fishing catchability over time. In response to this question it was noted that this is a very important question that needs addressing. However, it is difficult to directly measure and quantify changing catchability but that it should be explored.

8.5 Shortfin Mako Stock Assessment Update Meeting

The meeting was held at the ICCAT Secretariat in Madrid, Spain, 20-24 May 2019, to respond in part to the requests made by the Commission related to Rec. 17-08, namely to update the projections of future stock status for shortfin mako shark based on the 2017 stock assessment.

The Group reviewed the activities and progress of the Shark Research and Data Collection Programme (SRDCP), including habitat use based on electronic tagging; post-release mortality; genetic analysis of shortfin mako; movements, stock boundaries and habitat use of silky sharks and other species; movements and habitat use of porbeagle; and the 2020 workplan.

The most up-to-date information available in the ICCAT database system (ICCAT-DB) was revised for the three major shark species (BSH: *Prionace glauca*; SMA: *Isurus oxyrinchus*; POR: *Lamna nasus*), namely the fishery statistics data (Task I and Task II) and the conventional tagging data. Additionally, a document on an updated CPUE of the Moroccan longline fishery for shortfin mako and a document on population dynamics parameters for porbeagle in the western North Atlantic were presented.

Several documents were presented and discussed related to examples of diagnostics for Stock Synthesis model fit. The Group combined the Stock Synthesis MCMC projection results from Stock Synthesis run 1 and Stock Synthesis run 3 for making projections. An updated version of Stock Synthesis (Stock Synthesis 3.30 versus version 3.24 used in the 2017 assessment) was used because it had a negligible impact on projection results and because the new version can incorporate changes in size selectivity that can be used to evaluate the effect of size limits on projections. The projection results from the combined models showed that: i) a zero TAC will allow the stock to be rebuilt and without overfishing (in the green quadrant of the Kobe plot) by 2045 with a 53% probability; ii) regardless of the TAC, the stock will continue to decline until 2035 before any biomass increases can occur; iii) to be in the green quadrant of the Kobe plot with at least 60% probability by 2070, the realized TAC has to be 300 t or less; iv) a TAC of 700 t would end overfishing immediately with a 57% probability, but it would only have a 41% probability of rebuilding the stock by 2070. Although there is large uncertainty in the future productivity assumption for this stock, the Stock Synthesis projections show that there is a long lag time between when management measures are implemented and when stock size starts to rebuild.

The Group also reviewed the probability of success of several of the measures contemplated in ICCAT Rec. 17-08 through additional projections. Specifically, alternative TAC, size limit, and live release measures were explored with two tools: Stock Synthesis and the Decision Support Tool (DST). Stock Synthesis projections found that the stock could not reach MSY until 2070 with a TAC of zero tons with or without size regulations, but that the fixed TAC with a size regulation accelerated recovery of the stock. The Group also explored the effect of a live release regulation (through reduction in F) and found that all projection scenarios resulted in population declines until the 2030s regardless of the fixed level of F used and that MSY was only reached by 2070 for the F equal zero scenario. Projections with the DST revealed that if fishers are unable to avoid catching shortfin mako and those discarded have a substantial mortality rate, then it is necessary to greatly decrease the retained catch to allow the stock to rebuild. Size limits and other strategies to release live sharks must be accompanied by a reduction in retained catch. The Group thus concluded that a live release approach may be a way to reduce F if discard mortality rates are low, but other management measures such as reduction of soak time, time-area closures, and safe handling and best practices for the release of live specimens may also be required to further reduce incidental mortality.

The Group also continued to review the effectiveness of potential mitigation measures to reduce by-catch and mortality of shortfin mako in the ICCAT tuna fisheries.

The results of the Areas Beyond National Jurisdiction (ABNJ) porbeagle assessment for the southern Hemisphere was also reviewed. Under other matters, the Secretariat informed the Group of various CITES issues and inquiries related to the shortfin mako.

Finally, the Group drafted the Sharks Species Group workplan for 2020, but agreed to review it during the September species group meeting.

The detailed report was presented (Anon. 2019g). The Sharks Species Group workplan for 2020 is attached as **Appendix 13**.

Discussion

The rapporteur of the Shark Species Group presented the results of the intersessional meeting held in May in Madrid. The rapporteur focused primarily on the shortfin mako projections undertaken at the meeting. He noted that using Stock Synthesis (SS) was essential in order to model the effect of life-history features of the species, how they interact with the fishery through selectivity, and the corresponding lag between the application of management measures and predicted changes in the spawning stock fecundity.

The Committee discussed the workplan and lauded the collaborations that have occurred during the research activities. During that discussion it was noted that one obstacle to sampling could be the non-retention rule, but in response to this, it was noted that ICCAT has a regulation that allows for sampling to be conducted for prohibited sharks (Rec. 13-10). It was also noted that it might be beneficial for the Group to study how individual CPCs have implemented Rec. 17-08; although the rapporteur concurred with this point, he noted that the existing recommendation expires at the end of 2019. It was further noted that there has been great progress on sharks in ICCAT over the years and that an important scientific activity to pursue regarding this recommendation would be to evaluate the efficacy of the measures proposed in it.

It was noted that basic catch statistics are lacking for other "priority shark species" like silky sharks and whether there are plans to address this as part of the Group's workplan in the future. The Chair responded that some reasons why the Group had not done work on these species include that they are non-retention species and listed in Annex II of CITES, which complicates assessment of their status and access to samples, but also that focus on the three main species (blue shark, shortfin mako, and porbeagle) has relegated work on these other species.

It was also noted that given that the fishery mostly catches juveniles and very few adults, especially gravid females, and the lack of knowledge on where reproductive females and adults in general occur, there must still be a proportion of juveniles that reach maturity and reproduce and therefore contribute to recruitment. Also, if the decrease in mature females is related not only to the catch of immature females, but to other unknown reasons, the measures adopted by the Commission, which focus mostly on protecting the immature segment of the stock, may not suffice to recover the reproductive stock.

There were some concerns about the feasibility of attempting a close-kin mark-recapture study for shortfin mako. Given the CITES listing, collecting and returning samples of this species is problematic. Notwithstanding CITES, some other problems include collecting vertebrae for ageing and catching mature females that would allow for defining parent-offspring pairs. By way of response, the SCRS Vice-chair noted that CITES is adopting some measures that might allow for "the transportation into a State of specimens of any species which were taken in the marine environment not under the jurisdiction of any State" (Introductions from the Sea). The Vice-chair noted that he would report back to the Committee once he knows more about these measures. It was further noted that biological work on shortfin mako should continue because there are still gaps in knowledge.

8.6 White Marlin Data Preparatory and Stock Assessment Meetings

The White Marlin Data Preparatory Meeting was held in Madrid, Spain, from 12-15 March 2019. The objective of this meeting was to revise the available catch and size data, as well indices of abundance and other relevant biological and fisheries information intended for the Atlantic white marlin stock assessment in 2019. During the meeting, the models to be used for the assessment were reviewed, including surplus production models and an integrated stock synthesis model. Results of recent activities of the Enhanced Programme for Billfish Research (EPBR) were presented and new specific research recommendations were proposed for upcoming years. Finally, recommendations were made to review the rebuilding plans as regards data on monitoring and controls, to understand how such data can be used in support of the SCRS work.

The detailed report was presented (Anon. 2019h).

The White Marlin Stock Assessment Meeting was held at the Rosenstiel School of Marine and Atmospheric Science, Cooperative Institute of Marine and Atmospheric Studies, University of Miami, in Miami, United States from 10-14 June 2019. The objective of this meeting was to perform an assessment of the Atlantic white marlin stock. Two models were used for the 2019 assessment: Stock Synthesis (SS3) and a Bayesian production model (JABBA). The Group agreed to use a combination of results from JABBA and SS3 to produce the advice on stock status and outlook, as the combination of results would reflect more of the uncertainty associated with the estimates of stocks status. However, the Group noted that catches have exceeded the 400 t TAC in every year since its initial implementation and warns that if catches continue to exceed the TAC, the rebuilding of the stock will proceed more slowly, or be put at risk of further declines.

The detailed report was presented (Anon. 2019i).

The Billfish Species Group workplan for 2020 is attached as **Appendix 13**.

Discussion

The rapporteur of the Billfish Species Group presented the results for the data preparatory and stock assessment of the white marlin intersessional meetings held in March in Madrid, and in June in Miami, respectively. The rapporteur noted the increased participation of scientists from a wider number of CPCs. The stock assessment results indicated that white marlin is currently overfished and fishing mortality has decreased recently to levels below F_{MSY}.

The Committee noted the significant decrease of catches for both white marlin and blue marlin as reported in Task I, and enquired as to the reasons for the reductions in major fisheries. The implementation in 2019 of high restrictions on quotas or non-retention for blue marlin and white marlin was confirmed by CPCs. The Committee noted that albeit management regulations may explain the reductions of catches, the report of discards (live or dead), has not changed significantly in Task I, and it is unclear how fisheries are avoiding or reducing billfish catches, as they are primarily caught as by-catch. The Committee reiterated to CPCs the need to comply with the requirements of submitting annual fisheries statistics including catch and live and dead discard for these species. The Committee also noted the need to improve estimates of mortality of live discards for white marlin and blue marlin, based on scientific research and through national scientific observer programs to have better information of the post-release mortality.

The meaning of "Non-industrial fleets" was inquired about in relation with white marlin fisheries statistics described in the Executive Summary. The Committee agreed to change this term for "artisanal and small-scale fleets", terms more in accordance with the management recommendations from the Commission and the ICCAT Glossary.

With regards to the assessment of white marlin, the proportion of roundscale spearfish (RSP) in relation to the catches of white marlin and the potential impact on the assessment results were enquired about. The growth or size distribution of RSP was also enquired about. The rapporteur informed that the assessment is a combined evaluation for both species, as catch and indices of abundance reflect the combined data of white marlin/RSP. It was pointed out that species identification of RSP from white marlin is very difficult in the field, and that only trained observers or through genetic sampling is it possible to ascertain the species catch composition. It was noted that within the EPBR, biological samples are being collected from several fisheries in the Atlantic, aiming to genetically identify these two species.

The Secretariat informed that few (4) CPCs reported separate catches of white marlin and RSP since 1990, and overall RSP represents a small percent (≤ 5% on average) of the reported catches. The Committee was informed that there are no studies on growth for RSP and very limited information on other biological parameters are available to ascertain the potential impact of this uncertainty on the assessment overall.

Finally, enquiries were made regarding the status and research of other billfish, in particular billfish species in the Mediterranean Sea. The Committee, noting that some billfish species are currently missing from the billfish Executive Summaries, recommended the Group to revise the knowledge and the catch statistics of all billfish species in its next meeting, including the incidental ones, taking into account those mentioned in previous SCRS reports. Furthermore, considering the Billfish Species Group in 2011 and the *Report for Biennial Period 2012-2013, Part I (2012), Vol. 2* mentioning three main species of *Tetrapturus*, the SCRS requires the Group to indicate if the current knowledge and data are sufficient for the assessment of any other spearfish species. While one species (*Kajikia albida*) has been assessed, and the catch tables are available also for *T. pfluegeri*, for the other regular species (*T. belone*, *T. audax*, *T. angustirostris* and *T. georgii*) it is recommended that the catch tables for all species be added to the SCRS report.

The Committee requested the Group to promote research and data compilation for *T. belone*, and to include this activity in the workplan of the Group with a view to future evaluation of the status of this stock.

8.7 Yellowfin data preparatory and stock assessment meetings

The yellowfin tuna data preparatory meeting was held in Madrid, Spain from 22-26 April 2019. The objective of this meeting was to revise the available catch and size data, as well indices of abundance and other relevant biological and fisheries information intended for the Atlantic yellowfin tuna stock assessment in 2019. During the meeting, the models to be used for the assessment were reviewed, including surplus production models, age-structure production models and integrated analysis models (Stock Synthesis), similar to the previous yellowfin tuna assessments, which would capture a range of model assumptions and complexity. Finally, recommendations were made to collate and analyze additional information required for stock assessment.

The yellowfin data preparatory detailed report was presented (Anon. 2019j).

The Atlantic yellowfin tuna stock assessment meeting was held in Grand Bassam, Côte d'Ivoire from 8-16 July 2019. The objective of this meeting was to perform an assessment of the Atlantic yellowfin stock. Three models were used for the 2019 yellowfin stock assessment: production models (MPB and JABBA), and Stock Synthesis (SS3). Substantial revisions made to historical fishery data and new information on life history were applied to the assessment. The models show consistent results in stock status, and it was agreed to combine the results from all models to integrate multiple sources of uncertainty in the management advice provided.

The yellowfin stock assessment detailed report was presented (Anon. 2019k).

The tropical tuna Species Group workplan for 2020 is attached as **Appendix 13**.

Discussion

The rapporteur of the Yellowfin Tuna Species Group presented the results for the data preparatory and stock assessment intersessional meetings held in April in Madrid, and in July in Grand Bassam, respectively. The rapporteur expressed his appreciation to Côte d'Ivoire scientists and personnel from the Fisheries Ministry for hosting the 2019 yellowfin stock assessment meeting and for their excellent logistic and technical support. After the presentation of the yellowfin tuna stock status and assessment results, the Committee acknowledged the excellent work done by the Group, highlighting the importance of the assessment for the ICCAT Commission.

The Committee discussed changes in the modelling approaches and data available between the 2016 and 2019 assessments and how these changes may have led to changes in the management recommendations on yellowfin tuna.

The Committee noted that allocations, fisheries opportunities and other management actions (e.g. seasonal closures) are currently under discussion by the Commission's Panel 1. It was indicated that analyses on the impact of catches on juveniles have been reported in prior years, and the evaluation of alternative management options is part of the tropical tunas workplan for 2020.

The Committee enquired about the updates and modifications of Ghanaian fisheries statistics. The rapporteur indicated that the updates represented a small percent of the overall catches.

In response to a request from the Commission, the Committee agreed to review, in collaboration with the Subcommittee of Ecosystems and the Secretariat, the bycatch impacts from all tropical tuna fisheries, and report in 2020.

8.8 Intersessional Meeting of the Small Tunas Species Group

The meeting was held in Olhão, Portugal, 24-27 June 2019. Substantial revisions of Task I and II were made and new data sets provided for several important fisheries. The Group also reviewed the available and new information on biology and other life-history parameters of small tunas such as stock structure. In addition, an update of the work conducted on Data Poor Methods and related developments on appropriate approaches for future assessments and provision advice related to small tuna stocks were also carried out. The status of the Small Tuna Year Programme (SMTYP) was reviewed, particularly regarding the collection of biological samples aiming growth, maturity and stock structure studies on little tunny (LTA, *Euthynnus alletteratus*), Atlantic bonito (BON, *Sarda sarda*) and Wahoo (WAH, *Acanthocybium solandri*), which were conducted within the short-term contract issued to a consortium of 12 institutions (11 CPCs) by the ICCAT Secretariat. Preliminary results of the research conducted were presented and the priorities that should be taken into account in terms of the specimens and areas to be sampled within the new 2019 short-term contract. Finally, the workplans for 2019 and 2020 drafted, with a particular emphasis on the enhancement of coordination and collaboration between scientists and filling current knowledge gaps on small tunas.

The detailed report was presented (Anon. 2019l).

The Small Tunas Species Group workplan for 2020 is attached as **Appendix 13**.

Discussion

The rapporteur of the small tunas presented the results of the intersessional meetings held in June in Olhão. The rapporteur noted improvements on the collection of samples for growth, maturity, and genetics knowledge, which are essential to improve the data-poor stock assessments. To that end, the Group hopes to run a workshop on growth and reproduction. The rapporteur also highlighted the importance of continuing to fund the SMTYP activities.

The applicability of the Data-Limited catch-based methods was questioned given the weakness of the small tunas Task I series. The rapporteur clarified that the application of such models was required during the 2018 meeting but, after analyzing the results of this exercise, the Group discouraged the use of these methods for the small tuna species. Instead, the Group recommended a workshop on data limited MSE approaches due to the potential as tools for managing data-limited stocks.

It was also questioned how the Group plan to increase the number of tagged WAH as recommended. It was explained that one CP has a target fishery, which would allow the increase the number of WAH specimens tagged within AOTTP.

The Committee thanked the Species Group and noted that it had made significant progress in recent years.

The Executive Summary was adopted with minor changes, as well as the workplan.

9. Executive Summaries on species

The Committee reiterated that in order to achieve a more rigorous understanding of these Executive Summaries from a scientific point of view, the previous Executive Summaries should be consulted, as well as the corresponding detailed reports which are published in the *Collective Volume of Scientific Papers.*

The Committee also pointed out that the texts and tables of these Summaries generally reflect the information available in ICCAT immediately prior to the SCRS plenary sessions, since they were prepared during the meetings of the Species Groups. Therefore, the catches reported to ICCAT during or after the SCRS meeting cannot be included in these Summaries.

9.1 YFT – YELLOWFIN TUNA

A stock assessment for yellowfin tuna was conducted in 2019 using catch and effort data through 2018, although catch reports for 2018 were incomplete at the time of the stock assessment meeting, with 42% of the total catch being estimated using the average of the previous three years, by CPC and gear type. Species composition and catch at size from Ghanaian baitboats and purse seiners has been thoroughly reviewed during the past few years. This review led to new estimates of Task I and Task II catch/effort and size data for the period 1973-2013. Task I and II estimations for the period 2012 to 2018 (Ortiz and Palma, 2019) were updated for the 2019 yellowfin tuna stock assessment. The catch table presented in this Executive Summary (**YFT-Table 1**) has been updated to include these changes.

Readers interested in a more complete summary of the state of knowledge on yellowfin tuna stock status should consult the detailed Report of the 2019 ICCAT Yellowfin Tuna Stock Assessment Meeting (Anon. 2019k). The tropical tunas workplan (**Appendix 13**) includes plans to address research and assessment needs for yellowfin tuna.

YFT-1. Biology

Yellowfin tuna is a cosmopolitan species distributed mainly in the tropical and subtropical oceanic waters of the three oceans. The exploited sizes typically range from 30 cm to 170 cm FL. Juvenile yellowfin tuna form mixed schools with skipjack and juvenile bigeye, and are mainly limited to surface waters, while larger fish form schools in surface and sub-surface waters. Spawning on the main fishing grounds, the equatorial zone of the Gulf of Guinea, occurs primarily from December to April. Spawning also takes place in the Gulf of Mexico, the southeastern Caribbean Sea and off Cabo Verde, although peak spawning can occur in different months in these regions. The relative importance of the various spawning grounds is unknown.

Although the distinct spawning areas might imply separate stocks, or substantial heterogeneity in the distribution of yellowfin tuna, a single stock for the entire Atlantic is currently assumed. This assumption is based upon information such as observed transatlantic movements indicated by conventional tagging and longline catch data that indicates yellowfin are distributed continuously throughout the tropical Atlantic Ocean. Movement rates and timing, migratory routes, and local residence times remain uncertain, but recent tagging activities (e.g. AOTTP) offer insights (**YFT-Figure 1**). In addition, some electronic tagging studies in the Atlantic as well as in other oceans suggest that there may be some degree of extended local residence times and/or site fidelity.

The length at 50% maturity was estimated at 115.1 cm when vitellogenesis was used for the maturity threshold. Lacking additional information about the relationship between fecundity and age/length, the Committee agreed to retain a fecundity schedule based upon length - or weight-at-age at the peak of the spawning season.

A comprehensive set of direct ages was made available from yellowfin tuna sampled in the US Gulf of Mexico and the western Atlantic. Ages up to 18 years were observed using annual otolith increment counts validated using 14C bomb radiocarbon. Preliminary results of the AOTTP OTC validation work also support the annual deposition of otolith increments. A second study of yellowfin tuna captured in the Ascension Islands also observed ages up to 18 years and confirmed that individuals as old as 18 occur outside of the US, and closer to the areas where fishing pressure is higher (e.g. Gulf of Guinea). This information supported a change in maximum age from 11 to 18 years (**YFT-Figure 2**).

New information concerning growth was also available from the Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP). The data suggest that the growth of yellowfin tuna is better estimated using a Richards function than a von Bertalanffy function. Therefore, the age-structured models used that functional shape (**YFT-Figure 3**). The AOTTP data also support the previous conclusion that growth rates are relatively slow initially, increasing at the time the fish leave the nursery grounds.

Tagging studies of yellowfin in the Pacific and Indian Oceans suggest that natural mortality is age-specific, and higher for juveniles than for adults. As was done in the previous assessments of yellowfin and bigeye, an age-specific natural mortality function (e.g. Lorenzen) was developed and applied to the 2019 assessment of yellowfin tuna. The implied natural mortality based on the t_{MAX} of 18 is 0.35 yr^{-1}, which is lower than the 2016 assessment assumption of 0.54 yr^{-1} based on a t_{MAX} of 11 years. (**YFT-Figure 4**). The most recent stock assessment does not consider sex-specific natural mortality or growth, yet there are disparities in average size by gender. Males are predominant in the catches of larger sized fish (over 145 cm), which could result if large females experience a higher natural mortality rate, perhaps as a consequence of spawning. In contrast, females are predominant in the catches of intermediate sizes (120 to 135 cm), which could result from differential growth (e.g. females having a lower asymptotic size than males). Recent results from studies in the Indian Ocean suggest a combination of the two hypotheses.

Younger age classes of yellowfin tuna (40-80 cm) exhibit a strong association with floating objects (FOBs: any type of object that can affect fish aggregation). The Committee noted that this association with FOBs, which increases the vulnerability of these smaller fish to surface fishing gears, may also have an impact on the biology and on the ecology of yellowfin due to changes in feeding and migratory behaviors. These uncertainties in stock structure, natural mortality, and growth could have important implications for the stock assessment. Data collected by Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP) will continue to reduce these uncertainties.

YFT-2. Fishery indicators

Yellowfin tuna have been exploited by three major gears (longline, baitboat and purse seine fisheries) and by many countries throughout its range. Detailed data are available since the 1950s. Overall Atlantic catches declined by nearly half from the peak in 1990 (193,584 t) to 106,288 t estimated for 2013 but increased to an average of 140,143 t during 2016-2018. The most recent catch distribution is given in **YFT-Figure 5**.

In the eastern Atlantic, purse seine catches declined between 1990 and 2007 (129,144 t to 47,961 t) but have subsequently increased to 90,250 t in 2018 (**YFT-Table 1; YFT-Figure 6**). Baitboat catches declined between 1990 (19,717 t) and 2018 (7,255 t). Longline catches, which were 10,253 t in 1990, declined to 5,031 t in 2018. In the western Atlantic, purse seine catches (predominantly from Venezuela) were as high as 25,749 t during the mid-1980s but have since declined to 3,008 t in 2018. Baitboat catches also declined since a peak in 1994 (7,094 t), and for 2018 were estimated to be 943 t. Since 1990, longline catches have generally fluctuated between 10,000 t and 20,000 t.

It is difficult to discriminate fishing effort between free schools (composed of large yellowfin tunas) and FOB fishing (targeting skipjack) in the eastern Atlantic because the fishing strategies can change from one year to the next. In addition, the sea time devoted to activities on FOBs and the assistance provided by supply vessels are difficult to quantify. Nominal purse seine effort, expressed in terms of carrying capacity, decreased regularly from the mid-1990s until 2006. Since that time, several European Union purse seiners have transferred their effort to the eastern Atlantic due to piracy in the Indian Ocean, and a fleet of new purse seiners has started operating from Tema (Ghana), whose catches are probably underestimated. These factors have contributed to the growth in carrying capacity of the purse seiners, which is approaching the level observed in the early 1990s (**SKJ-Figure 9, SKJ-Table 2**). The nominal effort of baitboats has remained stable for over 20 years. By 2010, overall carrying capacity of the purse seine fleet had increased significantly, to about the same level as in the 1990s, and it has increased by nearly 50% since. These estimates do not include all purse seine vessels currently fishing for tropical tunas in the Atlantic. The total number of purse seine vessels (estimated by the Committee) targeting tropical tunas in the eastern Atlantic has increased in the last five years by 18%, from 49 in 2014 to 58 in 2018. FOB based fishing has accelerated even more rapidly than free school fishing.

Numerous changes have occurred in the yellowfin fishery since the early 1990s (e.g. the progressive use of FOBs and the latitudinal expansion and the westward extension of the fishing area). Since 2011, significant catches of yellowfin tuna have been obtained by EU purse seiners south of 15°S off the coast of West Africa (in association with skipjack and bigeye on FOBs). There has also been a significant increase in catches of yellowfin and bigeye by a new Brazilian “vessel associated-school” handline fishery, where the vessel is used to aggregate fish, operating in the western Atlantic. These catches have tripled from 5,200 t in 2013 to nearly 17,000 t in 2017, with a slight decrease to 15,000 t in 2018. Finally, a new strategy of fishing on floating objects off Mauritania (north of 15°N) began in 2012. Catches on floating objects in this area tended to consist almost entirely of skipjack, therefore, effort directed in this manner may have a minimal impact on yellowfin tuna.

Four indices of abundance were used in various stock assessment model runs used to develop management advice (**YFT-Figure 7**). A major advancement in this assessment was the development of a joint longline index using high resolution catch and effort information from the main longline fleets operating in the Atlantic (Japan, US, Brazil, Korea and Chinese Taipei). The indices were developed for 3 regions, but only two were used in the assessment: the North Atlantic (Region 1), and the tropical area (Region 2). A new echosounder-based buoy associated index (BAI) was developed and was assumed to represent the abundance of juvenile yellowfin tuna. An index of larger yellowfin tuna (>80 cm, 10 kg) in free schools for the EU purse seine fleet (EUPSFS index) was also used.

The recent average weight in European purse seine catches, which represent the majority of the landings, had declined to about half of the average weight of 1990. This decline is at least in part due to changes in selectivity associated with fishing on floating objects beginning in the 1990s, which was observed in the increased catches of small yellowfin. A declining trend in average weight and a corresponding increase in the catch of small yellowfin is also evident in eastern tropical baitboat catches. Longline mean weights and catch at size have been more variable.

YFT-3. State of the stock

A full stock assessment was conducted for yellowfin tuna in 2019, applying two production models (JABBA, MPB) and one age-structured model (Stock Synthesis) to the available catch data through 2018. The four Stock Synthesis model runs, were regarded as representing alternative recruitment, and steepness hypotheses. Likewise, the JABBA runs addressed different hypotheses about initial priors for *r*, and about which indices of abundance were representing the population. Finally, the base case selected for MPB estimated biomass and fishing mortality trends that varied somewhat from JABBA. The Group decided that, in order to capture this uncertainty in the population dynamics for developing the management advice, it was best to incorporate results from all of the accepted model runs.

The trend in the estimated biomass (relative to B_{MSY}) for all models shows a general continuous decline through time. Stock Synthesis runs suggest a few periods of large increases in spawning biomass associated with episodes of high recruitment. The model estimates that such very high recruitments have happened three times in the period 1960 to 2017. Production models show much less pronounced increases in total biomass at the equivalent times. Note, however, that for all models there are large uncertainties in the value of biomass at any point in the history, including 2018. Most model runs lead to biomasses at the end of 2018 above the level that produces MSY (**YFT-Figure 8**).

Estimates of historical fishing mortality (relative to F_{MSY}) show similar trends for all models. For most model runs, fishing mortality increased progressively until the early 1980s, it varied in level until the mid-1990s, after which it declined gradually until the mid-2000s. Since the mid-2000s, the fishing mortality has had a generally increasing trend with fluctuations until 2018. Overall the models estimate that the fishing mortality in 2018 was near the fishing mortality that would produce MSY. Again, for all models there are large uncertainties in the value of fishing mortality at any point in the history, including 2018 (**YFT-Figure 9**).

It is important to note that the Stock Synthesis model is the only one used that can provide estimates of recent recruitment (**YFT-Figure 10**). Recruitments were not estimated to vary from the stock-recruit relationship for 2018, due to the large uncertainty in terminal year recruitment estimates. The estimate of recruitment in 2017 is also more uncertain than for previous years, in part because there is no 2018 size frequency data to corroborate or contrast with it. Stock Synthesis models which use the buoy index suggest very high recruitment in 2017, whereas models that do not use the buoy index suggest that recruitment in 2017 was above average but not particularly high.

The Group gave equal weight to surplus production model and integrated assessment model results. Within surplus production models, JABBA and MPB were also given equal weight. Each run within a modeling platform (JABBA, and Stock Synthesis) were also given equal weight. For the combined results (MPB, JABBA, SS) used to develop management advice, the median estimate of B_{2018}/B_{MSY} is 1.17 - and the median estimate of F_{2018}/F_{MSY} is 0.96 -. The median MSY estimated is 121,298 t. Combining the results of all models provides a way to estimate the probability of the stock being in each quadrant of the Kobe plot in 2018 (**YFT-Figure 11**). The corresponding probabilities are 54% in the green (not overfished not subject to overfishing), 21% in the orange (subject to overfishing but not overfished) 2% in the yellow (overfished but not subject to overfishing) and 22% in the red (overfished and subject to overfishing). In summary, the results point to a stock status of not overfished (24% probability of overfished status), with no overfishing (43% probability of overfishing taking place).

The Group cautioned that the differences between the 2016 and 2019 assessment results are not due to stock recovery. In fact, the 2019 models indicate that the stock biomass declined between 2014 and 2018. Instead, the perceived improvement is more likely due to changes in key data inputs (M, growth, indices) and the suite of models applied (JABBA, MPB, SS).

The Group noted that catch reports for 2018 were incomplete, at the time when the assessment was conducted with 42% of the total catch being estimated using the average from the previous three years by CPC and gear type. Furthermore, no size data for 2018 were available at the time of the assessment. The 2018 estimated catch assumed for the stock assessment was 131,042 t. This was revised upwards to 135,689 t after additional reporting, a 3.5% change (there still remains an estimated 5% non-reported catch, for which in general the average of the last three years has been assumed). It was not possible to re-run the stock assessment results with the new 2018 catch estimates, however a change of this magnitude is not expected to have substantial implications.

YFT-4. Outlook

Combined catch projections from 9 runs (JABBA (Base Case, S2, S3, and S5), MPB, Stock Synthesis (runs 1, 2, 3 and 4) were provided at constant catches ranging 0 t and from 60,000 to 150,000 t. The method used to combine the projection results is described in section 4.4 of the detailed report (Anon. 2019k). In the projection results from the Stock Synthesis and JABBA models, some iterations were predicted with exceptionally small biomass ratios and extremely high F ratios indicating the potential for stock collapse. Thus, probability of biomass being less than 20% of the biomass that supports MSY was calculated for each projection year and catch scenario (**YFT-Table 2**). The probability increased with higher catch levels and in later projected years. The probabilities more than 1% or 10% were observed with the constant catch more than 110,000 t or 140,000 t, respectively. The highest probability was 23.3% with 150,000 t constant catch in 2033. It should be noted that the reference chosen, 20% of biomass that supports MSY, was selected for informational purposes and has not been adopted formally by the SCRS for tropical tunas.

The combined projections show that 120,000 t constant catch will maintain more than 50% probability of being in green quadrant through 2033 (**YFT-Figure 12** and **YFT-Table 3**).

YFT-5. Effect of current regulations

Concern over the catch of small yellowfin tuna partially led to the establishment of spatial closures to surface fishing gear in the Gulf of Guinea (Recs. 04-01, 08-01, 11-01, 14-01, 15-01). In previous years, the Committee examined trends on average bigeye tuna catches by areas as a broad indicator of the effects of such closures as well as changes in juvenile bigeye and yellowfin catches due to the moratorium. The efficacy of the area-time closure agreed in Rec. 15-01 was evaluated by examining fine-scale (1°x1°) skipjack, yellowfin, and bigeye catch by month distributions. After reviewing this information, the Committee concluded that the moratorium had not been effective at reducing the mortality of juvenile bigeye tuna, and any reduction in yellowfin tuna mortality was minimal, largely due to the redistribution of effort into areas adjacent to the moratorium area and increase in number of fishing vessels.

Rec. 11-01 (reiterated in Rec. 16-01) also implemented a TAC of 110,000 t for 2012 and subsequent years. During 2012 and 2014, overall catches exceeded the TAC by 3-5%. Since then, overages have increased substantially, to 17% (128,298 t) in 2015, 35% (148,874 t) in 2016, 24% (135,865 t) in 2017 and 23% (135,689 t) in 2018.

YFT-6. Management recommendations

The Group expressed strong concern that catches above 120,000 t are expected to further degrade the condition of the yellowfin stock if they continue. Furthermore, given that significant overages are frequent, existing conservation and management measures appear to be insufficient, and the Committee recommends that the Commission strengthen such measures.

The Commission should also be aware that increased harvests on small yellowfin tuna has had negative consequences to both long-term sustainable yield and stock status (**YFT-Figure 13**), and that continued increases in the harvest of small yellowfin tuna will continue to reduce the long-term sustainable yield the stock can produce. Should the Commission wish to increase long-term sustainable yield, the Committee continues to recommend that effective measures be found to reduce fishing mortality on small yellowfin tuna (e.g. FOB-related and other fishing mortality of small yellowfin tuna).

ATLANTIC YELLOWFIN TUNA SUMMARY

Estimates	Mean (90% confidence intervals)
Maximum Sustainable Yield (MSY)	121,298 t (90,428 - 267,350 t)[1]
2018 Yield	135,689 t
Relative Biomass[2]: B_{2018}/B_{MSY}	1.17 (0.75 - 1.62)
Relative Fishing Mortality: F_{2018}/F_{MSY}	0.96 (0.56 - 1.50)

2018 Total Biomass[3] 729,436 t

Stock Status (2018) Overfished: No[4]
Overfishing: No[5]

[Rec. 16-01]
- No fishing with natural or artificial floating objects during January and February in the area encompassed by the African coast, 20º W, 5ºN and 4ºS
- TAC of 110,000 t (since Rec. 11-01)
- Specific authorization to fish for tropical tunas for vessels 20 meters or greater
- Specific limits of number of longline and/or purse seine boats for a number of fleets
- Specific limits on FADs, non-entangling FADs required

1) Minimum and maximum values of 90%LCI and 90%UCI among all runs by the Stock Synthesis, JABBA, and MPB
2) SSB (Stock Synthesis) or exploited biomass (production models)
3) Mean of the central estimates of the SS, JABBA and MPB models
4) (24% probability of overfished status)
5) (43% probability of overfishing taking place)

YFT-Table 1. Estimated catches (t) of yellowfin (*Thunnus albacares*) by area, gear and flag.

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL			173739	154677	149187	137318	144513	136154	132315	153439	134770	122580	119558	105067	105885	100431	111868	117908	118043	113599	114937	106288	113414	128298	148874	135865	135689
	ATE		125524	119404	116132	104978	113594	104947	96692	113123	105105	97598	88303	75569	77613	76264	93745	99131	97189	94678	91652	82848	88947	102182	114057	100041	104140
	ATW		48215	35274	33056	32341	30919	31207	35623	40317	29665	24982	31255	29498	28272	24167	18123	18777	20855	18921	23285	23440	24468	26116	34817	35824	31549
Landings	ATE	Bait boat	15646	13570	11401	12639	14261	16558	9965	14018	11488	10099	14773	9770	12836	12914	9553	8851	9370	12382	9178	6803	9450	9354	10065	8065	7255
		Longline	14876	13935	14493	10740	13872	13063	11588	7576	5864	9183	11537	7206	7234	13437	8562	7443	5161	6298	5337	5657	4742	4343	4860	4583	5025
		Other surf.	1667	1658	1688	1770	1571	1465	2301	1951	1624	2309	2661	2110	2644	1951	1498	1740	1688	1101	1891	2979	1550	1596	2470	2329	1603
		Purse seine	90276	87732	87737	78334	82401	72079	70787	89191	85808	74702	57798	55429	54152	47126	73123	79674	79102	71875	73373	66076	71803	84898	94971	83847	88643
	ATW	Bait boat	7094	5297	4560	4275	5511	5364	6753	5572	6009	3764	4868	3867	2695	2304	886	1331	1436	2311	1299	1602	513	743	1216	866	943
		Longline	12626	11560	12605	11896	12426	14254	16163	15696	11926	10166	18165	18171	15463	16098	13773	14650	14882	11963	14933	11864	8939	8803	11456	10407	10107
		Other surf.	5465	4907	5107	4459	3826	4900	4838	5107	3763	6445	5004	4826	5667	3418	1392	1417	1806	2381	3754	6336	12431	14234	16809	20419	17487
		Purse seine	23030	13510	10784	11710	9157	6523	7870	13942	7966	4607	3217	2634	4442	2341	2067	1370	2722	2256	3292	3635	2581	2332	5334	4129	3008
Landings(FP)	ATE	Purse seine	3059	2509	813	1495	1488	1781	2051	387	321	1305	1534	1054	747	836	1008	1423	1869	3021	1872	1332	1401	1855	1691	1155	1567
Discards		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6
		Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	137	0	63	40
	ATW	Longline	0	0	0	0	0	167	0	0	0	0	0	0	5	6	5	9	8	9	7	3	3	3	3	3	5
		Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings	ATE CP	Angola	137	216	78	70	115	170	35	34	34	34	34	0	0	23	98	0	0	0	0	0	0	0	0	2	1
		Belize	0	1	0	3	963	0	326	406	0	0	0	0	0	0	0	405	1794	3172	5861	5207	7036	7132	3497	5811	8121
		Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Cape Verde	1943	1908	1518	1783	1421	1663	1851	1684	1953	1868	3236	6019	5648	4568	7905	4638	5856	6002	4603	7513	4507	7823	6990	2756	5498
		China PR	156	200	124	84	71	1535	1652	586	262	1033	1030	1112	1056	1000	365	214	169	220	170	130	20	78	286	346	188
		Curaçao	0	0	3183	6082	6110	4039	5646	4945	4619	6667	4747	24	1939	1368	7351	6293	5302	4413	6792	3727	5152	6140	7905	6535	7543
		Côte d'Ivoire	0	0	0	2	0	0	673	213	99	302	565	175	482	216	626	573	470	385	1481	2077	324	251	315	952	116
		EU.Denmark	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.España	40612	38278	34879	24550	31337	19947	24681	31105	31469	24884	21414	11795	11606	13584	24409	32793	25560	21026	18854	11878	14225	21094	19266	12308	10669
		EU.Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.France	35468	29567	33819	29966	30739	31246	29789	32211	32753	32429	23949	22672	18940	11330	16115	18923	20280	22037	18506	20291	21087	19443	26198	25831	24581
		EU.Ireland	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		EU.Latvia	0	55	151	223	97	25	36	72	334	334	334	334	334	0	0	0	200	143	15	0	0	23	0	0	
		EU.Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**0**
		EU.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.Portugal	126	231	288	176	267	177	194	4	6	4	5	16	274	865	300	990	537	452	355	335	69	76	112	67	133
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	21	22	1	0	0	0	0	**0**
		El Salvador	0	0	0	0	0	0	0	933	0	0	0	0	0	0	0	0	0	0	0	0	0	2750	8252	6227	5553
		Gabon	88	218	225	225	295	225	162	270	245	44	6	2	44	0	1	0	0	0	0	0	0	0	1	3	**0**
		Gambia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Ghana	9984	9268	8182	15087	13850	21450	12673	23845	18546	15839	15444	13019	14037	15570	16521	15858	20252	18501	16470	13921	18939	19659	20218	20398	23160
		Guatemala	0	0	0	0	0	0	0	0	0	2207	1588	2906	5265	3461	3736	2603	3124	2803	2949	4023	3754	5200	2703	3647	2499
		Guinea Ecuatorial	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	892	892	199	0	2	11	9	6	0	8
		Guinée Rep.	0	208	1956	820	0	0	0	0	0	0	0	0	0	0	0	0	298	292	1559	1484	823	0	0	0	
		Honduras	0	4	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	4194	4770	4246	2733	4092	2101	2286	1550	1534	1999	5066	3088	4206	8496	5266	3563	3041	3348	3637	3843	3358	2857	2914	2709	2946
		Korea Rep.	436	453	297	101	23	94	142	3	8	209	984	95	4	303	983	381	324	20	26	97	77	36	356	408	449
		Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	71	89	100	88	76	88	1
		Libya	0	0	0	0	0	0	0	208	73	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Maroc	3017	2290	3430	1947	2276	2307	2441	3000	2111	1675	814	1940	222	102	110	110	44	272	55	137	107	72	115	113	108
		Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Namibia	35	14	72	69	3	147	59	165	89	139	85	135	59	28	11	1	9	90	24	6	15	42	53	53	424
		Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	3	1	0	0	0	0	0	**0**
		Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Panama	12066	13442	7713	4293	2111	1315	1322	626	1112	0	1887	6170	8557	9363	6175	5982	5048	4358	5004	3899	4587	3202	4305	5073	4071
		Philippines	0	0	0	0	126	173	86	0	50	9	68	13	30	88	53	152	89	134	5	56	0	0	0	0	
		Russian Federation	1503	2936	2696	4275	4931	4359	737	0	0	0	0	4	42	211	42	33	0	0	0	0	0	0	0	0	**0**

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		S. Tomé e Príncipe	125	135	120	109	124	114	122	122	122	122	134	145	137	144	160	165	169	173	177	182	186	301	301	266	289
		Senegal	1	94	77	152	248	663	194	279	558	253	589	1106	1347	1071	720	1146	939	1235	1875	1081	603	1883	6850	3988	5029
		South Africa	486	199	157	116	261	320	191	342	152	298	402	1156	1187	1063	351	303	235	673	174	440	1512	925	706	387	389
		St. Vincent and Grenadines	2476	2142	2981	3146	3355	2170	2113	3715	189	56	14	0	101	209	83	74	28	0	0	0	0	0	0	71	**0**
		U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.Sta Helena	150	181	151	109	181	116	136	72	90	158	226	240	344	177	97	104	65	163	149	53	152	178	181	221	199
		Uruguay	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Vanuatu	2357	2357	1130	576	0	228	0	0	0	0	0	24	145	483	450	331	23	10	124	21	0	0	0	0	**0**
		Venezuela	0	0	0	0	0	0	0	0	3612	245	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCC	Chinese Taipei	3851	2681	3985	2993	3643	3389	4014	2787	3363	4946	4145	2327	860	1707	807	1180	537	1463	818	1023	902	927	761	563	550
	NCO	Benin	1	1	1	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cambodia	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cayman Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Congo	14	13	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	238	212	257	269	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Faroe Islands	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (ETRO)	477	1847	0	148	0	0	0	1510	1345	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	2524	2975	3588	3368	5464	5182	3072	2019	43	466	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Seychelles	0	0	0	0	0	0	6	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Ukraine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ATW	CP	Barbados	156	255	160	149	150	155	155	142	115	178	211	292	197	154	156	79	129	131	195	188	218	262	324	270	248
		Belize	0	0	0	0	0	0	0	0	0	0	0	0	143	1164	1160	940	264	42	41	38	33	0	2163	359	623
		Brazil	4169	4021	2767	2705	2514	4127	6145	6239	6172	3503	6985	7223	3790	5468	2749	3313	3677	3615	4639	7277	11645	13643	16682	18362	16381
		Canada	52	174	155	100	57	22	105	125	70	73	304	240	293	276	168	53	166	50	93	74	34	59	19	193	15
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	81	86
		China PR	0	0	0	0	628	655	22	470	435	17	275	74	29	124	284	248	258	126	94	81	73	91	182	232	172
		Curaçao	155	140	130	130	130	130	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	127	107	126	72
		EU.España	7	4	36	34	46	30	171	0	0	0	0	0	1	84	81	69	27	33	32	138	155	105	360	357	239
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	122	456	712	412	358	647	632	403	346	488
		EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0**
		EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	151	60	88	179	260	115	127	92	4	2	0	15	70	505
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	381	91	21
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Grenada	385	410	523	302	484	430	403	759	593	749	460	492	502	633	756	630	673	0	0	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	71	40
		Japan	589	457	1004	806	1081	1304	1775	1141	571	755	1194	1159	437	541	986	1431	1539	1106	1024	734	465	612	462	415	147
		Korea Rep.	0	0	84	156	0	0	0	0	0	0	0	580	279	270	10	52	56	470	472	115	39	11	12	3	6
		Mexico	1093	1126	771	826	788	1283	1390	1084	1133	1313	1208	1050	938	890	956	1211	916	1174	1414	1004	1045	968	1279	1241	1028
		Panama	0	0	0	0	0	5	0	20	28	0	0	0	2804	227	153	119	2134	1126	1630	1995	902	1580	1863	1620	2104
		Philippines	0	0	0	0	36	106	78	12	79	145	299	230	234	151	167	0	0	0	30	72	76	0	0	0	
		St. Vincent and Grenadines	16	43	37	35	48	687	1989	1365	1165	568	4251	3430	2680	2989	2547	2274	854	963	551	352	505	153	434	701	373
		Trinidad and Tobago	120	79	183	223	213	163	112	122	125	186	224	295	459	615	520	629	788	799	931	1128	1141	1179	1057	890	1214
		U.S.A.	8298	8131	7745	7674	5621	7567	7051	6703	5710	7695	6516	5568	7091	5529	2473	2788	2510	3010	4100	2332	3184	2798	4104	4444	2700
		UK.Bermuda	44	44	67	55	53	59	31	37	48	47	82	61	31	30	15	41	37	100	66	36	12	10	9	25	32
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	3	10	5	0	0	**0**
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	2	0	0	0	**0**
		Uruguay	59	53	171	53	88	45	45	91	91	95	204	644	218	35	66	76	122	24	6	7	0	0	0	0	**0**
		Vanuatu	0	0	0	0	0	0	0	0	0	0	681	689	661	555	873	816	720	330	207	124	17	0	0	0	**0**
		Venezuela	24789	9714	13772	14671	13995	11187	11663	18687	11421	7411	5792	5097	6514	3911	3272	3198	4783	4419	4837	5050	3772	3127	4204	5059	4125
	NCC	Chinese Taipei	2809	2017	2668	1473	1685	1022	1647	2018	1296	1540	1679	1269	400	240	315	211	287	305	252	236	139	293	181	213	395
		Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	183	181	126
		Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1943	1829	0	0	0	0	**0**
	NCO	Argentina	0	0	0	0	0	0	0	0	0	0	327	327	0	0	0	5	0	0	0	0	0	0	0	0	
		Colombia	3418	7172	238	46	46	46	46	46	46	46	46	46	46	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	14	54	40	40	15	15	0	0	65	65	65	65	65	0	0	0	0	0	0	0	0	0	0	0	

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Dominica	31	9	0	0	0	80	78	120	169	119	81	119	65	103	124	102	110	132	119	120	256	194	179	209	194
			Dominican Republic	0	0	0	0	89	220	226	226	226	226	226	226	226	0	0	0	0	0	0	0	0	0	0	0	
			Jamaica	0	0	21	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	1880	1227	2374	2732	2875	1578	2197	765	14	112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	29	13
			Seychelles	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	130	144	110	110	276	123	134	145	94	139	147	172	103	82	106	97	223	114	98	136	93	175	191	232	199
Landings(FP)	ATE	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	50	71	27	109	35	0	0	0	
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	77	28	39	40	103	152	58	35	82	256	0	0	0	
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	15	25	22	16	176	95	89	114	86	78	0	0	0	
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	267	116	24	0	0	0	
			EU.España	910	559	87	384	494	733	714	0	0	335	368	142	154	67	270	279	352	358	140	146	353	0	0	0	
			EU.France	1461	1074	472	658	703	832	914	344	309	672	597	244	128	33	52	203	181	344	347	129	115	0	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	57	35	17	32	9	34	8	12	13	19	0	0	0	
			Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	72	0	66	20	67	95	389	876	487	461	0	0	0	
			Panama	0	0	0	0	0	0	0	0	0	0	0	155	125	177	114	99	54	101	54	163	59	0	0	0	
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
		NCO	Mixed flags (EU tropical)	688	876	254	452	291	216	423	42	13	298	570	292	251	416	464	467	857	1601	0	0	0	1855	1691	1155	1567
Discards		CP	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	137	0	63	40
			Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
	ATW	CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Mexico	0	0	0	0	0	0	0	0	0	0	0	0	5	6	5	9	8	9	7	3	3	3	3	3	5
			U.S.A.	0	0	0	0	0	167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

YFT-Table 2. Estimated probabilities of biomass the Atlantic YFT stock levels < 20% of BMSY in the combined projections of JABBA (Base Case, S2, S3, and S5), MPB, Stock Synthesis (runs 1-4) in a given year for a given catch level (0, 60,000 – 150,000 t). This result was used to develop the management advice of Atlantic YFT stock.

TAC	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
60000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
70000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
80000	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
90000	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%
100000	0.0%	0.0%	0.1%	0.1%	0.2%	0.2%	0.3%	0.3%	0.4%	0.4%	0.5%	0.5%	0.6%	0.6%
110000	0.0%	0.0%	0.1%	0.1%	0.2%	0.4%	0.6%	0.7%	0.8%	0.9%	1.0%	1.2%	1.4%	1.5%
120000	0.0%	0.0%	0.1%	0.3%	0.5%	0.7%	1.0%	1.2%	1.5%	1.8%	2.1%	2.4%	2.6%	2.9%
130000	0.0%	0.1%	0.2%	0.5%	0.8%	1.2%	1.6%	2.1%	2.6%	3.0%	3.5%	3.9%	4.3%	4.7%
140000	0.0%	0.1%	0.3%	0.7%	1.2%	1.8%	2.6%	3.2%	4.0%	4.8%	10.4%	12.2%	12.9%	13.4%
150000	0.0%	0.1%	0.3%	1.0%	1.7%	2.7%	3.7%	4.8%	11.9%	12.7%	15.9%	21.3%	22.1%	23.3%

YFT-Table 3. Estimated probabilities of the Atlantic YFT stock (a) being below F_{MSY} (overfishing not occurring), (b) above B_{MSY} (not overfished) and (c) above B_{MSY} and below F_{MSY} (green zone) in a given year for a given catch level (0, 60,000 – 150,000 t), based upon the combined projections of JABBA (Base Case, S2, S3, and S5), MPB, Stock Synthesis (runs 1-4). This result was used to develop the management advice of Atlantic YFT stock.

a) Probability that $F \leq F_{MSY}$

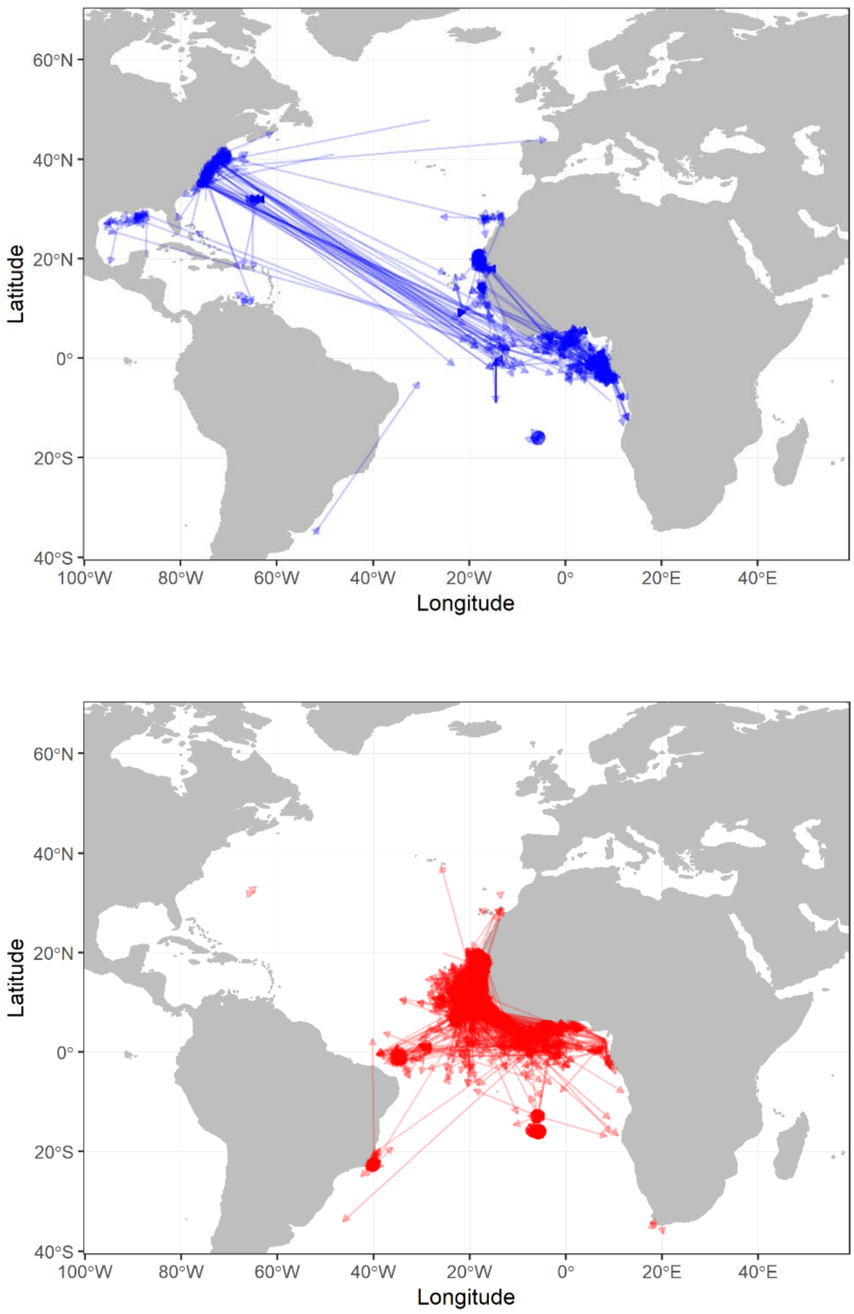
TAC | Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	100	100	100	100	100	100	100	100	100	100	100	100	100	100
60000	99	99	100	100	100	100	100	100	100	100	100	100	100	100
70000	98	99	99	99	100	100	100	100	100	100	100	100	100	100
80000	96	97	98	98	99	99	99	99	99	100	100	100	100	100
90000	93	95	96	97	97	98	98	98	98	99	99	99	99	99
100000	88	90	92	93	94	95	95	95	96	96	97	97	97	97
110000	81	84	85	86	87	87	88	88	89	90	90	90	90	90
120000	71	72	72	73	73	74	74	74	74	74	70	70	70	70
130000	60	59	58	56	55	53	50	49	47	46	46	45	39	39
140000	48	46	43	39	36	32	30	26	24	23	22	21	21	19
150000	39	35	30	25	22	17	15	13	13	12	11	10	10	8

b) Probability that $B \geq B_{MSY}$

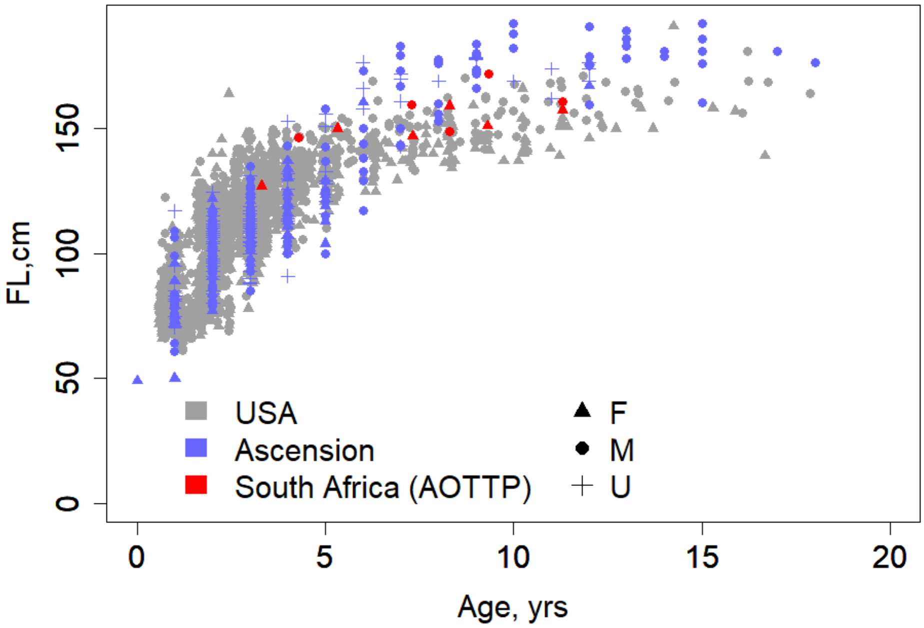
TAC | Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	64	84	95	99	100	100	100	100	100	100	100	100	100	100
60000	64	75	85	92	96	97	98	99	99	99	100	100	100	100
70000	64	74	83	90	94	96	97	98	98	99	99	99	100	100
80000	64	72	79	86	91	94	96	97	97	98	98	99	99	99
90000	64	70	77	82	87	90	92	94	95	96	97	97	98	98
100000	64	68	73	78	82	85	87	89	91	92	93	94	94	95
110000	64	67	69	72	75	77	79	81	83	84	85	86	86	87
120000	64	65	65	67	68	68	69	70	71	71	68	69	69	69
130000	65	63	62	61	60	59	56	56	55	53	52	51	46	45
140000	64	61	59	56	54	49	46	40	37	34	31	29	27	25
150000	64	60	55	50	45	37	32	27	23	20	18	13	12	8

c) Probability that $F \leq F_{MSY}$ and $B \geq B_{MSY}$

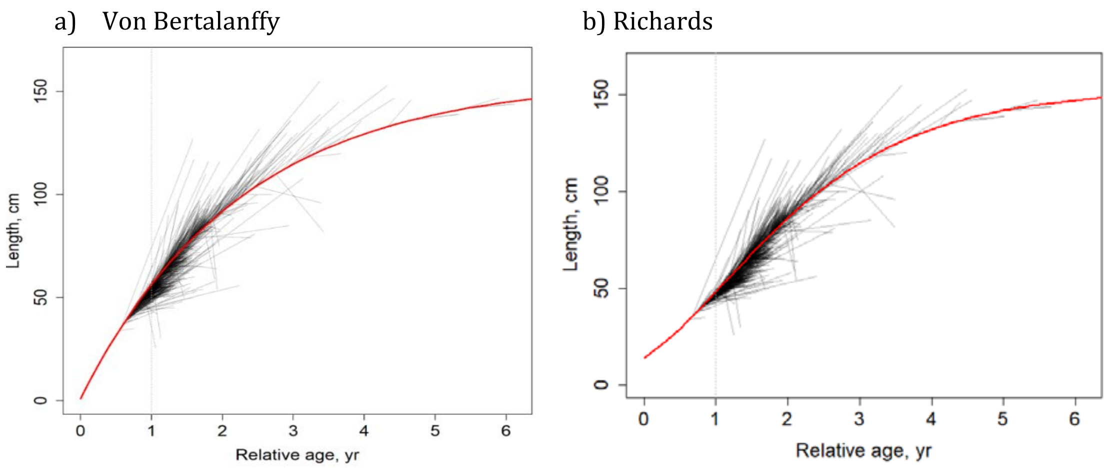
TAC | Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	64	84	95	99	100	100	100	100	100	100	100	100	100	100
60000	64	75	85	92	96	97	98	99	99	99	100	100	100	100
70000	64	74	83	90	94	96	97	98	98	99	99	99	100	100
80000	64	72	79	86	91	94	96	97	97	98	98	99	99	99
90000	64	70	77	82	87	90	92	94	95	96	97	97	98	98
100000	64	68	73	77	82	85	87	89	90	92	93	94	94	95
110000	64	66	69	72	75	77	79	81	82	83	84	85	86	86
120000	63	63	64	65	65	66	66	67	67	68	65	65	66	66
130000	58	57	56	54	52	50	47	46	45	44	43	42	38	38
140000	48	45	42	38	35	31	29	26	24	22	21	20	20	19
150000	39	34	30	25	21	17	15	13	12	12	11	10	9	7



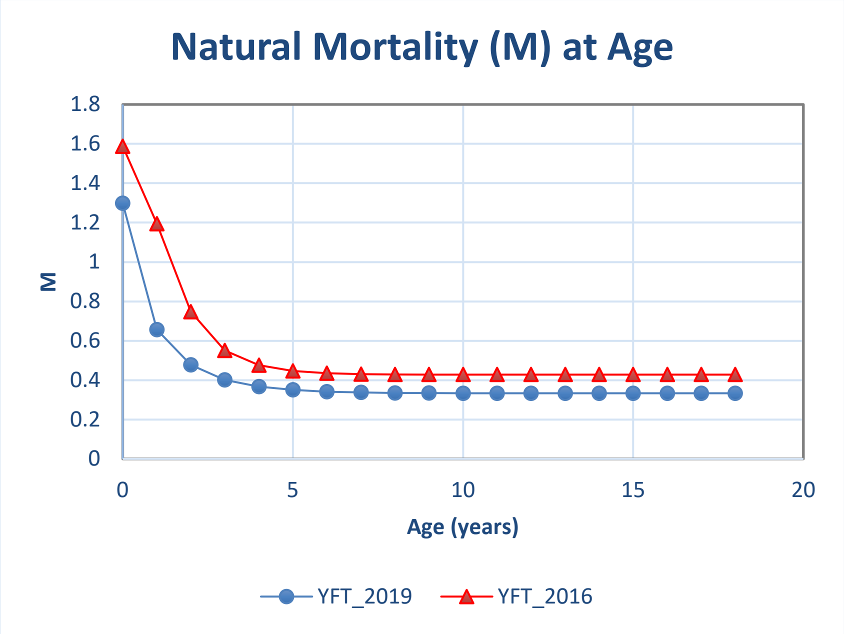
YFT-Figure 1. Apparent movements (straight line distance between the tagging location and that of recovery) calculated from conventional tagging from the historical ICCAT tagging database (top panel) and the current AOTTP activities (bottom panel).



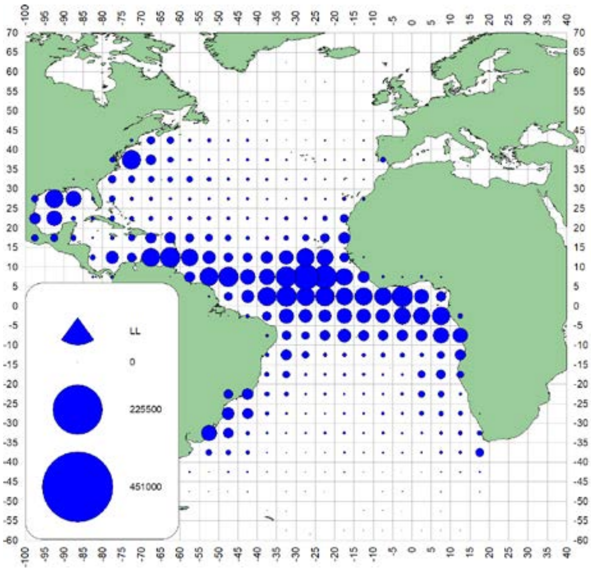
YFT-Figure 2. The size at age of YFT fish sampled off Ascension Island, the USA and South Africa (AOTTP), by gender. Ages of USA and AOTTP samples were assigned based on assumed birthday. No adjustment was made to annulus count for Ascension data.



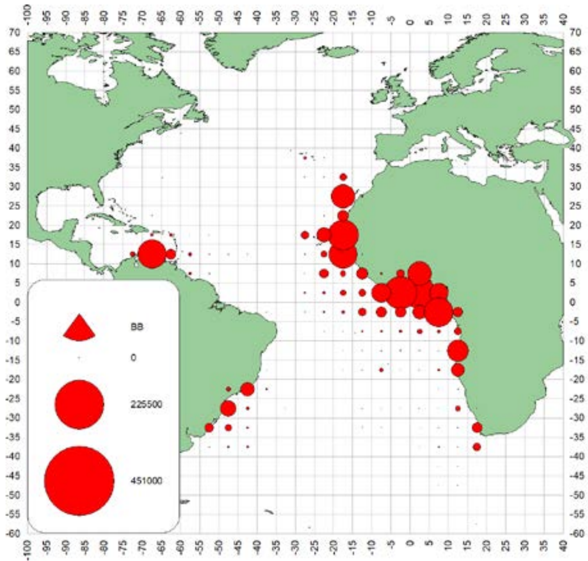
YFT-Figure 3. Vector plot of the growth increments of AOTTP fish measured upon recovery. The relative age of each fish at the time of tagging is estimated from the length at tagging by inverting the von Bertalanffy (left panel) and Richards (right panel) growth equations using parameters estimated by SS. The age at recapture is then taken to be the age at tagging plus the time at liberty. Each growth trajectory (shown in grey) starts on the fitted curve (shown in red).



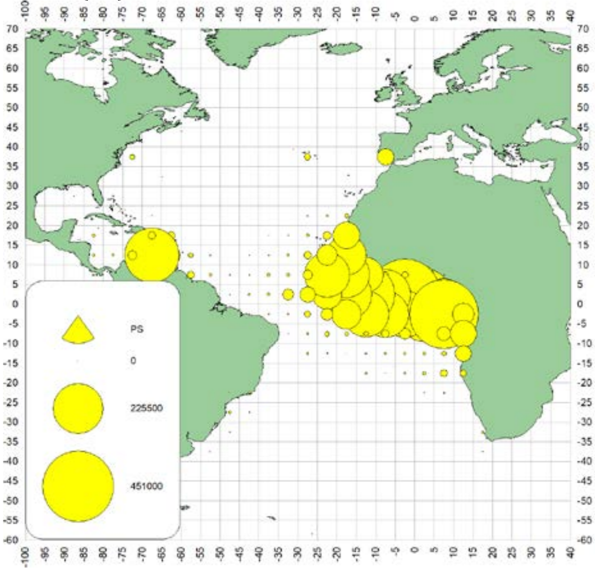
YFT-Figure 4. New information on age and growth supported a Richards growth function, and a change in maximum age from 11 to 18 years which had implications for the estimated (Lorenzen) natural mortality at age which depends on both. The implied 2019 natural mortality based on the t_{MAX} of 18 is 0.35 yr^{-1}, which is lower than the 2016 assessment assumption of 0.54 yr^{-1} based on a t_{MAX} of 11 years.



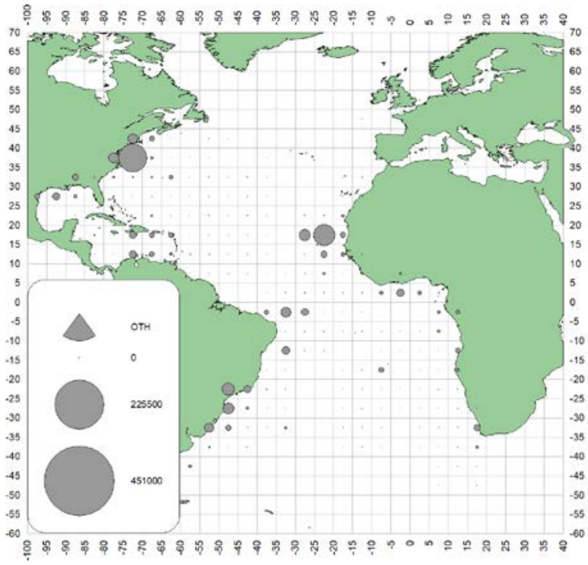
a. YFT (LL)



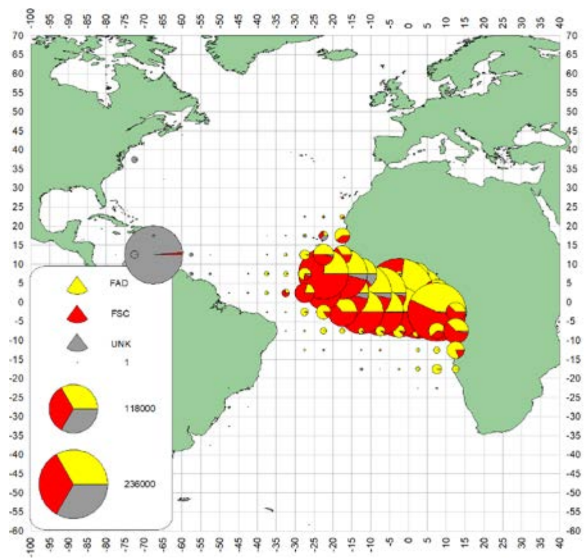
b. YFT (BB)



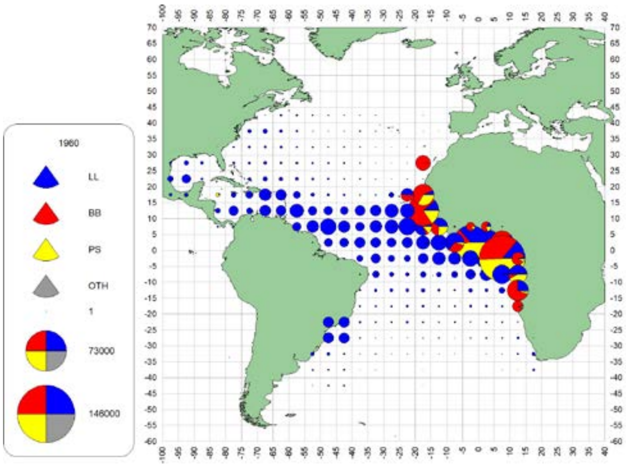
c. YFT (PS)



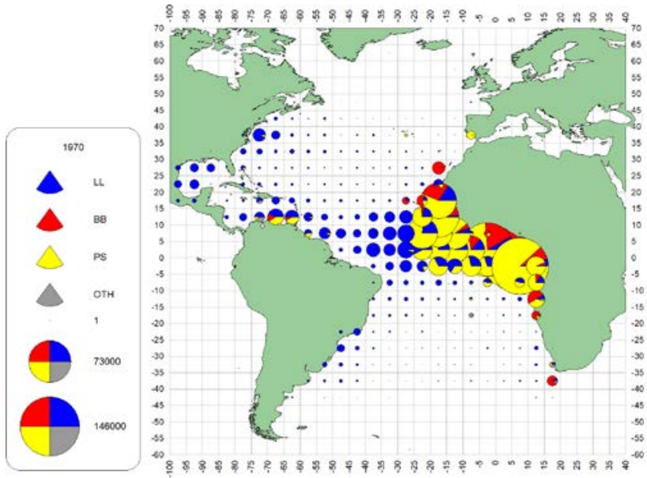
d. YFT (oth)



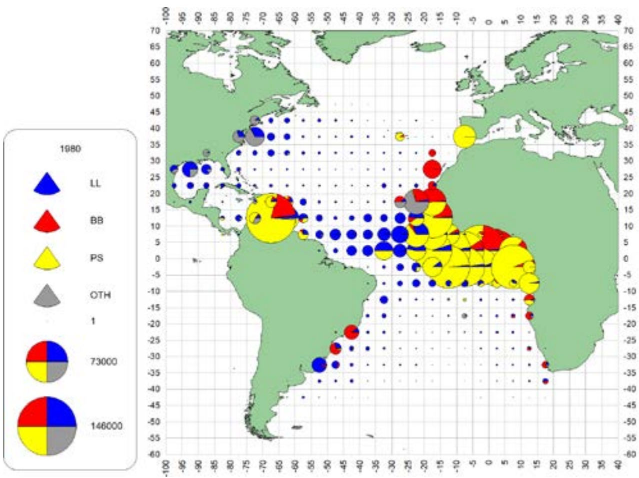
e. YFT (FAD/FREE 1991-2017)



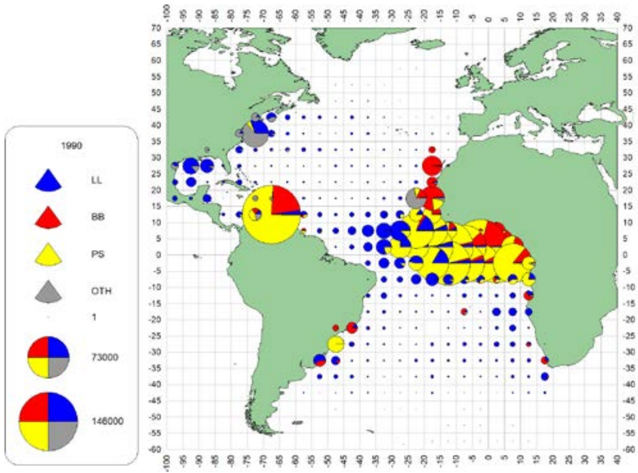
f. YFT (1960-69)



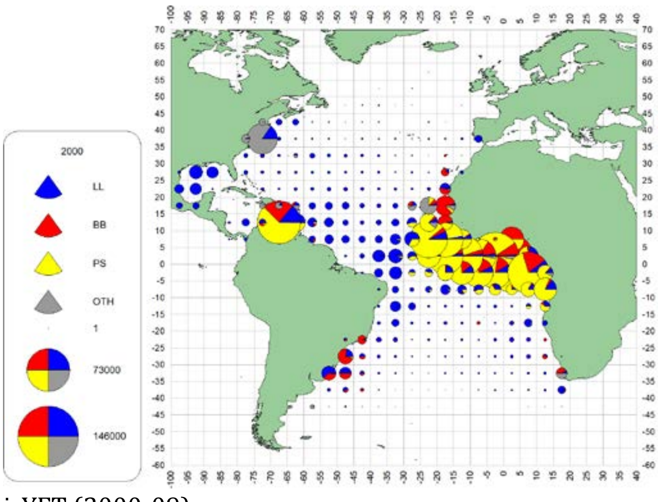
g. YFT (1970-79)



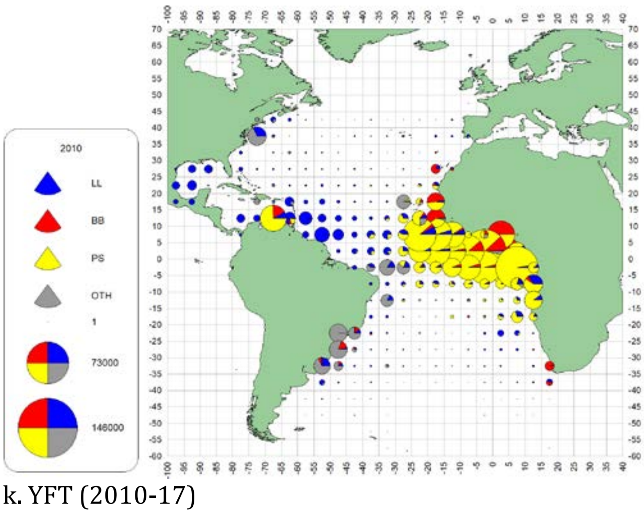
h. YFT (1980-89)



i. YFT (1990-99)

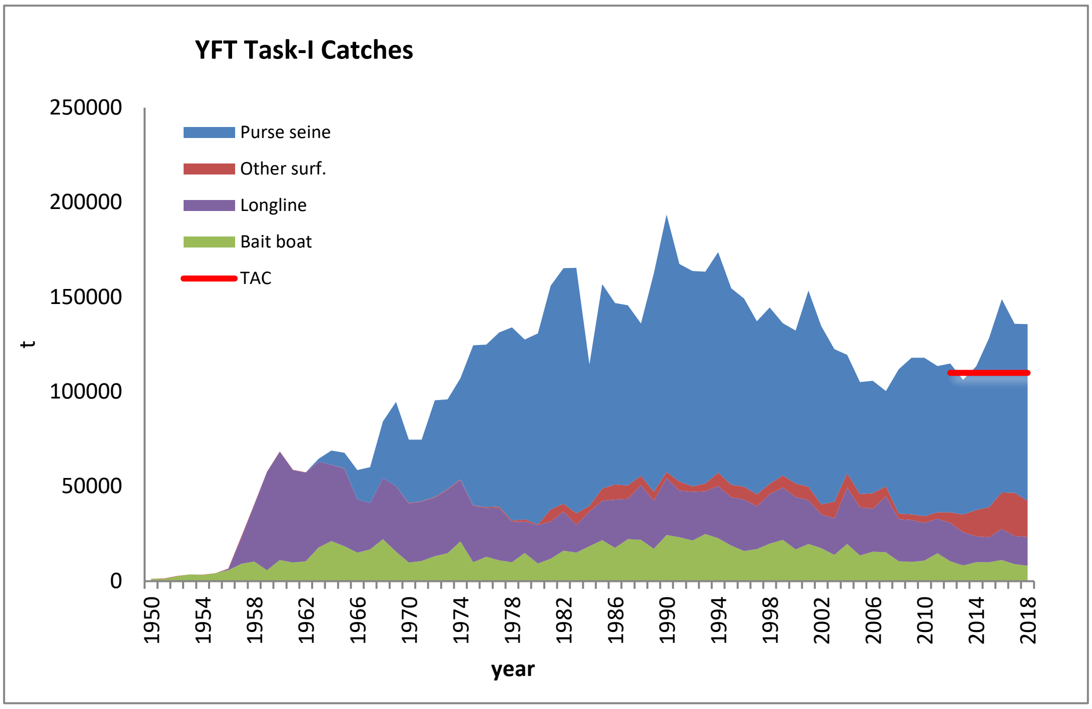


j. YFT (2000-09)

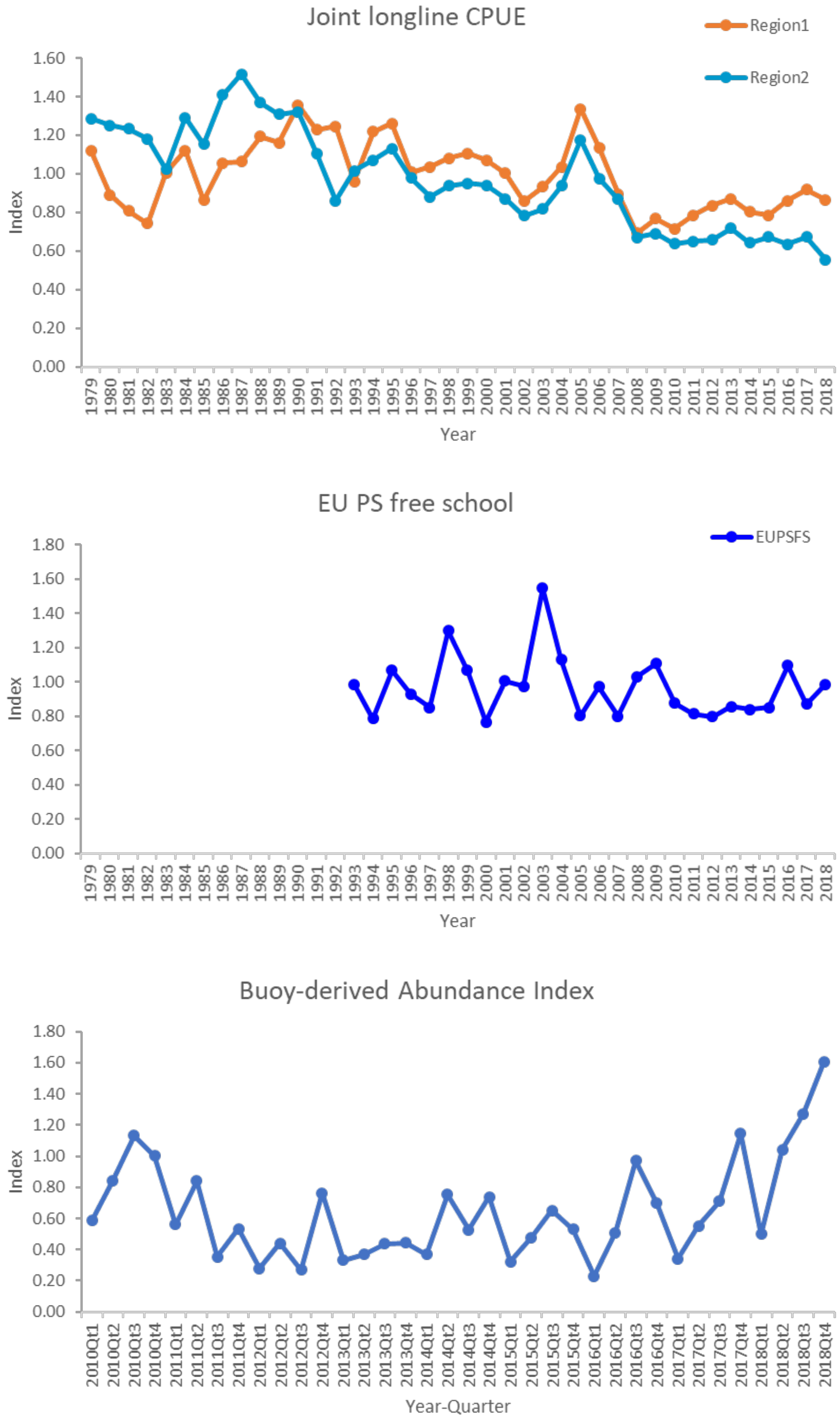


k. YFT (2010-17)

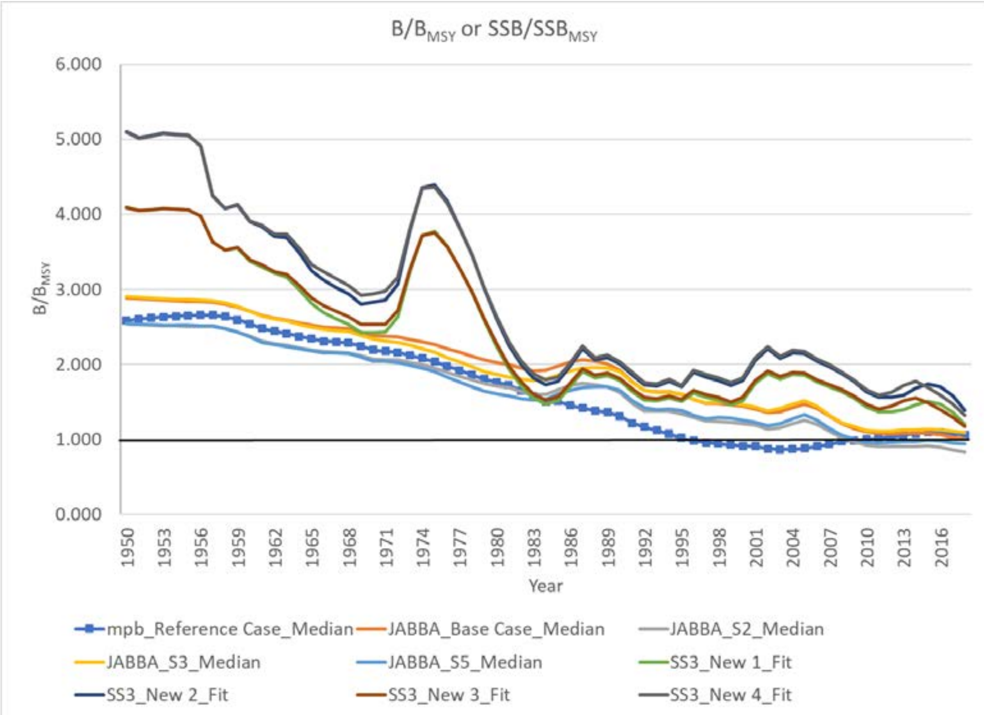
YFT-Figure 5. Geographical distribution of yellowfin tuna total catches by major gears [a-e] and by decade [f-k]. The maps are scaled to the maximum catch observed during 1960-2017. Note: the last panel (k) shows only 8 years of information. Thus, apparent changes in the size of the pie charts (in k) should not be interpreted as a reduction in catch during 2010-2017.



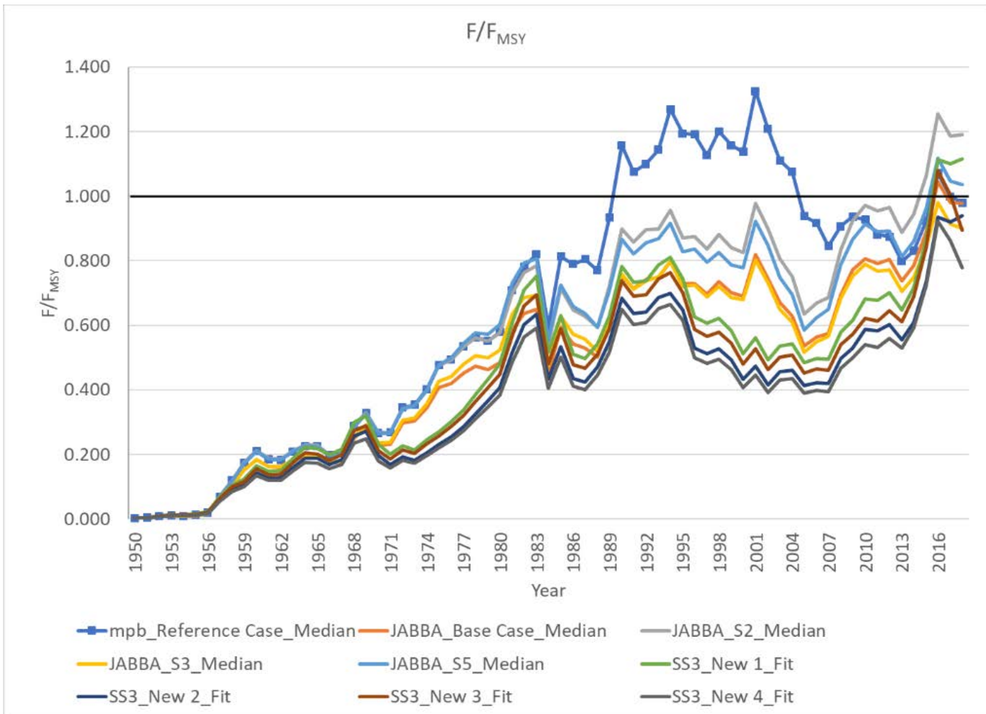
YFT-Figure 6. Yellowfin tuna total catch 1950 – 2018 by main fishing gear group.



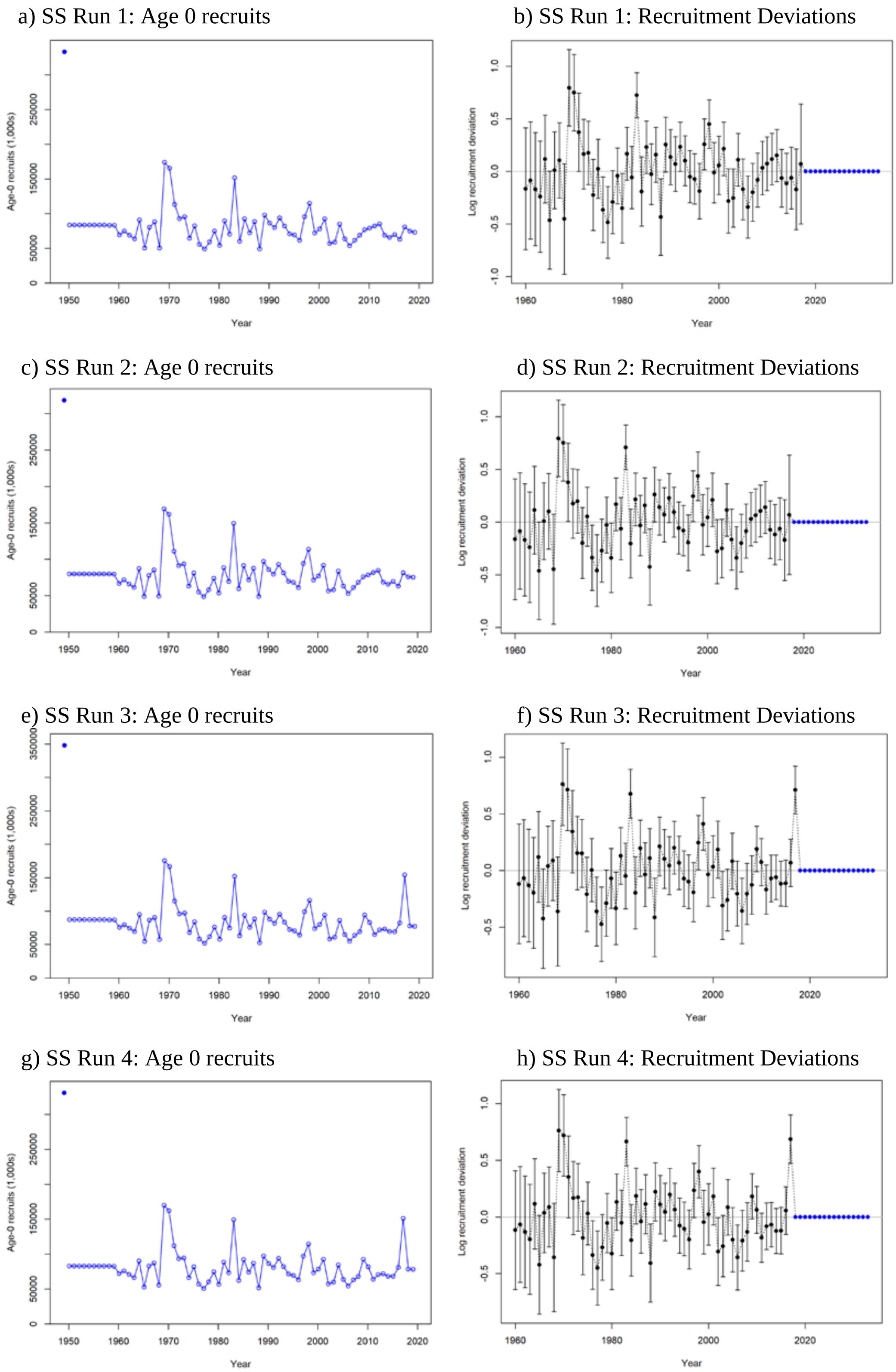
YFT-Figure 7. Annual abundance indices used for the Atlantic yellowfin tuna stock assessment reference cases. Regions 1 and 2 for joint longline mean the area of index that are northern and tropical areas, respectively. Buoy-derived abundance index was used only in Stock Synthesis and joint longline index in region 1 only for JABBA.



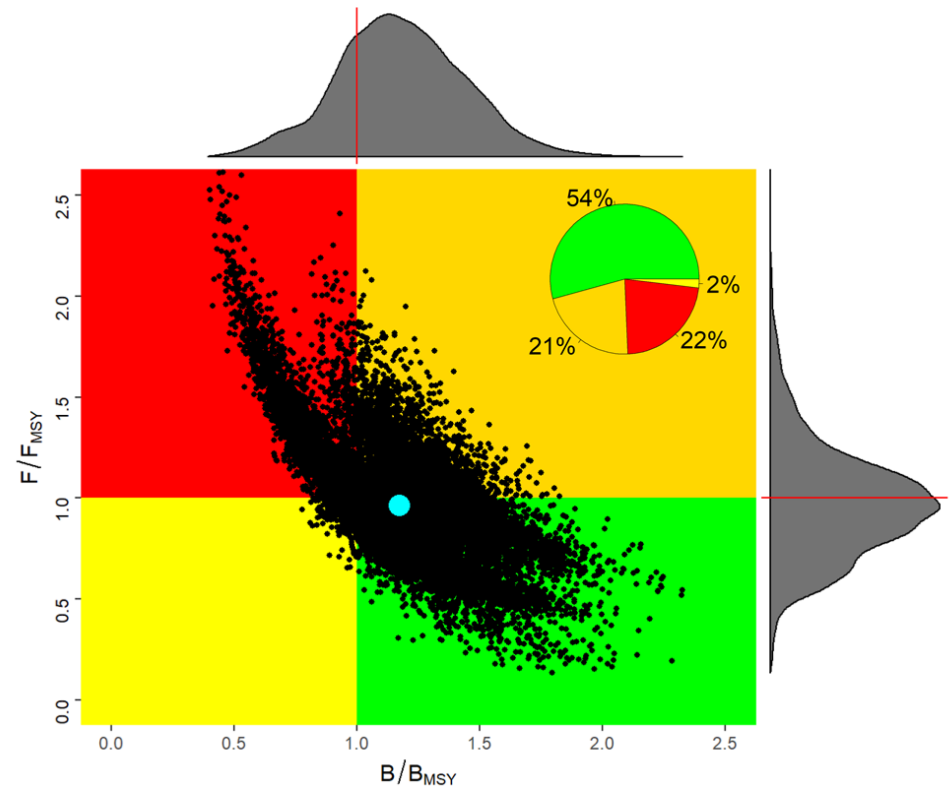
YFT-Figure 8. Estimates of relative Biomass (B/B_{MSY}) obtained for all model runs used to develop the management advice.



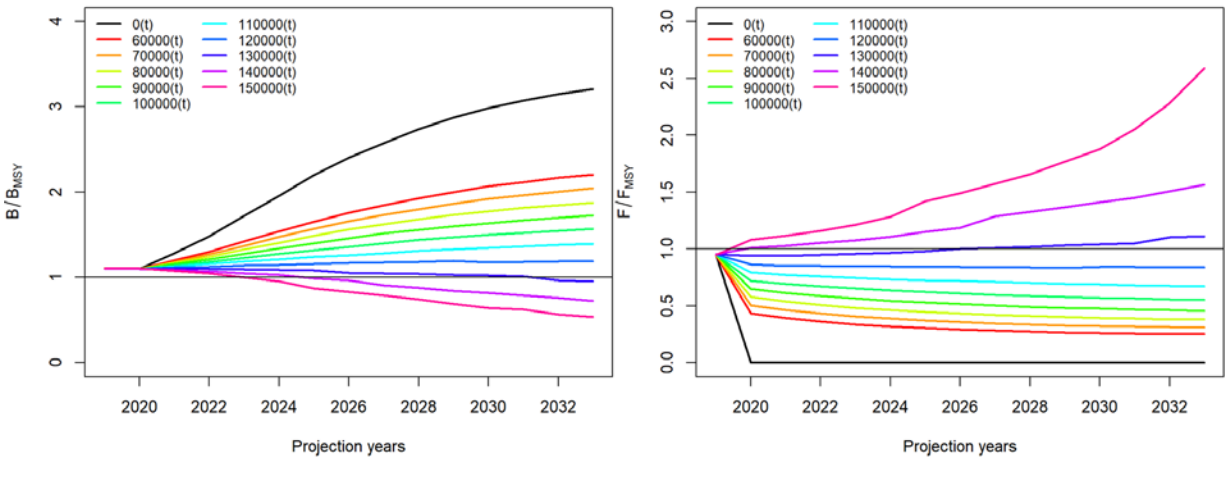
YFT-Figure 9. Estimates of relative fishing mortality (F/F_{MSY}) obtained for all model runs used to develop the management advice.



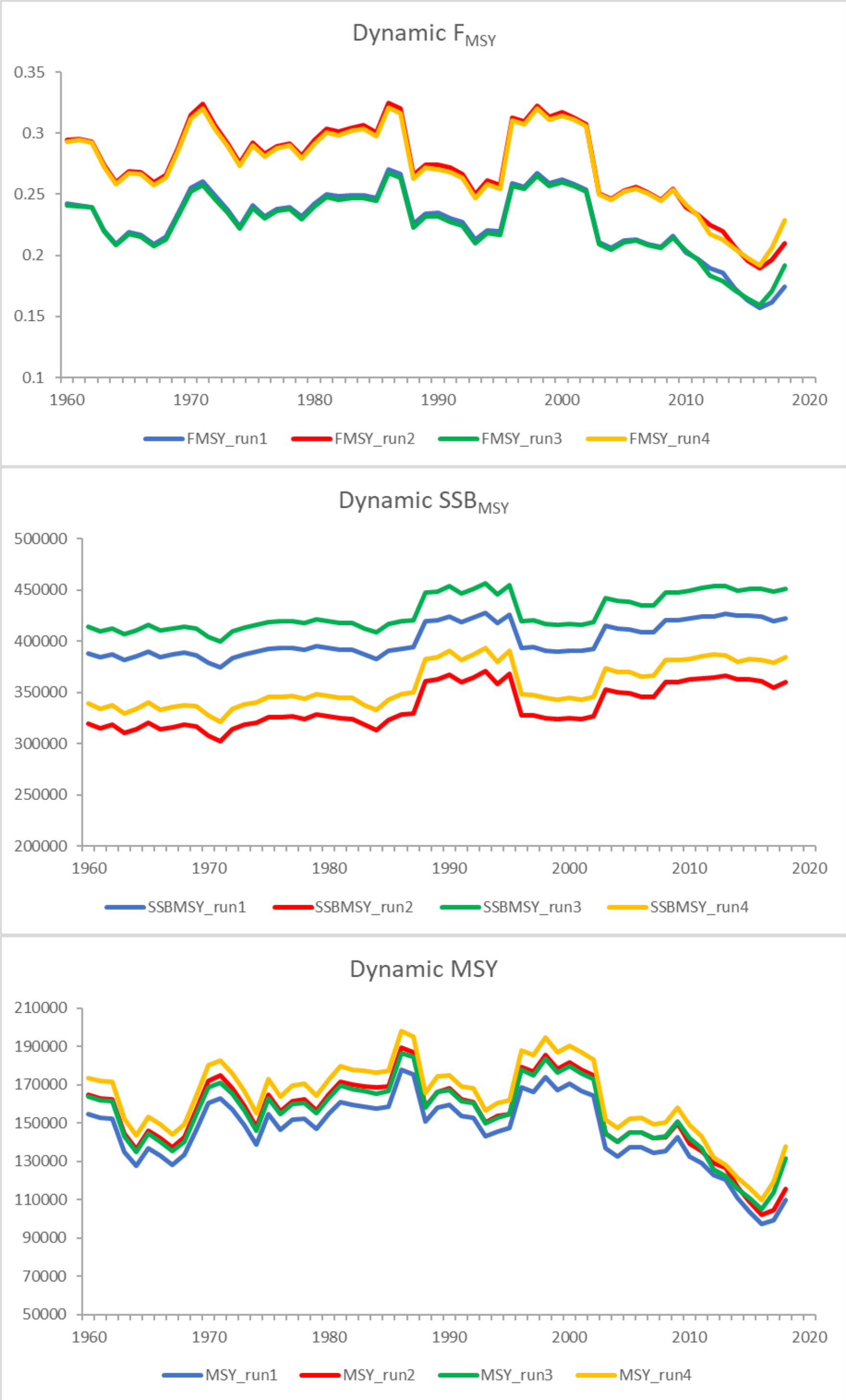
YFT-Figure 10. Annual estimates of Age-0 recruits (left panels) and recruitment deviations with 95% confidence intervals (right panels) for Stock Synthesis model runs. Models which used the buoy index suggest very high recruitment in 2017, whereas models that do not use the buoy index suggest that recruitment in 2017 was not particularly high. Note: Production models (JABBA, MPB) do not produce estimates of recruitment.



YFT-Figure 11. Kobe plot estimated from the combination of Stock Synthesis, JABBA and MPB model runs chosen to develop the management advice. The trajectory of individual runs are shown in the detailed report, and in **Figures 8 and 9** above.



YFT-Figure 12. Trends of projected relative biomass (left panel, B/B$_{MSY}$) and fishing mortality (right panel, F/F$_{MSY}$) of Atlantic yellowfin stock under different TAC scenarios (0, 60000 – 150000 t) from JABBA, MPB, and SS3 using 9 runs (JABBA (Base Case, S2, S3, and S5), MPB, Stock Synthesis (runs 1-4)). Each line represents the median of 20000 iterations by projected year. In 2019, the catch was assumed to be 131,042 t, equal to the 2018 estimated landings.



YFT-Figure 13. Effect of changes in overall fisheries selectivity on estimate of MSY and reference points used for the determination of stock status (Dynamic SSB_{MSY}, F_{MSY} and MSY for the Stock Synthesis runs.). For each year, reference points are calculated with the selectivity of each gear for that year, and relative yearly catch of each fleet.

9.2 BET – BIGEYE TUNA

The last stock assessment for bigeye tuna was conducted in 2018 (Anon. 2018a) through a process that included a data preparatory meeting in April and an assessment meeting in July. The stock assessment used fishery data from the period 1950-2017 and all indices of relative abundance used in the assessment were constructed through 2017. This Executive Summary reports stock status and management advice for bigeye in 2019 but it is mostly based on the 2018 assessment results. Only a few fishery indicators have been updated (catch and a new index of relative abundance for juveniles from acoustic buoys). The complete description of the stock assessment process and the development of management advice is found in the Report of the 2018 ICCAT Bigeye Tuna Data Preparatory Meeting (Anon. 2018b) and the Report of the 2018 ICCAT Bigeye Tuna Stock Assessment Meeting (Anon. 2018a) as well as in Walter *et al*., 2018 where stock projections and Kobe 2 Strategic Matrix are described.

BET-1. Biology

Bigeye tunas are distributed throughout the Atlantic Ocean between 50ºN and 45ºS, but not in the Mediterranean Sea. This species swims at deeper depths than other tropical tuna species and exhibits extensive vertical movements. Similar to the results obtained in other oceans, pop-up tagging and archival acoustic tracking studies conducted on adult fish in the Atlantic have revealed that they exhibit clear diurnal patterns: they are found much deeper during the daytime than at night. In the eastern tropical Pacific, this diurnal pattern is exhibited equally by juveniles and adults. In the western Pacific these daily patterns have been associated with feeding and are synchronized with depth changes in the deep scattering layer. Spawning takes place in tropical waters when the environment is favorable. From nursery areas in tropical waters, juvenile fish tend to diffuse into temperate waters as they grow. Catch information from surface gears indicate that the Gulf of Guinea is a major nursery ground for this species. Dietary habits of bigeye tuna are varied and prey organisms like fish, mollusks, and crustaceans are found in their stomach contents. Bigeye tuna exhibit relatively fast growth: about 110 cm fork length at age three, 145 cm at age five and 163 cm at age seven. Recently, however, reports from other oceans suggest that growth rates of juvenile bigeye are lower than those estimated in the Atlantic. The growth rates of bigeye tuna differ between sexes based on Indian Ocean tagging data, males reaching around 10 cm larger L_{INF} than females. Bigeye tuna become mature around 100 cm at around 3 years old. Young fish form schools mixed with other tunas such as young yellowfin tuna and skipjack. These schools are often associated with drifting objects, whale sharks and sea mounts. This association weakens as bigeye tuna grow. Indian and Pacific Oceans tagging data showed that bigeye longevity is over 10 years, which may imply lower natural mortality rates than previously being assumed for the Atlantic Ocean. Therefore, the Committee adopted a new natural mortality vector in the 2015 assessment which has also been used in 2018 (but using the Richards growth curve of Hallier *et al.* 2005 in the Lorenzen natural mortality estimation as this is the growth curve used in the assessment). Various pieces of evidence, such as a lack of identified genetic heterogeneity, the time-area distribution of fish and movements of tagged fish (**BET-Figure 1**), suggest an Atlantic-wide single stock for this species. However, the possibility of other more complex scenarios of stock structure should not be disregarded. These uncertainties in stock structure, natural mortality, and growth could have important implications for the stock assessment. The ongoing Atlantic Ocean Tropical tuna Tagging Programme (AOTTP) is contributing to reduce some of these uncertainties.

BET-2. Fisheries indicators

The stock has been exploited by three major gears (longline, baitboat and purse seine fisheries) and by many countries throughout its range, ICCAT has detailed data on the fishery for this stock since the 1950s. Scientific sampling at landing ports for purse seine vessels from the EU and other fleets has been conducted since 1980 to estimate bigeye tuna catches (**BET-Figure 2, BET-Table 1**). The size of fish caught varies among fisheries: medium to large fish for the longline fishery and purse seine free school sets, small to large for subtropical baitboat fishery, and small for tropical baitboat and for purse seine FAD fisheries.

The major historical baitboat fisheries are located in Ghana, Senegal, the Canary Islands, Madeira and the Azores. Since 2013, a new "vessel associated-school" fishing method using handline, where the vessels acts as a fish aggregating device developed in the western equatorial area, with bigeye catches increasing from 555 t in 2012 to 2,012 t in 2013 and further to around 5,000 t in 2015-2017. The tropical purse seine fleets operate in the Gulf of Guinea in the eastern Atlantic with these fleets are comprised of vessels flying the flags of Ghana, EU-France, EU-Spain and others. The longline fleets operate across a broader geographic range, covering tropical and temperate regions (**BET-Figure 2**). While bigeye tuna is a primary target species for most of the longline and some baitboat fisheries, this species has always been of secondary importance for the other surface fisheries. In the purse seine fishery, unlike yellowfin tuna, bigeye tunas are mostly caught while fishing on floating objects such as logs or manmade fish aggregating devices (FADs). The estimated total numbers of FADs released yearly has increased since the beginning of the FAD fishery, especially in recent years. During 2013-2017, landings of bigeye in weight caught by longline fleets represent 48%, while purse seine fleets represent 34% and baitboat and other surface fleets represent 18% of the total (**BET-Table 1**). In 2018, landings of bigeye in weight caught by longline represent 44%, purse seiner and baitboat 39% and other surface fleets 17%.

The total annual Task I catch (**BET-Table 1**, **BET-Figure 3**) increased continuously up to the mid-1970s reaching 60,000 t and fluctuated over the next 15 years. In 1992, catch reached 100,000 t and continued to increase, reaching a historic high of about 135,000 t in 1994. Since then, reported and estimated catch continuously declined and fell to 59,192 t by 2006. From the low level of 2006, catches have increased again and reached 79,524 t in 2015. Catches have averaged since then 77,646 t in the period 2015-2018. The preliminary catch estimated for 2018 was 73,366 t (there still remains an estimate 2.4% non-reported catch, for which in general the average of the last three years has been assumed). The agreed TAC of 65,000 t imposed since 2016 has been exceeded every year.

After the historic high catch in 1994, all major fisheries exhibited a decline in catch while the relative share of each fishery in total catch remained relatively constant until 2008. These reductions in catch were related to declines in fishing fleet size (longline) as well as decline in CPUE (longline and baitboat). Although the general trend of decreasing catches continued for longline and baitboat, the purse seiner catches increased, as did the relative contribution of purse seine in the total catches in the period 2010-2017. Other surface fisheries, from CPCs with no specific catch limits under Rec. 16-01, also have increased the catches in recent years from around 1,000 t in 2011 to around 7,000 t in 2017, mainly due to the development of the new handline vessel associated-school fishery in the equatorial western Atlantic.

Nominal purse seine effort, expressed in terms of carrying capacity, has decreased regularly since the mid-1990s up to 2006. However, after this date, several European Union purse seiners have transferred their effort to the eastern Atlantic, due to piracy in the Indian Ocean, and a fleet of new purse seiners have started operating from Tema (Ghana), whose catches are probably underestimated. All this has contributed to the growth in carrying capacity of the purse seiners, which is gradually nearing the level observed in the early 1990s (**SKJ-Figure 9, SKJ-Table 2**). The nominal effort of baitboats has remained stable for over 20 years. By 2010, overall carrying capacity of the purse seine fleet had increased significantly, to about the same level as in the 1990s, and has increased by nearly 50% since. The above number do not include all purse seine vessels currently fishing for tropical tunas in the Atlantic. The total number of purse seine vessels (estimated by the Committee) targeting tropical tunas in the eastern Atlantic has increased in the last five years by 18%, from 49 in 2014 to 58 in 2018. FOB based fishing has accelerated even more rapidly than free school fishing.

Species composition and catch at size from the Ghanaian fleet of baitboats and purse seiners, has been thoroughly reviewed during the past few years. This review has led to new estimates of Task I, and partially Task II catch and effort and size, for these fleets for the period 1973-2013. This revision has shown that catches of bigeye tuna by Ghanaian fleets over the period 1996-2005 were significantly lower than previously estimated by an average of 2,500 t, whereas catches were larger for yellowfin tuna. The Task II estimations for the period 2006 to 2014 (made by the Secretariat during 2016, Ortiz and Palma, 2017) were updated in order to include the last three years (2015 to 2017) using the same methodology as in 2016. The updated Ghanaian bigeye catch estimates done in 2018 were significantly lower than previously estimated because a different area stratification for species composition was used, which is believed to be more accurately represent Ghanaian catches.

Significant catches of small bigeye tuna continue to be diverted to local West African markets, predominantly in Abidjan, and sold as *faux poissons* in ways that make their monitoring and official reporting challenging. Monitoring of such catches has recently progressed through a coordinated approach that allows ICCAT to properly account for these catches and thus increase the quality of the basic catch and size data available for assessments. Currently those catches are included with those from the main purse seine fleet in the ICCAT Task I data used for the assessments.

Mean average weight of bigeye tuna decreased prior to 2004 but has remained relatively stable at around 10 kg for the last decade. This mean weight, however, is quite different for the different fishing gears in recent years, around 55 kg for longliners, around an average of 10 kg for baitboats, and 6 kg for purse seiners. Since 2000, several longline fleets have shown increases in the mean weight of bigeye tuna caught, with the average longline-caught fish increasing from 40 kg to 60 kg between 2000 and 2008. During the same period, purse seine-caught bigeye tuna had average weights between 5 and 6 kg. Average weight of bigeye tuna caught in free schools is more than double the average weight of those caught around FADs. Since 1991, when bigeye catches were identified separately for FADs for EU and other CPCs purse seine fleets, the majority of bigeye tuna are caught in sets associated with FADs; particularly since the mid-2000s (60%-80%). Similarly, baitboat-caught bigeye tuna weighed between 6 and 10 kg up to 2011, but with greater inter-annual variability in average weight compared to longline or purse seine caught fish, while it increased to around 18 kg in 2014 to decrease to 10 kg again since then.

The main change from the previous assessment was the development and use of a single Joint Longline standardized abundance index (Hoyle *et al*., 2019) instead of each individual CPC's standardized CPUE indices used in the 2015 assessment. The joint longline standardized index for 1959-2017 was constructed using detailed operational data of major longline fleets (Japan, Korea, United States and Chinese Taipei) (**BET-Figure 4**).

The development of this joint standardized CPUE index was motivated to reduce data conflicts that arise when CPUE trends differ for different fleets in the same period. This can occur when available data are sparse, when the fishery occurs at the extremes of the spatial distribution of the stock and/or does not represent a meaningful proportion of the stock biomass, or when the index references only a small portion of the age or size distribution. This can also occur when there are important changes in fisheries operations (e.g. targeting, regulations, spatial distribution) that cannot be addressed in the standardization process.

It was concluded that the joint longline index was an improvement over fleet-specific indices because of the integrated temporal and spatial coverage it afforded to index stock biomass, and because it minimizes data conflicts in the stock assessment models. The joint index uses the vessel effect that accounts for different fishing efficiency of each vessel. The selectivity used to model the index should reflect the selectivity of the combined fleets used to produce the index. The use of the index in the stock assessment model requires an assumption of its selectivity (size composition), which should reflect the selectivity of the combined fleets used to produce the index. However, given the modelled shift in the selectivity of Chinese Taipei since 2003, size composition data from Chinese Taipei was not used to estimate selectivity of the joint index in the stock assessment to maintain continuity of the time series.

Moreover, a number of standardized indices of abundance were developed by national scientists for selected fleets for which data were available at finer spatial and/or temporal resolution for the assessment. These indices represented data from six different fleets: five longline fleets (Japan, Uruguay, Brazil, Chinese Taipei, USA) and one baitboat fleet (EU-Spain operating off Dakar) which were used in different stock assessment methods as sensitivity runs (**BET-Figure 5**).

BET-3. State of the stock

The 2018 stock assessment was conducted using similar assessment models to those used in 2015 but updating data and new relative abundance indices up to 2017. Stock status evaluations for Atlantic bigeye tuna used in 2018 several modeling approaches, ranging from non-equilibrium (MPD) and Bayesian state-space (JABBA) production models to integrated statistical assessment models (Stock Synthesis). Different model formulations considered to be plausible representations of the stock dynamics were used to characterize stock status and the uncertainties in stock status evaluations.

The Stock Synthesis integrated statistical assessment model allows the incorporation of more detailed information, both for the biology of the species as well as fishery data, including the size data and selectivity by different fleet and gear components. As Stock Synthesis allows modelling of the changes in selectivity of different fleets as well as to investigate the effect of the length/age structure of the catches of different fisheries in the population dynamic, productivity and fishing mortality, it was the agreed model to be used for the management advice. The Stock Synthesis uncertainty grid includes 18 model configurations that were investigated to ensure that major sources of structural uncertainty were incorporated and represented in the assessment results. Although the results of two production models, non-equilibrium and Bayesian state-space, are not used for management advice they supported the Stock Synthesis stock assessment results.

Results of the uncertainty grid of Stock Synthesis runs (**BET-Table 2**) show a long-term decline in SSB with the current estimate being at the lowest level in the time series (**BET-Figure 6**) and increasing trend of fishing mortality (average F on ages 1-7) starting in the early 1990s, with the highest fishing mortality at 1994 and has remained high since then (**BET-Figure 6**).

SS3 uncertainty grid, despite a broad range of assumptions regarding stock productivity (steepness) and model parameterization, shows trajectories of increasing F decreasing B towards the red area of the Kobe plot ($F > F_{MSY}$ and $SSB < SSB_{MSY}$), overfishing starting in around 1994 and an overfished stock at around 1996-1997, and being in the red quadrant of the Kobe plot since then (**BET-Figure 7**). According to the results of the SS3 uncertainty grid, Atlantic bigeye stock is currently overfished (SSB/SSB_{MSY} =0.59, ranging from 0.42 to 0.80) and undergoing overfishing (F/F_{MSY} = 1.6, ranging from 1.14 to 2.12) with very high probability (99%) (**BET-Figure 8**).

The current MSY may be below what was achieved in past decades because overall selectivity has shifted to smaller fish. Calculations of the time-varying benchmarks from SS3 uncertainty grid show a long-term increase in SSB_{MSY} and a general long-term decrease in MSY (**BET-Figure 9**).

The Committee is confident that uncertainty of the stock assessment results has decreased from previous stock assessments. This is likely the result of the use of the improved joint LL index, the confirmation that catches continue to exceed TACs, and the use of a single model platform for the provision of the management advice.

BET-4. Outlook

Projections were conducted for the uncertainty grid Stock Synthesis for a range of fixed catches from 35,000 to 90,000 t for 15 years (which corresponds to 2 generation times of bigeye) from 2019-2033.

For some of the projections, the modelled stock could not sustain higher constant catches over several years in the long term (**BET-Table 3**). In such cases, projections were adjusted to prevent this undesirable projection behavior and made it possible to produce Kobe 2 Strategic Matrices. The results of projections of the Stock Synthesis are provided in the form of Kobe 2 Strategic Matrices including with probabilities that overfishing is not occurring ($F<=F_{MSY}$), stock is not overfished ($SSB>=SSB_{MSY}$) and the joint probability of being in the green quadrant of the Kobe plot (i.e. $F<= F_{MSY}$ and $SSB>= SSB_{MSY}$) (**BET-Table 4**).

It was noted in 2018 that the modeled probabilities of the stock achieving levels consistent with the Convention objective of the projected time period in 2028 and 2033 was 28% and 44%, respectively, for a future constant catches of 65,000 t, which is the TAC established in Rec. 16-01. Projections with the current TAC level are not expected to end overfishing ($F<F_{MSY}$) with 50% probability until 2032. Higher probabilities of rebuilding require longer timeframes and/or larger reduction of current catches (**BET-Table 4**). It was also noted that the modeled probabilities of the stock being in the green quadrant at the end of the projected time period in 2033, as well as the probability to end overfishing by 2033, was 1% for a future constant catch at current levels of around 78,482 t. Moreover, when projecting at current catch level 56% of the model runs resulted in SSB levels below 10% of SSB_{MSY} by 2032 (**BET-Table 3**).

It needs to be noted that projections made by the Committee assume that future constant catches represent the total removals from the stock, and not just the reported catches. Projections also assume that the current selectivity pattern will be maintained. Any future changes in selectivity due to changes in the ratios of relative mortality exerted by the different fleets – such as an increase in the relative mortality of small fish – will change and add to the uncertainty of these projections.

BET-5. Effect of current regulations

During the period 2005-2008 an overall TAC was set at 90,000 t. The TAC was later lowered (Rec. 09-01 and later modified by Rec. 14-01) to 85,000 t. Estimates of reported catch for 2009-2015 (**BET-Table 1**) have been always lower than 85,000 t. The TAC was again reduced to 65,000 t in Recommendation 15-01 which entered into force in 2016 and Recommendation 18-01. Catches in 2016-2017 exceeded the TAC by 20% and those in 2018 by 13%, contributing to further declines in stock size since 2015. Note that because the current TAC does not affect all countries that can catch bigeye tuna, the total catch removed from the stock can exceed the TAC.

Concern over the catch of small bigeye tuna partially led to the establishment of spatial closures to surface fishing gear in the Gulf of Guinea (Recs. 04-01, 08-01, 11-01, 14-01, 15-01). The Committee examined trends on average bigeye tuna catches by areas as a broad indicator of the effects of such closures as well as changes in juvenile bigeye and yellowfin catches due to the moratorium. The efficacy of the area-time closure agreed in Rec. 15-01 was evaluated by examining fine-scale (1^ox1^o) skipjack, yellowfin, and bigeye catch by month distributions. After reviewing this information, the Committee concluded that the moratorium has not been effective at reducing the mortality of juvenile bigeye tuna, and any reduction in bigeye tuna mortality was minimal, largely due to the redistribution of effort into areas adjacent to the moratorium area and increase in number of fishing vessels.

BET-6. Management recommendations

The Atlantic bigeye tuna stock in 2017 was estimated to be overfished and that overfishing was occurring. Maintaining the catches at 2016-2018 levels in the future (around 77,000 t and about 20% greater than the 65,000 TAC), will reduce the probability of achieving Convention objectives by 2033 ($B>B_{MSY}$, $F<F_{MSY}$) to around 1% (**BET-Table 4**).

The Committee notes that current and previous FOB time area closures and possible future changes of the allocation of catch to different gears provide some benefits to the stock (sections 19.2 and 19.4 to the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 2*). The necessary reduction of fishing mortality on bigeye tuna required for stock recovery, however, cannot be achieved only with such measures. The Commission should urgently ensure that catches are appropriately reduced to end overfishing and allow the stock to recover following the Decision Framework adopted in paragraph 3 of Rec. 11-13.

The Commission should be aware that increased harvests on small fishes could have had negative consequences for the productivity of bigeye tuna fisheries (e.g. reduced yield at MSY and increased SSB required to produce MSY) (**BET-Figure 9**) and, therefore, should the Commission wish to increase long-term sustainable yield, the Committee continues to recommend that effective measures be found to reduce fishing mortality of small bigeye tunas.

ATLANTIC BIGEYE TUNA SUMMARY	
Maximum Sustainable Yield	76,232 t (72,664-79,700 t)[1]
Current (2018) Yield	73,366 t[2]
Relative Spawning Biomass (SSB_{2017}/SSB_{MSY})	0.59 (0.42-0.80)[1]
Relative Fishing Mortality (F_{2017}/F_{MSY})	1.63 (1.14-2.12)[1]
Stock Status (2017)	Overfished: Yes[3] Overfishing: Yes[3]
Conservation & management measures in effect:	Rec. 16-01, Rec. 18-01 – Total allowable catch for 2016-2019 was set at 65,000 t for Contracting Parties and Cooperating non-Contracting Parties, Entities or Fishing Entities. – Be restricted to the number of their vessels notified to ICCAT in 2005 as fishing for bigeye tuna. – Specific limits of number of longline boats; China (65), Chinese Taipei (75), Philippines (5), Korea (14), EU (269) and Japan (231). – Specific limits of number of purse seine boats; EU (34) and Ghana (17). – No fishing with natural or artificial floating objects during January and February in the area encompassed by the African coast, 20º W, 5ºN and 4ºS. – No more than 500 FADs active at any time by vessel. – Use of non-entangling FADs.

[1] Combined result of SS3 18 uncertainty grid. Median and 10 and 90% percentile in brackets.
[2] Reports for 2018 reflect most recent data but should be considered provisional.
[3] Probability of overfished > 99%, probability of overfishing > 99%.

BET-Table 1. Estimated catches (t) of bigeye tuna (Thunnus obesus) by area, gear and flag.

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL	A+M		134933	128148	120803	110280	107994	121541	103510	91051	75658	87487	89981	67956	59192	69998	63172	76426	76041	76606	71457	66954	75019	79524	79109	78585	73366
Landings		Bait boat	20358	25697	18352	21289	19190	22200	12149	14391	8455	11235	20259	13124	10631	10333	6335	11565	7853	12849	10510	9214	8726	8020	6787	8436	7940
		Longline	78908	74872	74930	68312	71857	77227	72011	56123	47351	55356	49400	37961	34182	46231	41063	43533	42516	37899	34930	32245	36769	40362	36321	35156	32032
		Other surf.	967	551	353	534	428	672	451	766	221	447	286	716	527	431	192	241	470	813	1101	2742	4950	5957	6395	7144	4567
		Purse seine	32668	25361	26628	19152	15531	20258	17537	19516	19418	19582	19016	15129	13310	12311	14810	20007	24209	23767	24080	22122	23965	24159	28418	26838	27749
Landings(FP)		Purse seine	2032	1667	540	993	989	1184	1363	257	214	867	1019	1026	542	692	772	1081	994	1277	823	632	609	989	1187	972	1049
Discards		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	2	0	0	27
		Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	38	2
Landings	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	**0**
		Barbados	0	0	0	24	17	18	18	6	11	16	19	27	18	14	14	7	12	7	15	11	26	30	19	16	29
		Belize	0	10	0	5	195	0	134	96	0	0	0	0	4	60	70	234	249	1218	1242	1336	1502	1877	1764	1961	2135
		Brazil	601	1935	1707	1237	776	2024	2768	2659	2582	2455	1496	1081	1479	1593	958	1189	1173	1841	2120	3623	6456	7750	7660	7258	5096
		Canada	111	148	144	166	120	263	327	241	279	182	143	187	196	144	130	111	103	137	166	197	218	257	171	214	237
		Cape Verde	385	271	299	228	140	9	2	0	1	1	1	1077	1406	1247	444	545	554	1037	713	1333	2271	2764	1680	1107	1418
		China PR	428	476	520	427	1503	7347	6564	7210	5840	7890	6555	6200	7200	7399	5686	4973	5489	3720	3231	2371	2232	4942	5852	5514	4823
		Curaçao	0	0	1893	2890	2919	4016	3098	3757	2221	3203	3526	27	416	252	1721	2348	2688	3441	2890	1964	2315	2573	3598	2844	3530
		Côte d'Ivoire	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	790	576	47	507	635	441	12	544	1239	384
		EU.España	22096	17849	15393	12513	7110	13739	11250	10133	10572	11120	8365	7618	7454	6675	7494	11966	11272	13100	10914	10082	10736	10058	11469	11544	8400
		EU.France	12263	8363	9171	5980	5624	5529	5949	4948	4293	3940	2926	2816	2984	1629	1130	2313	3329	3507	3756	3222	3549	2548	4566	4039	4055
		EU.Ireland	0	0	0	4	0	0	0	10	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
		EU.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.Portugal	3099	9662	5810	5437	6334	3314	1498	1605	2590	1655	3204	4146	5071	5505	3422	5605	3682	6920	6128	5345	3869	3135	2187	3146	4405
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	32	0	0	0	0	0	0	0	0	**0**
		El Salvador	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	992	1450	1826	2634
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	90	21	0	28	6	0	2	3	0	2	0	0	0	0	0	0	0	**0**
		Gabon	87	10	0	0	0	184	150	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Ghana	4738	5517	4751	10174	10647	11704	5632	9864	6480	9061	17888	8860	2307	2559	3372	4515	6253	3541	4468	2963	4175	5918	5194	3838	3571
		Grenada	10	10	0	1	0	0	0	0	0	0	0	0	0	10	31	0	0	0	0	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	736	831	998	949	836	998	913	1011	282	262	163	993	340	1103	1602	1488
		Guinea Ecuatorial	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	50	0	58	0	3	10	17	4	11	7
		Guinée Rep.	0	334	2394	885	0	0	0	0	0	0	0	0	0	0	0	0	328	322	1516	1429	902	0	0	0	
		Honduras	0	61	28	59	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Iceland	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Japan	38503	35477	33171	26490	24330	21833	24605	18087	15306	19572	18509	14026	15735	17993	16684	16395	15205	12306	15390	13397	13603	12390	10365	10994	9854
		Korea Rep.	386	423	1250	796	163	124	43	1	87	143	629	770	2067	2136	2599	2134	2646	2762	1908	1151	1039	675	562	432	623
		Liberia	53	57	57	57	57	57	57	57	57	57	0	0	0	0	0	0	0	0	0	0	0	0	27	98	1
		Libya	500	400	400	400	400	400	400	31	593	593	0	0	4	0	0	0	0	0	0	0	0	0	0	0	**0**
		Maroc	977	553	654	255	336	1444	1160	1181	1154	1399	1145	786	929	700	802	795	276	300	300	308	300	309	350	410	500
		Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**0**
		Mexico	4	0	2	6	8	6	2	2	7	4	5	4	3	3	1	1	3	1	1	2	1	2	2	3	3
		Namibia	715	29	7	46	16	423	589	640	274	215	177	307	283	41	146	108	181	289	376	135	240	465	359	141	109
		Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	**0**
		Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Panama	13234	9927	4777	2098	1252	580	952	562	211	0	1521	2310	2415	2922	2263	2405	3047	3462	1694	2774	2315	1289	2337	1664	2067
		Philippines	0	0	0	0	1154	2113	975	377	837	855	1854	1743	1816	2368	1874	1880	1399	1267	532	1323	1964	0	0	0	
		Russian Federation	0	0	13	38	4	8	91	0	0	0	0	1	1	26	73	43	0	0	0	0	0	0	0	0	**0**
		S. Tomé e Príncipe	3	6	4	5	6	5	4	4	4	4	11	6	4	0	92	94	97	100	103	107	110	633	421	393	482
		Senegal	123	357	190	272	789	1372	915	1159	497	322	490	770	1318	1293	734	1144	969	479	436	606	369	1031	1500	2978	2870

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Sierra Leone	0	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		South Africa	79	27	7	10	53	55	249	239	341	113	270	221	84	171	226	159	145	153	47	435	332	193	121	257	282
		St. Vincent and Grenadines	812	519	596	545	1937	2940	1921	1143	130	103	18	0	114	567	171	293	396	38	25	16	30	496	622	889	428
		Trinidad and Tobago	29	27	37	36	24	19	5	11	30	6	5	9	12	27	69	56	40	33	33	37	59	77	37	25	17
		U.S.A.	1402	1209	882	1138	929	1263	574	1085	601	482	416	484	991	527	508	515	571	722	867	881	892	1082	568	836	921
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.Bermuda	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		UK.Sta Helena	6	10	10	12	17	6	8	5	5	4	6	18	25	18	28	17	11	190	51	19	17	44	77	70	45
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0
		Uruguay	37	80	124	69	59	28	25	51	67	59	40	62	83	22	27	201	23	15	2	30	0	0	0	0	0
		Vanuatu	2713	2610	2016	828	0	314	0	0	0	0	104	109	52	132	91	34	42	39	23	9	4	0	0	0	0
		Venezuela	457	457	189	274	222	140	221	708	1241	847	1060	243	261	318	122	229	85	264	98	94	169	132	156	318	202
	NCC	Chinese Taipei	19680	18023	21850	19242	16314	16837	16795	16429	18483	21563	17717	11984	2965	12116	10418	13252	13189	13732	10805	10316	13272	16453	13115	11845	11630
		Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	25	34	22
	NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Benin	9	9	9	30	13	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cambodia	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Congo	9	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	7	7	5	0	0	0	0	0	16	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Dominica	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Faroe Islands	0	0	0	0	0	11	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (ETRO)	356	915	0	7	0	0	0	362	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	8964	10697	11862	16565	23484	22190	15092	7907	383	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	
		Seychelles	0	0	0	0	0	0	58	0	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Sta. Lucia	0	0	0	0	0	0	0	1	2	2	0	2	0	0	0	0	0	0	0	0	0	6	10	24	13
		Togo	23	6	33	33	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings(FP)	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	46	42	16	41	23	0	0	0	
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	75	28	37	38	61	102	40	22	45	97	0	0	0	
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	13	25	20	13	117	59	46	60	34	42	0	0	0	
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	95	45	0	0	0	0	
		EU.España	605	371	58	255	328	487	474	0	0	223	244	143	88	49	190	250	211	216	98	80	143	0	0	0	
		EU.France	970	713	314	437	467	553	607	229	205	446	397	222	79	26	51	150	122	394	192	56	54	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	56	28	15	26	9	18	6	11	5	15	0	0	0	
		Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	72	0	60	20	22	74	203	288	245	209	0	0	0	
		Panama	0	0	0	0	0	0	0	0	0	0	0	151	106	135	97	85	38	70	41	80	27	0	0	0	
	NCO	Mixed flags (EU tropical)	457	582	169	301	193	143	281	28	8	198	378	294	189	348	337	375	324	257	0	0	0	989	1187	972	1049
Discards	CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	38	2
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
		South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	

BET-Table 2. Details of the 18 Stock Synthesis uncertainty grid run specifications for the Atlantic bigeye tuna. M refers to the natural mortality reference (0.28, M ref) and alternative (0.35, M alt).

Stock Synthesis Uncertainty Parameters	Name			Nº scenarios in the grid
CPUE	Joint LL index split (1959-1978 without vessel identification and 1979-2017 with vessels identification)			1
Natural Mortality (M)	M ref (0.28)	M alt (0.35)		2
Steepness (h)	0.7	0.8	0.9	3
Relative importance of the size data (Lambda)		0.1		1
Recruitment annual variation (SigmaR)	0.2	0.4	0.6	3
Total number of scenarios in the grid				**18**

BET-Table 3. Percent of the model runs that resulted in SSB levels <= 10% of SSB_{MSY} during the projection period in a given year for a given catch level (in 1000 t) for Atlantic bigeye tuna.

Catch	Perc0.1 2024	Perc0.1 2025	Perc0.1 2026	Perc0.1 2027	Perc0.1 2028	Perc0.1 2029	Perc0.1 2030	Perc0.1 2031	Perc0.1 2032	Perc0.1 2033
35	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
37.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
40	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
42.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
45	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
47.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
52.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
55	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
57.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
60	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
62.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
65	0%	0%	0%	0%	0%	0%	0%	0%	0%	6%
67.5	0%	0%	0%	0%	0%	0%	6%	17%	17%	17%
70	0%	0%	0%	0%	0%	11%	17%	17%	17%	22%
72.5	0%	0%	0%	0%	11%	17%	17%	28%	33%	33%
75	0%	0%	0%	11%	17%	28%	33%	33%	33%	33%
77.5	0%	0%	6%	17%	28%	33%	33%	33%	56%	56%
80	0%	0%	17%	33%	33%	33%	44%	61%	67%	67%
82.5	0%	6%	22%	33%	39%	61%	61%	67%	67%	78%
85	0%	17%	33%	39%	61%	67%	67%	78%	78%	83%
87.5	0%	28%	39%	50%	61%	67%	78%	83%	83%	94%
90	11%	33%	50%	61%	67%	78%	83%	94%	94%	100%

BET-Table 4. Estimated probabilities of the Atlantic bigeye tuna stock being below F_{MSY} (overfishing not occurring), above B_{MSY} (not overfished) and above B_{MSY} and below F_{MSY} (green zone) in a given year for a given catch level ('000 t), based upon Stock Synthesis 2018 assessment outcomes.

a) Probability of Overfishing Not Occurring (F <= F_{MSY})

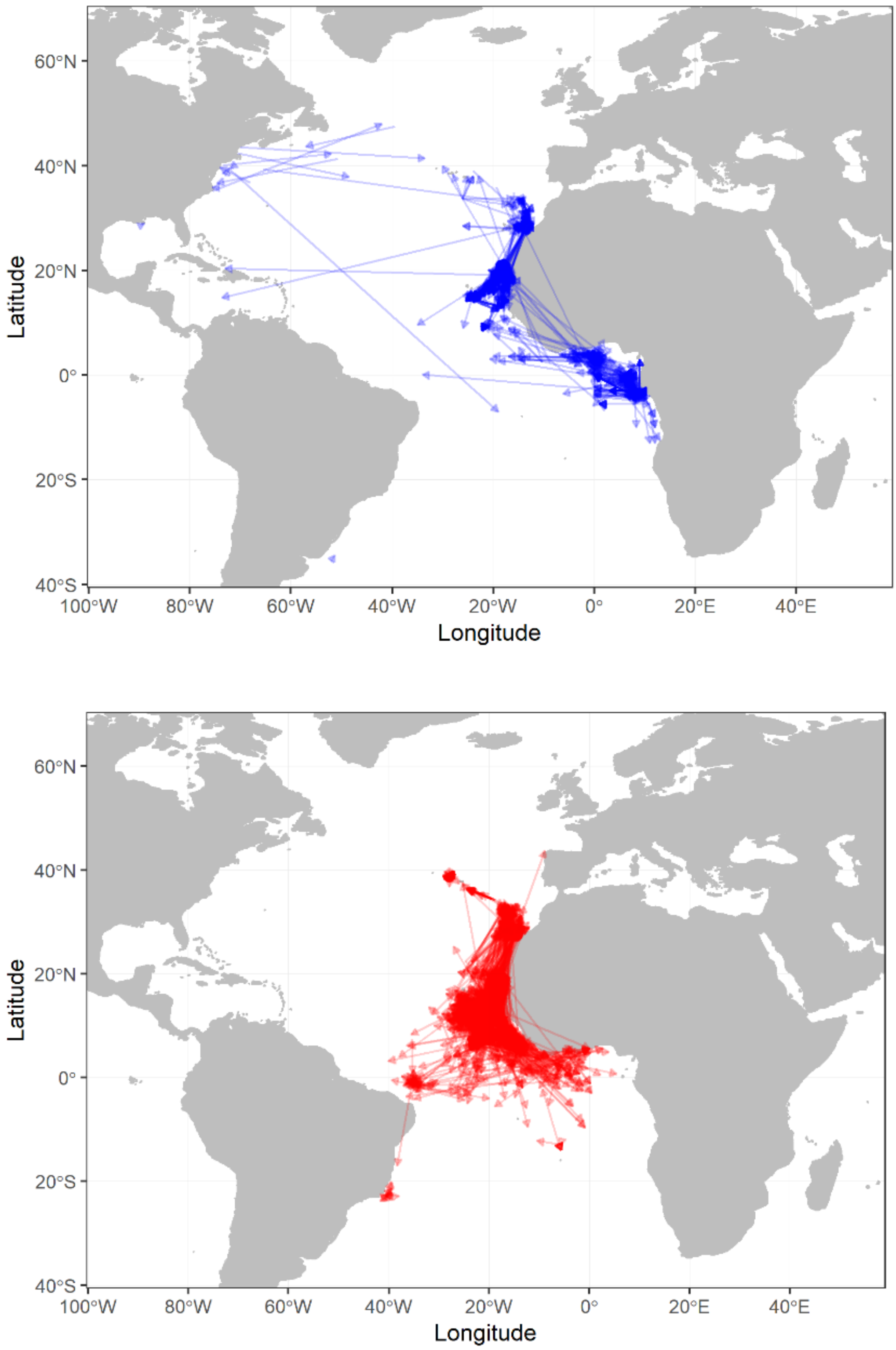
Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
35	93	98	99	100	100	100	100	100	100	100	100	100	100	100	100
37.5	88	95	98	99	100	100	100	100	100	100	100	100	100	100	100
40	80	91	96	98	99	100	100	100	100	100	100	100	100	100	100
42.5	72	85	92	96	98	99	100	100	100	100	100	100	100	100	100
45	63	75	86	91	95	97	99	99	100	100	100	100	100	100	100
47.5	53	67	77	85	91	94	97	98	99	100	100	100	100	100	100
50	44	56	68	76	83	88	92	95	97	98	99	100	100	100	100
52.5	35	46	58	66	75	80	85	89	92	95	96	98	99	99	100
55	28	37	48	55	63	70	75	79	84	87	90	93	94	96	97
57.5	22	29	37	44	52	58	63	69	73	77	79	82	85	88	89
60	17	22	29	35	42	47	51	57	60	64	67	70	72	74	76
62.5	12	17	21	26	32	36	40	45	48	51	53	57	59	60	62
65	9	12	16	19	23	27	32	34	38	40	43	46	47	50	50
67.5	7	8	11	13	16	19	23	27	30	34	36	39	41	42	42
70	4	6	7	9	12	14	16	20	25	28	31	32	33	34	34
72.5	3	5	6	6	8	10	13	17	22	23	23	24	25	24	23
75	2	3	3	5	6	8	11	15	16	16	16	14	12	8	6
77.5	1	2	3	3	4	7	10	11	12	10	7	4	1	1	1
80	1	1	1	2	3	5	8	9	6	3	1	0	0	0	0
82.5	1	1	1	2	3	5	6	5	2	1	0	0	0	0	0
85	1	1	1	1	2	4	4	1	0	0	0	0	0	0	0
87.5	0	0	1	1	2	3	1	0	0	0	0	0	0	0	0
90	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0

b) Probability of Not Overfished (SSB >= SSB_{MSY})

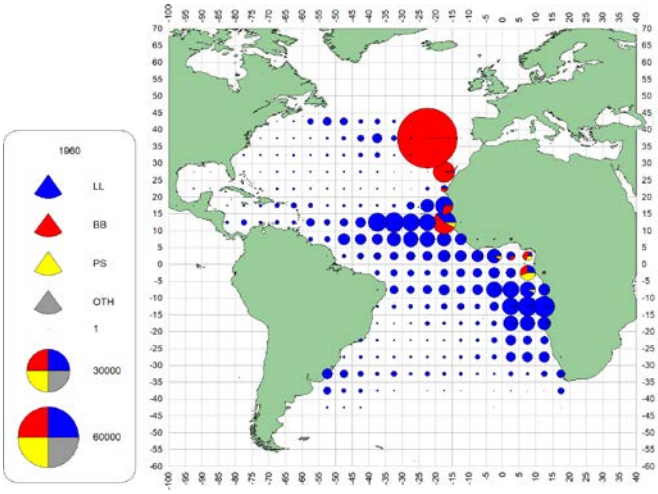
Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
35	0	3	11	26	46	62	77	88	94	97	99	100	100	100	100
37.5	0	3	10	24	41	58	73	82	90	95	98	99	100	100	100
40	0	2	9	21	37	53	67	78	87	93	96	98	99	100	100
42.5	0	2	9	19	33	49	62	73	81	89	94	96	98	99	100
45	0	2	8	17	30	43	56	67	76	84	90	94	96	98	99
47.5	0	2	7	15	26	37	50	60	70	78	84	90	93	96	98
50	0	2	6	13	22	33	44	55	63	70	77	84	88	92	94
52.5	0	2	5	11	20	28	37	47	55	62	70	76	80	85	89
55	0	2	5	10	17	25	32	40	48	55	61	67	72	76	80
57.5	0	2	4	9	14	20	26	35	40	47	52	56	62	67	70
60	0	2	4	7	12	17	23	29	35	39	44	49	52	55	59
62.5	0	1	3	6	10	14	19	24	29	33	37	41	44	48	51
65	0	1	3	5	8	12	16	19	24	28	31	35	38	42	44
67.5	0	1	2	4	7	9	12	16	19	24	28	32	34	36	37
70	0	1	2	3	5	8	10	12	17	20	26	27	27	28	29
72.5	0	1	2	3	4	6	8	11	15	19	18	19	20	19	19
75	0	1	2	3	4	5	7	10	14	13	13	12	9	6	4
77.5	0	1	2	2	3	4	7	9	10	10	7	4	2	1	1
80	0	1	1	2	3	3	5	8	7	4	2	0	0	0	0
82.5	0	1	1	1	2	3	6	6	3	1	0	0	0	0	0
85	0	1	1	1	1	3	4	2	1	0	0	0	0	0	0
87.5	0	0	1	1	1	3	2	1	0	0	0	0	0	0	0
90	0	0	1	1	1	3	1	0	0	0	0	0	0	0	0

c) Probability of Not Overfished (SSB >= SSB_{MSY}) and Overfishing not occurring (F <= F_{MSY})

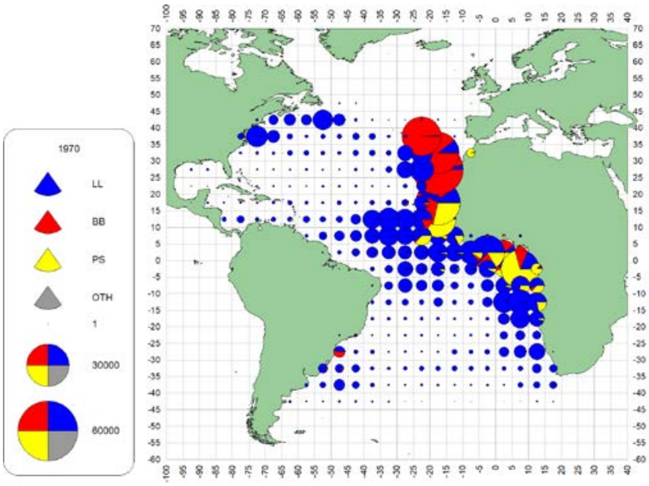
Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
35	0	3	11	26	46	62	77	88	94	97	99	100	100	100	100
37.5	0	3	10	24	41	58	73	82	90	95	98	99	100	100	100
40	0	2	9	21	37	53	67	78	87	93	96	98	99	100	100
42.5	0	2	9	19	33	49	62	73	81	89	94	96	98	99	100
45	0	2	8	17	30	43	56	67	76	84	90	94	96	98	99
47.5	0	2	7	15	26	37	50	60	70	78	84	90	93	96	98
50	0	2	6	13	22	33	44	55	63	70	77	84	88	92	94
52.5	0	2	5	11	20	28	37	47	55	62	70	76	80	85	89
55	0	2	5	10	17	25	32	40	48	55	61	67	72	76	80
57.5	0	2	4	9	14	20	26	35	40	47	52	56	62	67	70
60	0	2	4	7	12	17	23	29	35	39	44	49	52	55	59
62.5	0	1	3	6	10	14	19	24	29	33	37	41	44	48	51
65	0	1	3	5	8	12	16	19	24	28	31	35	38	42	44
67.5	0	1	2	4	7	9	12	16	19	24	28	32	34	36	37
70	0	1	2	3	5	8	10	12	17	20	26	27	27	28	29
72.5	0	1	2	3	4	6	8	11	15	19	18	19	20	19	19
75	0	1	2	3	4	5	7	10	14	13	13	12	9	6	4
77.5	0	1	2	2	3	4	6	9	10	10	6	4	1	1	1
80	0	1	1	2	3	3	5	8	6	3	1	0	0	0	0
82.5	0	1	1	1	2	3	5	5	2	1	0	0	0	0	0
85	0	0	1	1	1	3	4	1	0	0	0	0	0	0	0
87.5	0	0	1	1	1	2	1	0	0	0	0	0	0	0	0
90	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0



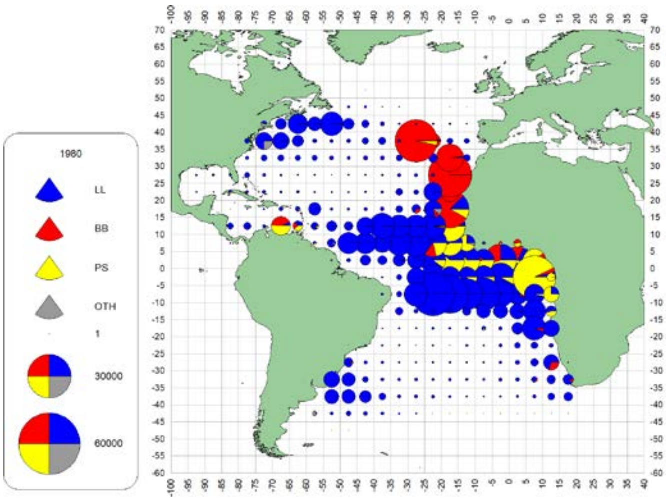
BET-Figure BET-1. Apparent movements (straight line distance between the tagging location and that of recovery) calculated from conventional tagging from the historical ICCAT tagging database (top panel) and the current AOTTP activities (bottom panel).



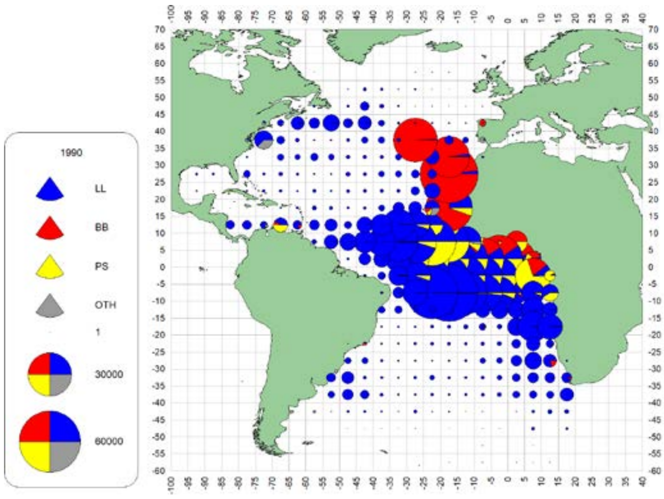
a. BET (1960-69)



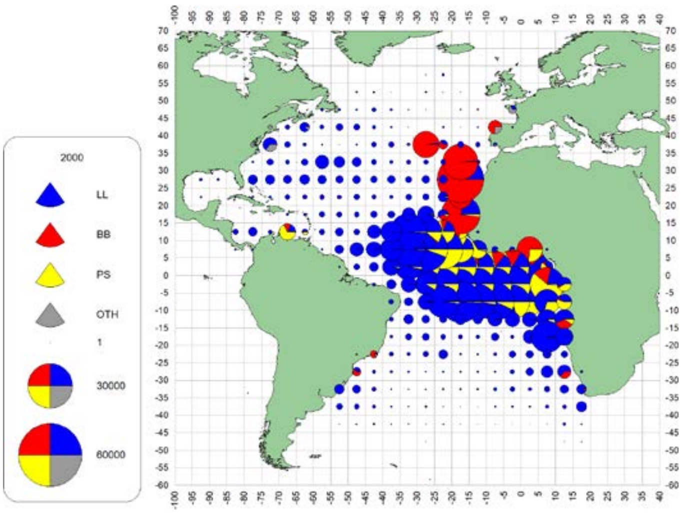
b. BET (1970-79)



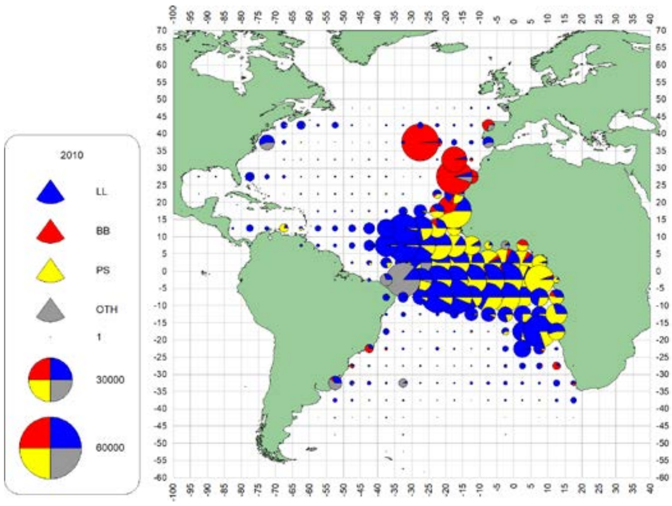
c. BET (1980-89)



d. BET (1990-99)

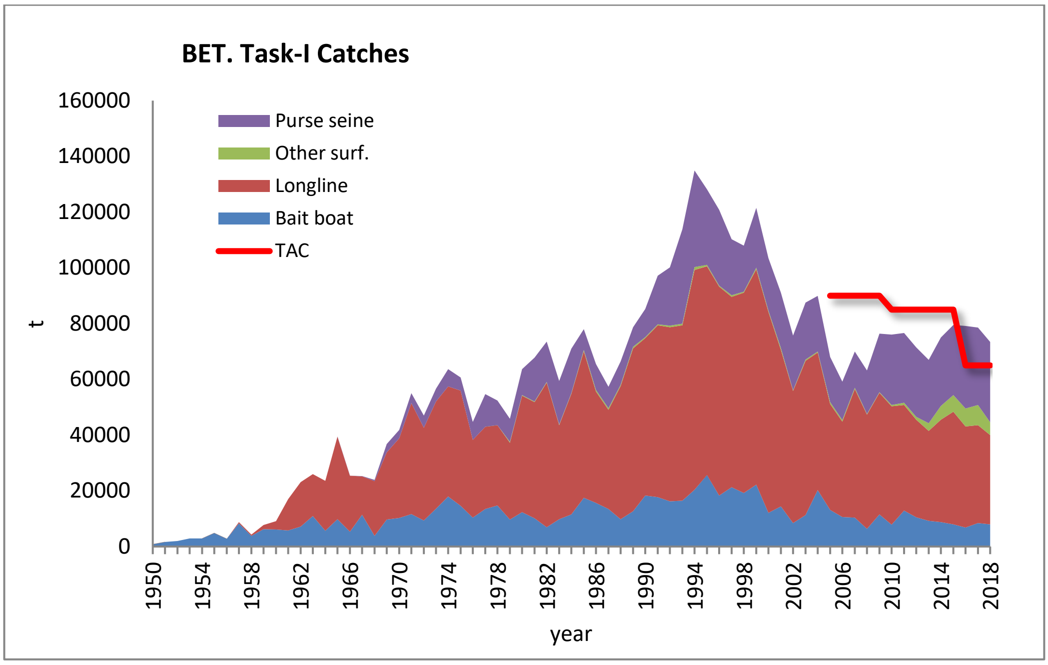


e. BET (2000-09)

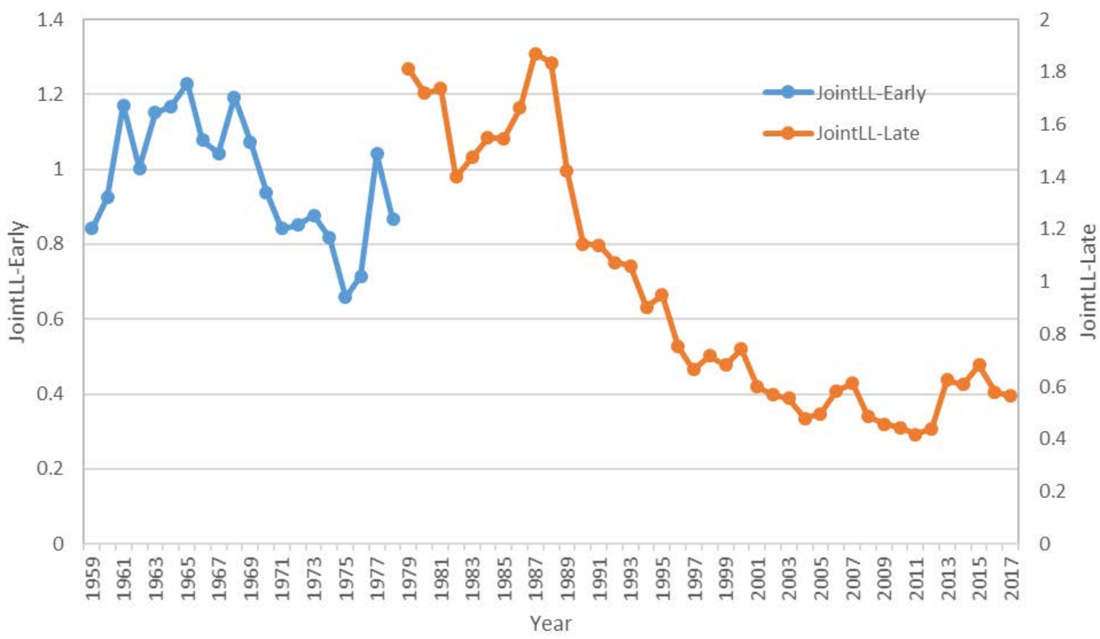


f. BET (2010-17)

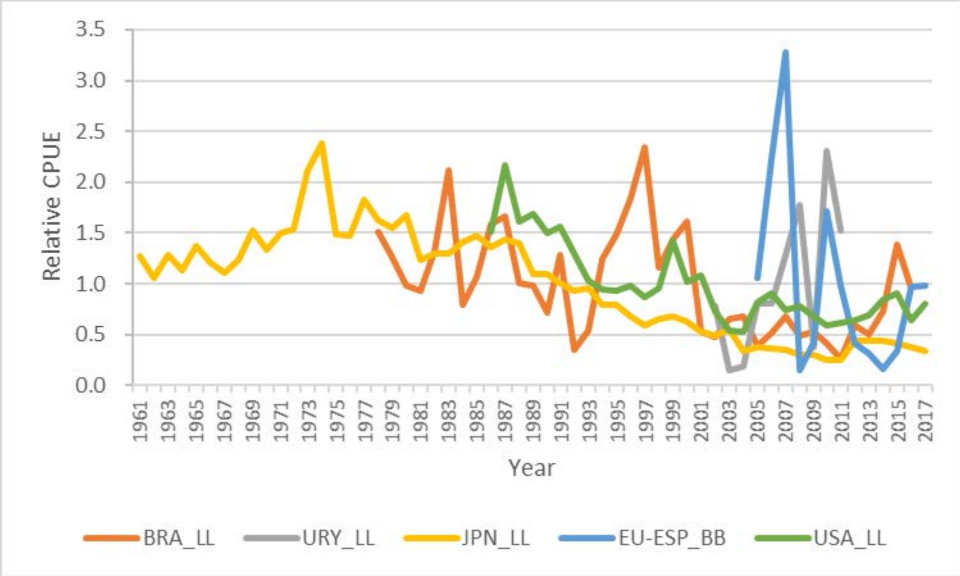
BET-Figure 2 [a-f]. Geographical distribution of the bigeye tuna catch by major gears and decade. The maps are scaled to the maximum catch observed during 1960-2017 (the last decade only covers 8 years).



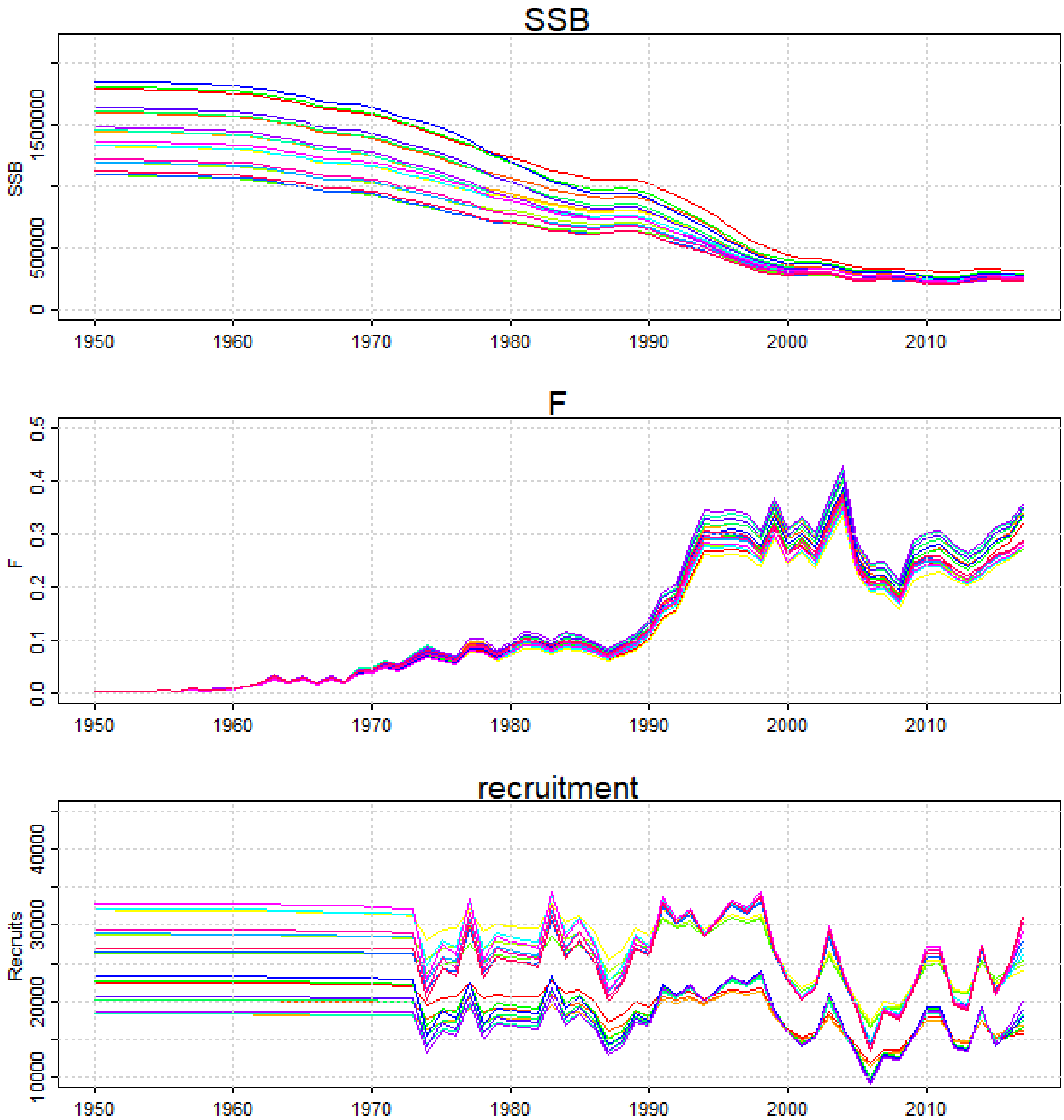
BET-Figure 3. Bigeye estimated and reported catches for all the Atlantic stock (t). The value for 2018 represents preliminary estimates because some countries have yet to provide data for this year or are under revision.



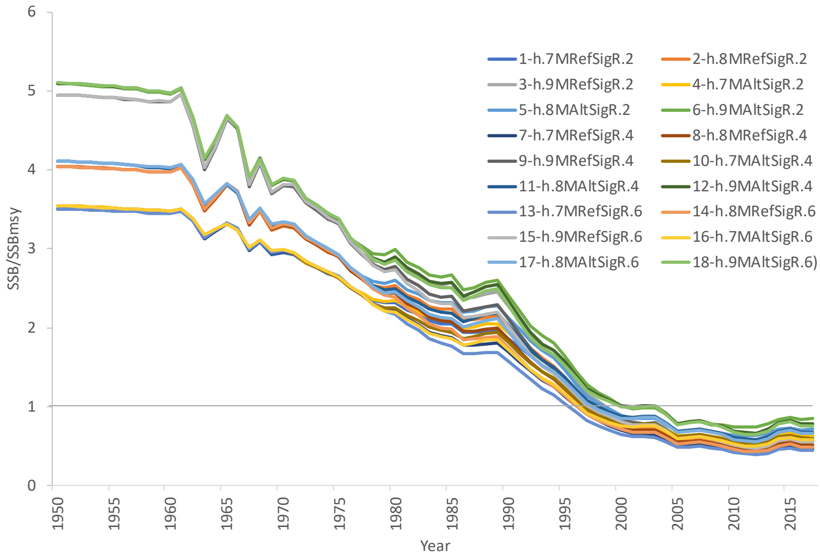
BET-Figure 4. Joint Longline index (1959-1978 without vessel identification and 1979-2017 with vessel identification included in the standardization) used in the integrated stock assessment models and the production assessment models. Note that the second time period of the split index is on the second y-axis.

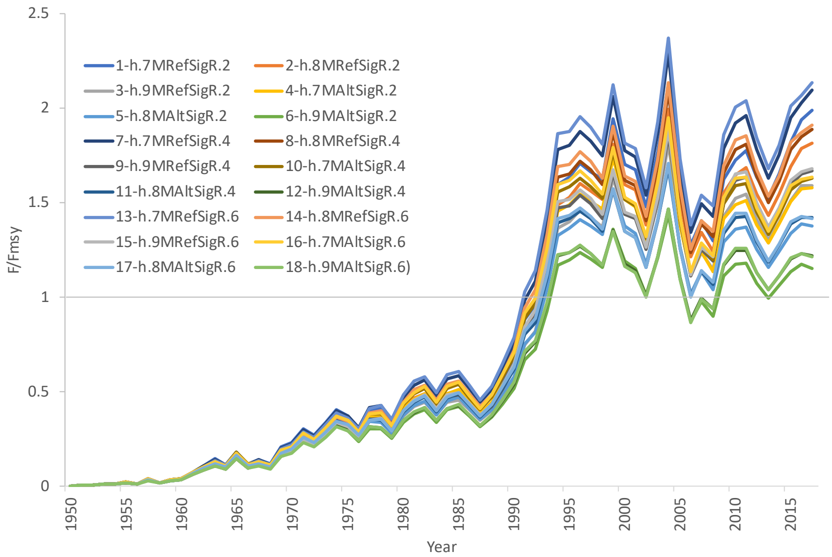


BET-Figure 5. Annual relative indices of abundances for bigeye tuna from different fleets used in the stock assessment as sensitivity runs.

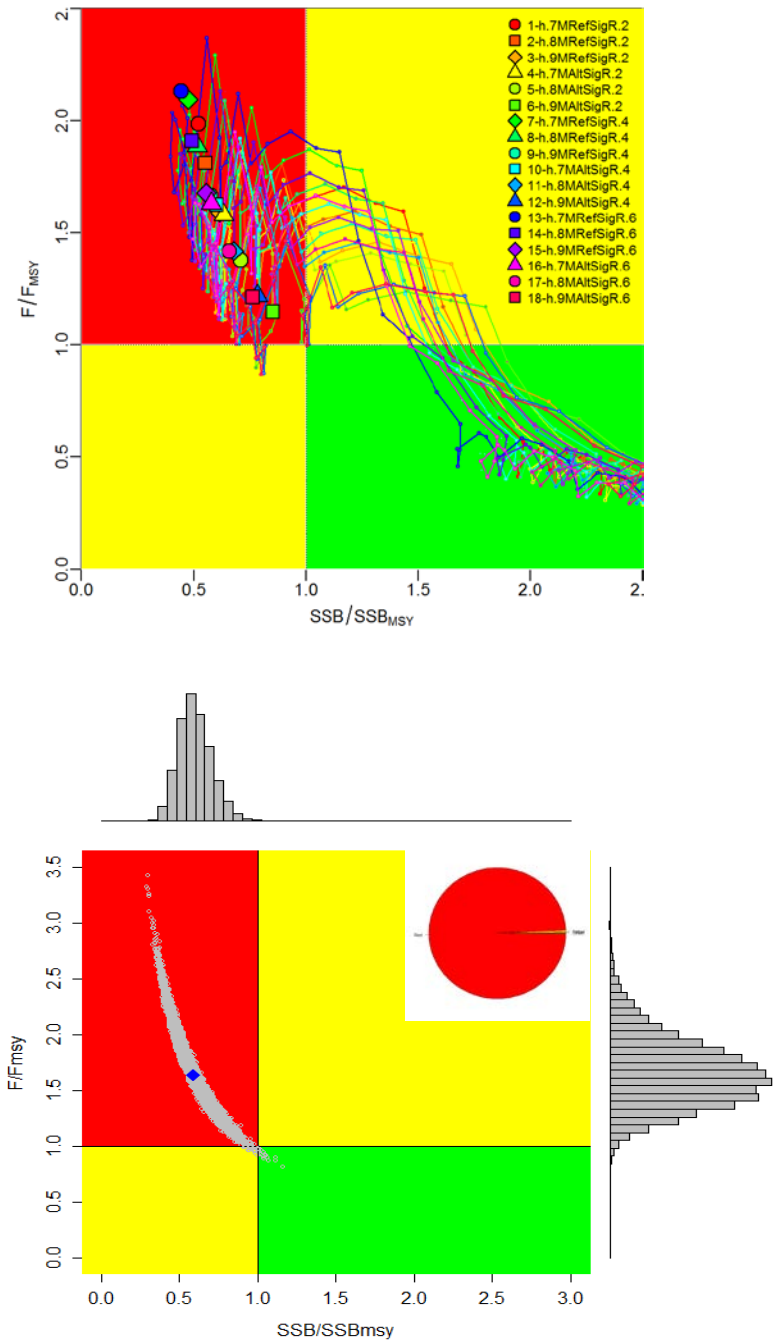


BET-Figure 6. Trajectories of Spawning Stock Biomass (SSB), Fishing mortality (average F on ages 1-7) and recruitment (age 0) for the 18 Stock Synthesis uncertainty grid runs for Atlantic bigeye tuna.

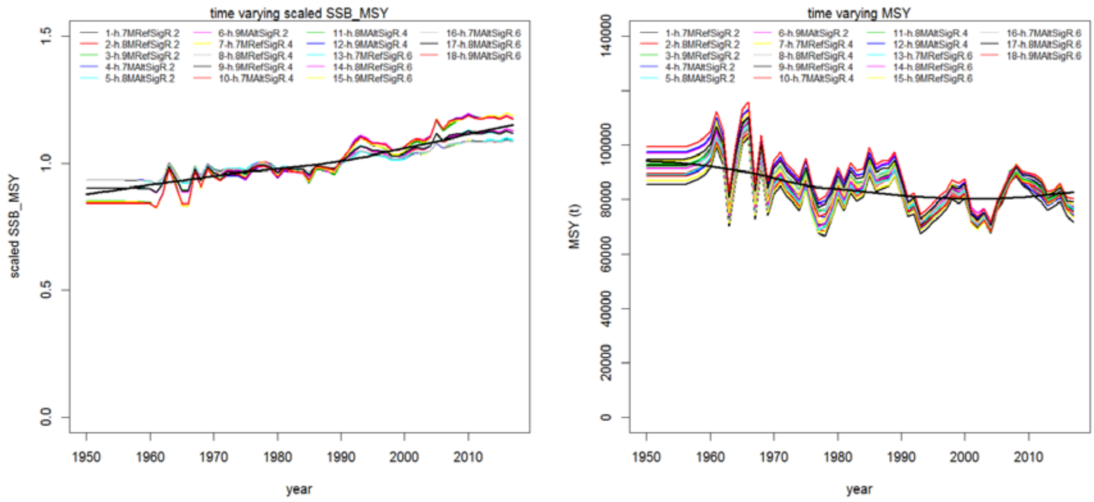




BET-Figure 7. Trajectories of SSB/SSB$_{MSY}$ and F/F$_{MSY}$ estimated from the 18 Stock Synthesis uncertainty grid runs for Atlantic bigeye tuna. For each run the benchmarks are calculated from the year-specific selectivity and fleet allocations.



BET-Figure 8 Stock Synthesis: (a) Kobe phase plot for the deterministic runs of the 18 Stock Synthesis uncertainty grid runs for Atlantic bigeye tuna. For each run the benchmarks are calculated from the year-specific selectivity and fleet allocations. (b) Kobe plot of SSB/SSB_{MSY} and F/F_{MSY} for stock status of Atlantic bigeye tuna in 2017 based on the log multivariate normal approximation across the 18 uncertainty grid model runs of Stock Synthesis with an insert pie chart showing the probability of being in the red quadrant (99.5 %), green quadrant (0.2 %), and in yellow (0.3 %). Blue square is the median and marginal histograms represent distribution of either SSB/SSB_{MSY} or F/F_{MSY}.



BET-Figure 9. Year-specific SSB at MSY and MSY for 18 SS3-uncertainty grid model runs for Atlantic bigeye tuna. Black solid line is a Loess smooth fitted across all runs.

9.3 SKJ – SKIPJACK TUNA

Stock assessments for East and West Atlantic skipjack were conducted in 2014 using catch data available to 2013 (Anon. 2015). The previous assessment of skipjack stocks was only conducted in 2008. This report is an update of that of 2018 covering the most recent information on the state of the stocks on this species.

SKJ-1. Biology

Skipjack tuna is a gregarious species that is found in schools in the tropical and subtropical waters of the three oceans (**SKJ-Figure 1A and B**). Skipjack is the predominant species aggregated to FOBs where it is caught in association with juvenile yellowfin tuna, bigeye tuna and with other species of epipelagic fauna. Skipjack reproductive potential is considered to be high because it reaches sexual maturity around one year and it spawns opportunistically in warm waters above 25ºC throughout the year and in large areas of the ocean. Moreover, the analysis of eastern Atlantic tagging data has confirmed that the growth of skipjack was quicker in sub-tropical waters than in equatorial waters where it produces most of its spawn. These growth differences depending on latitude must be taken into account if the assessments are carried out on separate stocks between sub-tropical and tropical areas. It is also possible that the growth does not follow the conventional Von Bertalanffy model but rather a two-stanza model. The appropriate growth model may be confirmed before the next skipjack stock assessment by using the tag data from the AOTTP. Based on the relationships between life history characteristics and natural mortality, a natural mortality vector decreasing with size has been estimated (**SKJ-Figure 2**). The natural mortality values estimated by this approach are greater than those used in the past for eastern Atlantic skipjack. Lower values have been obtained by another approach which has been applied for the western stock, whose catches are however composed of larger sized individuals than in the eastern stock.

The increasing use of fish aggregation devices (FOBs) since the early 1990s, have changed the species composition of free schools. It is noted that, in fact, the free schools of mixed species were considerably more common prior to the introduction of FOBs. Furthermore, the association with FOBs may also have an impact on the biology (growth rate, plumpness of the fish) and on the ecology (distances, movement orientation) of skipjack and yellowfin ("ecological trap" concept).

SKJ-2. Fishery indicators

Following the historic record in 2013 (259,016 t), the total catches of skipjack throughout the Atlantic Ocean (including catches of *faux poisson*s landed in Côte d'Ivoire) remain high, reaching 305,300 t in 2018 (there still remains an estimated 4.2% non-reported catch, for which in general the average of the last three years has been assumed, **SKJ-Table 1, SKJ-Figure 3**). This represents a very sharp rise compared to the average catches of the five years prior to 2010 (152,643 t). It is possible, however, that the catches of a segment of the Ghanaian purse seine fleet, transshipped on carriers, have escaped the fishery statistics collection process before 2011. In addition, following the expert missions carried out in Ghana which have shown the existence of bias in the sampling protocol which aims to correct the multi-species compositions of the catches reported in the logbooks, Ghanaian Task I and II statistics have been reviewed in several stages (1973-2005). The review for the period 2006-2014 had shown that the skipjack catches reported by Ghana were underestimated by around 28%, which gives an average of 12,000 t/year. Therefore, all of these historical data have consequently been corrected.

The numerous changes that have occurred in the skipjack fishery since the early 1990s (e.g. the progressive use of FOBs and the latitudinal expansion and the westward extension of the fishing area) have brought about an increase in skipjack catchability and in the proportion of biomass exploited. Currently, the major fisheries are the purse seine fisheries, particularly those of Belize, Curaçao, EU-France, EU-Spain, Ghana, Senegal, Panama, and Cabo Verde, followed by the baitboat fisheries of EU-Portugal, EU-Spain, Ghana, and Senegal. The preliminary estimates of catches made in 2018 in the eastern Atlantic amounted to 282,427 t, which is an increase of about 85% as compared to the average of 2005-2009 (**SKJ-Figure 4**). It should be noted that there has been a sharp increase in the skipjack catches by the European purse seiners, probably due to the high selling price of this species from 2011 to mid-2013 (**SKJ-Figure 5**). This increase in catches is accompanied by changes in fishing strategies since the proportion of skipjack catches using floating objects has continued to increase. This is the result to some extent of the sharp reduction in seasonal fishing by European purse seiners on free schools after 2006 off the coast of Senegal and of the emergence as from 2012 of atypical fishing off FOBs since it involves single species schools composed of large individuals off the coast of Mauritania (**SKJ-Figure 1B**). Some changes in fishing zones and strategies has been observed in EU PS at different time-frames due to non-renewal of fishing agreements between EU and some CPCs.

These changes in fishing strategy can take place differently in the purse seine fleets, including in fleets that operated similarly in the past (**SKJ-Figure 6**) and are therefore difficult to integrate into stock assessment models.

The unreported catches of some purse seiners were estimated by comparing the monitored landings in West African ports and cannery data to the catches reported to ICCAT. Estimates of the unreported catches of these purse seiners have increased since 2006 and may have exceeded 20,000 t for the three main species of tropical tunas. The Committee expressed the need for the countries and the industry concerned in the region to cooperate to estimate and report these catches accurately to ICCAT. Recent progress in the transmission and review of data submitted to the ICCAT Secretariat has enabled the Committee to partially include these catches and the associated sizes in the skipjack assessment. The magnitudes of these estimates of IUU catch, however, are likely to influence the assessments and the perception of stock status.

The average rate of discards of skipjack on FOBs by European purse seiners operating in the eastern Atlantic has been estimated based on onboard observer programmes to be 42 kg per t of skipjack landed. Furthermore, the amount of small skipjack (average size 37 cm FL) landed in the local market of Abidjan in Côte d'Ivoire as *faux poissons* has been estimated at 235 kg per t of skipjack landed (i.e. an average of 6,641 t/year between 1988 and 2007 for the European or other CPCs purse seiners, **SKJ-Figure 7**). However, the latest estimates indicate values close to 10,000 t/year between 2005 and 2014 and over 20,000 t/year the last 5 years, for all purse seiners operating in the eastern Atlantic (skipjack representing around 30% of the total *faux poissons*: the species composition in 2014 has not been taken into account because it seems less accurate than in previous years). The Committee regularly incorporates these estimates into the reported historical catches for the EU purse seiners since 1982, as well as in the catch-at-size matrix. The Group needs additional information on modification to the access rights to fishing grounds along the African coast to be able to assess catch trends.

Species composition and catch at size from Ghanaian baitboats and purse seiners, has been thoroughly reviewed during the past few years. This review led to new estimates of Task I and Task II catch/effort and size data for the period 1973-2013. Task II estimations for the period 2006 to 2014 (made by the Secretariat during 2016, Ortiz and Palma, 2017) were updated in order to include the last three years (2015 to 2017) using the same methodology as in 2016.

In the West Atlantic the major fishery is the Brazilian baitboat fishery, followed by the Venezuelan purse seine fleet. The preliminary estimates of catches in 2018 made in the western Atlantic amounted to 22,873 t (there still remains an estimated 10.1% non-reported catch, for which in general the average of the last three years has been assumed), lower than the historic record of 40,272 t in 1985 (**SKJ-Figure 8**).

It is difficult to discriminate a fishing effort between free schools (composed of large yellowfin tunas) and for FOB fishing (targeting skipjack) in the eastern Atlantic because the fishing strategies can change from one year to the next and in addition, the sea time devoted to activities on FOBs and the assistance provided by supply vessels are difficult to quantify. The Committee recognizes that the use of data series on the yearly progression of the sale prices of tropical species by commercial category enables identification of the years when skipjack is most targeted by the purse seiners (which seems to be the case in the past few years, **SKJ-Figure 6**). Nominal purse seine effort, expressed in terms of carrying capacity, has decreased regularly since the mid-1990s up to 2006. However, after this date, several European Union purse seiners have transferred their effort to the eastern Atlantic, due to piracy in the Indian Ocean, and a fleet of new purse seiners have started operating from Tema (Ghana), whose catches are probably underestimated. All this has contributed to the growth in carrying capacity of the purse seiners, which is gradually nearing the level observed in the early 1990s (**SKJ-Figure 9, SKJ-Table 2**). The nominal effort of baitboats has remained stable for over 20 years. By 2010, overall carrying capacity of the purse seine fleet had increased significantly, to about the same level as in the 1990s, and has increased by nearly 50% since. The above number do not include all purse seine vessels currently fishing for tropical tunas in the Atlantic. The total number of purse seine vessels (estimated by the Committee) targeting tropical tunas in the eastern Atlantic has increased in the last five years by 18%, from 49 in 2014 to 58 in 2018. FOB based fishing has accelerated even more rapidly than free school fishing.

It is recognized that the increase in fishing power linked to the introduction of technological innovation on board the vessels as well as to the development of fishing using floating objects has resulted in an increase in the efficiency of the various fleets, since the early 1980s. In order to take into account the effect of the technological changes in skipjack catchability, an annual yearly growth of 3% is generally assumed as the working hypothesis, although an analysis carried out fixing the MSY and K at the values estimated in the previous stock assessment would suggest an increase in catchability between 1 and 13% per year.

Moreover, the estimates on growth in bigeye catchability, whose juveniles are also captured using FOBs, would indeed indicate a value of 2.5% per year before 1991 and 6 to 8% thereafter. However, it is not known whether these estimates only reflect technological changes, or the availability of fish as well, resulting from the expansion of the surface area exploited over the years, reaching its historic high in 2013 and which corresponds to the expansion of the fishery towards the West Central Atlantic or more recently to the level of the North and South latitudes (**SKJ-Figure 10**).

The increase in total mortality (Z) between the early 1980s and the late 1990s, estimated using different methods, such as the tag-recovery model, the catch curves by size and the average size observed in the yearly catches, is consistent with an increase in catchability. The steady decrease in average weight up to 2011 (**SKJ-Figure 11**) is also consistent with the fact that the purse seine fleet has increased pressure on juvenile tunas. This trend has reversed since 2012 and at the same time a broadening of the range of sizes caught is observed (**SKJ-Figure 12**). Generally, except the East Pacific, it has been noted that the average skipjack weight observed in the eastern Atlantic (close to 2 kg) was much lower than the estimates provided for the other oceans (close to 3 kg).

With respect to the West Atlantic, the fishing effort of the Brazilian baitboats, which constitute the main skipjack fishery in this region, decreased by 30% in recent years, promoting a reduction in catches. No marked trend regarding the structure of catches by size has been observed (**SKJ-Figure 13**).

SKJ-3. State of the stocks

In all the oceans, the traditional stock assessment models are difficult to apply to skipjack because of their particular biological and fishery characteristics (on the one hand, continuous spawning, spatial variation in growth and on the other, discrimination of effort for free schools and FOBs, transition between these two fishing methods which are difficult to quantify). In order to overcome these difficulties, several assessment methods, conventional and non-conventional (based solely on catches, or on development of average size) have been applied to the two stocks of Atlantic skipjack. Several fishery indicators have also been analysed in order to track the development of the state of the stock over time.

Based on the large geographic distances between the fishing areas and current knowledge on small-scale migrations of skipjack in the Atlantic (**SKJ-Figure 1A and B** and **SKJ-Figure 14**), the Committee has also analyzed the possibility of using smaller stock units. While recognizing the validity of this approach, the Committee does not currently have evidence, such as a sufficient amount of tag-recovery data covering the entire tropical ocean, in order to validate smaller stock units. Consequently, the Committee has decided to maintain the working hypothesis which favours two different units of eastern and western stocks but on an experimental basis to assess a sub-unit in each of the two stocks. The use of smaller areas has however been recommended to monitor the development over time of fishery indicators. It is expected that the five year Atlantic Tropical Tuna Tagging Programme (AOTTP), may improve our understanding of skipjack stock structures and movement patterns.

Eastern stock

The Committee has analyzed two standardized fishery indices from the EU-purse seine fishery: an index which accounts for skipjack caught in free schools off the coast of Senegal up to 2006 and the second index which characterizes fish captured off FOBs and in free schools in the equatorial area (**SKJ-Figure 15**). The increase in CPUE of the European purse seiners in the late 1990s is partly the consequence of the increase in the catches of positive sets under FOBs, in particular for Spanish vessels since 2011 (**SKJ-Figure 16**). In addition, the introduction of the price of skipjack (price adjusted for inflation) into the standardization of the CPUE has not improved the fit. Furthermore, the regular increase in the skipjack yields of the baitboats based in Senegal may only be the result of an increase in catchability linked to the adoption of the so-called "baitboat associated school" fishing towards the mid-1980s (**SKJ-Figure 15**). No marked trend has been observed for the Canary Islands baitboats, nor for the peripheral fishery of the Azorean baitboat fishery. Although the Committee has only considered a single stock for the eastern Atlantic, due to the very low apparent exchange rates between the sectors (based on available information, only 0.9% of tagged fish on both sides of the latitude 10ºN have exceeded this limit), a decrease in abundance for a local segment of the stock would probably have little repercussion on abundance in other areas (refer to notion of stock viscosity).

Regardless of the model used: 2 surplus biomass production models (one non-equilibrium conventional model, and one Bayesian model), a model based only on catch and a mortality estimation model based on the average sizes of fish captured, the Committee was not in a position to provide a reliable estimate of the maximum sustainable yield and therefore nor provide advice on the state of the eastern stock. This applies in the Bayesian case, (1) after testing different working hypotheses on the a priori distribution of the input parameters of the surplus production model (i.e. the growth rate and the carrying capacity), and on the impact of the growth of the catchability coefficient on the CPUE of each fleet, and (2) after performing a retrospective analysis in the case of the catch-only based model. The absence of definition of a fishing effort associated with FOBs for the purse seiners, the difficulty of taking into account changes in catchability, the lack of marked contrast in the datasets despite the historical development of the fishing pressure (**SKJ-Figure 9**) and the fact that the catches and the CPUEs have increased in parallel in recent years are constraints for effective use of the classic stock assessment methods. The Committee has also highlighted that it is difficult to estimate the MSY in conditions of continuous growth of catches without having reliable indicators on the response of the stock to these increases. These indicators may be improved CPUE series, fishing mortality estimates from tagging programmes or other indicators on the exploitation of this species.

Even if caution must be exercised when formulating a diagnosis on the state of the stock in the absence of quantification by an adequate approach, there is no evidence of a fall in yield, or in the average weight of individuals captured (**SKJ-Figure 11**). The estimated value of the MSY, according to the catch-only assessment model, has tended to increase in recent years but at a growth rate that is lower than that observed for the catches for the same period. However, according to this model, although it is unlikely that the eastern skipjack stock is overexploited, current catches could be at, even above, the MSY.

As in the past, it is difficult to know whether this hypothesis can be applied to all spatial components of this stock in the eastern Atlantic, due to the moderate exchange rates which seem to exist between the different sectors of this region. The Committee considers that the MSY should be higher than that estimated in the 2008 assessment in a different exploitation plot to the current one, but cannot express an opinion on the level of the new MSY and the sustainability of the current catches, nor on the repercussions of this exploitation plot on juveniles of the two other species of tropical tunas.

Taking into account the biological and fishery specificities of skipjack, the Committee has attempted to develop Harvest Control Rules based on the proportion of individuals whose sizes are larger than the reference sizes (e.g. size at sexual maturity, the size corresponding to the length which maximizes the catches for a given cohort, etc.). The Committee recommends, however, that due to the multi-species nature of the tropical tuna fishery, the HCRs on skipjack take into account the consequences of targeting skipjack on the other two species of tropical tunas.

Western stock

The CPUEs in the West were those of the Brazilian baitboat, those of the Venezuelan purse seiner, the US pelagic longline and a larval index (**SKJ-Figure 17**).

In addition, the average weight of skipjack caught in the western Atlantic is higher than in the eastern (3 to 4.5 kg compared to 2 to 2.5 kg), at least for the Brazilian baitboat fishery.

The model based on catches and the non-equilibrium surplus biomass production model have estimated respectively the MSY at 30,000 t - 32,000 t (which remains close to the previous estimates in the order of 34,000 t). The fishing mortality vector estimated by a method based on the development of average size of individuals captured over time (mainly from Brazilian catches) shows a profiles which is very close to that estimated by the non-equilibrium surplus biomass model (**SKJ-Figure 18**).

It should be emphasized that all these analyses rest on the assumption of a single western stock from the US coast to Brazil and correspond to the current geographic coverage of this fishery.

For the western Atlantic stock, in light of the information provided by the trajectory of B/B_{MSY} and F/F_{MSY} ratios (**SKJ-Figure 19**), it is unlikely that the current catch is larger than the replacement yield.

SKJ-4. Effect of current regulations

There is currently no specific regulation in place for skipjack tuna. Several time/area regulatory measures on banning fishing on FOBs (Rec. 98-01, Rec. 99-01, Rec. 14-01 and Rec. 16-01) or on complete closure to surface fleets (Rec. 04-01) have however been implemented in the eastern Atlantic but the intended aim was to protect yellowfin and bigeye tuna juveniles.

The Recommendation (Rec. 15-01) establishes a moratorium on FOB fishing in the area that extends from to 4ºS and 5ºN latitude and from African coast to 20ºW longitude during the months of January and February, entered into force in 2016.

The efficacy of the area-time closure agreed in Rec. 15-01 was evaluated by examining fine-scale (1ºx1º) skipjack, yellowfin, and bigeye catch by month distributions. After reviewing this information, the Committee concluded that the moratorium has not been effective at reducing the mortality of juvenile bigeye tuna, and any reduction in yellowfin tuna mortality was minimal, largely due to the redistribution of effort into areas adjacent to the moratorium area and increase in number of fishing vessels. The efficacy of the area-time closure of Rec. 16-01 is described in section 19.2 of this report.

SKJ-5. Management recommendations

Despite the absence of evidence that the eastern stock is overexploited, but considering (1) the lack of quantitative findings for the eastern stock assessment, and (2) pending the submission of additional data (including on FOBs and on the ongoing AOTTP) which are necessary to improve the stock assessment, the Committee recommends that the catch and effort levels for the eastern stock do not exceed the level of 2012-2013 catch or effort. The catches in 2016-2018 exceeded that level by 6%, 11% and 28%, respectively. In addition, the Commission should be aware that increasing harvests and fishing effort for skipjack could lead to involuntary consequences for other species that are caught in combination with skipjack in certain fisheries (particularly juveniles of yellowfin and bigeye). For the West Atlantic, the Committee recommends that the catches should not be allowed to exceed the MSY.

The Committee recommends improvements in the estimation of *faux poissons* that is mainly composed of skipjack so that the uncertainty of the total skipjack catches are reduced.

ATLANTIC SKIPJACK SUMMARY TABLE

	East Atlantic	**West Atlantic**
Maximum Sustainable Yield (MSY)		Around 30,000-32,000 t
Current yield (2018[1])	282,427 t	22,873 t
Current Replacement Yield	Unknown	Somewhat below 32,000 t
Relative Biomass (B_{2013}/B_{MSY})	Likely >1	Probably close to 1.3
Mortality due to fishing (F_{2013}/F_{MSY})	Likely <1	Probably close to 0.7
Stock Status		
Overfished:	Not likely	Not
Overfishing:	Not likely	Not
Management measures in force	Rec. 16-01	None

[1] Reports of catches for 2018 should be considered provisional.

SKJ-Table 1. Estimated catches (t) of skipjack tuna (*Katsuwonus pelamis*) by area, gear and flag.

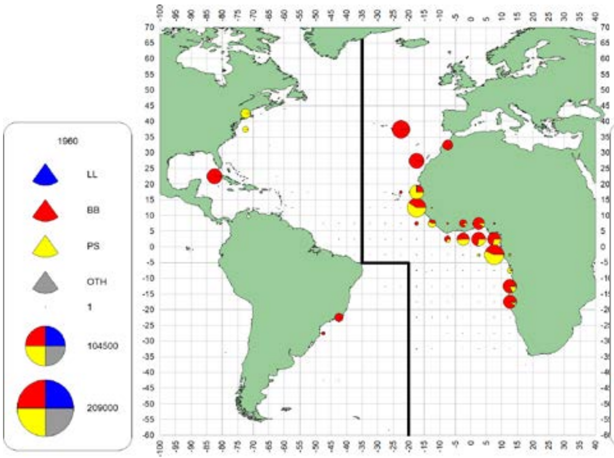
				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL				191386	174793	157191	148928	161471	180840	155521	163633	122642	155504	182020	172499	138376	143635	145104	163603	189740	219463	251511	259016	232405	241903	257289	268506	305300
	ATE			161437	152933	129629	117217	132384	153484	126328	132182	101042	130755	154558	143982	111924	118192	123082	137828	163875	187073	218663	224143	205208	221192	235206	244938	282427
	ATW			29949	21860	27562	31712	29087	27356	29193	31451	21600	24749	27461	28517	26453	25443	22022	25774	25866	32390	32848	34872	27196	20711	22083	23568	22873
Landings	ATE		Bait boat	37821	33955	35947	37288	46804	44915	33759	56702	31195	34466	54917	48601	44788	43451	31908	35119	38632	38456	44843	30746	25709	23848	29002	25786	32944
			Longline	10	3	7	47	85	42	48	53	59	83	67	83	204	428	199	59	46	35	58	79	54	21	540	498	113
			Other surf.	311	308	323	131	930	288	2335	662	534	385	1008	2351	5181	3323	3749	5121	5073	5491	6740	7199	2158	2521	2496	4689	5077
			Purse seine	107434	105657	89135	72002	76849	99003	79552	72760	67589	89053	90610	87659	58570	65764	81431	89059	111919	133696	160113	179826	170369	183211	190383	202675	232590
	ATW		Bait boat	22855	17744	23741	27045	24727	23881	25641	25142	18737	21990	24082	26028	23766	23898	20702	23518	22803	29468	30693	32187	24814	17538	16810	14647	15053
			Longline	16	36	21	7	21	58	22	60	334	95	206	207	286	52	49	20	854	352	62	1194	464	206	804	291	319
			Other surf.	1367	2021	450	313	513	481	467	951	413	367	404	316	355	283	370	202	265	710	511	584	837	709	1520	5693	4767
			Purse seine	5712	2059	3349	4347	3826	2936	3063	5297	2116	2296	2769	1967	2045	1209	901	2035	1943	1859	1582	908	1081	2259	2950	2937	2734
Landings(FP)	ATE		Purse seine	15860	13010	4217	7749	7716	9237	10634	2004	1666	6769	7956	5288	3181	5226	5796	8471	8205	9395	6909	6293	6918	10960	12785	11196	11647
Discards			Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	631	0	94	56
	ATW		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Landings	ATE	CP	Algerie	0	0	0	0	171	43	89	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Angola	7	3	15	52	2	32	14	14	14	14	10	0	0	0	0	50	636	44	91	514	0	1	1	1	**0**
			Belize	0	0	0	0	720	0	229	278	0	0	0	0	0	0	0	1373	2714	7429	15554	6218	10779	12599	7730	9958	20748
			Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Cape Verde	1176	1585	581	858	1245	1040	789	794	398	343	1097	7157	4754	5453	4682	4909	5155	7883	5535	16016	15254	17600	10925	7823	7852
			China PR	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Curaçao	0	0	7096	8444	8553	10045	11056	15450	7246	12084	10225	101	3042	1587	6436	9143	9179	11939	12779	17792	18086	19621	22180	20660	24539
			Côte d'Ivoire	0	0	0	0	0	0	1173	259	292	143	559	1259	1565	1817	2328	2840	2840	5968	10923	8063	2365	254	675	1534	22
			EU.España	50538	51594	38538	38513	36008	44520	37226	30954	25466	44837	38751	28178	22292	23723	35124	36722	41235	56908	67040	66911	51628	46085	52110	57458	52912
			EU.Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.France	32779	25188	23107	17023	18382	20344	18183	16593	16637	19899	21879	14850	7034	4168	4439	7789	14749	13067	13139	16242	17406	20563	19435	16574	22862
			EU.Germany	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**0**
			EU.Greece	0	0	0	0	0	0	0	0	0	102	99	99	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Ireland	0	0	0	0	0	0	0	0	0	0	14	14	14	0	0	8	6	0	0	0	0	0	0	7	**0**
			EU.Italy	0	0	0	0	0	0	0	0	4	29	34	17	0	0	0	0	0	0	0	0	0	0	47	57	91
			EU.Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95	0	0	6	**0**
			EU.Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1
			EU.Portugal	7528	4996	8297	4399	4544	1810	1302	2167	2958	4315	8504	4735	11158	8995	6057	1084	12974	4143	2794	4049	1712	1347	708	1785	7480
			EU.Rumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6970	16949	14577	17045
			Gabon	11	51	26	0	59	76	21	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Ghana	21258	18607	24205	26380	43612	54088	36517	57540	40194	34435	47746	54209	31934	35419	38648	43922	45505	44169	54264	48131	50146	62114	54883	57907	66787
			Guatemala	0	0	0	0	0	0	0	0	0	2120	4808	6389	4959	5546	6319	4036	2951	2829	3631	4907	5811	7078	7386	9800	8648
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1224	1224	1010	0	1	1	3	1	0	1
			Guinée Rep.	0	975	6432	2408	0	0	0	0	0	0	0	0	0	0	0	0	1500	1473	7942	7363	5484	0	0	0	
			Japan	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	4	5	2	4	1	1	3
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	61	80	49	98	21	19	29
			Maroc	3672	6886	2859	5532	4741	4176	4091	1737	1303	3403	3843	4666	4032	1592	1309	2580	2343	2151	2267	2045	1068	576	258	750	3585
			Namibia	2	15	0	1	0	0	0	8	0	0	0	0	0	0	0	71	2	2	15	1	0	0	1	1	0
			Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	12	4	0	0	0	6	2	**0**
			Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Panama	12978	14853	5855	1300	572	1308	1559	281	342	0	7126	11490	13468	18821	8253	8518	9590	12509	10927	14558	14165	8372	11510	8815	9089
			Russian Federation	1471	1450	381	1146	2086	1426	374	0	0	0	0	0	392	1130	313	260	0	20	0	0	2	1	1	110	178
			S. Tomé e Príncipe	190	180	187	178	169	181	179	179	179	179	117	166	143	0	229	235	241	247	254	260	266	360	380	346	362
			Senegal	64	282	238	429	1983	1784	1357	1284	1178	639	1456	5033	3858	4552	3045	4566	2743	5441	4477	4659	3931	5943	17082	25431	28476
			South Africa	4	4	1	6	2	1	7	1	1	2	2	1	0	0	4	4	2	6	8	2	5	2	2	1	2
			St. Vincent and Grenadines	2184	1847	1501	1191	1441	2127	1422	1435	524	42	0	0	1	0	0	0	0	0	0	0	0	0	0	8	**0**
			Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	38	36	0	0	0	15	17	0	0	0	0	**0**
			U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			UK.Sta Helena	55	115	86	294	298	13	64	205	63	178	317	321	88	110	45	15	25	371	29	7	26	6	127	9	7
			Vanuatu	10896	8477	5992	1233	0	1192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Venezuela	0	0	0	0	0	0	0	35	2407	1197	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	10	3	5	47	73	39	41	24	23	26	16	10	9	14	19	6	11	15	2	12	9	4	2	2	3

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		NCO	Benin	2	2	2	7	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cayman Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Congo	7	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (ETRO)	744	2803	0	27	0	0	0	760	148	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATW	CP	Barbados	6	6	5	5	10	3	3	0	0	0	0	0	0	0	0	0	0	1	2	0	1	1	1	2	1
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	164	0	**0**
			Brazil	20588	16560	22528	26564	23789	23188	25164	24146	18338	20416	23037	26388	23270	24191	20846	23307	23456	30571	30863	32438	25195	18133	18231	20068	19687
			Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94
			Curaçao	40	35	30	30	30	30	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	100	123	157
			EU.España	0	0	0	0	0	1	1	0	0	0	0	0	0	5	11	0	0	0	0	0	0	0	641	223	109
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	10	0	0	0	0	25	224	282
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	4	9	0	0	23	0	0	0	0	0	0	**0**
			EU.Portugal	0	0	0	0	0	0	4	1	0	3	3	5	21	11	0	6	0	8	0	0	0	0	0	0	**0**
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	35	135	27
			Grenada	11	12	11	15	23	23	23	15	14	16	21	22	15	26	20	0	0	0	0	0	0	0	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	86	54
			Japan	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	**0**
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Mexico	1	0	2	3	6	51	13	54	71	75	9	7	10	7	8	9	7	9	8	5	5	7	10	6	6
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	543	410	161	185	0	**0**
			St. Vincent and Grenadines	56	53	37	42	57	37	68	97	357	92	251	251	355	90	83	54	46	50	0	36	39	47	0	78	36
			Trinidad and Tobago	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			U.S.A.	99	82	85	84	106	152	44	70	88	79	103	30	61	66	67	119	54	87	112	117	183	94	179	199	78
			UK.Bermuda	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0
			Venezuela	6697	2387	3574	3834	4114	2981	2890	6870	2554	3247	3270	1093	2008	921	757	2250	2119	1473	1742	1002	1179	2019	2317	2222	2186
		NCC	Chinese Taipei	7	2	10	1	2	1	0	1	16	14	27	28	29	2	8	0	2	1	11	1	2	21	17	34	32
			Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	552	0	0	0	0	**0**
		NCO	Argentina	1	0	1	0	2	0	1	0	0	0	30	0	0	0	0	3	12	0	0	0	0	0	0	0	
			Colombia	789	1583	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	1268	886	1000	1000	651	651	651	0	0	624	545	514	536	0	0	0	0	0	0	0	0	0	0	0	
			Dominica	43	33	33	33	33	85	86	45	55	51	30	20	28	32	45	25	0	13	0	4	41	16	27	28	
			Dominican Republic	257	146	146	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Jamaica	0	0	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
			Sta. Lucia	86	72	38	100	263	153	216	151	106	132	137	159	120	89	168	0	153	143	109	171	139	87	138	142	122
Landings(FP)	ATE	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	395	368	179	636	301	0	0	0	
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	419	131	162	276	603	726	411	230	428	1362	0	0	0	
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	88	171	116	105	917	415	441	545	520	351	0	0	0	
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	562	544	202	0	0	0	
			EU.España	4719	2899	453	1990	2562	3802	3700	0	0	1738	1907	713	437	366	1158	1994	1394	1842	983	998	1623	0	0	0	
			EU.France	7573	5568	2447	3414	3647	4316	4740	1786	1601	3484	3096	918	346	206	287	1120	743	1480	1646	463	440	0	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	260	69	66	162	59	136	51	102	72	93	0	0	0	
			Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	387	0	330	118	359	614	1778	2379	1670	2146	0	0	0	
			Panama	0	0	0	0	0	0	0	0	0	0	0	796	548	977	693	680	354	609	284	962	400	0	0	0	
		NCO	Mixed flags (EU tropical)	3568	4543	1316	2345	1508	1119	2194	218	65	1547	2953	1708	1478	3003	2998	2624	3427	2372	0	0	0	10960	12785	11196	11647
Discards		CP	Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	631	0	94	56
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATW	CP	Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

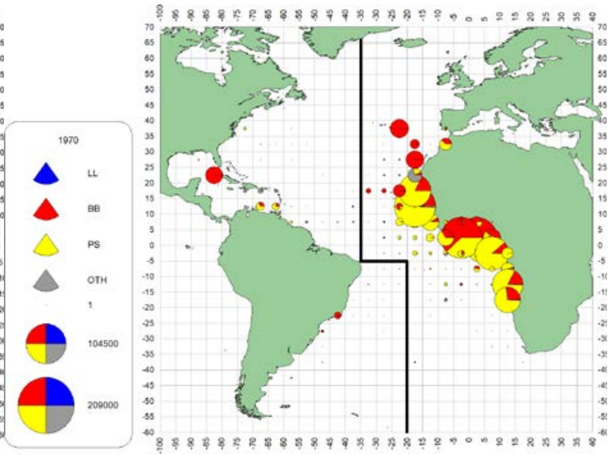
SKJ-Table 2. Number of large PS with active fishing operations per year in the eastern tropical tuna fisheries (not including support vessels)*.

Flag	2014	2015	2016	2017	2018
Neth. Antilles	2				
Belize	3	2	2	3	2
Cape Verde	3	4	2	1	1
Curaçao		4	5	5	5
Cote d' Ivoire	1	0	0	0	0
El Salvador	0	2	4	4	4
Spain	15	12	10	10	10
France	9	9	11	10	10
Ghana	12	12	13	13	15
Guatemala	2	2	2	2	2
Panama	2	3	2	2	2
Senegal	0	3	4	5	7
Total	49	53	55	55	58

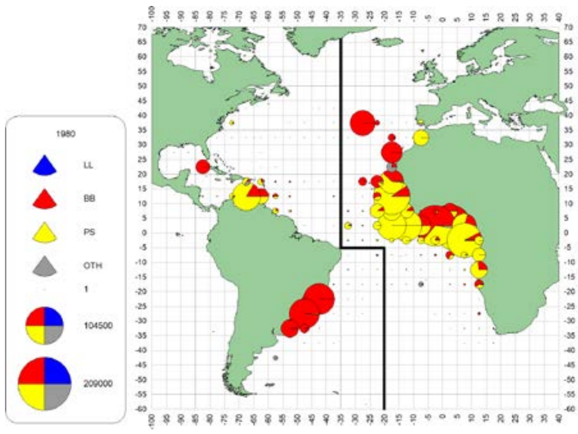
**Information were estimated during the 2019 species group meeting. The group encourage the CPCs to submit these data in the form ST01FC*



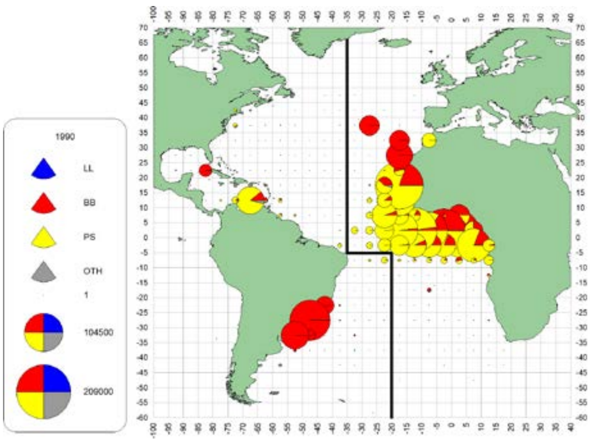
a. SKJ (1960-69)



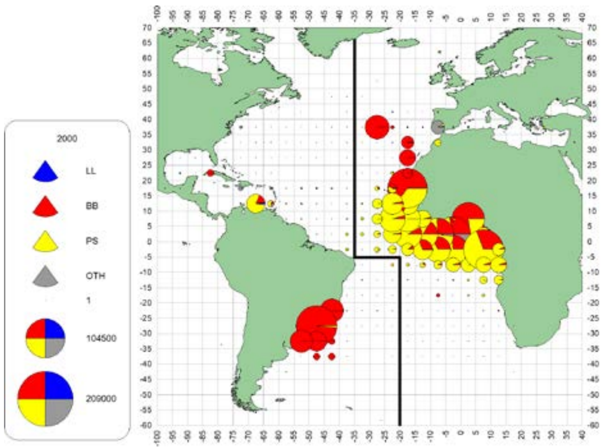
b. SKJ (1970-79)



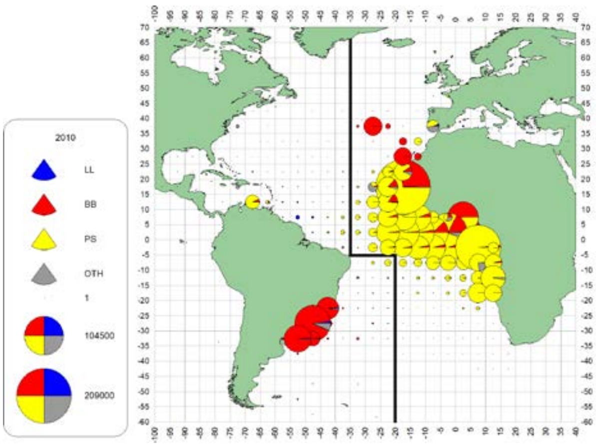
c. SKJ (1980-89)



d. SKJ (1990-99)

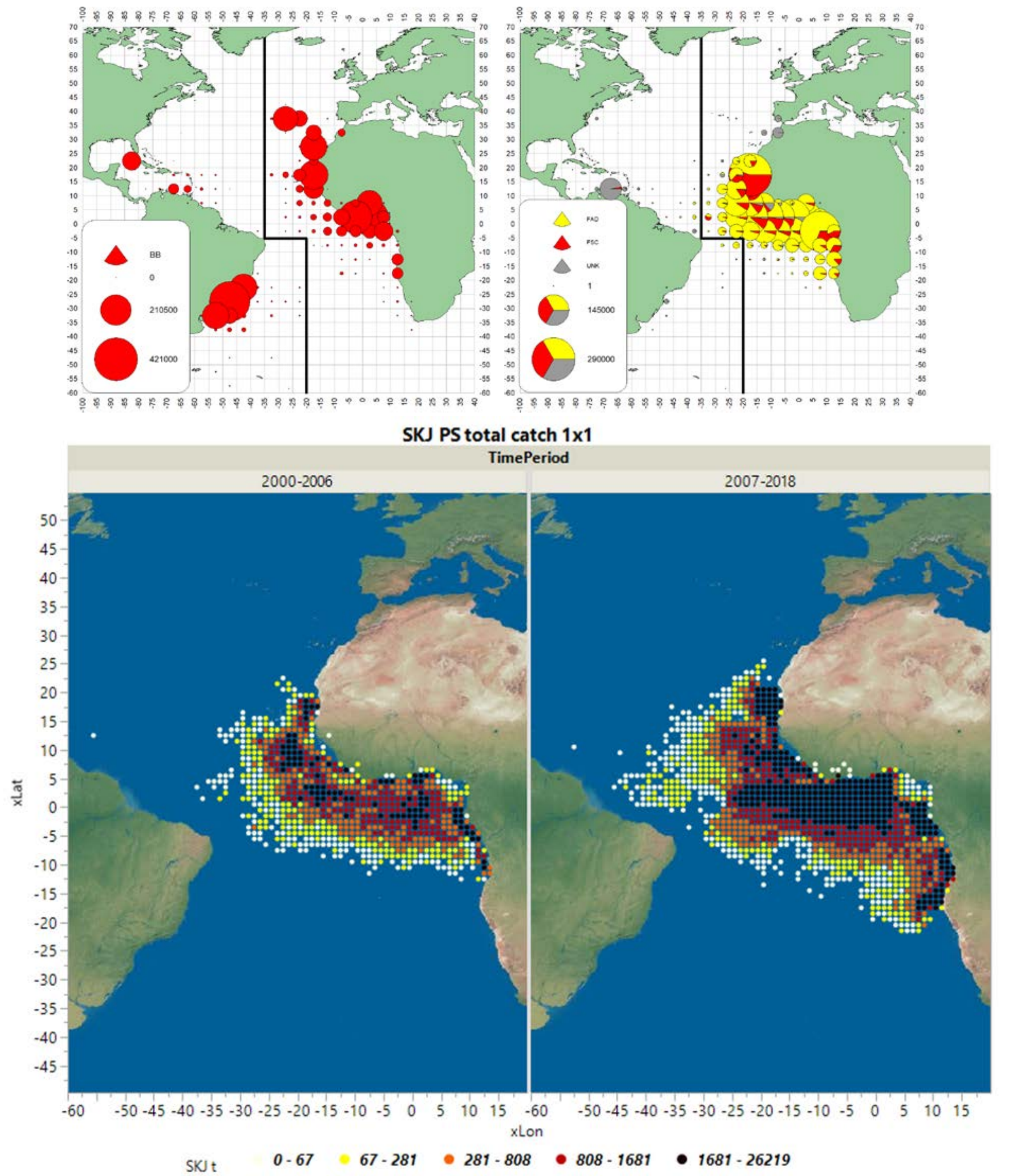


e. SKJ (2000-09)

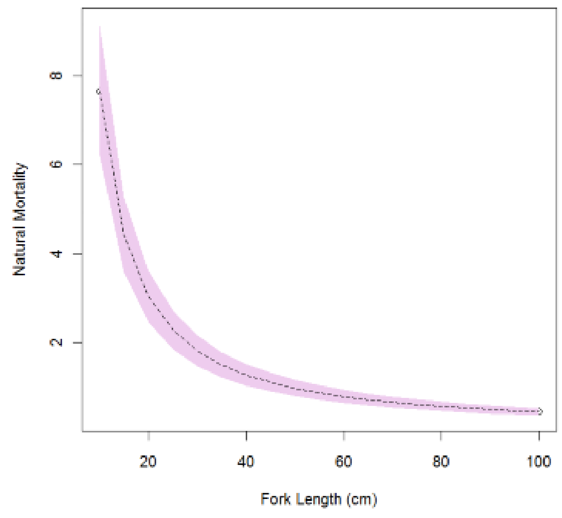


f. SKJ (2010-17)

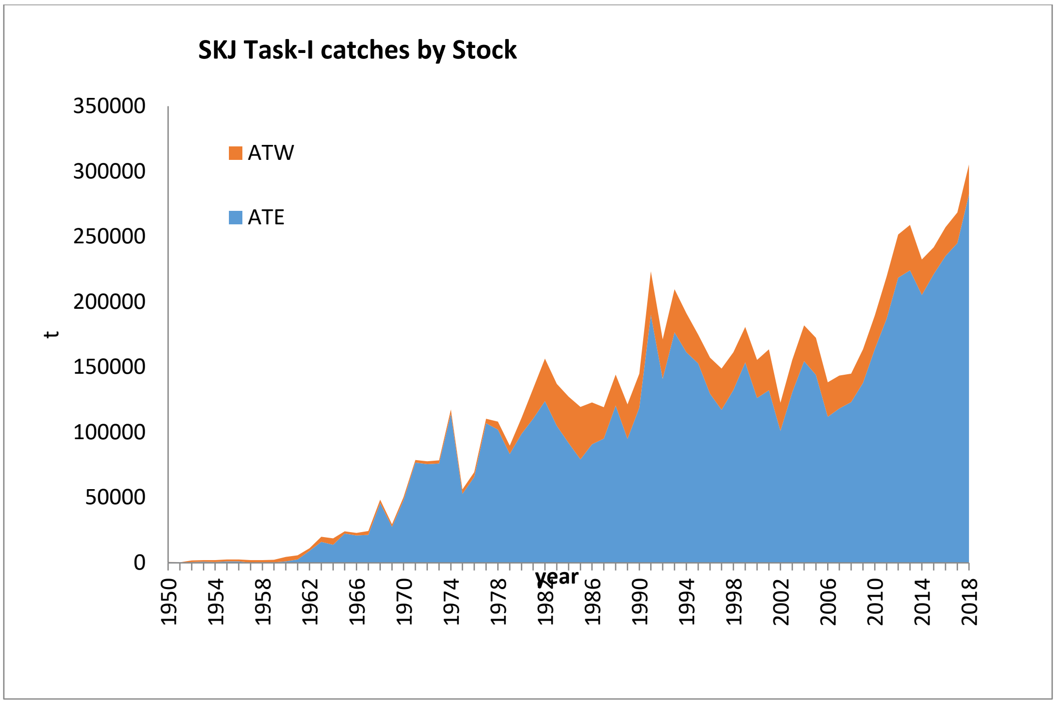
SKJ-Figure 1A [a-f]. Geographical distribution of the skipjack catch by major gears and decade. The maps are scaled to the maximum catch observed during 1960-2017 (last decade only covers 8 years).



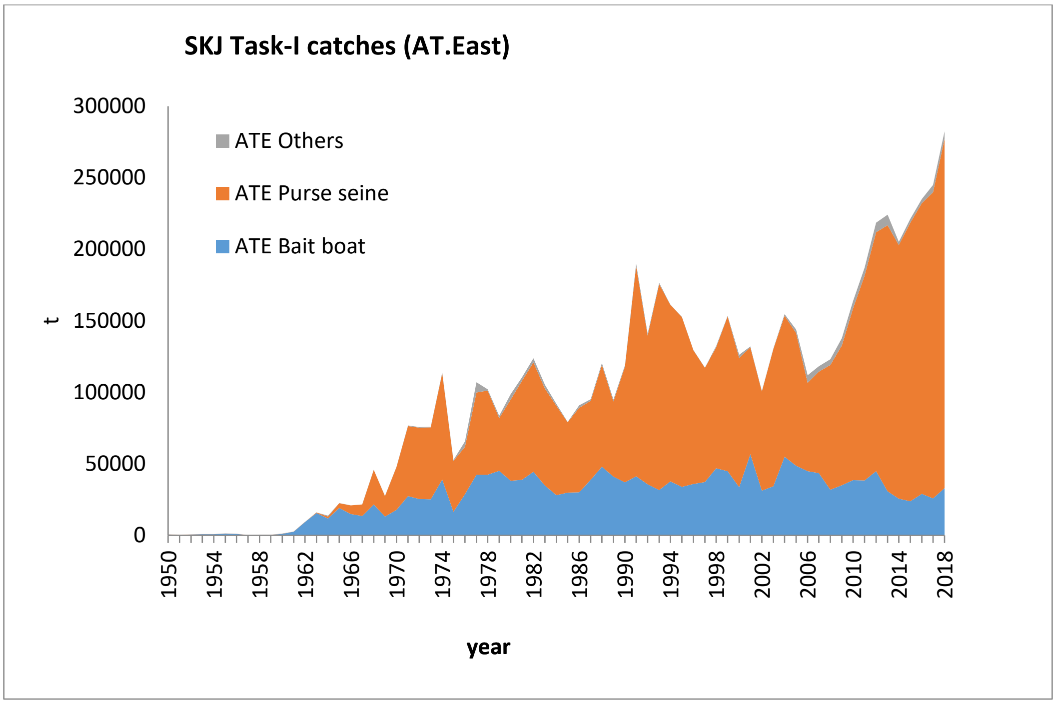
SKJ-Figure 1B. Distribution of skipjack catches in the Atlantic for baitboat (upper left panel) between 1950 and 2014 and for purse seiners (upper right panel) by fishing mode (free schools vs. FOBs. UNK is considered to be mainly free schools in the Western and mainly FOB in the Eastern Atlantic) between 1991 and 2014. Skipjack cumulative catches made by European and other CPCs purse seiners between the seven years period from 2000 to 2006 (lower left panel) and the twelve years period from 2007 to 2018 (lower right panel).



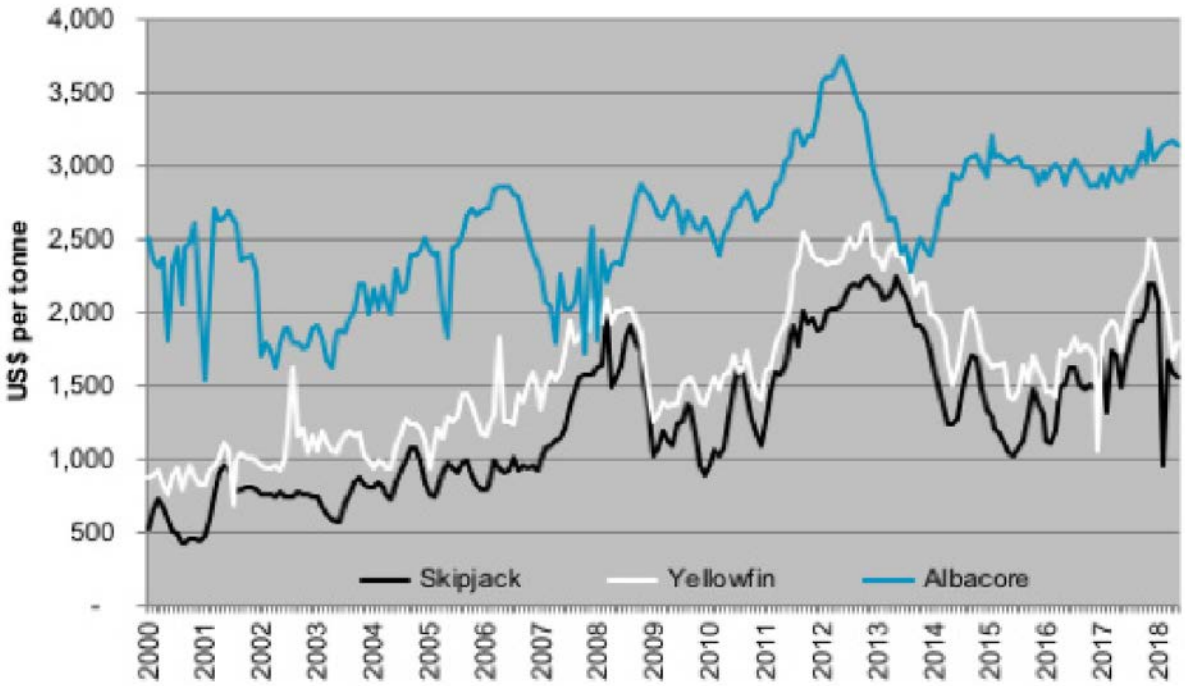
SKJ-Figure 2. Estimates of natural mortality by size of Atlantic skipjack calculated by empirical relationships between mortality and some biological parameters (which show different values from those traditionally used in the East).



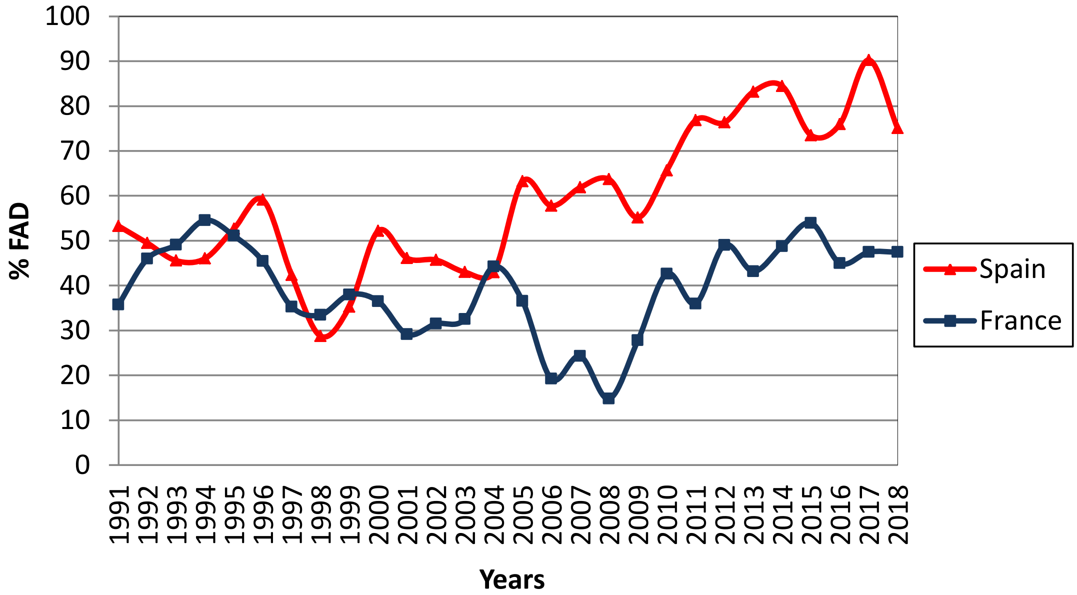
SKJ-Figure 3. Total skipjack catches (t) in the Atlantic and by stock (East and West) between 1950 and 2018. It is possible that skipjack catches taken in the eastern Atlantic in recent years were not reported or were under-estimated in the logbook correction of species composition based on multi-species sampling carried out at the ports. The 2018 figure is still preliminary.



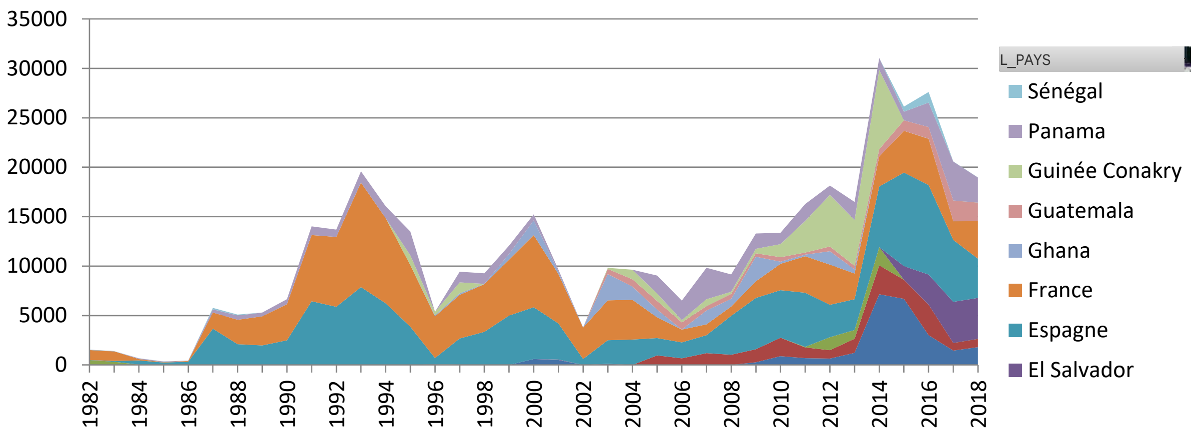
SKJ-Figure 4. Skipjack catches in the eastern Atlantic, by gear (1950-2018), after correction of Ghana's data by species (1996-2014).



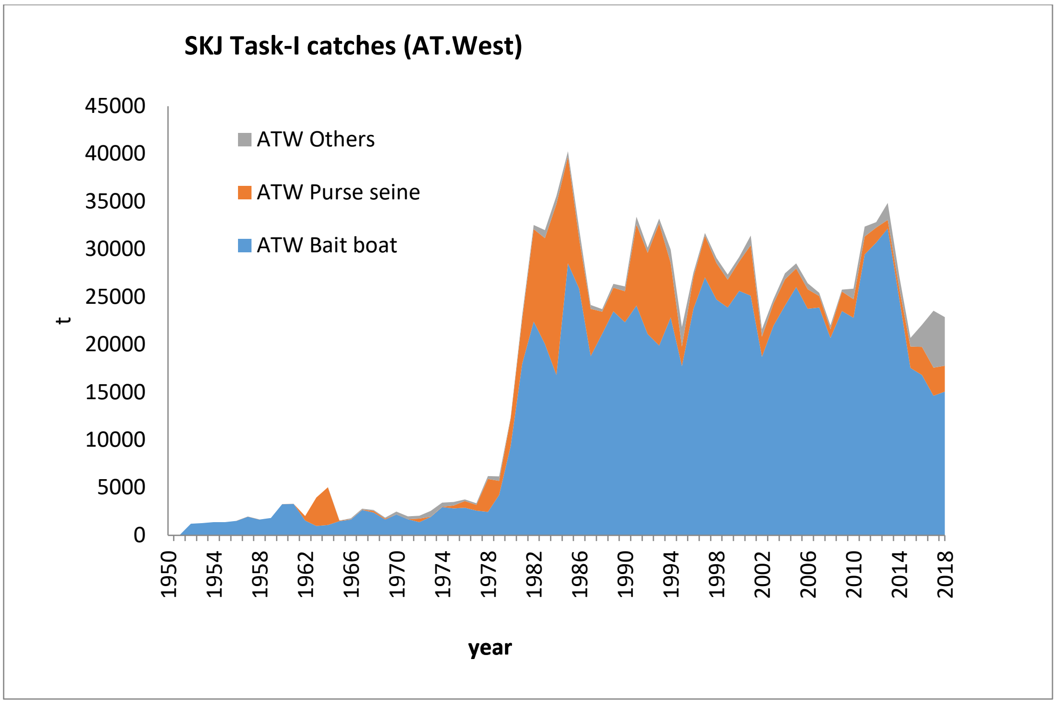
SKJ-Figure 5. Average prices of skipjack and yellowfin in U.S. dollars (adjusted for inflation and converted into the value of the 2015$US) in the Bangkok market.
(Source at 2018-09-25: https://www.ffa.int/system/files/FFA_TIN-May-June_2018.pdf)



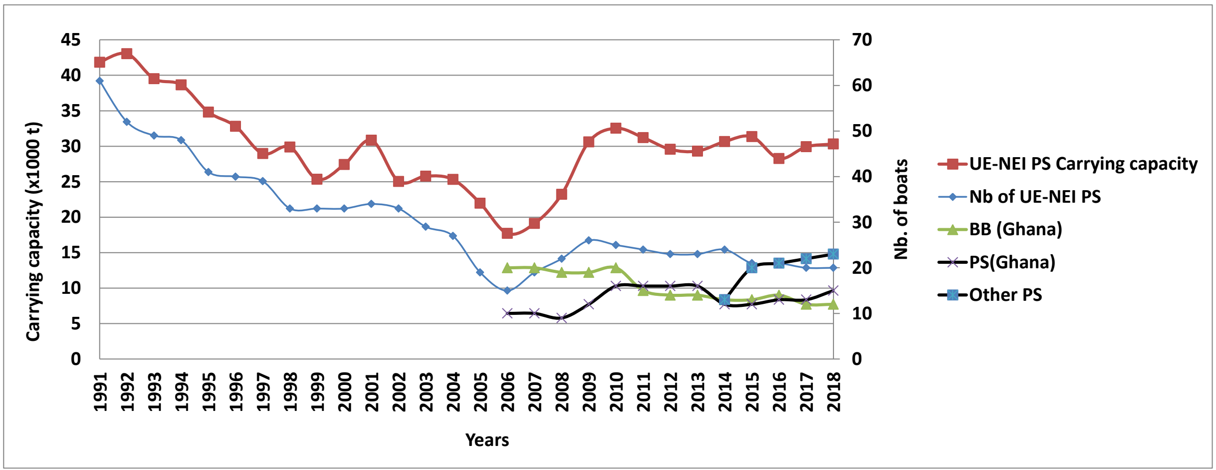
SKJ-Figure 6. Changes in the proportion of total catches under FOBs made by French and Spanish purse seiners (1991-2018). The increase in the percentage of catches under FOBs coincides with the shift from the Senegal area, known for its seasonal fishing on free schools (see **Figure 1**), and with the increase of skipjack prices.



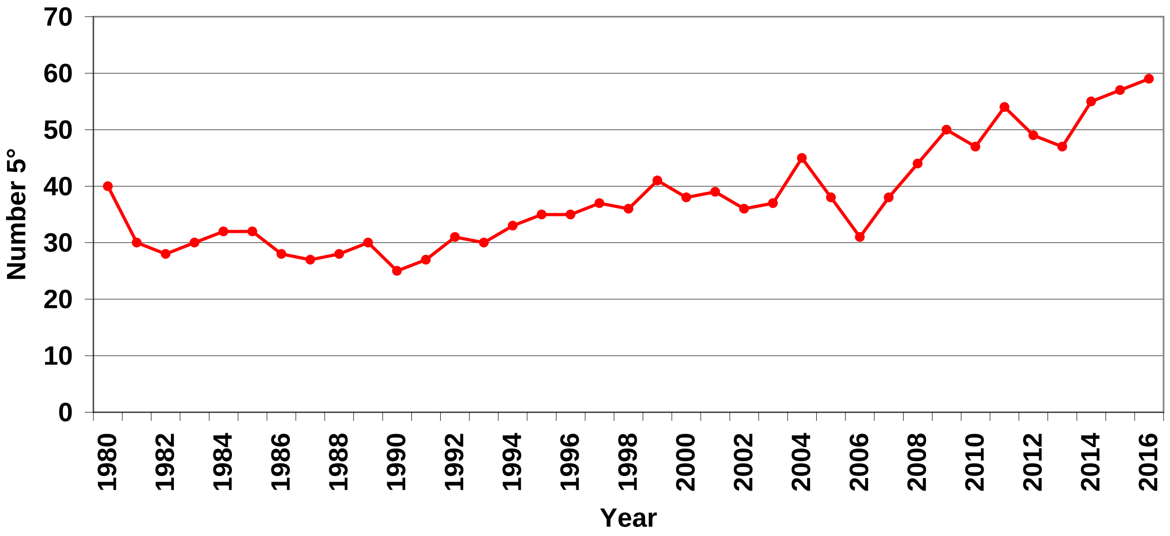
SKJ-Figure 7. Estimated landings of *faux poissons* (1981-2018) by purse seiners operating in the eastern Atlantic for the three major species of tropical tunas in the local market of Abidjan (Côte d'Ivoire).



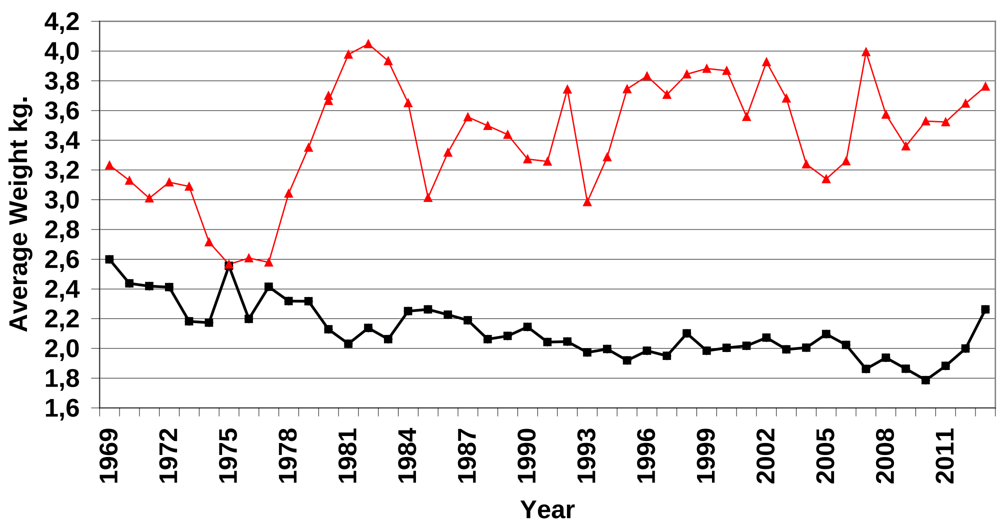
SKJ-Figure 8. Skipjack catches in the western Atlantic, by gear (1950-2018). The values for 2018 are preliminary.



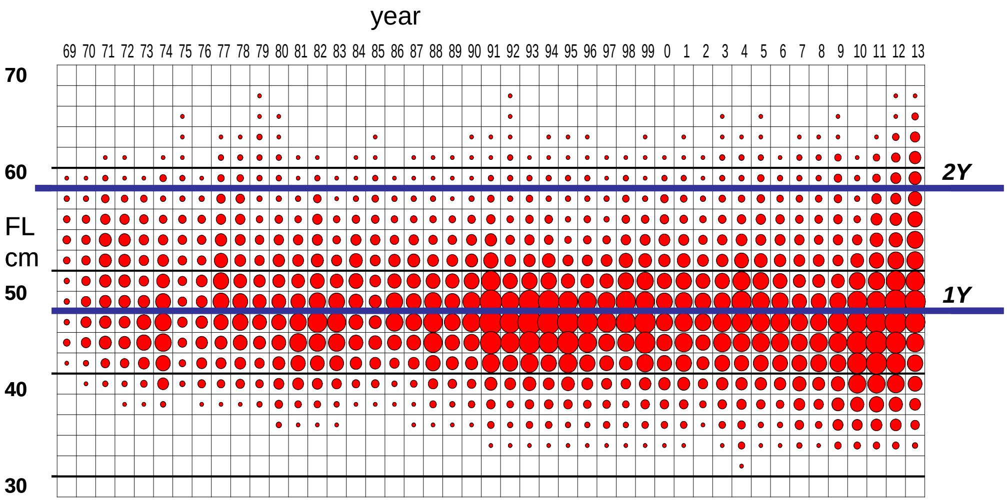
SKJ-Figure 9. Changes over time in the carrying capacity, corrected by the annual percentage of time at sea, (left axis) for the overall purse seiners and baitboats (2006-2018) operating in the eastern Atlantic. The carrying capacity and number of vessels (right axis) include boats for the European purse seiners, Ghanaian fleets, and other CPCs. This figure does not reflect all the purse seine and baitboats operating in the eastern Atlantic particularly for recent years.



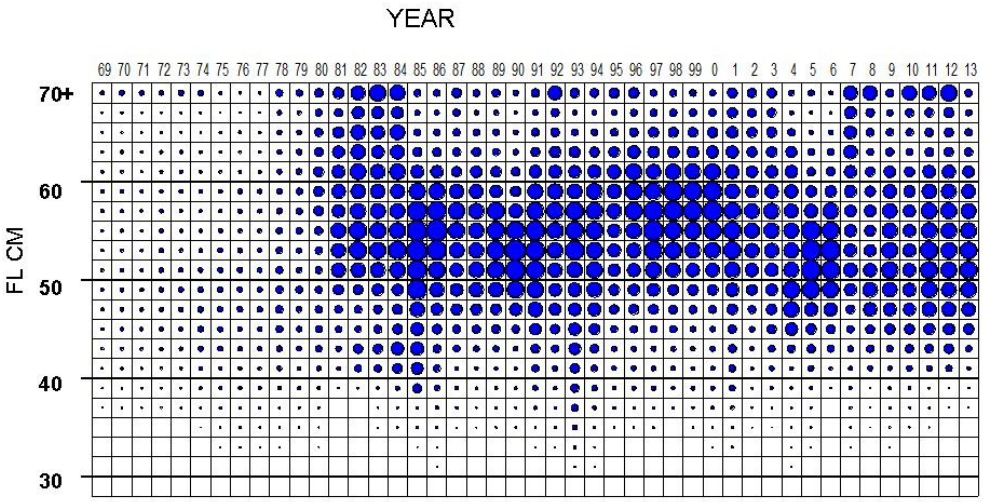
SKJ-Figure 10. Number of 5°x5° squares with annual skipjack catches above 10 t for the European and other CPCs purse seiners operating in the eastern Atlantic (1980-2016). The recent increase in the successfully exploited surface area is an extension of the fishery towards the western central Atlantic and off the coasts of Mauritania and Angola.



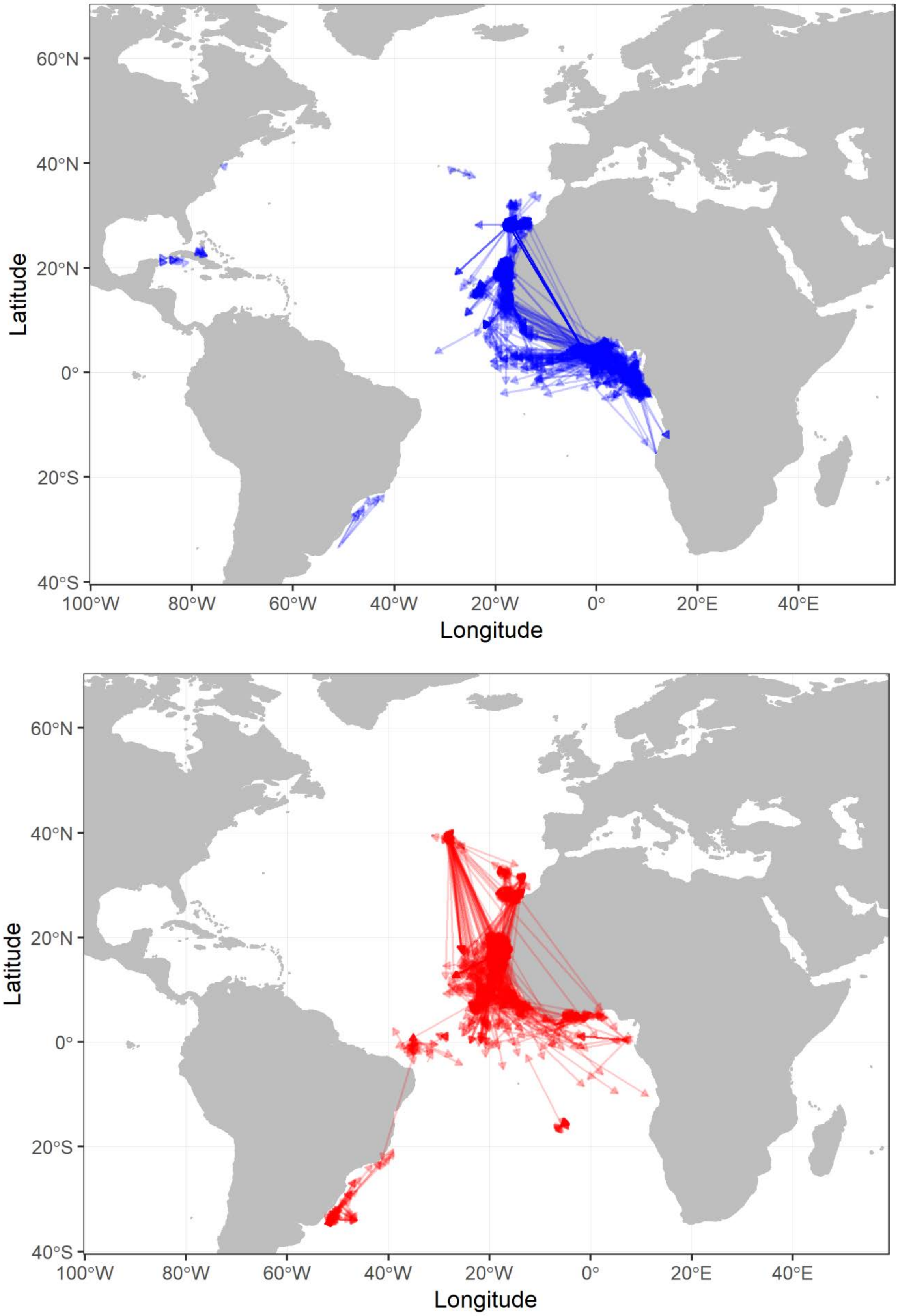
SKJ-Figure 11. Changes in the average weight of skipjack in the eastern (black) and western Atlantic (red).



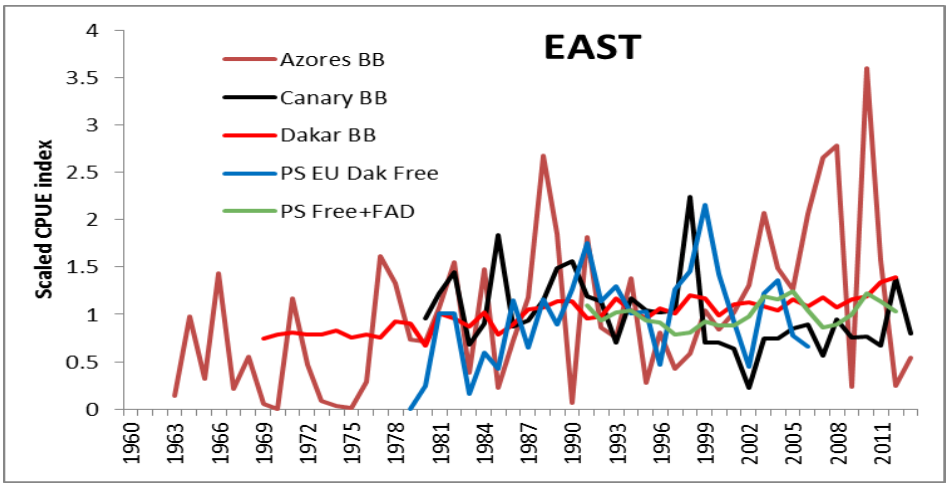
SKJ-Figure 12. Distribution of skipjack catch-at-size by size class (2 cm FL size bin) and year for the eastern Atlantic stock. Each bubble represents the proportion of catch weight stratified by size bin and year. The size limits of ages 1 and 2 are indicated by the horizontal lines (blue).



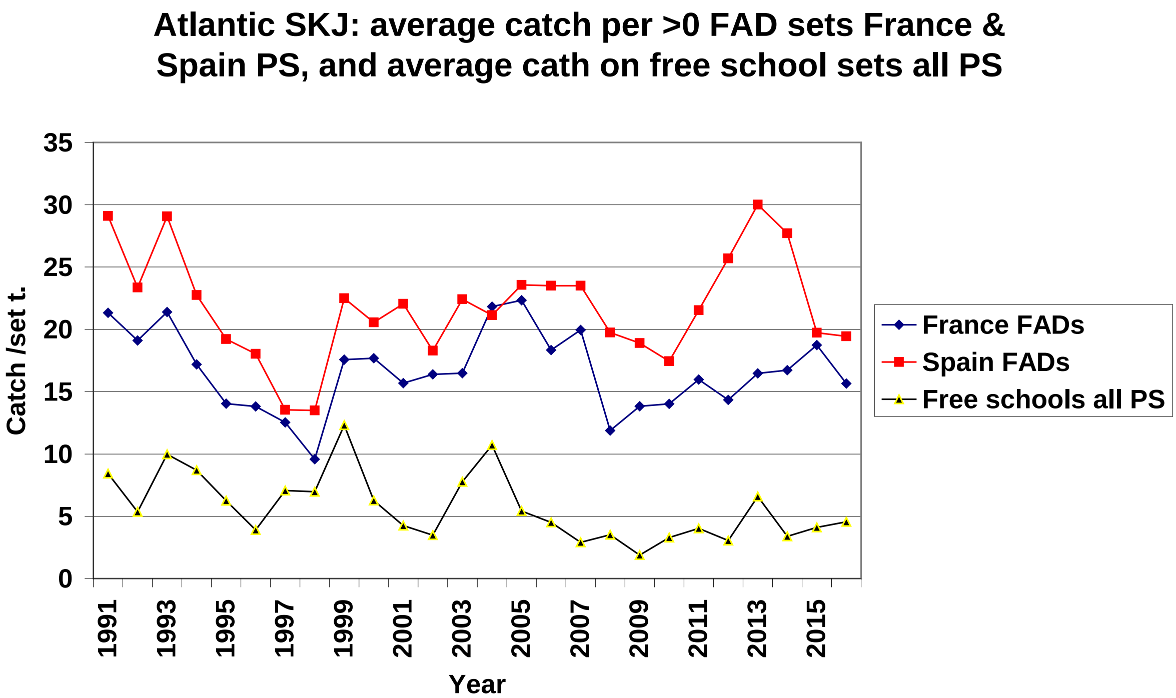
SKJ-Figure 13. Distribution of skipjack catch-at-size by size class (2 cm FL size bin) and year for the western Atlantic stock. Each bubble represents the proportion of catch weight stratified by size bin and year.



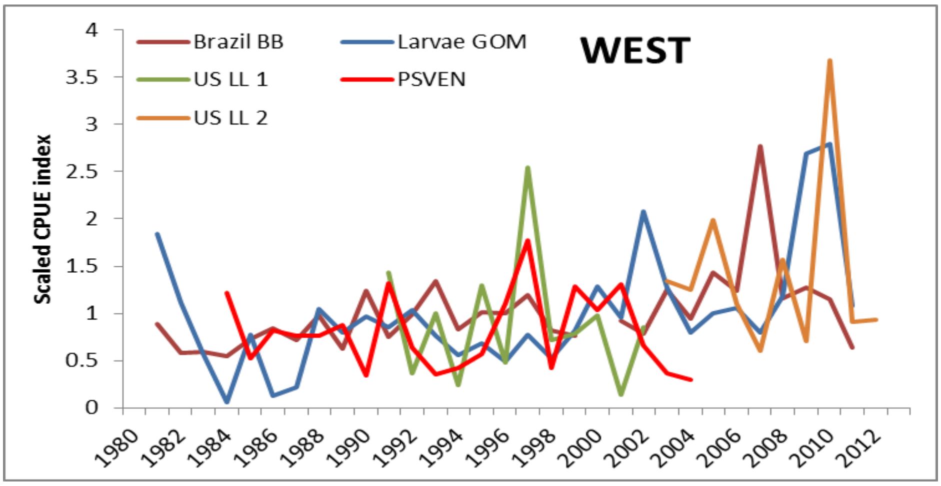
SKJ-Figure 14. Apparent movements (straight line distance between the tagging location and that of recovery) calculated from conventional tagging from the historical ICCAT tagging database (top) and the current AOTTP activities (bottom).



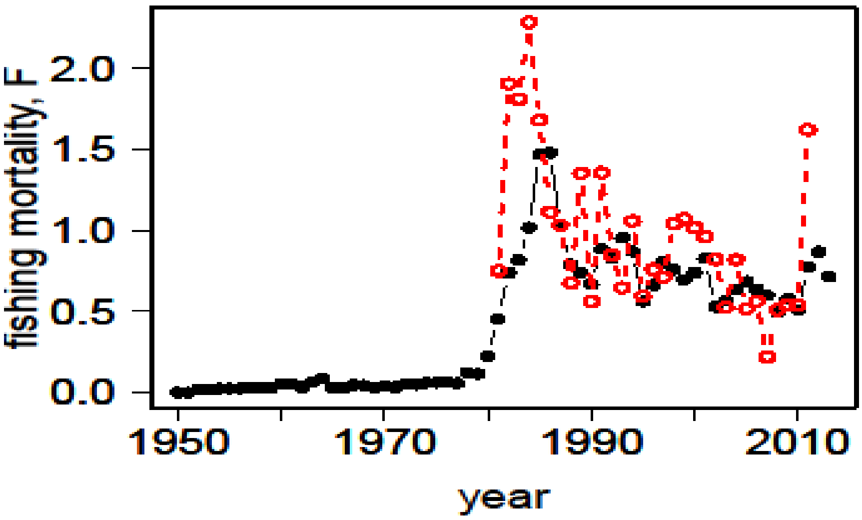
SKJ-Figure 15. Relative abundance indices for the eastern skipjack stock. Each index has been adjusted to its own average level given that to resolve problems regarding scaling, the indices for purse seine have been adjusted to the same level as the Azorean baitboat series.



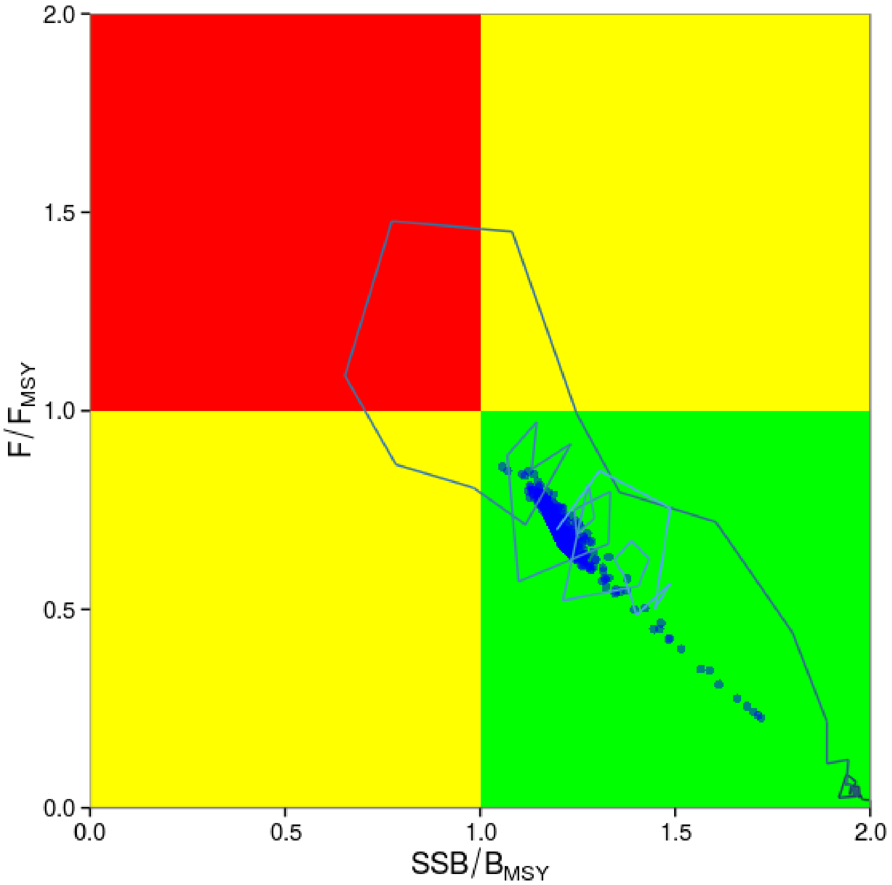
SKJ-Figure 16. Catches by set (t) of eastern Atlantic skipjack and on FOBs (France and Spain + other CPCs fleets) and on free schools (all purse seiners).



SKJ-Figure 17. Relative abundance indices for the western skipjack stock. Each index has been adjusted to its own average level given that to resolve problems regarding scaling, the indices for purse seiners and longliners have been adjusted to the level of the larvae index of the Gulf of Mexico.



SKJ-Figure 18. Comparison of coefficient mortality estimates of skipjack fishing in the western Atlantic obtained from a biomass surplus production model (ASPIC black line and solid circles) and by the model based on the average size of catches (so called *Then Hoenig-Gédamke* in red and empty circles).



SKJ-Figure 19. Western skipjack stock status: trajectories of B/B$_{MSY}$ and F/F$_{MSY}$ from the ASPIC surplus production model (Schaefer type).

9.4 ALB – ALBACORE

The status of the North and South Atlantic albacore stocks is based on the most recent analyses conducted in May 2016 by means of using the available data up to 2014. Complete information on the assessment can be found in the Report of the 2016 ICCAT North and South Atlantic Albacore Stock Assessment Meeting (Anon. 2017a).

The status of the Mediterranean albacore stock is based on the 2017 assessment using available data up to 2015. Complete information is found in the Report of the 2017 ICCAT Albacore Species Group Intersessional Meeting (including assessment of Mediterranean albacore) (Anon. 2017b).

ALB-1. Biology

Albacore is a temperate tuna widely distributed throughout the Atlantic Ocean and Mediterranean Sea. On the basis of the biological information available for assessment purposes, the existence of three stocks is assumed: northern and southern Atlantic stocks (separated at 5ºN) and a Mediterranean stock (**ALB-Figure 1**). However, some studies support the hypothesis that various sub populations of albacore exist in the North Atlantic and Mediterranean. Likewise, there is likely intermingling of Indian Ocean and South Atlantic immature albacore which needs further research.

Scientific studies on albacore stocks, in the North Atlantic, North Pacific and the Mediterranean, suggest that environmental variability may have a serious potential impact on albacore stocks, affecting fisheries by changing the fishing grounds, as well as productivity levels and potential MSY of the stocks. Those yet sufficiently unexplored aspects might explain recently observed changes in fisheries, such as the lack of availability of the resource in the Bay of Biscay in some years, or the apparent decline in the estimated recruitment which are demanding focussed research.

The expected life-span for albacore is around 15 years. While albacore is a temperate species, spawning in the Atlantic occurs in tropical waters. Present available knowledge on habitat, distribution, spawning areas and maturity of Atlantic albacore is based on limited studies, mostly from past decades. In the Mediterranean, there is a need to integrate different available studies so as to better characterize growth of Mediterranean albacore. Besides some additional recent studies on maturity, in general, there is poor knowledge about Mediterranean albacore biology and ecology.

More information on albacore biology and ecology is published in the *ICCAT Manual*.

ALB-2. Description of fisheries or fishery indicators

North Atlantic

The northern stock is exploited by surface fisheries targeting mainly immature and sub-adult fish (50 cm to 90 cm FL) and longline fisheries targeting immature and adult albacore (60 cm to 130 cm FL). The main surface fisheries are carried out by EU fleets (Ireland, France, Portugal and Spain) in the Bay of Biscay, in the adjacent waters of the Northeast Atlantic and in the vicinity of the Canary and Azores Islands in summer and autumn. The main longline fleet is the Chinese Taipei fleet which operates in the central and western North Atlantic year round. However, Chinese Taipei fishing effort decreased in the late 1980s due to a shift towards targeting on tropical tunas, and then continued at this lower level to the present. Over time, the relative contribution of different fleets to the total catch of North Atlantic albacore has changed, which resulted in differential effects on the age structure of the stock. Since the 1980s, a reduction of the area fished for albacore was observed for both longline and surface fisheries.

Total reported landings, steadily increased since 1930 to peak above 60,000 t in the early 1960s, declining afterwards, largely due to a reduction of fishing effort by the traditional surface (troll and baitboat) and longline fisheries (**ALB-Table 1**; **ALB-Figure 2A**). Some stabilization was observed in the 1990s, mainly due to increased effort and catch by new surface fisheries (driftnet and mid-water pair pelagic trawl), with a maximum catch in 2006 of 36,989 t and, since then, a generally decreasing trend of catch is observed in the North Atlantic.

The preliminary total reported catch in 2018 was 29,363 t (below the TAC of 33,600 t), and the catch in the last five years has remained about 27,000 t, above the historical minimum of around 15,000 t recorded in 2009. During the last years, the surface fisheries contributed to approximately 80% of the total catch (**ALB-Table 1**). The reported catch for 2016, when compared with the average of the last five years, was similar for EU-Spain, EU-Ireland and EU-France.

Longline catch contributed to approximately 20% of the total catch during the last five years. During the last decades, both Chinese Taipei and Japan have reduced their fishing effort directed to albacore. In the case of Japan, albacore was taken mainly as by-catch. The catch reported in 2016 for Japan was below the last 5 year average, while for Chinese Taipei it was similar.

The trend in mean weight for northern albacore remained stable between 1975 and 2014, ranging between 7 and 11 kg. The mean weight for surface fleets (baitboat and troll) showed a stable trend with an average of 7 kg (range of 4 to 10 kg), and for longline fleets it showed no clear trend with an average of 19 kg, but some important fluctuations between 15 and 26 kg since the 1990 (**ALB-Figure 3A**).

South Atlantic

The recent total annual South Atlantic albacore landings were largely attributed to four fisheries, namely the surface baitboat fleets of South Africa and Namibia, and the longline fleets of Brazil and Chinese Taipei (**ALB-Table 1**; **ALB-Figure 2B**). The surface fleets are entirely albacore directed and mainly catch sub-adult fish (70 cm to 90 cm FL). These surface fisheries operate seasonally, from October to May, when albacore are available in coastal waters. Brazilian longliners target albacore during the first and fourth quarters of the year, when an important concentration of adult fish (>90 cm) is observed off the Northeast coast of Brazil, between 5ºS and 20ºS, being likely related to favorable environmental conditions for spawning, particularly of sea surface temperature. The longline Chinese Taipei fleet operates over a larger area and throughout the year, and consists of vessels that target albacore and vessels that take albacore as by-catch, in bigeye directed fishing operations. On average, the longline vessels catch larger albacore (60 cm to 120 cm FL) than the surface fleets.

Albacore landings increased sharply since the mid-1950s to reach values oscillating around 25,000 t between the mid-1960s and the 1980s, 35,000 t until the last decade when they oscillated around 20,000 t. However, total reported albacore landings for 2017 decreased to 13,825 t, which is among the lowest values in the time series. The preliminary total reported catch in 2018 was 17098 t. The Chinese Taipei catch in the last years has decreased compared to historical catches, mainly due to a decrease in fishing effort targeting albacore. Chinese Taipei longliners (including boats flagged in Belize and St. Vincent and the Grenadines) stopped fishing for Brazil in 2003, which resulted in albacore only being caught as bycatch in tropical tuna-directed longline fisheries. Albacore is only caught as bycatch in Brazilian tropical tuna-directed longline and baitboat fisheries. The significantly higher average catch of about 4,287 t during the period 2000-2003 was obtained by the Brazilian longline fleet when albacore was a target species.

In 2017, the estimated South African and Namibian catch (mainly baitboat) was below the average of the last five years. During the last decades, Japan took albacore as bycatch using longline gear, but recently Japan is again targeting albacore and increased the fishing effort in waters off South Africa and Namibia (20-40˚S). Thus, catches during the last six years double those in the last few decades.

The trend in mean weight from 1975 to 2014 is shown in **ALB-Figure 3B**. Surface fleets showed a stable trend from 1981 onwards with an average of 13 kg and a maximum and minimum average weight of 17 kg and 10 kg, respectively. Longline fleets showed a relatively stable trend for the mean weight around 17 kg until 1996 where the average weight increased to about 20 kg, oscillating between 16 and 26 kg.

Mediterranean

During the last assessment, the catch series was revisited and, after revision, some series were included in the ICCAT database. In 2018, the reported landings were 2,434 t, below those in the last decade (**ALB-Table 1** and **ALB-Figure 2C**). The majority of the catch came from longline fisheries. EU-Italy is the main producer of Mediterranean albacore, with around 53% of the catch during the last 10 years. In 2017 the Italian catch remained similar to the last five years average. 2015 was an unusual year in that the fishing pattern was very different as compared to previous years, possibly related to the anticipation of management measures directed to Mediterranean swordfish that modified the fishing strategy in 2015. Therefore, the relative abundance estimates for 2015 CPUE indices were not used in the assessment.

ALB-3. State of stocks

North Atlantic

In the 2013 stock assessment, several model formulations (Multifan-CL, Stock Synthesis, VPA and ASPIC) with varying degrees of complexity were used. This allowed the modeling of different scenarios that represented different hypotheses, and the characterization of the uncertainty around the stock status. The results showed that although the range of estimated management benchmarks was relatively wide, most models were in agreement that the stock was overfished, and no model indicated that the stock was undergoing overfishing. These models from all the various platforms showed a general drop in stock biomass from 1930 to about 1990 and an increasing trend in biomass starting in around 2000. Likewise, most models within all configurations showed a peak in fishing mortality in around 1990 with a decreasing trend thereafter. The analyses conducted in 2013 involved a large amount of data preparation and scrutiny, and the Committee suggested that future assessment updates could be conducted using simpler models (e.g. production models).

Thus, in 2016 a production model was used to assess the stock status. A thorough revision of North Atlantic Task I data was conducted and catch rate analyses were improved and updated with new information for the northern albacore fisheries. Decisions on the final specifications of the base case model were guided by first principles (e.g. knowledge of the fisheries) and data exploration (e.g. correlation between indices). The results of these efforts are reflected in the following summaries of stock status that analyzed data through 2014.

Four longline and one baitboat CPUE indices were selected to be used in a production model framework. The Committee lacked a basis to decide which CPUE series could best represent abundance. In fact, it was assumed that different CPUE series reflected local abundance available to different fleets operating in different areas, and that overall they represented the global population trend. On this basis, the Committee agreed to use all the 5 CPUEs jointly in the base case scenario, and to weight them equally. Despite their variable pattern, these indices showed an overall increasing trend towards the end of the time series (**ALB-Figure 4**), which could be reflecting the increasing trend of the stock during this period of relatively low catch. The Chinese Taipei longline index showed the steepest increase during the last years of the series.

The biomass dynamic model results for the base case suggest a biomass drop between 1930 and the 1990s and a recovery since then, while fishing mortality decreases. Relative to MSY benchmarks, the base case scenario estimates that the stock remained slightly overfished with B below B_{MSY} during the 1980s and 1990s, but now has recovered to levels well above B_{MSY} (**ALB-Figure 5**). Peak relative fishing mortality levels in the order of 1.4 were observed in the early 1980s but overfishing stopped in the 1990s, current F_{2014}/F_{MSY} ratio being 0.54. The uncertainty around the current stock status has a clear shape determined by the strong correlation between parameters estimated by the production model. The probability of the stock currently being in the green area of the Kobe plot (not overfished and not undergoing overfishing, $F<F_{MSY}$ and $B>B_{MSY}$) is 96.8% while the probability of being in the yellow area (overfished, $B<B_{MSY}$) is 3.2%. The probability of being in the red area (overfished and undergoing overfishing, $F>F_{MSY}$ and $B<B_{MSY}$) is 0% (**ALB-Figure 6**).

Sensitivity analyses revealed that recent stock status indicators are sensitive to different modelling assumptions as well as the choice of the CPUE series. When a logistic function was assumed in the biomass dynamic model lower values of B/B_{MSY} were predicted over the whole time series, while excluding the Chinese-Taipei longline CPUE resulted in much larger values of B/B_{MSY} in the recent period. Other sensitivity analyses did not show strong deviations from the base case. However, although the recent status varied across scenarios, all predicted the stock to be in the green quadrant. Finally, the Committee noted that the B/B_{MSY} trajectory showed a strong retrospective pattern that might imply that the current stock status is overestimated, although all the retrospective trajectories showed an improvement in stock status in the most recent period.

In summary, the available information indicates that the stock has improved and is most likely in the green area of the Kobe plot, although the exact condition of the stock is not well determined.

South Atlantic

In 2016, a stock assessment of South Atlantic albacore was conducted including catch, effort and size data up until 2014, and considering similar methods as in the previous assessment.

The southern standardized CPUE trends are mainly for longline fisheries, which harvest mostly adult albacore. The longest time series of Chinese Taipei, showed a strong declining trend in the early part of the time series, and less steep decline over the last three decades, similar to the Japanese longline index. However, the Uruguayan longline CPUE series showed significant decreases since the 1980s (**ALB-Figure 7**).

In the 2016 assessment, the same eight scenarios as in 2013 were considered, but after screening during the assessment meeting, the early Japanese CPUE series was not used to fit the models. Stock status results varied significantly among scenarios (**ALB-Figure 8A**). Two different production model forms were considered, each with four scenarios. One showed more optimistic results than the other. However, the Committee lacked enough objective information to identify the most plausible scenarios and considered them equally likely. Six of eight scenarios indicated that the stock is not overfished and not undergoing overfishing, and two other scenarios indicated that the stock is overfished but not undergoing overfishing. Six scenarios estimated a higher B/B_{MSY} than in the last stock assessment, and seven scenarios estimated a lower F/F_{MSY} than in the previous assessment. This indicated that current stock status has improved since the last assessment. Considering the whole range of scenarios, the median MSY value was 25,901 t (ranging between 15,270 t and 31,768 t), the median estimate of current B/B_{MSY} was 1.10 (ranging between 0.51 and 1.80 t) and the median estimate of current F/F_{MSY} was 0.54 (ranging between 0.31 and 0.87). The wide confidence intervals reflect the large uncertainty around the estimates of stock status. Considering all scenarios, there is 3% probability for the stock to be both overfished and experiencing overfishing, 31% probability for the stock to be either overfished or experiencing overfishing but not both, and 66% probability that biomass is above and fishing mortality is below the Convention objectives (**ALB-Figure 8B**).

Mediterranean

In 2017, the stock assessment for Mediterranean albacore was conducted using catch data up until 2015 and CPUE data up until 2014. The methods used were coherent with "limited data" category of this stock. The methods applied included a length-based catch curve analysis and a Bayesian state space surplus production model (JABBA).

Two standardized CPUE series for EU-Spain and EU-Italy longline fisheries were used during this last assessment (**ALB-Figure 9**). In addition, a larval index independent of the fishery, providing information on the trends of the spawning biomass, was used. The three indices showed a decreasing trend for the period 2013-2014.

The results of the 2017 assessment, based on the limited information available, show that the status of the stock is highly uncertain with respect to both fishing mortality and biomass. Despite the high uncertainty, the results would seem to indicate that recent albacore median biomass levels are at about B_{MSY}, and median fishing mortality levels are below F_{MSY} (**ALB-Figure 10A**). The probability to be in the red, yellow and green parts of the Kobe plot is 35.7%, 15.8% and 48,5%, respectively (**ALB-Figure 10B**).

However, the Group noted the lack of CPUE estimates in 2015. Given the recent downward trends of the available series, it is very important to corroborate, in the coming years, whether this trend continues or not. However, the Committee reiterates that the ability to monitor stock trends is limited, and that the currently used fishery dependent indices might be affected by the ban imposed as part of the swordfish recovery plan.

During 2018 and 2019, only two of the three indices (namely, the larval index and the Spanish longline index) were preliminarily updated, and an additional one (from the Spanish recreational fishery) was presented. The larval index still showed a general decreasing trend in the last years, while the others did not.

ALB-4. Outlook

North Atlantic

In 2016, the estimated population was projected under both alternative TACs and HCRs, as combinations of target fishing mortality (F_{TAR}), threshold biomass (B_{THRESH}) and an interim biomass limit reference point (B_{LIM}) of 0.4 B_{MSY}. The projections assuming catch levels similar to those observed during the last five years (between 25,000 t and 30,000 t) suggest that biomass would continue to increase and are likely sustainable. The Committee noted that the new projections suggested higher sustainable catch levels compared to most of the previous assessments. However, the Committee had little trust in the absolute biomass estimate and the projections did not fully account for many other sources of uncertainty (i.e. model structure and assumptions) that need further evaluation. Thus, the Committee did not have confidence in the projections and the Kobe 2 Strategy Matrix and decided not to provide or use these analyses for advice.

During 2017, considering that Rec. 16-06 requested the SCRS to "refine the testing of candidate reference points (e.g., $SSB_{THRESHOLD}$, SSB_{LIM} and F_{TARGET}) and associated harvest control rules (HCRs) that would support the management objective", a set of alternative HCRs were tested by projecting a wide range of simulated albacore populations in a management strategy evaluation (MSE) framework. The MSE used was tailored specifically to support the process to discuss and eventually adopt an HCR for North Atlantic albacore in 2017 but not to provide TAC recommendation. As such, the simulated management procedure was consistent with the 2016 assessment approach, and thus, if the Commission selected a HCR, it would be appropriate to apply it to the outcome of the 2016 stock assessment to set the TAC for the next three years. However, as every MSE process, this framework can be further improved and expanded in the future (e.g. by exploring alternative management procedures).

Although a larger set of HCRs were tested, following the advice of the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers (SWGSM), a reduced number of eight HCRs was finally considered. Eight HCRs are all the combinations of the following elements: two alternative target fishing mortalities (0.8 and 1 x F_{MSY}); two threshold biomasses (0.8 and 1 x B_{MSY}); and 2 stability clauses. The 2 stability clauses were: (SC1) maximum change in TAC of 20% always applied from one 3-year management period to the next while also always imposing a 15,000-50,000 t min-max TAC; and (SC2) same as (SC1) but not restricting TAC reductions and not imposing a minimum TAC when $B<B_{THR}$.

All HCRs tested met the objective to be in the green quadrant of the Kobe plot with a probability higher than 60% (**ALB-Table 2**). 96% of the OMs showed biomass above B_{MSY} with 60% probability between 2020-2045. HCRs with higher target fishing mortalities (F_{MSY}) were associated with lower probabilities of being in the Kobe green quadrant, higher probabilities of the stock being between B_{LIM} and $B_{THRESHOLD}$, and slightly higher long-term yields. The different stability clauses had important effects on long term yield and stability. In SC1 (maximum change in TAC of 20% always allowed), higher stability and higher long-term yields were achieved, compared to SC2 (**ALB-Figure 11**, **ALB-Table 2**). Note that **Table 2** was prepared for the comparison of the performance of alternative HCRs, but not for actual TAC calculation. For more detail on the MSE, please refer to 2017 Responses to the Commission 20.16 and 17 as well as the Report of the 2017 ICCAT Albacore Species Group Intersessional Meeting (including assessment of Mediterranean albacore) (Anon. 2017b).

Whichever HCR was selected in 2017, its application would result in a short-term TAC of 33,600 t which results from the maximum 20% increase from the previous TAC (28000 t); this conforms to the positive stock status estimated in the 2016 assessment.

Since 2018, the HCR adopted in Rec. 17-04 was tested together with variants accounting for i) the carry over, ii) the effect of setting a lower TAC limit of 15000t, iii) the effect of applying the 20% stability clause when $B_{CUR}>B_{LIM}$ iv) the effect of 20% maximum TAC reduction and 25% maximum TAC increase when $B_{LIM}<B_{CUR}<B_{THR}$ and v) the effect of 20% maximum TAC reduction and 25% maximum TAC increase when $B_{CUR}>B_{LIM}$. Results indicate that the HCR adopted in Rec. 17-04 and all the variants tested achieve ICCAT's management objective of maintaining stocks in the green quadrant of the Kobe plot with at least 60% probability. Compared to a perfect implementation of the TAC, the carry over scenario (i) produced lower yield and stability, but better stock condition and safety. Historically, catch remained below TAC in most of the years, and only occasionally was slightly above the TAC (see **ALB-Figure 2A**). The carry over effect was tested assuming that these historical differences between catch and TAC would remain in the future, and the Committee notes that the results of the analyses might differ under other assumptions. The other variants tested (ii, iii, iv, v) led to more stability together with comparable yield and while meeting the objective of being in green area of the Kobe plot with more than 60% probability (**ALB-Figure 13**).

South Atlantic

The projection results differ between the base case scenarios. Since there is not objective information with which to select which scenario is most plausible, the Committee considered the entire range of scenarios, thus characterizing the range of possible responses to the distinct catch levels projected, as done in 2013. The Kobe matrix indicates that, depending on the scenario, catches which enable the stock to be in the Kobe green zone in 2020 with at least a 60% probability ranged from 18,000 to 34,000 t, with an average of 25,750 t and a median of 26,000 t (**ALB-Table 3**). Averaging all scenarios, projections at a level consistent with the 2016 TAC (24,000 t) showed that probabilities of being in the green area of the Kobe plot would be higher than 60% in 2020 (**ALB-Table 3**).

Projections at F_{MSY}, without considering implementation errors, suggested that the probability of the stock to be in the green quadrant of the Kobe plot would not consistently increase over time, while it would when projected at 0.95*F_{MSY} or any lower fishing mortality rate.

Mediterranean

Due to the limited quantitative information available to the SCRS, the sensitivity of the stock assessment to different sources of information, and the limited prediction skill of the assessment model, the projections for this stock were not conducted. As a result, future stock status in response to constant catch levels could not be quantified.

ALB-5. Effect of current regulations

North Atlantic

In 2017, the Commission adopted the interim HCR described in **ALB-Figure 12**, with a maximum TAC of 50,000 t and a maximum change of 20% when B_{CUR}>B_{THR}. Its application established a TAC of 33,600 t for 2018-2020 (Rec. 17-04) and the possibility to carry over some unused portions of the quotas to be caught later in time (Rec. 16-06) remained. The Committee noted that, since the establishment of the TAC in the year 2001, catch remained substantially below the TAC in all but four years (**ALB-Figure 2**), which might have accelerated rebuilding over the last decade. The bulk of the catch is caught by traditional surface fisheries operating in the Bay of Biscay and surrounding waters. Thus, it is likely that the fluctuations in catches reflect the fluctuations in the availability of the resource to those local regional fisheries, and the carry over allows to compensate the fleets for the years where the stock was less available.

Furthermore, Rec. 98-08 that limits fishing capacity to the average of 1993-1995, remains in force. The effect of this recommendation has not been evaluated but a general decrease of fishing mortality is observed since its implementation.

South Atlantic

In 2016 the Commission established a new TAC of 24,000 t for 2017-2020 (Rec. 16-07). The Committee noted that, since 2004, reported catches remained below 24,000 t, except in 2006, 2011 and 2012, where reported catches were slightly above this value (**ALB-Table 1**). As in the case of the North Atlantic, the Committee did not test the effect of perfect implementation of the TAC.

Mediterranean

In 2017 the Commission adopted Rec. 17-05, according to which, no increase in catch and fishing effort is allowed until more accurate scientific advice can be provided by the SCRS. Moreover, a time closure of two months (1 October - 30 November), originally aimed at protecting the Mediterranean swordfish juveniles, applies to the longline fleet targeting albacore in the Mediterranean from 2017 onwards. Furthermore, the number of vessels for each CPC is limited to the number of vessels that were authorized to target Mediterranean albacore in 2017 under Rec. 16-05.

ALB-6. Management recommendations

North Atlantic

Recommendation 16-06 sets the objective of maintaining the stock in the green area of the Kobe plot with a 60% probability while maximizing long-term yield, and, if $B<B_{MSY}$, to recover it as soon as possible, while maximizing average catch and minimizing inter-annual fluctuations in TAC levels.

In 2016, the Committee noted that the relative abundance of North Atlantic albacore had continued to increase over the last decades and was likely somewhere in the green area of the Kobe plot. However, without additional information, the magnitude of the recovery was not well determined and remained sensitive to many different assumptions. This undermined the ability of the Committee to reliably quantify the effects of future TAC or HCR scenarios on the status of the stock, until more sources of uncertainty and the robustness of the advice were evaluated in the future through MSE and/or benchmark stock assessment after accumulating sufficient new information. The projections assuming catch levels similar to those observed during the last five years (between 25,000 t and 30,000 t) suggested that biomass would continue to increase and are likely sustainable. However, the Committee reminded the Commission that our ability to monitor changes in stock abundance is currently limited due to incomplete fishery dependent information. Thus, it is desirable to pursue alternative fishery independent tools to provide improved bases for monitoring stock condition.

Although the SCRS will continue working on reviewing and improving the MSE for northern albacore, the MSE simulations conducted in 2017 allowed the Committee to provide advice that is robust to a wide range of uncertainties, including those affecting the 2016 assessment.

In 2017, MSE results highlighted that the implementation of any of the tested HCRs would meet the objective to be in the green quadrant of the Kobe plot (with a probability higher than 60%) (**ALB-Table 2**). In HCRs where maximum change in TAC of 20% is always applied (SC1), higher stability and higher long term yields were achieved, compared to HCRs where the 20% restriction for decrease is not used when $B<B_{THRESHOLD}$ (SC2). Not restricting TAC reductions improves safety and might allow quicker recoveries if the stock is really overexploited, but can also cause large unnecessary TAC reductions, or even fishery closures, when the stock is healthy but it is wrongly perceived to be overexploited.

In 2018, an external peer review was conducted and it confirmed that, overall, the MSE framework appears to be scientifically sound and robust to uncertainty. Thus, the interim HCR adopted by the Commission in 2017 that led to a TAC of 33,600 t had a robust scientific basis. Likewise, the additional analyses conducted by the species group in 2018 and 2019 are based on the same MSE framework and suggest that the Commission could adopt alternative harvest control rules to provide additional stability to the fisheries while meeting management objectives. These alternatives include applying the restriction of 20% maximum TAC change when B is estimated to be higher than B_{LIM}, and applying the restriction of 20% maximum TAC reduction and 25% maximum TAC increase when B is estimated to be higher than B_{LIM}. On the other hand, the Committee noted that imposing the minimum TAC of 15,000 t would also meet management objectives, but would override the application of paragraph 7.c of Rec. 17-04 (with current estimates of B_{MSY}, F_{MSY} and MSY). Results also showed that this scenario scored lowest in stock status indicators.

South Atlantic

Results indicate that, most probably, the South Atlantic albacore stock is not overfished and that overfishing is not occurring. However, there is considerable uncertainty about the current stock status, and the effect of alternative catch limits on the rebuilding probabilities of the southern stock. The different model scenarios considered in the south Atlantic albacore stock assessment provide different views on the future effects of alternative management actions. Projections at a level consistent with the 2016 TAC (24,000 t) showed that probabilities of being in the green quadrant of the Kobe plot across all scenarios would increase to 63% by 2020. Further reductions in TAC would increase the probability of being in the green zone in those timeframes. On the other hand, catches above 26,000 t will not permit maintaining the stock in the green area with at least 60% probability by 2020 (**ALB-Table 3 and 4**).

Mediterranean

Unfortunately, limited quantitative information is available to the SCRS for use in conducting a robust quantitative characterization on biomass status relative to Convention objectives. Recent fishing mortality levels appear to be below F_{MSY}, and current biomass is approximately at B_{MSY} level. However, there is considerable uncertainty about current stock status. For this reason, the Commission should maintain management measures designed to avoid increases in catch and effort directed at Mediterranean albacore. The analyses suggest that catch levels as high as those in the years 2006-2007 (beyond 5,900 t) proved to be clearly unsustainable. Moreover, recent average catches for this stock are close to the estimated MSY. Considering the high uncertainty regarding the most recent abundance trends, the Committee recommends to maintain catches below MSY at least until these abundance trends are further updated. The precise level of catch would depend on the level of risk the Commission is willing to take.

ATLANTIC AND MEDITERRANEAN ALBACORE SUMMARY			
	North Atlantic	**South Atlantic**	**Mediterranean**
Maximum Sustainable Yield	37,082 t (35,396-42,364)[1]	25,901 t (15,270-31,768)[2]	3,419 t (2,187-7,842)[4]
Current (2018) Yield	29,363 t	17,098 t	2,434 t
Yield in last year of assessment (2014)	26,651 t	13,677 t	
Yield in last year of assessment (2015)			2,774 t
B_{MSY}	407,567 t (366,309-463,685) [1]	120,465 t (71,312-208,438) [2]	29,168 t (17,939-65,861)[4]
F_{MSY}	0.097 (0.079-0.109) [1]	0.202 (0.119-0.373) [2]	0.119 (0.072-0.192)[4]
B_{2015}/B_{MSY}	1.36 (1.05-1.78)[1]	1.10 (0.51-1.80) [2]	1.002 (0.456-1.760)[4]
B_{2015}/B_{LIM}[3]	3.4		
F_{2014}/F_{MSY}	0.54 (0.35-0.72) [1]	0.54 (0.31-0.87) [2]	
F_{2015}/F_{MSY}			0.830 (0.223-2.194)
Stock Status	Overfished: NO	Overfished: NO	Overfished: NOT LIKELY
	Overfishing: NO	Overfishing: NO	Overfishing: NOT LIKELY
Management measures in effect:	Rec. 98-08: Limit number of vessels to 1993-1995 average. Rec. 17-04: TAC of 33,600 t for 2018-2020, according to interim HCR. Management objective is to keep the stock in (or rebuild it to) the green area of the Kobe plot with 60% probability, while maximizing catch and reducing variability of TAC.	Rec. 16-07: TAC of 24,000 t for 2017-2020	Rec. 17-05: Time closure of two months (1 October- 30 November) for longlines, aimed at protecting the Mediterranean swordfish juveniles. A list of vessels authorized to target Mediterranean albacore implemented in 2017. No increase of catch and effort until more accurate advice is delivered.

[1] Median and 80% CI for the base case.
[2] Median and 80% CI for the range of the 8 base cases.
[3] The interim B_{LIM} is 0.4*B_{MSY}.
[4] Median and 95% CI for the base case.

ALB-Table 1. Estimated catches (t) of albacore (*Thunnus alalunga*) by area, gear and flag.

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL				71812	67517	60379	59585	59039	67063	70088	69919	60095	61470	53379	57763	67407	48794	42320	41663	40857	48796	53008	45594	42757	44304	48995	45006	48895
	ATN			35163	38377	28803	29023	25746	34551	33124	26253	22741	25567	25960	35318	36989	21991	20483	15375	19509	20039	25680	24633	26655	25551	30340	28401	29363
	ATS			35300	27552	28426	28022	30595	27656	31387	38796	31746	28005	22545	18916	24453	20283	18867	22265	19225	24129	25282	19457	13702	15199	14336	13825	17098
	MED			1349	1587	3150	2541	2698	4856	5577	4870	5608	7898	4874	3529	5965	6520	2970	4024	2124	4628	2047	1503	2400	3554	4319	2780	2434
Landings	ATN		Bait boat	11967	16411	11338	9821	7562	8780	11072	6103	6638	7840	8128	10458	14273	8496	7931	4994	6026	5530	8816	4975	7341	9265	14455	12196	11330
			Longline	7309	4859	4641	4051	4035	6710	7321	7372	6235	7826	7037	6911	5223	3237	2647	2619	3913	3666	3759	6514	3093	4458	5394	4951	4305
			Other surf.	7506	3555	3337	4378	6846	6817	5971	2828	365	470	577	624	625	525	274	427	324	412	352	596	163	136	95	138	62
			Purse seine	292	278	263	26	91	56	191	264	118	211	348	99	188	198	70	84	74	0	167	7	35	115	45	38	39
			Trawl	2131	3049	2571	2877	1318	5343	3547	5374	5376	3846	2369	7001	6385	3429	4321	2811	2026	6852	6678	6558	9184	5771	6299	6611	8820
			Troll	5959	10226	6652	7870	5894	6845	5023	4312	4009	5373	7501	10224	10296	6105	5239	4440	7146	3578	5909	5891	6660	5597	3753	4165	4807
	ATS		Bait boat	9339	7091	6960	8110	10353	6709	6873	10355	9712	6976	7477	5119	5938	3421	4443	8007	3750	6058	6933	5213	4765	4965	2949	1846	3228
			Longline	24806	20040	21000	19547	19799	20640	24398	28039	21671	20626	14735	12977	17740	15087	13218	12113	13471	16445	17846	13888	8888	10104	11243	11674	13767
			Other surf.	91	10	209	127	0	73	58	377	323	82	299	288	333	1716	1125	1985	1648	1418	64	264	7	0	108	114	84
			Purse seine	1064	412	257	117	434	183	58	25	39	309	16	534	442	58	81	160	355	208	437	91	42	129	36	190	19
			Trawl	0	0	0	120	9	52	0	0	0	12	18	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED		Bait boat	81	163	205	0	33	96	88	77	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Longline	350	87	391	348	194	416	2796	2597	3704	4248	2335	1997	3026	4101	2694	2160	1719	2327	1959	1392	2343	3235	4258	2706	2378
			Other surf.	766	1031	2435	1991	2426	4271	2693	2196	1757	46	87	169	134	182	246	634	404	1408	8	18	27	58	29	46	40
			Purse seine	23	0	0	0	0	0	0	0	1	3557	2452	1362	2803	2237	24	1230	0	869	68	86	14	247	7	26	14
			Trawl	0	0	0	0	0	0	0	0	0	48	0	0	0	0	5	0	0	0	0	0	5	4	9	0	2
			Troll	129	306	119	202	45	73	0	0	117	0	0	0	1	0	1	0	1	0	6	0	3	0	0	2	1
Discards	ATN		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	179	209	300	302	0
	ATS		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
			Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MED		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	6	7	8	10	16	0	
Landings	ATN	CP	Barbados	0	0	0	1	1	1	0	2	5	8	10	13	9	7	7	4	6	4	20	22	13	16	38	32	15
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	22	26	39	416	351	155	230	79	1	399	448	385
			Brazil	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Canada	32	12	24	31	23	38	122	51	113	56	27	52	27	25	33	11	14	28	34	32	47	32	20	17	26
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	**0**
			China PR	14	8	20	0	0	21	16	57	196	155	32	112	202	59	24	27	142	101	21	81	35	21	103	124	124
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	53	39	146	0	0	0	151	549	**0**
			EU.España	16998	20197	16324	17295	13285	15363	16000	9177	8952	12530	15379	20447	24538	14582	12725	9617	12961	8357	13719	10502	11607	14126	17077	13964	15691
			EU.France	5934	5304	4694	4618	3711	6888	5718	6006	4345	3456	2448	7266	6585	3179	3009	1122	1298	3348	3361	4592	6716	3441	4224	4191	5824
			EU.Ireland	2534	918	874	1913	3750	4858	3464	2093	1100	755	175	306	521	596	1517	1997	788	3597	3575	2231	2485	2390	2337	2492	3102
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	**0**
			EU.Portugal	974	6470	1634	395	91	324	278	1175	1953	553	513	556	119	184	614	108	202	1046	1231	567	2609	929	1111	2527	498
			EU.United Kingdom	613	196	49	33	117	343	15	0	0	0	0	6	19	30	50	67	118	57	50	133	136	31	0	0	**0**
			FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	4	0	7	2	0	3	0	0	0	0	0	0	0	0	0	0	**0**

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Grenada	0	2	1	6	7	6	12	21	23	46	25	29	19	20	15	18	18	18	0	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	**0**
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Japan	505	386	466	414	446	425	688	1126	711	680	893	1336	781	288	402	288	525	336	400	1745	267	276	297	366	196
		Korea Rep.	0	2	2	1	0	0	0	0	0	0	0	59	45	12	59	82	110	60	200	184	64	5	13	8	27
		Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	90	3
		Maroc	0	0	0	0	0	0	0	0	55	81	120	178	98	96	99	130	0	0	0	0	0	0	20	20	20
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	2	0	7
		Panama	117	73	11	5	0	0	0	0	0	0	0	0	96	298	113	45	154	103	0	246	126	103	200	0	196
		Philippines	0	0	0	0	151	4	0	0	0	0	0	9	0	8	19	54	0	0	83	0	0	0	0	0	
		Sierra Leone	0	0	0	0	0	0	0	91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		St. Vincent and Grenadines	0	0	0	0	0	1	704	1370	300	1555	89	802	76	263	130	135	177	329	305	286	328	305	291	297	173
		Trinidad and Tobago	0	0	0	2	1	1	2	11	9	12	12	9	12	18	32	17	17	23	47	67	71	95	71	48	33
		U.S.A.	741	545	472	577	829	315	406	322	480	444	646	488	400	532	257	189	315	422	418	599	458	354	250	238	103
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		UK.Bermuda	0	0	0	1	0	2	2	2	0	0	1	1	0	0	0	0	0	1	0	0	1	0	1	0	0
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	**0**
		Vanuatu	0	0	0	0	0	0	0	0	0	0	414	507	235	95	20	140	187	196	172	228	195	0	0	0	**0**
		Venezuela	282	279	315	75	107	91	299	348	162	346	457	175	321	375	222	398	288	247	312	181	285	351	287	301	
	NCC	Chinese Taipei	6409	3977	3905	3330	3098	5785	5299	4399	4330	4557	4278	2540	2357	1297	1107	863	1587	1367	1180	2394	947	2857	3134	2385	2926
		Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	249	216	0	0	0	0	**0**
	NCO	Cuba	0	0	0	0	0	0	0	0	1	322	435	424	527	0	0	0	0	0	0	0	0	0	0	0	
		Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	0	
		Dominican Republic	0	0	0	323	121	73	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	10	8	11	3	8	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Sta. Lucia	0	1	1	0	0	0	1	3	2	10	0	2	2	2	2	0	130	2	3	2	0	0	2	1	
ATS	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	168	0	5	0	0	0	**0**
		Belize	0	2	0	0	0	8	2	0	0	0	0	0	54	32	31	213	303	365	171	87	98	0	123	219	311
		Brazil	1227	923	819	652	3418	1872	4411	6862	3228	2647	522	556	361	535	487	202	271	1269	2077	2016	462	490	658	497	396
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	8	46	24	0	5	0	5	0	0	0	0	0	0	**0**
		China PR	0	0	0	0	0	39	89	26	30	26	112	95	100	35	25	89	97	80	61	65	34	120	94	185	116
		Curaçao	0	0	0	9	192	0	2	0	0	0	0	0	0	0	0	21	4	4	24	0	0	1	14	10	**0**
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47	43	45	50	0	0	0	0	0	6
		EU.España	831	457	184	256	193	1027	288	573	836	376	81	285	367	758	933	1061	294	314	351	369	259	418	195	347	303
		EU.France	129	82	190	38	40	13	23	11	18	63	16	478	347	12	50	60	109	53	161	73	38	53	17	78	16
		EU.Portugal	1185	655	494	256	124	232	486	41	433	415	9	43	8	13	49	254	84	44	11	1	3	1	9	9	11
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0**
		Ghana	0	0	0	0	0	0	0	0	0	53	0	0	0	5	10	14	25	0	0	0	0	0	0	0	**0**
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	56	0	0	15	0	1	3	1	**0**
		Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	1

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	74	0	0	0	0	0	
		Honduras	0	2	0	7	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	651	389	435	424	418	601	554	341	231	322	509	312	316	238	1370	921	973	1194	2903	3106	1131	1752	1096	1189	2985
		Korea Rep.	3	3	18	4	7	14	18	1	0	5	37	42	66	56	88	374	130	70	89	33	2	4	48	86	167
		Maroc	24	24	0	5	4	0	0	0	14	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Namibia	1111	950	982	1199	1429	1162	2418	3419	2962	3152	3328	2344	5100	1196	1958	4936	1320	3791	2420	848	1057	1062	994	214	888
		Panama	458	228	380	53	60	14	0	0	0	0	0	17	0	87	5	6	1	0	12	3	0	6	5	13	1
		Philippines	0	0	0	0	5	4	0	0	0	0	0	52	0	13	79	45	95	96	203	415	18	0	0	0	
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	**0**
		South Africa	6931	5214	5634	6708	8412	5101	3610	7236	6507	3469	4502	3198	3735	3797	3468	5043	4147	3380	3553	3510	3719	4030	2065	1785	2572
		St. Vincent and Grenadines	29	30	41	0	23	0	2116	4303	44	0	0	0	65	160	71	51	31	94	92	97	110	100	107	101	98
		Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		U.S.A.	0	0	1	5	1	1	1	2	8	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		UK.Sta Helena	5	82	47	18	1	1	58	12	2	3	1	35	62	46	94	81	3	120	2	2	0	0	0	0	**0**
		Uruguay	16	49	75	56	110	90	90	135	111	108	120	32	93	34	53	97	24	37	12	209	0	0	0	0	**0**
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	684	1400	96	131	64	104	85	35	83	91	0	0	0	**0**
	NCC	Chinese Taipei	22573	18351	18956	18165	16106	17377	17221	15833	17321	17351	13288	10730	12293	13146	9966	8678	10975	13032	12812	8519	6675	7157	8907	9090	9227
	NCO	Argentina	2	0	0	120	9	52	0	0	0	12	18	0	0	0	0	0	130	43	0	0	0	0	0	0	
		Cambodia	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (ETRO)	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	123	102	169	47	42	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MED	CP	EU.Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	12	20	30	11	7	2	2
		EU.Cyprus	0	0	0	0	0	0	6	0	12	30	255	425	507	712	209	223	206	222	315	350	377	495	542	568	624
		EU.España	218	475	429	380	126	284	152	200	209	1	138	189	382	516	238	204	277	343	389	244	283	53	51	206	71
		EU.France	23	3	0	5	5	0	0	0	1	0	0	0	0	2	1	0	1	2	0	0	1	1	0	0	**0**
		EU.Greece	1	0	952	741	1152	2005	1786	1840	1352	950	773	623	402	448	191	116	125	126	126	165	287	541	1332	608	522
		EU.Italy	1107	1109	1769	1414	1414	2561	3630	2826	4032	6913	3671	2248	4584	3970	2104	2727	1109	2501	1117	615	1353	1602	1490	1348	1044
		EU.Malta	0	0	0	1	1	6	4	4	2	5	10	15	18	1	5	1	2	5	19	29	62	37	56	4	104
		EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	**0**
		Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	750	800	0	30
		Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120	0	0	0	0	0	0	0	0	**0**
		Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	19	14	0	0	0	1	1	0	0	0	0	**0**
		Turkey	0	0	0	0	0	0	0	0	0	0	27	30	73	852	208	631	402	1396	62	71	0	53	25	44	38
	NCO	NEI (MED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Yugoslavia Fed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards ATN	CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	179	209	300	302	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ATS	CP	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
MED	CP	EU.Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	6	7	8	10	16	0	
		EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

ALB-Table 2. Performance of 8 HCRs, according to the performance statistics defined by Panel 2 (only one performance indicator per block is shown, which represents median values across 132 operating models). The combination of the target fishing mortality (F_{TARGET}), Biomass threshold ($B_{THRESHOLD}$) and the type of stability clause defines the HCR. Two stability clauses were considered: (SC1) maximum change in TAC of 20% always applied from one 3-year management period to the next while also always imposing a 15,000-50,000 t min-max TAC; and (SC2) same as SC1 but not restricting TAC reductions and not imposing a minimum TAC when $B<B_{THRESHOLD}$. Each HCR has a unique identification number in this table and in **ALB-Figure 12**. pGR% = probability of being in the green quadrant of the Kobe plot; pBint% = probability of $B_{THRESHOLD}>B>B_{LIM}$; LongY (kt) = mean yield for the period 2030-2045 in thousands of tons; MAP = mean absolute proportional change in catch.

HCR				Stock Status	Safety	Catch	Stability
Number	Ftar	Bthresh	Stability clause	pGr%	pBint%	LongY (kt)	MAP (%)
1	0,80	0,80	SC2	85,5	9,0	26,5	8,3
2	1,00	0,80	SC2	78,9	13,0	29,0	8,8
3	0,80	1,00	SC2	88,6	8,3	26,9	8,3
4	1,00	1,00	SC2	84,5	9,2	26,9	8,9
1	0,80	0,80	SC1	85,8	9,3	32,1	5,6
2	1,00	0,80	SC1	74,7	15,8	34,1	6,2
3	0,80	1,00	SC1	86,0	10,4	32,2	6,0
4	1,00	1,00	SC1	77,9	14,3	35,0	6,3

ALB-Table 3. South Atlantic albacore. Maximum catch which enables the stock to be in the Kobe green zone in 2020 with a probability higher than 60%, for each ASPIC and BSP run. Average and median across runs is also provided.

Model	Run	Catch
ASPIC	Run2	26,000
	Run6	24,000
	Run7	26,000
	Run8	26,000
BSPM	EQ SH	30,000
	EQ FOX	34,000
	CW SH	22,000
	CW FOX	18,000
Average		25,750
Median		26,000

ALB-Table 4. South Atlantic albacore estimated probabilities (in %) that the South Atlantic albacore stock fishing mortality is below F_{MSY} (a), biomass is above B_{MSY} (b) and both (c). Projections for constant F and constant catch levels are shown, combining all base case scenarios.

(a) Probability $F<F_{MSY}$

Catch (t)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
12,000	96	96	96	96	96	97	97	97	97	97	97	97	97
14,000	96	96	96	96	96	96	96	96	96	96	96	96	96
16,000	95	95	96	96	96	96	96	96	96	96	96	96	96
18,000	90	91	92	93	93	94	94	94	94	95	95	95	95
20,000	84	85	85	86	86	87	87	88	88	88	88	89	89
22,000	79	81	81	81	82	82	82	82	82	82	83	83	83
24,000	66	72	75	75	74	74	74	73	73	72	72	71	71
26,000	56	57	59	61	62	61	60	59	58	56	55	54	53
28,000	48	45	43	41	40	39	39	39	38	38	38	37	36
30,000	39	35	33	30	28	26	24	23	22	21	20	19	18
32,000	32	29	26	24	22	19	17	16	14	13	12	11	11
34,000	28	25	22	19	15	13	11	9	8	7	7	6	6

(b) Probability $B>B_{MSY}$

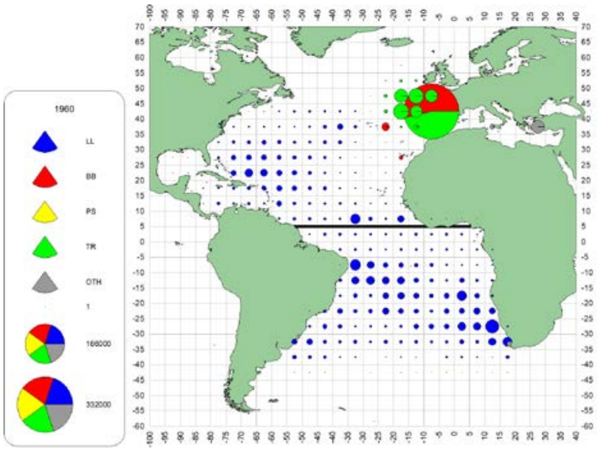
Catch (t)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
12,000	75	80	94	95	96	96	96	96	96	96	96	96	96
14,000	75	79	93	95	95	95	95	96	96	96	96	96	96
16,000	75	78	91	94	94	95	95	95	95	95	95	95	95
18,000	75	77	87	93	93	94	94	94	94	95	95	95	95
20,000	75	76	81	90	91	92	92	92	92	92	92	91	91
22,000	75	75	76	84	87	86	85	84	84	83	83	83	82
24,000	75	74	73	72	74	75	75	74	73	73	73	72	72
26,000	75	73	67	61	60	62	65	65	65	63	62	61	59
28,000	75	71	61	55	53	51	49	48	47	46	45	43	42
30,000	75	69	56	51	47	43	40	36	32	30	27	26	25
32,000	75	66	53	47	42	37	32	28	25	23	21	19	18
34,000	75	62	50	43	37	31	26	23	20	18	16	14	13

F	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
0.75*FMSY	75	76	89	90	90	91	91	92	92	92	92	92	92
0.80*FMSY	75	75	86	88	89	89	89	89	89	90	90	90	90
0.85*FMSY	75	74	82	86	86	87	87	86	87	87	87	87	87
0.90*FMSY	75	74	77	84	84	84	84	84	84	84	83	83	83
0.95*FMSY	75	73	72	80	80	80	81	80	80	79	79	79	79
1.00*FMSY	75	72	68	70	74	74	73	72	68	63	60	59	59

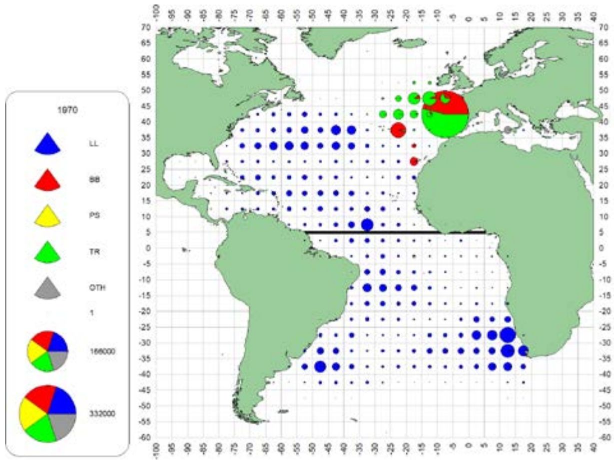
(c) Probability of green status ($B>B_{MSY}$ and $F<F_{MSY}$).

Catch (t)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
12,000	74	80	94	95	95	96	96	96	96	96	96	96	96
14,000	74	78	93	94	95	95	95	96	96	96	96	96	96
16,000	73	77	90	93	94	94	95	95	95	95	95	95	95
18,000	68	72	83	89	91	92	92	93	93	93	93	94	94
20,000	63	65	71	81	83	84	84	85	86	86	86	87	87
22,000	62	63	65	73	78	79	79	79	80	80	80	80	80
24,000	61	60	60	63	69	72	72	72	71	71	70	70	69
26,000	55	54	53	52	52	55	56	57	56	55	54	53	52
28,000	48	45	42	40	37	35	35	35	35	35	35	35	35
30,000	39	35	33	30	28	26	24	23	21	20	19	18	18
32,000	32	29	26	24	22	19	17	16	14	13	12	11	11
34,000	28	25	22	19	15	13	11	9	8	7	7	6	6

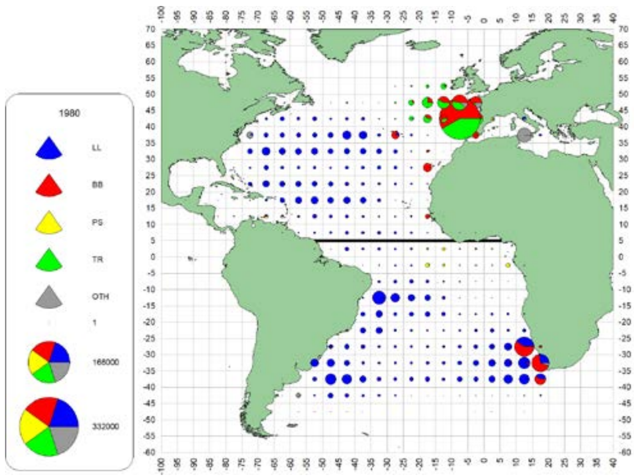
F	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
0.75*FMSY	75	76	89	90	90	91	91	92	92	92	92	92	92
0.80*FMSY	74	75	86	88	89	89	89	89	89	89	90	90	90
0.85*FMSY	72	73	81	85	86	86	86	86	86	86	86	86	86
0.90*FMSY	69	69	74	81	81	82	82	82	82	82	82	82	82
0.95*FMSY	64	64	65	73	75	75	77	77	77	77	77	77	77
1.00*FMSY	59	59	57	61	66	67	67	67	63	59	57	56	57



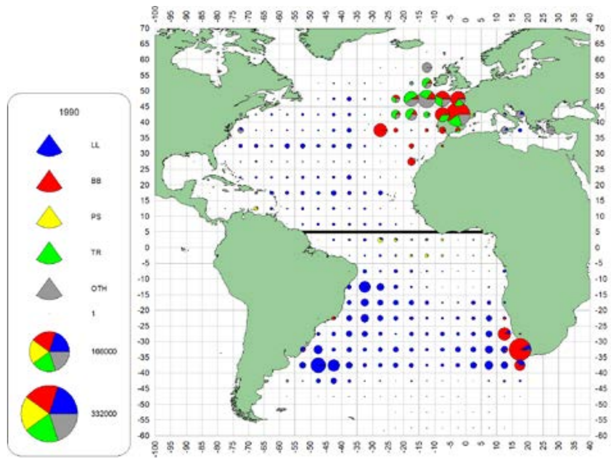
a. ALB (1960-69)



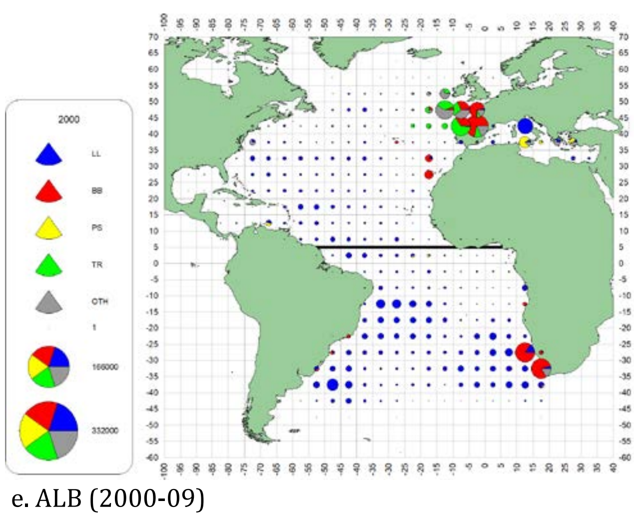
b. ALB (1970-79)



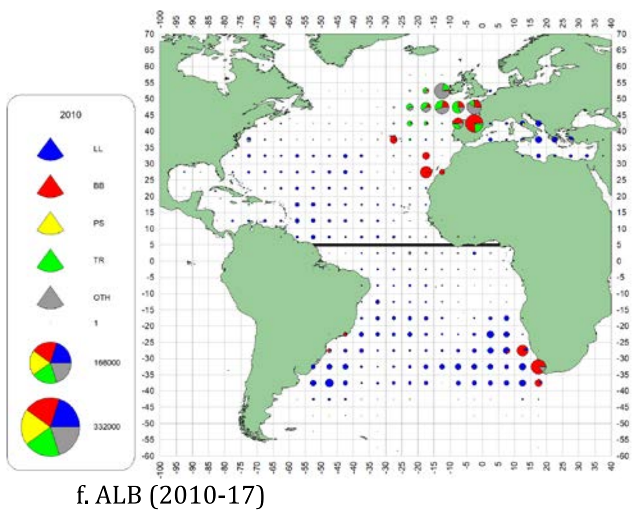
c. ALB (1980-89)



d. ALB (1990-99)



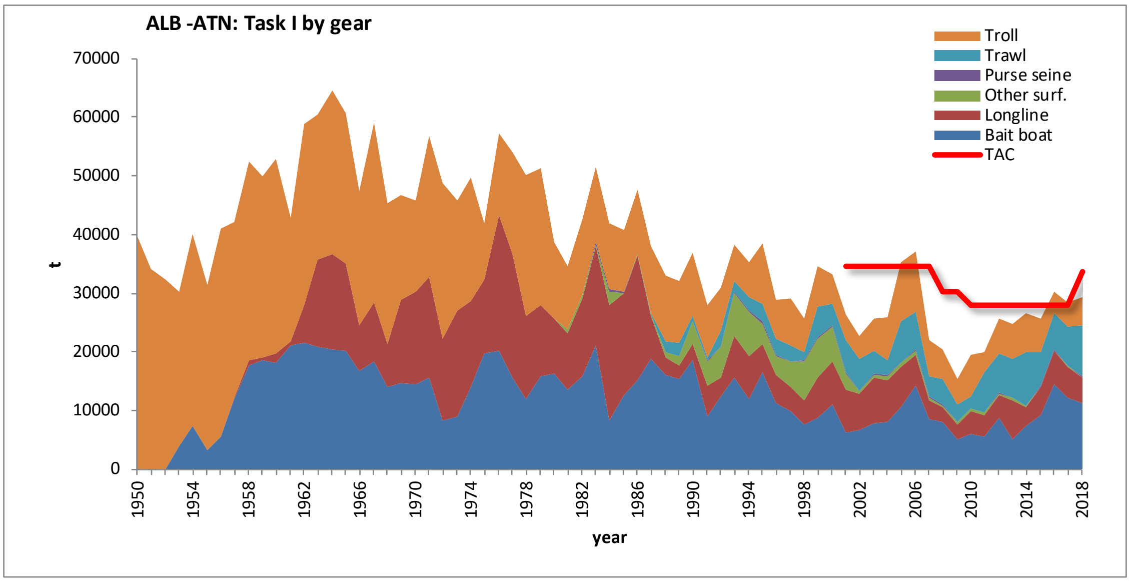
e. ALB (2000-09)



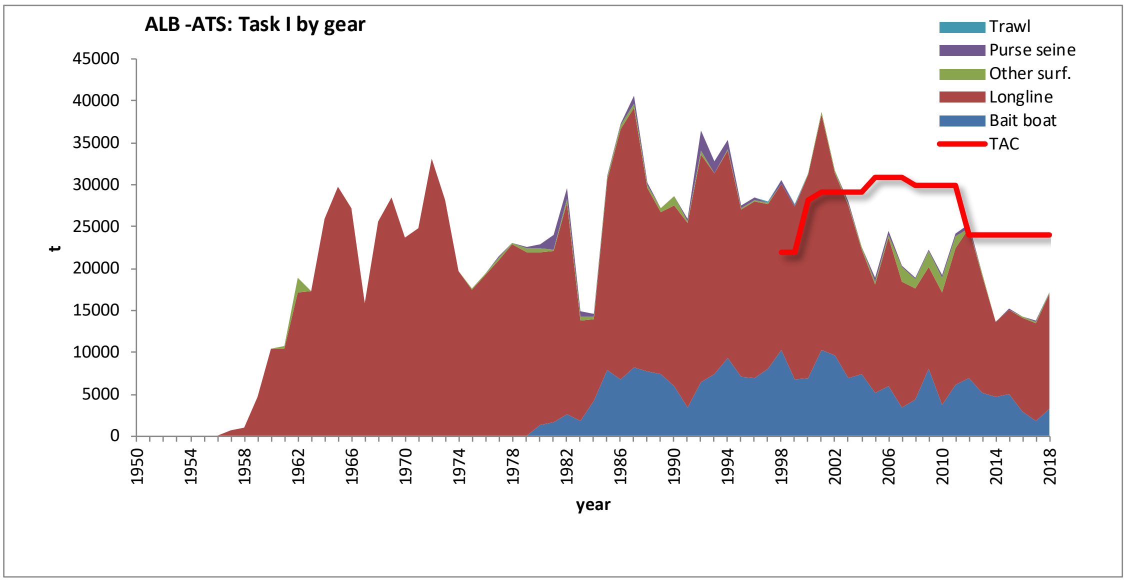
f. ALB (2010-17)

ALB-Figure 1. Geographic distribution of albacore accumulated catch by major gears and decade (1960-2017). Baitboat and troll catches prior to the 1990s, these catches were assigned to only one 5ºx5º stratum in the Bay of Biscay. Plots are scaled to the maximum catch observed from 1960 to 2017 (last decade only covers 8 years).

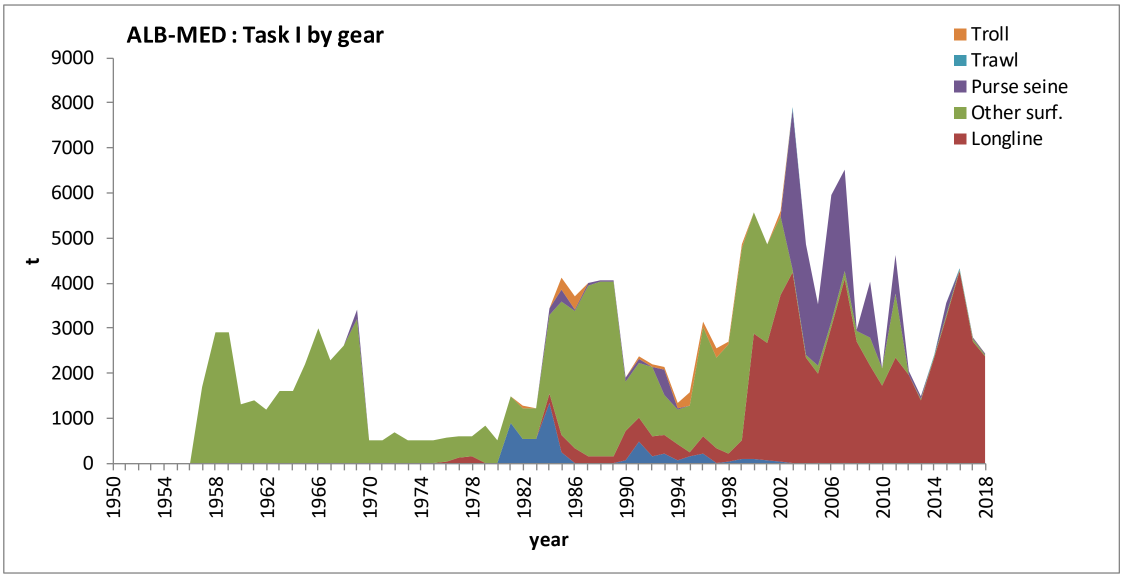
a)



b)

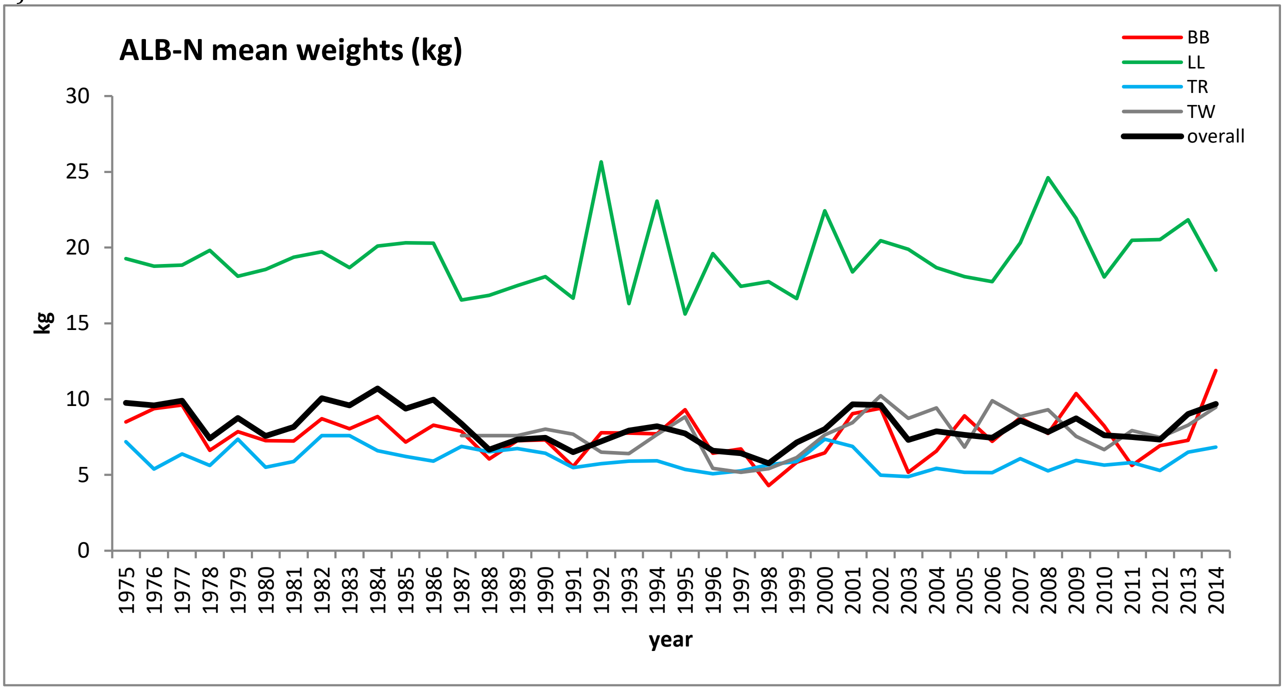


c)

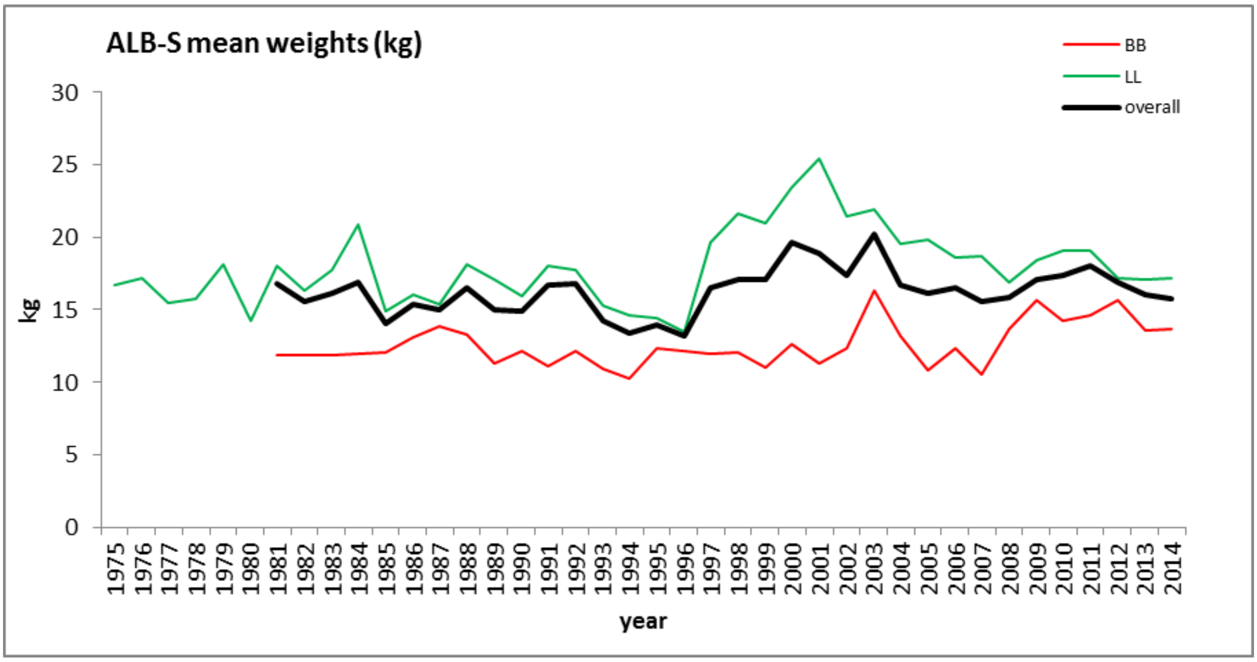


ALB-Figure 2a, b, c. Total albacore catches reported to ICCAT (Task I) by gear for the northern, southern Atlantic stocks including TAC, and the Mediterranean stock.

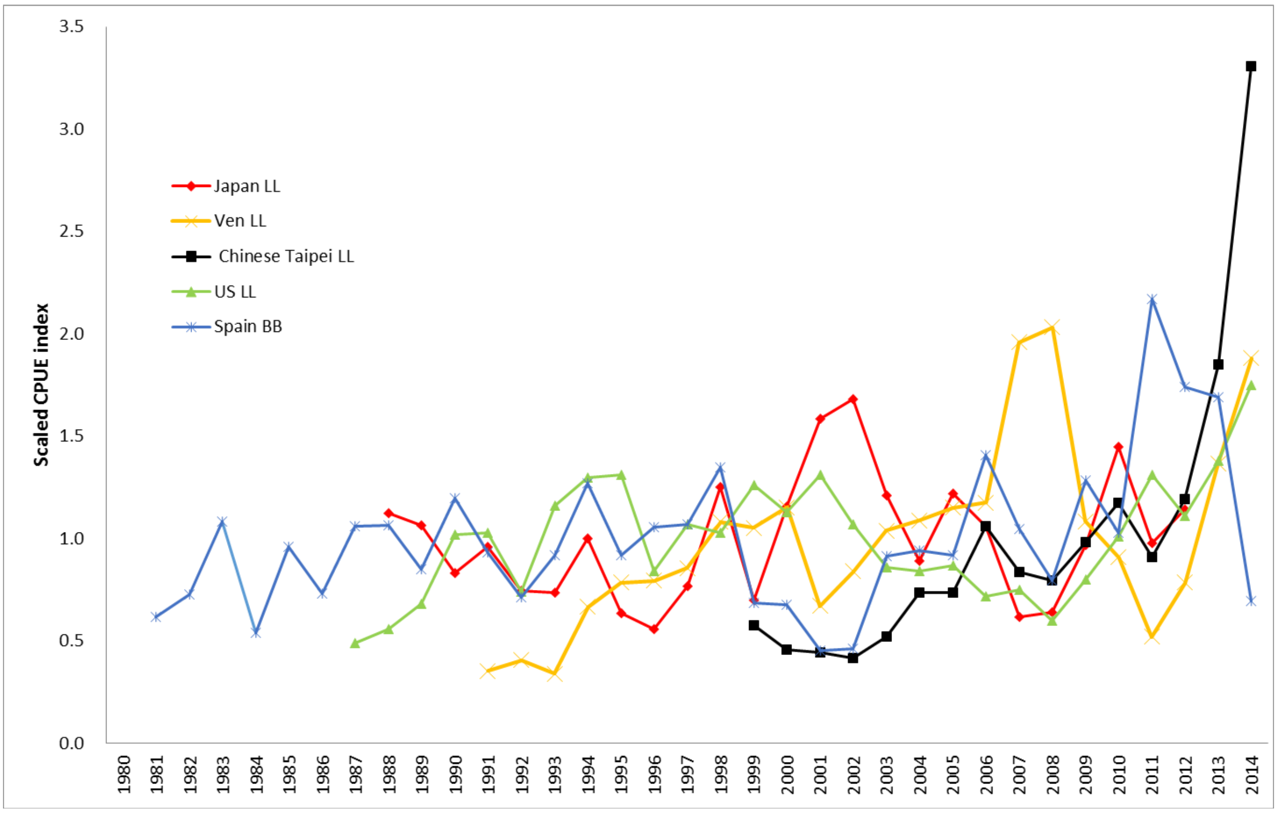
a)



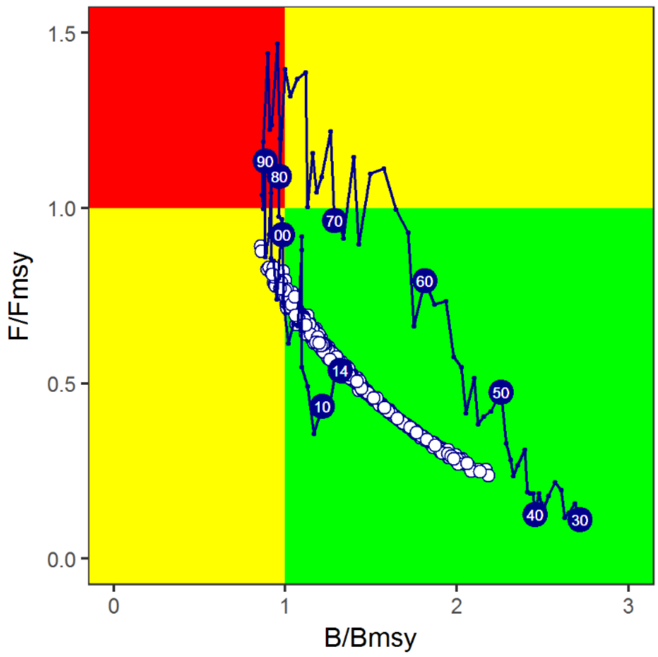
b)



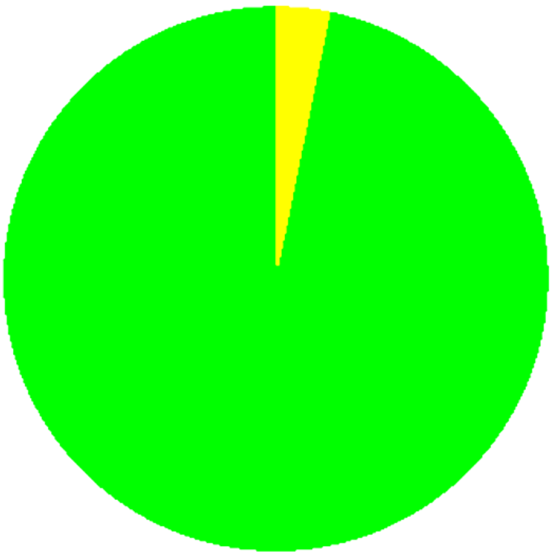
ALB-Figure 3a, b. Mean weight trend by surface and longline fisheries in North Atlantic (a) and South Atlantic (b) stocks. The baitboat fishery in the South Atlantic started in 1979 and mean weights are provided from 1980 onwards.



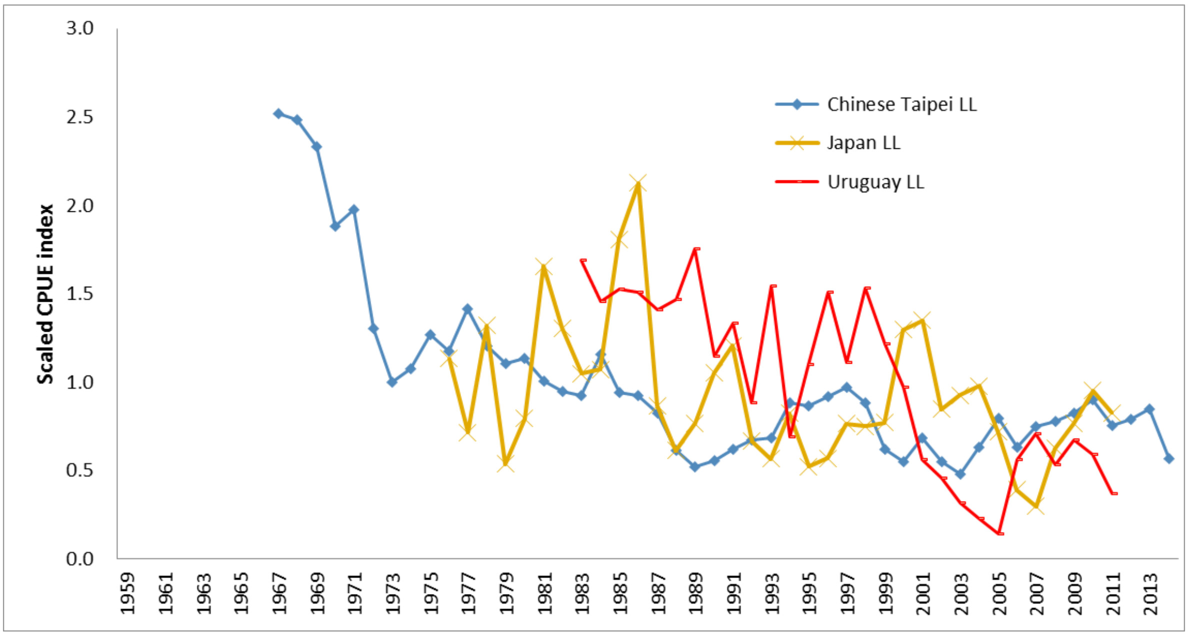
ALB-Figure 4. North Atlantic albacore. Standardized catch rate indices used in the 2016 stock assessment from the surface fisheries, which take mostly juvenile fish, and from the longline fisheries, which take mostly adult fish.



ALB-Figure 5. North Atlantic albacore. Joint trajectories of B/B_{MSY} and F/F_{MSY} over time (1930-2014) and current stock status according to the Base Case biomass dynamic model. Dots represent the uncertainty on the estimated 2014 stock status.

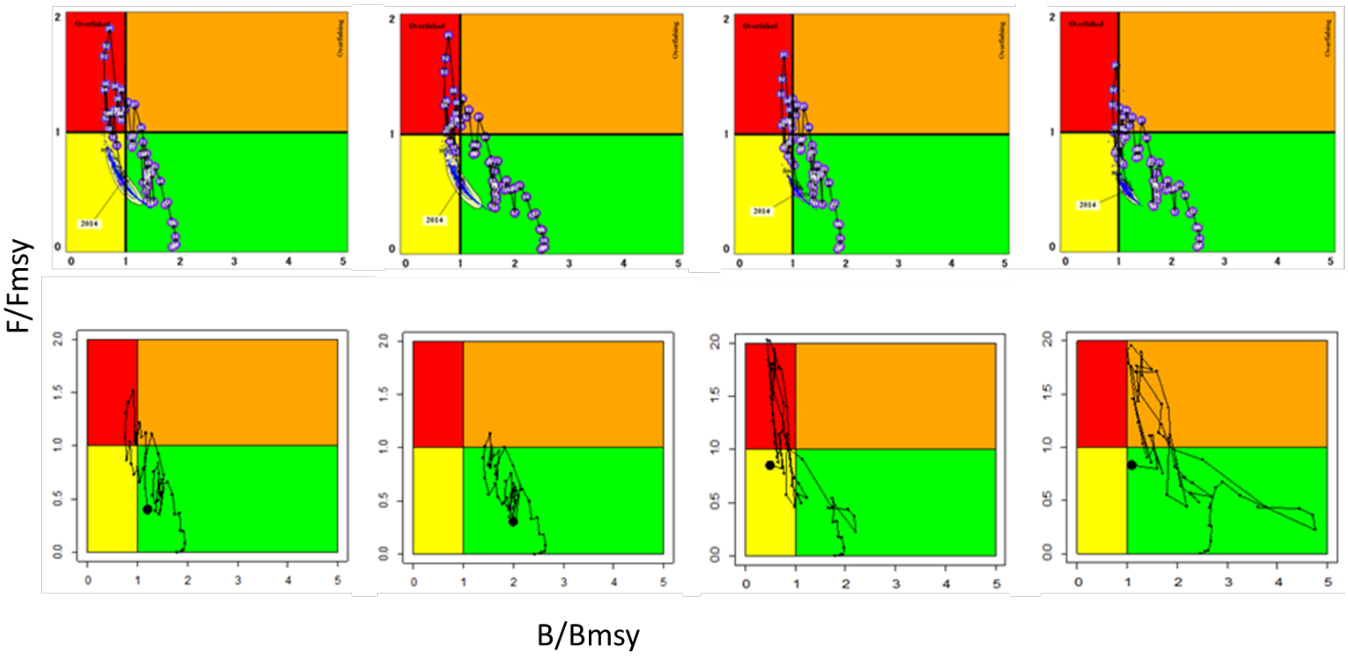


ALB-Figure 6. North Atlantic albacore probability of being overfished and overfishing (red, 0%), of being neither overfished nor overfishing (green, 96.8%), and of being overfished (yellow, 3.2%), according to the Base Case.

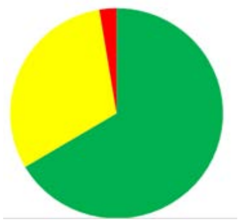


ALB-Figure 7. South Atlantic albacore. Standardized catch rates used in the 2016 stock assessment.

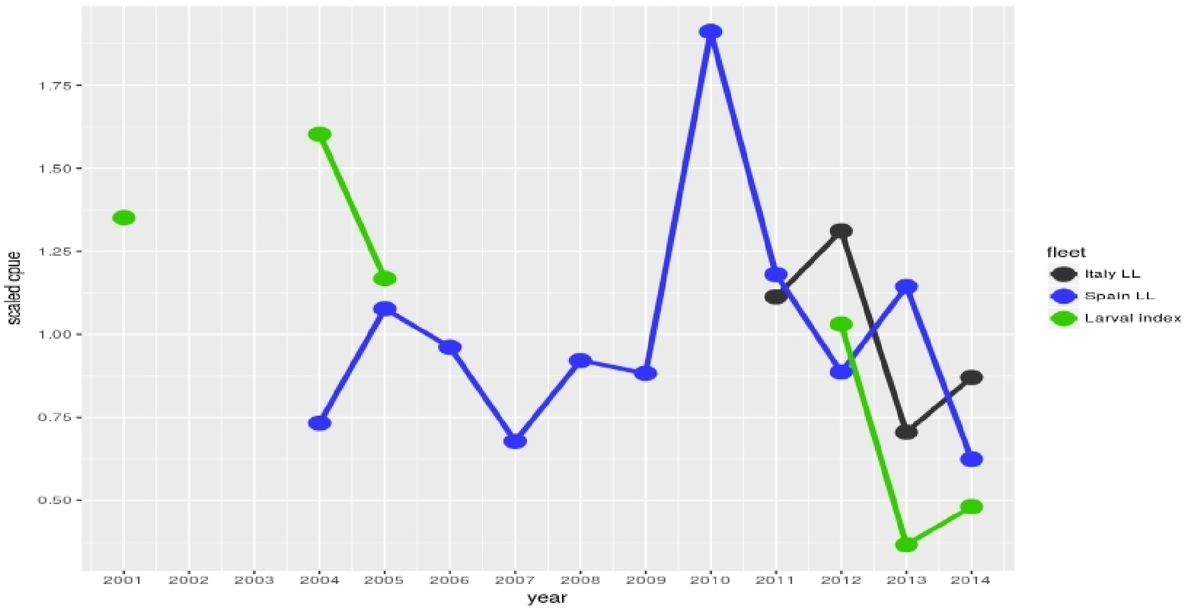
a)



b)

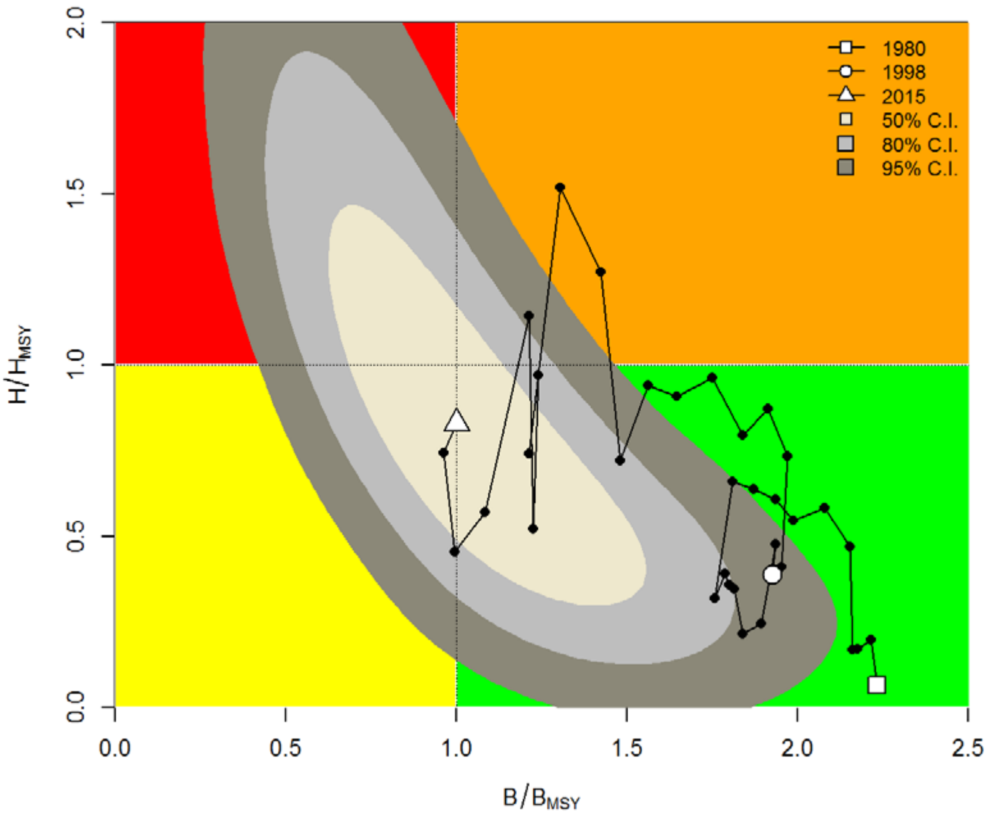


ALB-Figure 8. South Atlantic albacore. a) Stock status trajectories of B/B_{MSY} and F/F_{MSY}, as well as uncertainty around the current estimate (Kobe plots) for the base case ASPIC models (upper row) alongside those from the base case BSP runs (bottom row). From left to right, boxes indicate the following scenarios: Equal weight, Schaefer; Equal weight, Fox; Catch weight, Schaefer; Catch weight, Fox. (b) Combined probability of being overfished and overfishing (red, 3%), of being neither overfished nor overfishing (green (66%), and of being overfished or overfishing, but not both (yellow, 31%).

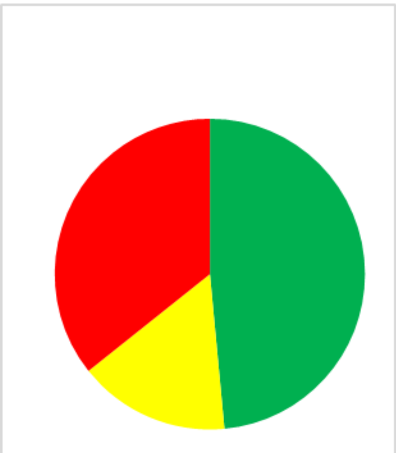


ALB-Figure 9. Set of abundance indices used in the 2017 assessment of the Mediterranean albacore stock.

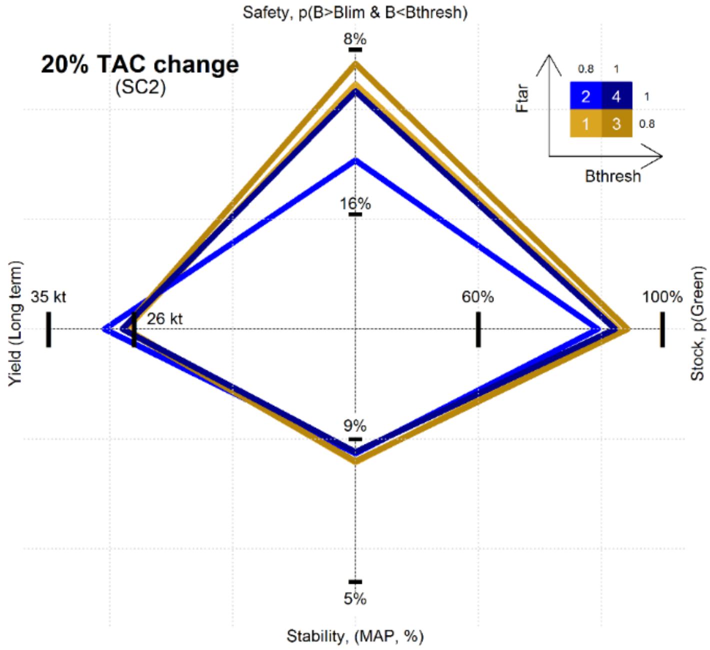
a)

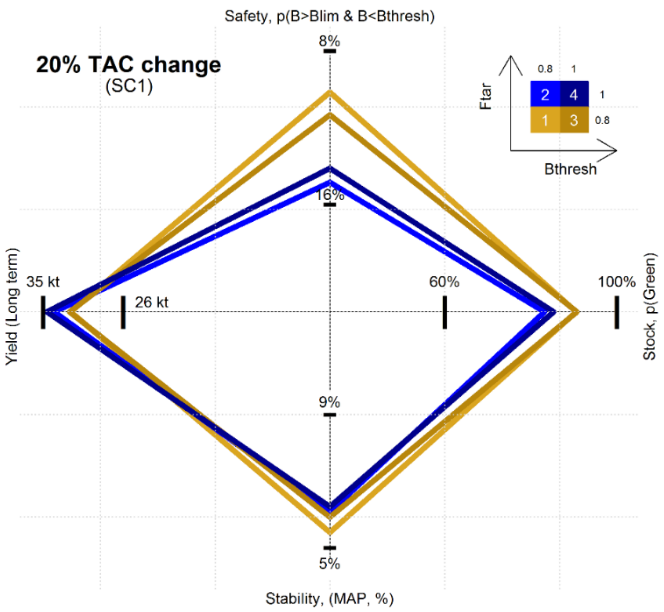


b)

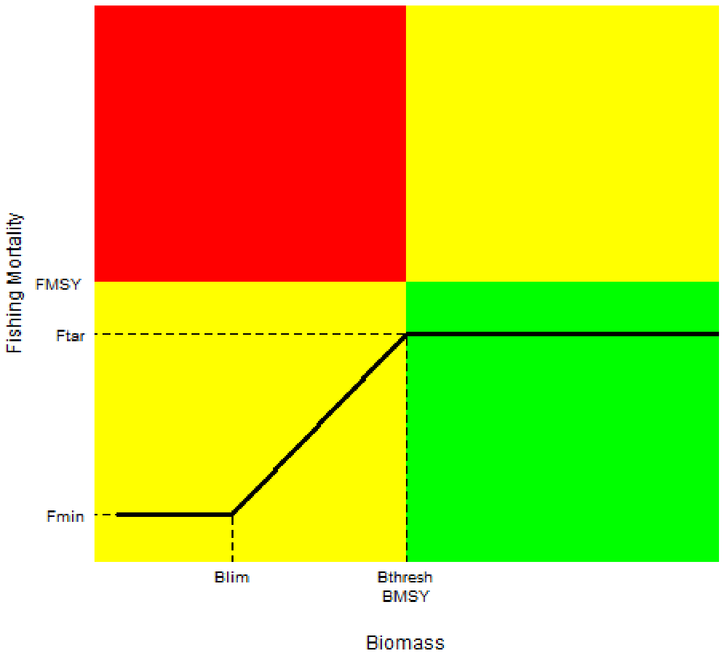


ALB-Figure 10. Mediterranean albacore. a) Stock status trajectories of B/B$_{MSY}$ and F/F$_{MSY}$, as well as uncertainty around the current estimate (Kobe plots) for the base case JABBA model. (b) Probability of being overfished and overfishing (red, 36%), of being neither overfished nor overfishing (green (48%), and of being overfished or overfishing, but not both (yellow, 16%).

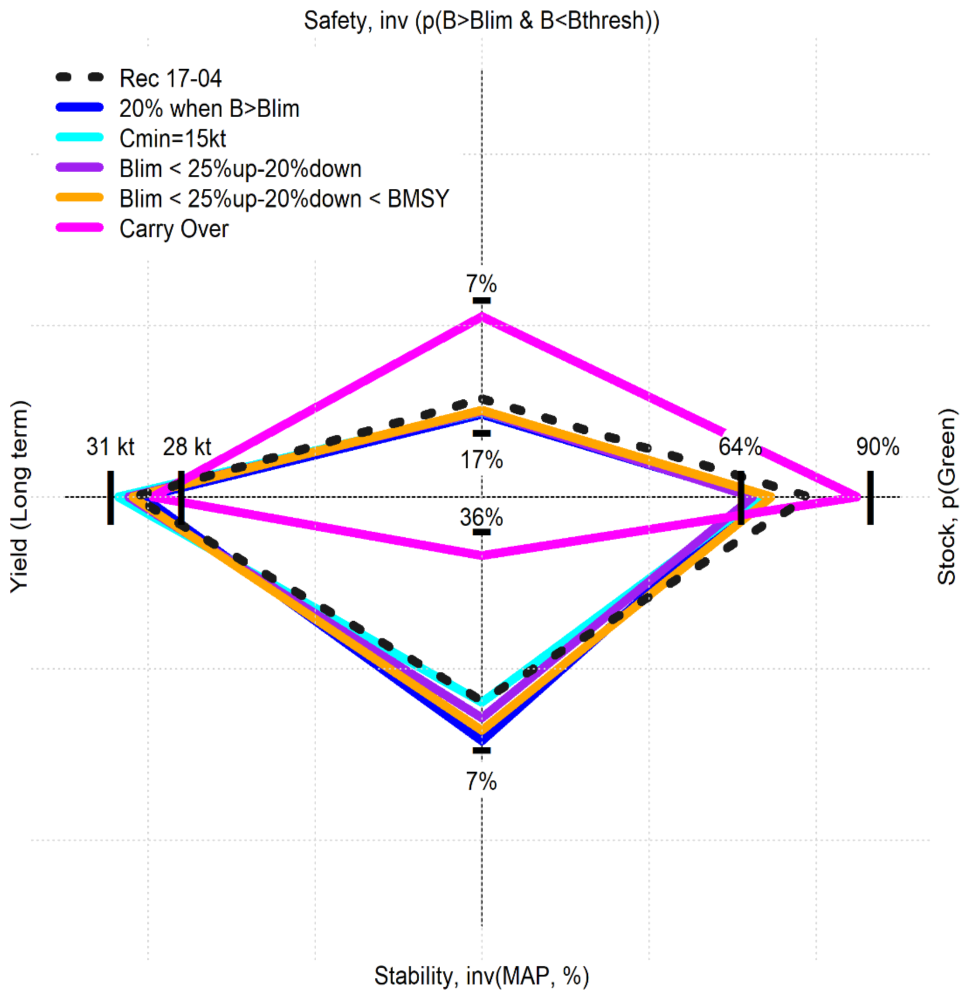




ALB-Figure 11. Spider plots representing the relative performance of HCRs with alternative stability clauses: SC1 (panel below), maximum change in TAC of 20% always applied from one 3-year management period to the next while also always imposing a 15,000-50,000 t min-max TAC; and (SC2) same as SC1 but not restricting TAC reductions and not imposing a minimum TAC when $B<B_{THRESHOLD}$. Among the 15 performance statistics identified by Panel 2, a single performance statistic per main group (namely stock status, stability, yield and safety) is represented in each of the axes. Each HCR has a unique identification number in this figure and **ALB-Table 2.** Different tickmarks in the axes are included to inform about absolute values. The exact values for all the HCRs can be seen in **ALB-Table 2.**



ALB-Figure 12. Graphic form of the HCR adopted in Rec 17-04. B_{LIM} (set at 0.4BMSY) is the limit biomass reference point, B_{THRESH} (set at B_{MSY}) is the point below which fishing mortality decreases linearly, F_{TAR} (set at $0.8F_{MSY}$) is the target fishing mortality rate to be applied to achieve the management objectives, and F_{MIN} (set at $0.1F_{MSY}$) is the fishing mortality to be applied when $B<B_{LIM}$.



ALB-Figure 13. Spider plots representing the relative performance of the HCR adopted in Rec. 17-04, as well as different variants, namely the effect of the carry over as allowed in Rec (17.04) (pink), the effect of setting a lower TAC limit of 15000 t (light blue), the effect of applying the 20% stability clause when $B_{CUR}>B_{LIM}$ (dark blue), and the effect of 20% maximum TAC reduction and 25% maximum TAC increase when $B_{THR}>B_{CUR}>B_{LIM}$ (orange) and when $B_{CUR}>B_{LIM}$ (purple).

9.5 BFT – ATLANTIC BLUEFIN TUNA

The primary focus of the Committee for the past year has been on the Management Strategy Evaluation (MSE). The Committee is of the opinion that the MSE process is likely the best means of developing management advice robust to the complexities of bluefin tuna including stock mixing, environmental variability and other uncertainties that affect current assessment advice. The Committee has made progress in developing operating models (OMs), addressing data and coding issues, and initial development of candidate management procedures. Nonetheless, after examining the diagnostics from the conditioned OMs, the Committee has concluded that additional technical work is needed to improve some important aspects of the OMs and that it cannot yet recommend a final reference set of OMs.

Therefore, the MSE process will not be completed in time for the 2020 Commission meeting to provide TAC advice for 2021-2023 based on a management procedure. Accordingly, the Committee recommends moving to "option B", extending the MSE process for another year with a goal of completing the MSE process in time for the 2021 Commission meeting to provide TAC advice for 2022-2024 as outlined in the revised roadmap (**Appendix 16**). To provide a stock assessment in 2020 as the basis for 2021 TAC advice, the Committee recommends a simple update of the VPA for both West and East and Stock Synthesis for the West based on data up to 2018 (**Appendix 15**). In the event of a further delay in the MSE process, the decision on whether such an update assessment could provide TAC advice for the following year(s) will be determined at the 2020 SCRS meeting.

Further, the Committee recommends that interfacing with the Commission for further input (Panel 2, Scientists and Managers meeting, etc.) is not required intersessionally until the end of 2020. These interactions will be most effective when interim results of the MSE are available to convey the inherent trade-offs. Multiple dialogue sessions will be required in 2021, before SCRS provides final advice at the 2021 annual meeting.

BFT-1. Biology

Atlantic bluefin tuna (BFT) have a wide geographical distribution but mainly live in the temperate pelagic ecosystem of the entire North Atlantic and its adjacent waters, for example the Gulf of Mexico, Gulf of St. Lawrence and the Mediterranean Sea. Historical catch information documented the presence in the south Atlantic however recent information is incomplete (**BFT-Figure 1**), Archival tagging information confirmed that bluefin tuna can tolerate cold as well as warm water temperatures while maintaining a stable internal body temperature. Bluefin tuna preferentially occupy the surface and subsurface waters of the coastal and open-sea areas, but archival tagging and ultrasonic telemetry data indicate that they frequently dive to depths of more than 1,000 m. Bluefin tuna are a highly migratory species that seems to display a homing behavior and spawning site fidelity to primary spawning areas in both the Mediterranean Sea and Gulf of Mexico. Evidence indicates that spawning has been observed in other areas for example the vicinity of the Slope Sea off the Northeast USA and in the Cantabrian Sea, though their persistence and importance remain to be determined. Electronic tagging is also resolving the movements to the foraging areas within the Mediterranean and the North Atlantic and indicate that bluefin tuna movement patterns vary by tagging site, by month of tagging and according to the age of the fish. The reappearance of bluefin tuna in historical fishing areas (e.g. northern waters and in the Black Sea) suggest that important changes in the spatial dynamics of bluefin tuna may also have resulted from interactions between biological factors, environmental variations and the reduction in fishing effort.

The fisheries on Atlantic bluefin tuna are managed as two management units, conventionally separated by the 45°W meridian, however efforts to understand the population structure through tagging, genetic and microchemistry studies indicate that mixing is occurring at variable rates between the two management areas.

The ICCAT GBYP, as well as national research programs provided the basis for improved biological studies. Substantial progress has been made in estimating regional, time varying mixing rates for Atlantic bluefin tuna, using otolith stable isotope and genetic analyses. Research on larval ecology of Atlantic bluefin tuna has advanced in recent years through oceanographic habitat suitability models. Direct age estimations, using otoliths and dorsal fin spine from both stock areas, have been calibrated between readers from several institutions resulting in stock specific age length keys and a new growth model for the western population. Otolith preparation and reading protocols have been updated to minimize bias in age estimations. Following the Recommendation 18-02 paragraph 28 a research study of growth in farms has been launched in 2019 in five locations and a new database will be created to integrate all the data from stereo-cameras measurements and harvesting operations. Due to the timing of the harvesting operations, the first relevant results will be available in 2021 (please see Item 19.9 for further details).

Currently, the Committee assumes for assessment purpose that eastern Atlantic and Mediterranean bluefin tuna contribute fully to spawning at age 5. There are also indications that some young individuals (age 5) of unknown origin caught in the West Atlantic were mature, but there was considerable uncertainty with regards to their contribution to the western stock spawning. Therefore, for the western stock the Committee considered two spawning schedules; one identical to that used for the East and one with peak spawning at age 15. However, the review of the reproductive biology showed that both current vectors of spawning fraction might be biased, and the magnitude of the bias is unknown. Juvenile growth is rapid for a teleost fish, but slower than other tuna and billfish species. Fish born in June attain a length of about 30-40 cm long and a weight of about 1 kg by October. After one year, fish reach about 4 kg and 60 cm long. At 10 years old, a bluefin tuna is about 200 cm and 170 kg and reaches about 270 cm and 400 kg by 20 years. Bluefin tuna is a long-lived species, with a lifespan of about 40 years, as indicated by radiocarbon deposition and can reach 330 cm (SFL) and weigh up to 725 kg. In 2017, the Committee revised the natural mortality assumptions and adopted a single new age specific natural mortality curve for both stocks.

Important electronic and conventional tagging activity on both juveniles and adult fish has been performed for several years in the Atlantic and Mediterranean by ICCAT GBYP, National Programmes and NGOs. Contribution of e-Tags data from all groups are supporting ongoing efforts to provide significant insight into bluefin tuna stock structure, distribution, mixing and migrations and are helping to estimate fishing mortality rates and condition the MSE operating models.

BFTE-2. Fishery trends and indicators –East Atlantic and Mediterranean

Reported catches in the East Atlantic and Mediterranean reached a peak of over 50,000 t in 1996 and then decreased substantially, stabilizing around TAC levels established by ICCAT for the most recent period (**BFTE-Figure 2**). Catches between 2014 and 2018 were, 13,261 t, 16,201 t, 19,131 t, 23,616 t, and 27,757 t for the East Atlantic and Mediterranean, of which, 9,343 t, 11,360 t, 13,163 t, 16,401 t, and 19,600 t was reported for the Mediterranean for those same years (**BFT-Table 1**). The Committee was informed of the existence of unquantified IUU catches which should be taken into account.

Information available has demonstrated that catches of bluefin tuna from the East Atlantic and Mediterranean were seriously under-reported between the mid-1990s through 2007. The Committee has estimated that realized catch during this period was likely in the order of 50,000 t to 61,000 t per year based on the number of vessels operating in the Mediterranean Sea and their respective catch rates. The 2017 assessment (Anon. 2017c) uses these estimates (1996-2007) rather than the declared catches.

During the 2017 Stock Assessment meeting (Anon. 2017c), it was decided to use ten indices up to 2015 (7 CPUE series and 3 fisheries independent index). Several of the ten indices used for the 2017 stock assessment were updated up to 2018 (**BFTE-Figure 3**). The Committee anticipates that additional indices could be used for tracking the abundance of the stock (e.g. GBYP aerial survey).

CPUE indices (**BFTE-Figure 3**) have been affected significantly by regulatory measures through the change of operational patterns, length of the fishing season and target sizes; thus it is difficult to distinguish the effect of these changes on CPUEs from the effects of changes in abundance.

The Committee was requested to annually evaluate whether the indicators support the TACs outlined in Rec. 18-02. To most effectively evaluate whether the indicators are in line with the assessment projections, and hence support the current TACs, the Committee compared updated indices with 80% prediction intervals from projection of the VPA model using observed catches in 2016-2018 (**BFTE-Figure 4**). The projection interval comparison serves as a means to evaluate whether the updated indicators are within the range of expectation for the models. To interpret the implications of points outside of the 80% intervals, 20% of the observations might fall outside of the interval by random chance. Considering this in general the indices fitted reasonably well within the prediction intervals and do not warrant concerns from the Committee.

BFTE-3. State of the stock

There have been considerable improvements in the data quality and quantity over the past few years, nevertheless there remain important gaps in the temporal and spatial coverage for detailed size and catch-effort statistics for several fisheries prior to 2014, especially in the Mediterranean.

The 2017 assessment results from the VPA base case, indicated that the spawning stock biomass (SSB) peaked in the mid-1970s after increasing initially and then declined until 1991 and remained steady up to the mid-2000s. From the late 2000s, SSB exhibited a substantial increase through 2015 (**BFTE-Figure 5**). The extent of that increase depends on the choices of model configuration and the indices of abundance and terminal year (2014 vs 2015). This led to some concern that the model was very sensitive to adding one additional year of data (i.e. the estimating of a substantial overall increase in biomass with the addition of only the last year of data). Concerns also remain that the size composition of many eastern Atlantic and Mediterranean fleets is poorly characterized for a number of years before the implementation of stereo video camera in 2014.

The estimated fishing mortality rates on the younger ages (i.e., average F for ages 2 to 5) displayed a continuous increase until the late 1990s and then showed a sharp decline to reach very low levels after the late 2000s (**BFTE-Figure 5**). This result is a consequence of the dramatic reduction in the catches at ages 2 to 3 in the recent years in response to the new minimum size regulations implemented in 2007. The trend of F in young ages was similar to that in the 2014 assessment. For oldest fish (F at plus group for ages 10 and older) showed (**BFTE-Figure 5**) an initial decline from 1968 to 1973, and slightly fluctuated around 0.03 afterwards. It increased in 1994 and continued increasing up to 2007 (F_{10+}=0.2). This period (from the mid-1990s to the mid-2000s) observed the highest level on fishing mortality of larger fish. Since 2008, there has been a rapid decrease in F_{10+}, as already noted in the previous assessments, which related to the regulation, i.e. the drastic reduction of TAC.

F0.1 was considered a reasonable proxy for F_{MSY}, although it can be higher or lower than F_{MSY} depending on the stock recruitment relationship, which in this case is poorly determined. However, given the uncertainties about future recruitment, estimates of biomass base reference points were unreliable. In addition to those uncertainties, the current perception of the stock status was also closely related to the assumptions made about stock structure and migratory behaviour, which remain poorly known. Nonetheless, compared to 2014 the extra data now available do better confirm recent stock increase though the level of increase remains difficult to quantify. F_{CUR} appears to be clearly below $F_{0.1}$ $F_{CUR}/F_{0.1}$= 0.34. The current status of the stock, and status in 2022 under a F0.1 strategy, relative to B0.1 depends on assumptions made for longer term future recruitment. For medium[1] and low recruitment levels, the stock is already above $B_{0.1}$, whereas for the high level it is below.

If an $F_{0.1}$ strategy were to continue to be applied, over the longer term the resource would fluctuate around the true, but unknown value of $B_{0.1}$ whatever the future recruitment level.

BFTE- 4. Outlook

In 2017, the Committee presented short-term projections until 2022 (**BFTE-Figure 6**). According to the base model annual constant catches up to 36,000 t have higher than 60% probability of maintaining F below $F_{0.1}$ throughout 2022 (**BFTE-Table 1**). Constant annual catches over approximately 32,000 t led to projected reduction in biomass (**BFTE-Figure 6**).

Projections are known to be impaired by various sources of uncertainties that have not yet been fully quantified. Due to the limited possibility of improving the quality of the data the Committee does not expect to provide further clarity regarding future recruitment. Therefore, the Kobe matrix is presented only in terms of the probability that F is less than $F_{0.1}$ (**BFTE-Table 1**).

BFTE-5. Effect of current regulations

Based on SCRS advice the Commission in 2017 adopted Rec. 17-07, and updated it in 2018 with Rec. 18-02. It is too early since the associated TACs have been implemented to be able to evaluate the effect on the resource.

[1] Averages taken over the years 1968-1980/ 1968-2012/1990-2005, for the low medium and high scenarios respectively.

The Committee noted that reported catches are in line with recent TACs. However, the Committee was informed of the existence of unquantified illegal catches of unknown magnitude.

The combination of size limits and the reduction of catch has certainly contributed to a rapid increase of the abundance of the stock.

BFTE-6. Management recommendations

The Committee was requested to annually evaluate whether the indicators support the TACs outlined in Rec. 18-02. The fishery indicators did not indicate a reason to alter current management advice. Consequently, the Committee is of the view that the stepped increase for 2020 from Rec. 18-02 can be maintained.

EAST ATLANTIC AND MEDITERRANEAN BLUEFIN TUNA SUMMARY	
Current reported yield (2018)	27,757 t*
$F_{0.1}$	0.107 (0.103-0.120)[1]
$F_{2012-2014}/F_{0.1}$[2]	0.339 (0.254-0.438)[1]
Stock Status [3]	Overfishing: No
Rec. 18-02 TAC 2019-2020	32,240 - 36,000

[1] Median and approximate 80% confidence interval from bootstrapping from the assessment.
[2] $F_{2012-2014}$ refers to the geometric mean of the estimates for 2012-2014 (a proxy for recent F levels).
[3] Biomass reference points to determine stock status were not estimated in the 2017 assessment due to uncertainty in recruitment potential
* As of 26 September 2019.

BFT-Table 1. Estimated catches (t) of northern bluefin tuna (*Thunnus thynnus*) by area, gear and flag.

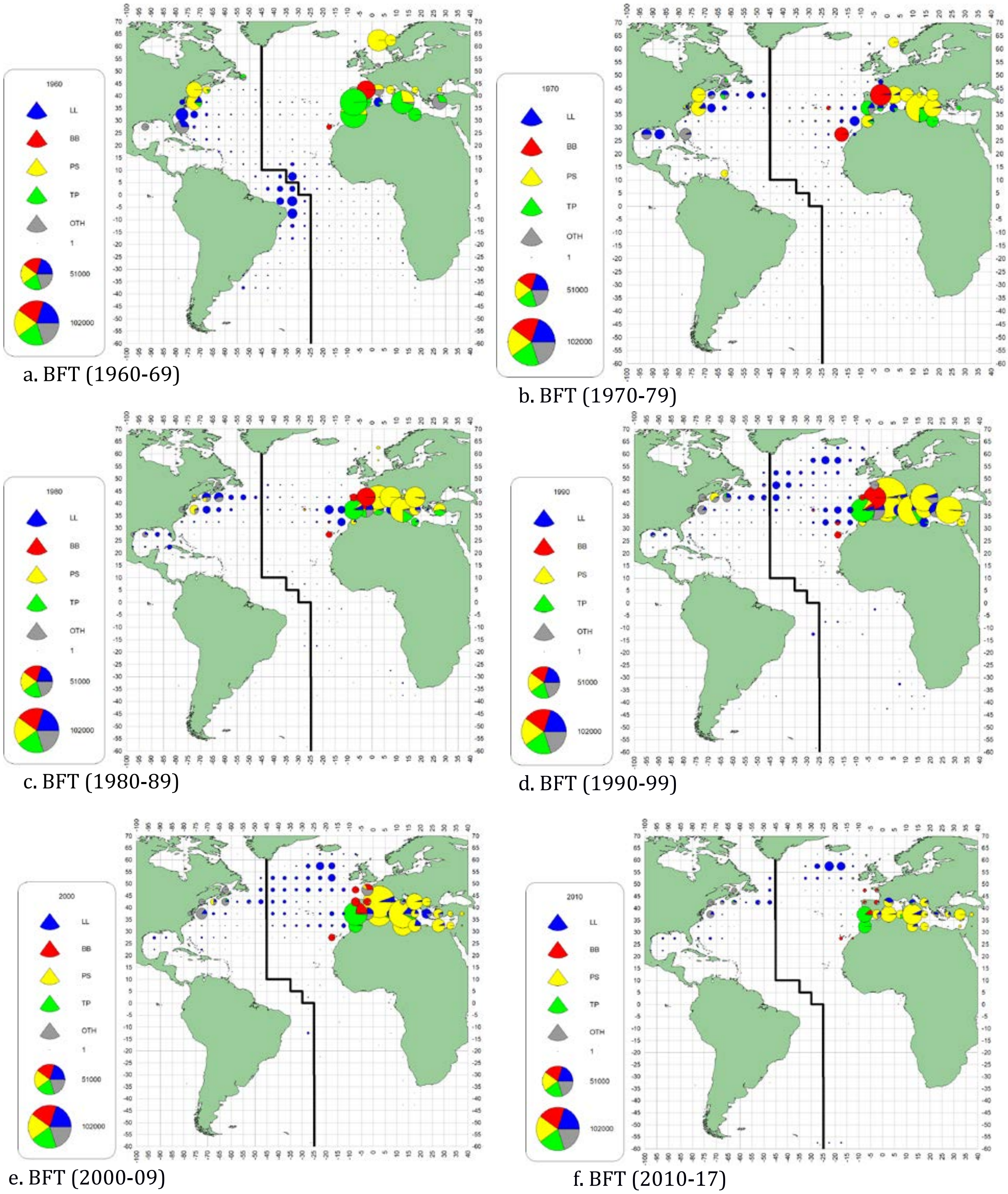
			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL			48881	49751	54009	53545	52657	52772	52775	52784	53319	52305	52125	51756	51812	62638	26460	21798	13195	11781	12688	14725	14887	18042	21032	25466	29784
BFT-E			46769	47303	51497	51211	50000	50000	50000	50000	50000	50000	50000	50000	50000	61000	24460	19818	11338	9774	10934	13243	13261	16201	19131	23616	27757
	ATE		7054	9780	12098	16379	11630	10247	10061	10086	10347	7394	7402	9023	7529	8441	8243	6684	4379	3984	3834	4163	3918	4841	5968	7216	8157
	MED		39715	37523	39399	34831	38370	39753	39939	39914	39653	42606	42598	40977	42471	52559	16217	13133	6959	5790	7100	9080	9343	11360	13163	16401	19600
BFT-W	ATW		2113	2448	2512	2334	2657	2772	2775	2784	3319	2305	2125	1756	1811	1638	2000	1980	1857	2007	1754	1482	1627	1842	1901	1850	2027
Landings	ATE	Bait boat	2284	3093	5369	7215	3139	1554	2032	2426	2635	1409	1902	2282	1263	2436	2393	1260	725	636	283	243	95	172	1085	1195	692
		Longline	2311	4522	4212	4057	3789	3570	3736	3303	2896	2748	2064	2700	2033	1705	2491	1951	1194	1125	1139	1167	1194	1467	1829	2208	2730
		Other surf.	590	555	273	60	387	404	509	558	631	521	290	424	831	502	181	297	124	35	49	141	210	193	261	295	340
		Purse seine	213	458	323	828	700	726	661	153	887	490	1078	1197	408	0	0	2	1	0	0	2	0	0	42	49	11
		Sport (HL+RR)	25	0	0	237	28	33	126	61	63	109	89	11	99	11	12	11	44	51	53	46	43	104	35	101	118
		Traps	1630	1152	1921	3982	3586	3960	2996	3585	3235	2116	1978	2408	2895	3788	3166	3164	2292	2137	2311	2564	2376	2905	2716	3363	4258
	MED	Bait boat	0	206	5	4	11	4	38	28	1	9	17	5	0	0	0	38	1	0	2	2	9	25	0	50	56
		Longline	6993	8469	9856	7313	4117	3338	3424	4144	3234	3484	3036	3427	3408	3269	2376	1344	1242	962	587	605	588	776	1523	1184	1517
		Other surf.	776	545	417	282	284	228	728	354	340	198	197	175	81	85	0	0	1	1	1	20	29	3	37	90	34
		Purse seine	27948	23799	26021	24279	31792	33798	33237	33043	34044	37291	37869	36639	38363	48994	13540	11448	4986	4293	6172	7982	8184	9993	11315	14466	17119
		Sport (HL+RR)	2307	3562	2149	2340	1092	1533	1773	1167	1520	1404	1325	619	494	117	149	160	448	356	202	240	289	361	284	335	567
		Traps	1691	942	951	613	1074	852	739	1177	515	221	154	112	125	93	152	144	281	165	125	222	232	192	0	272	300
	ATW	Longline	539	491	545	382	764	915	858	610	729	186	644	425	565	420	606	366	529	743	478	470	498	553	562	559	664
		Other surf.	307	384	429	293	342	279	283	201	107	139	97	89	85	63	78	121	107	147	117	121	119	138	93	123	77
		Purse seine	301	249	245	250	249	248	275	196	208	265	32	178	4	28	0	11	0	0	2	29	38	34	0	0	
		Sport (HL+RR)	804	1114	1032	1181	1108	1125	1121	1650	2036	1399	1139	924	1005	1023	1134	1251	1009	888	917	692	810	1085	1204	1144	1264
		Traps	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	39	26	17	11	20	6	10	13	3
Discards	ATE	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7
	MED	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	
		Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	12	9	11	2	4	5	6
	ATW	Longline	83	138	167	155	123	160	222	105	211	232	181	131	149	100	159	207	174	202	224	145	139	19	29	10	16
		Other surf.	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	2
		Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	4	5	0	0	
		Sport (HL+RR)	0	0	0	14	3	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Landings	ATE CP	Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		China PR	0	0	0	0	85	103	80	68	39	19	41	24	42	72	119	42	38	36	36	38	37	45	54	64	79
		EU.Denmark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0**
		EU.España	3137	3819	6186	9519	4565	4429	3493	3633	4089	2172	2801	3102	2339	3680	3536	2409	1550	1483	1329	1553	1282	1655	1986	2509	2489
		EU.France	336	725	563	269	613	588	542	629	755	648	561	818	1218	629	253	366	228	135	148	223	212	254	343	350	461
		EU.Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Ireland	0	0	0	14	21	52	22	8	15	3	1	1	2	1	1	1	2	4	10	13	19	14	32	16	17
		EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
		EU.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.Portugal	363	169	199	712	323	411	441	404	186	61	27	82	104	29	36	53	58	180	223	235	243	263	327	429	450
		EU.Sweden	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.United Kingdom	0	1	0	1	1	12	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	**0**
		Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7
		Guinée Rep.	330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Iceland	0	0	0	0	2	27	0	0	1	0	0	0	0	0	0	0	0	2	5	4	30	37	6	0	**0**
		Japan	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	1155	1089	1093	1129	1134	1386	1578	1905	2262
		Korea Rep.	4	205	92	203	0	0	6	1	0	0	3	0	1	0	0	0	0	0	0	0	0	0	161	181	208
		Maroc	720	678	1035	2068	2341	1591	2228	2497	2565	1795	1953	2389	1923	2418	1947	1909	1348	1055	990	960	959	1176	1433	1703	2164
		Norway	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	44	51	12
		Panama	1	19	550	255	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	**0**

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Sierra Leone	0	0	0	0	0	0	93	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NCC	Chinese Taipei	20	4	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0
	NCO	Faroe Islands	0	0	0	0	67	104	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
		NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	68	189	71	208	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Seychelles	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MED	CP	Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	9	34	40	47	56	100
		Algerie	1560	156	638	829	1674	1760	2083	2098	2056	1504	1440	1500	1673	1489	1311	0	0	0	69	244	244	370	448	1038	1300
		China PR	97	137	93	49	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		EU.Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		EU.Croatia	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	834	619	389	371	369	384	385	456	515	630	738
		EU.Cyprus	10	10	10	10	21	31	61	85	91	79	105	149	110	1	132	2	3	10	18	17	18	22	59	110	133
		EU.España	2741	4607	2588	2209	2000	2003	2772	2234	2215	2512	2353	2758	2689	2414	2465	1769	1056	942	1064	948	1164	1238	1467	1688	2706
		EU.France	11843	9604	9171	8235	7122	6156	6794	6167	5832	5859	6471	8638	7663	10200	2670	3087	1755	805	791	2191	2216	2565	3054	3661	4360
		EU.Greece	886	1004	874	1217	286	248	622	361	438	422	389	318	255	285	350	373	224	172	176	178	161	195	218	235	267
		EU.Italy	6901	7076	10200	9619	4441	3283	3847	4383	4628	4981	4697	4853	4708	4638	2247	2749	1061	1783	1788	1938	1946	2273	2488	3196	3860
		EU.Malta	580	590	402	396	409	449	378	224	244	258	264	350	270	334	296	316	136	142	137	155	160	182	212	261	308
		EU.Portugal	306	313	274	37	54	76	61	64	0	2	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0
		Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	77	77	155	99	124	181
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0
		Japan	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18	0	0	0	0	0	0	0	0	0
		Korea Rep.	684	458	591	410	66	0	0	0	0	0	700	1145	26	276	335	102	0	0	77	80	81	0	0	0	0
		Libya	1422	1540	1388	1029	1331	1195	1549	1941	638	752	1300	1091	1327	1358	1318	1082	645	0	756	929	933	1153	1368	1631	1792
		Maroc	1092	1035	586	535	687	636	695	511	421	762	827	108	463	641	531	369	205	182	223	309	310	322	350	439	407
		Panama	1499	1498	2850	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	50	41	0	34	0	0	0	0	40	47	57	66
		Tunisie	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	2545	431	2679	1932	1042	852	1017	1057	1047	1248	1461	1755	2092
		Turkey	3466	4219	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	519	536	551	555	1091	1324	1515	1284
	NCC	Chinese Taipei	709	494	411	278	106	27	169	329	508	445	51	267	5	0	0	0	0	0	0	0	0	0	0	0	0
	NCO	ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	1	0	1	1	0
		Israel	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NEI (Flag related)	427	639	171	1058	761	78	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NEI (combined)	773	211	0	101	1030	1995	109	571	508	610	709	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NEI (inflated)	0	0	0	0	9471	16893	16458	15298	15880	18873	18376	14164	18343	28234	0	0	0	0	0	0	0	0	0	0	0
		Serbia & Montenegro	0	2	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Yugoslavia Fed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ATW	CP	Brazil	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Canada	392	576	597	503	595	576	549	524	604	557	537	600	733	491	575	530	505	474	477	480	463	531	466	472	508
		FR.St Pierre et Miquelon	0	0	0	0	0	1	0	0	3	1	10	5	0	4	3	2	8	0	0	0	0	9	0	0	0
		Japan	427	387	436	322	691	365	492	506	575	57	470	265	376	277	492	162	353	578	289	317	302	347	345	346	406
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	1	52	0	0	0	0	0	0	0	0	0	0	0	0
		Mexico	4	23	19	2	8	14	29	10	12	22	9	10	14	7	7	10	14	14	51	23	51	53	55	34	80
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		U.S.A.	1163	1311	1285	1334	1235	1213	1212	1583	1840	1426	899	717	468	758	764	1068	803	738	713	502	667	877	1002	986	1014
		UK.Bermuda	0	0	1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NCC	Chinese Taipei	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	0	0	0	0	0	0	0	0	74	11	19	27	19	0	0	0	0	0	0	0	0	0	0	0	

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	0	0	0	0	0	429	270	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	43	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards	ATE	CP	Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7
	MED		Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	5	2	2	4	5	6
			EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	
			Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	0	0	0	0	
			Tunisie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	
			Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	
	ATW		Canada	0	0	0	6	16	11	46	13	37	14	15	0	2	0	1	3	25	36	17	0	0	3	8	1	3
			Japan	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
			U.S.A.	83	138	171	155	110	149	176	98	174	218	167	131	147	100	158	204	150	166	206	159	143	22	24	10	15

BFTE-Table 1. The probabilities of $F<F_{0.1}$ for quotas from 0 to 50,000 t for 2018 through 2022 under the recent 6 years (2006-2011) recruitment scenario. Shading corresponds to the probabilities of being in the ranges of 50-59%, 60-69%, 70-79%, 80-89% and greater or equal to 90%. Catches for 2016 and 2017 are assumed to be equal to the 2016 and 2017 TAC in all scenarios.

Catch (t)	2018	2019	2020	2021	2022
18,000	100	100	100	100	100
20,000	99	99	99	99	99
22,000	99	99	98	98	98
23,655	98	98	98	98	98
24,000	98	98	97	98	97
26,000	97	96	96	96	96
28,000	95	94	94	94	94
30,000	93	92	92	90	89
31,000	90	90	89	89	88
32,000	89	88	87	86	83
33,000	86	85	83	81	80
34,000	82	81	79	78	75
35,000	79	77	76	72	70
36,000	75	73	70	68	64
37,000	70	68	65	62	59
38,000	65	63	60	57	54
39,000	59	57	54	52	49
40,000	56	52	49	46	44
45,000	36	35	34	30	28
50,000	24	22	20	18	18



a. BFT (1960-69)

b. BFT (1970-79)

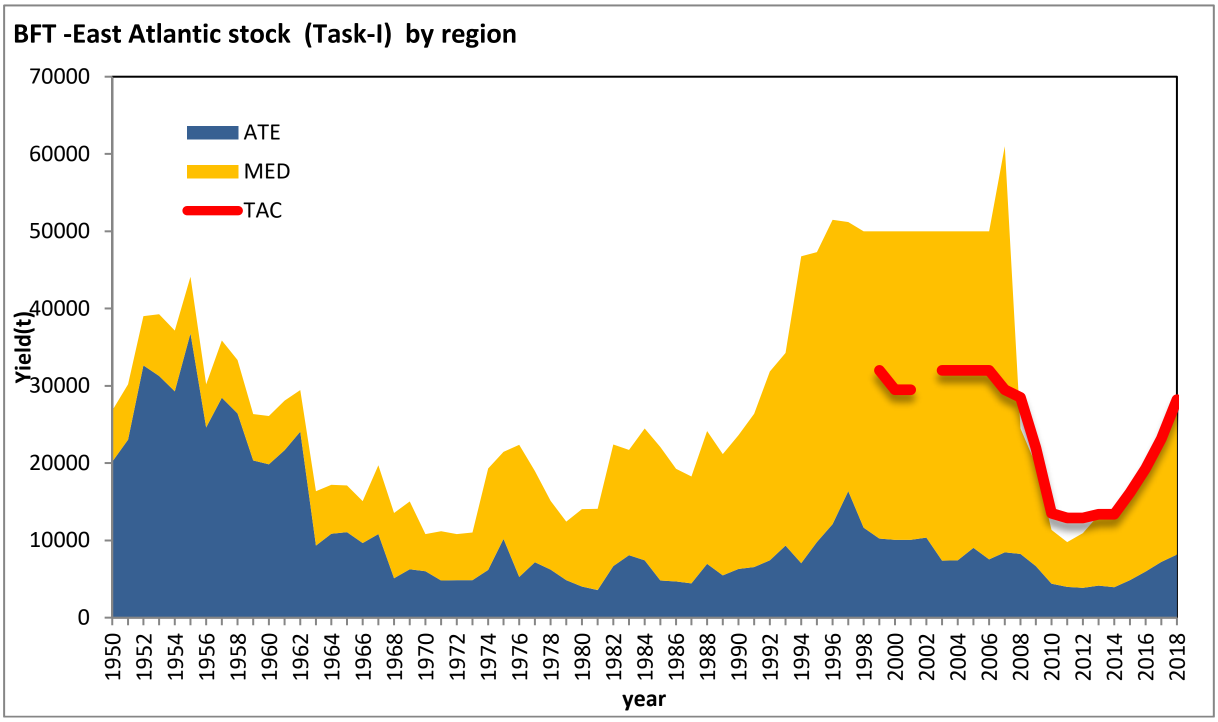
c. BFT (1980-89)

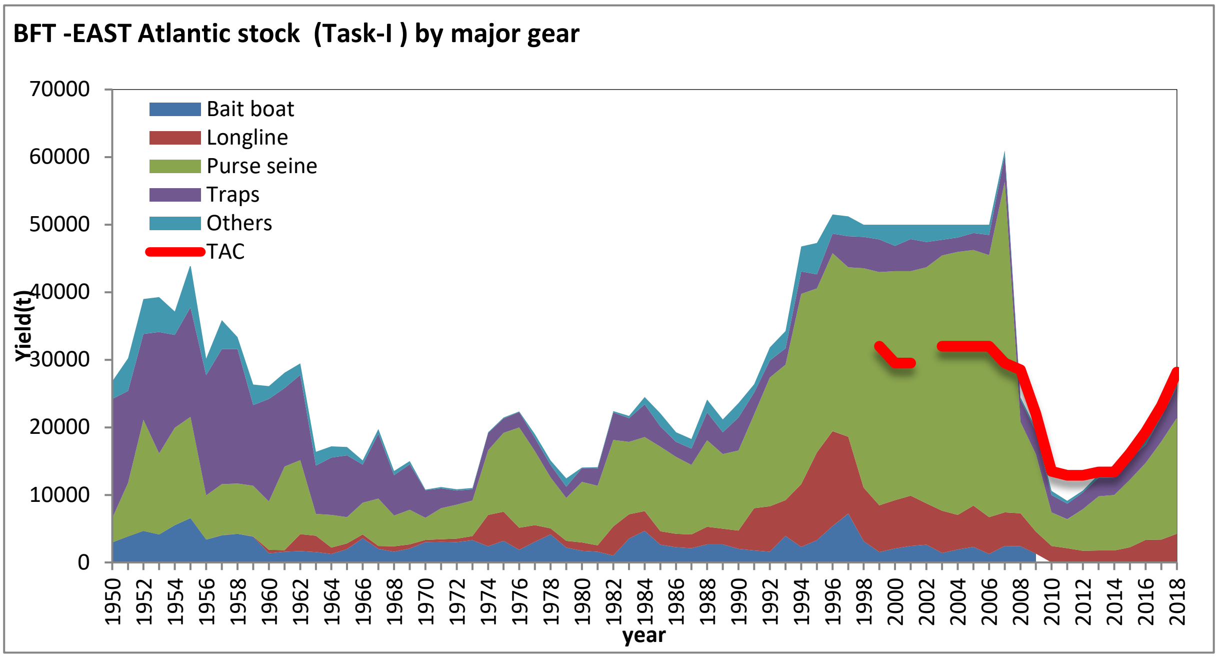
d. BFT (1990-99)

e. BFT (2000-09)

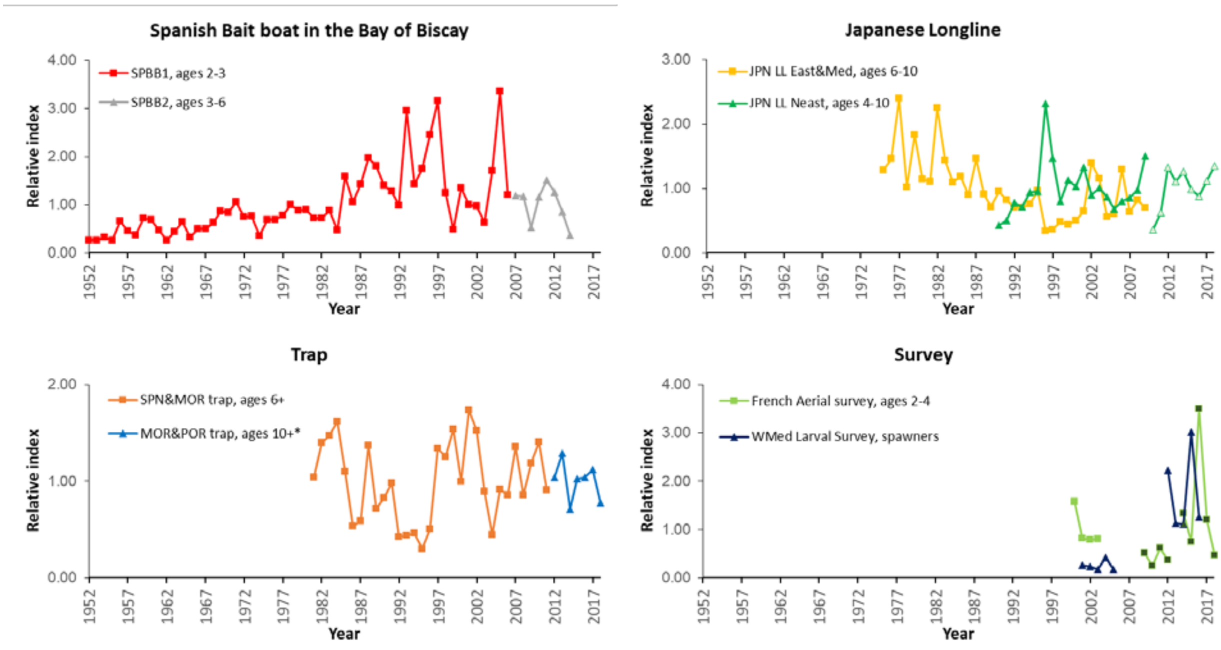
f. BFT (2010-17)

BFT-Figure 1. Geographic distribution of bluefin tuna catches per 5x5 degrees and per main gears from 1960 to 2017 (last decade only covers 8 years).

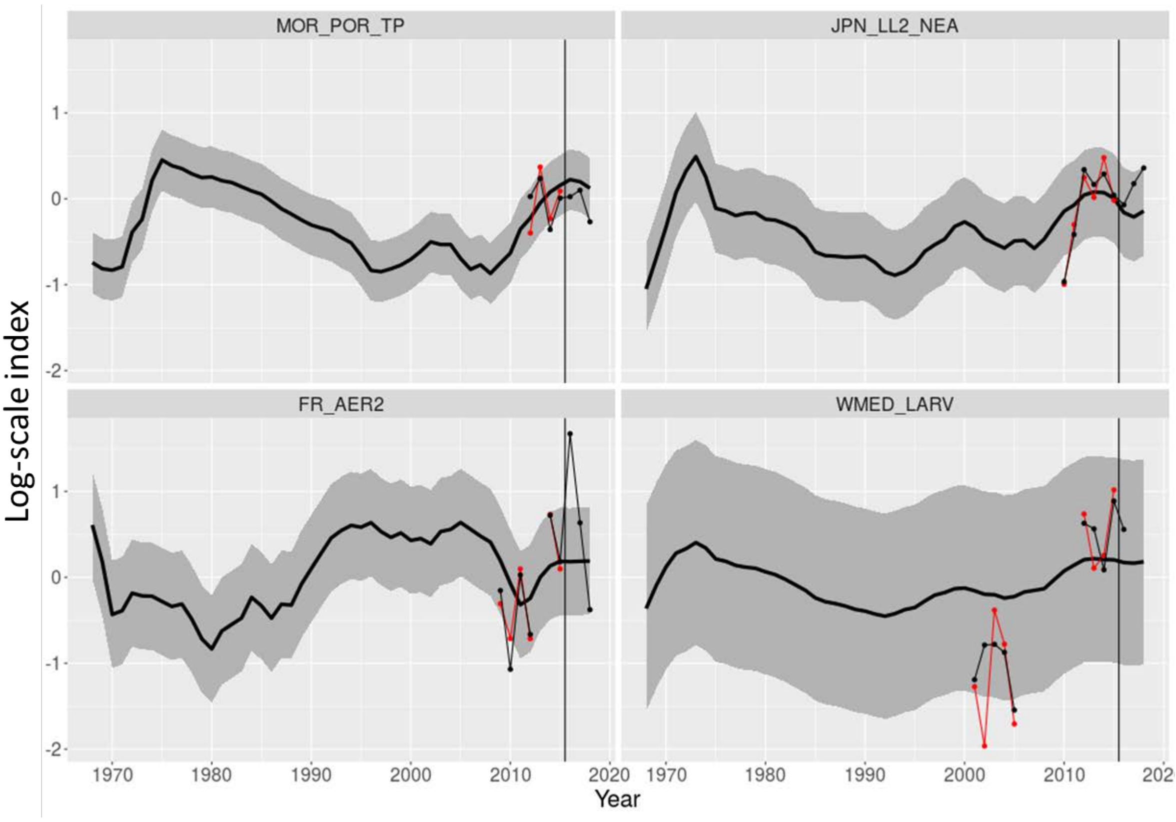




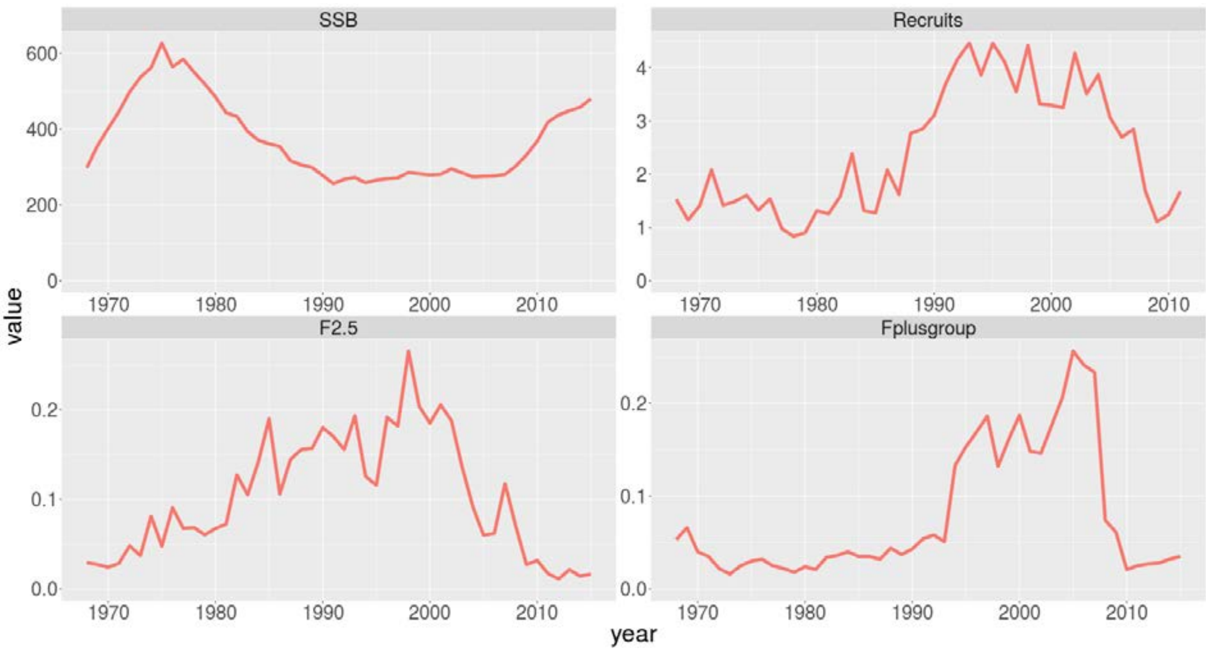
BFTE-Figure 2. Reported catch for the East Atlantic and Mediterranean from Task I data from 1950 to 2018 split by main geographic areas (top panel) and by gears (bottom panel) together with unreported catch estimated by the SCRS (using fishing capacity information and mean catch rates over the last decade) from 1998 to 2007 and TAC levels since 1998.



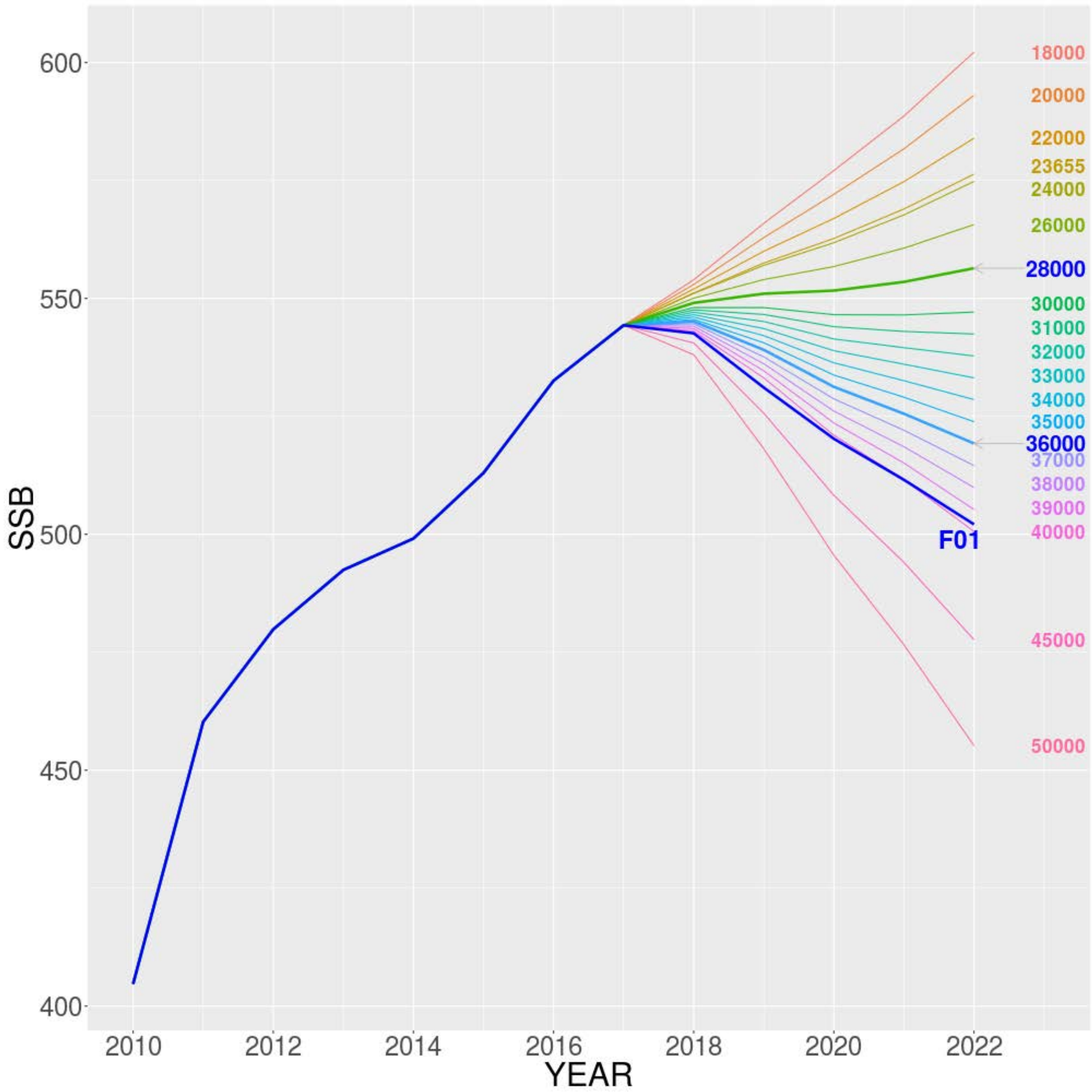
BFTE-Figure 3. Plots of the updated fishery dependent and independent indicators which used for the East Atlantic and Mediterranean bluefin tuna stock. All indicators are standardized series and scaled to their averages. Indices denoted with "*" represent revised indices rather than strict updates of indices used in the 2017 stock assessment. The Spanish BB series was split in two series to account for changes in selectivity patterns, and the latest series was calculated using French BB data due to the sale of the quota by the Spanish fleet. The Japanese Longlines CPUE for the Northeast Atlantic (split in 2009/2010), the Morocco-Portugal Trap combined CPUE and French aerial survey index (split in 2008/2009) have been updated until 2018. The larval survey in the western Mediterranean was updated until 2016.



BFTE-Figure 4. Updated indices (values post 2015, vertical black line) compared with 80% prediction intervals from the 2017 VPA projected forward with observed catches and 6-year average recruitment. Red points are the indices used in the assessment and black points are the updated or revised index values. Thick black lines are the central tendency of the population component corresponding to the index. To interpret the implications of points outside of the 80% intervals, 20% of the observations might fall outside of the interval by random chance.



BFTE-Figure 5. Spawning stock biomass (in thousand metric ton), recruitment (in million), and fishing mortality (average over ages 2 to 5, and 10+) estimates from VPA base run from the 2017 stock assessment for the period between 1968 and 2015. The last four years recruitments (2012-2015) are not shown because they are poorly estimated.



BFTE-Figure 6. Median trends in the 2017 projections of spawning stock biomass (in 1000 metric t) up to 2022 under the recent 6 years (2006-2011) recruitment scenario with various levels of constant catch starting in 2018, assuming TAC is caught in 2016 and 2017. The TAC values for 2016 (19,296 t) and 2017 (23,655 t) were also used for the projection. Currents TAC in 2018 to 2020 are: 28200 t, 32240 t and 36000 t.

BLUEFIN TUNA - WEST

BFTW-2. Fishery indicators

The total catch for the West Atlantic peaked at 18,608 t in 1964, mostly due to the Japanese longline fishery for large fish off Brazil (that started in 1962) and the U.S. purse seine fishery for juvenile fish (**BFT-Table 1**, **BFTW-Figure 1**). Catches dropped sharply thereafter to slightly above 3,000 t in 1969 with declines in longline catches off Brazil in 1967 and in purse seines. Catches increased to over 5,000 t in the 1970s due to the expansion of the Japanese longline fleet into the northwest Atlantic and Gulf of Mexico and an increase in purse seine effort targeting larger fish for the sashimi market. Catches declined abruptly in 1982 from close to 6,000 t in the late 1970s early 1980s with the imposition of a quota. The total catch for the West Atlantic, including discards, fluctuated without trend after 1982 reaching 3,319 t in 2002 (the highest since 1981, with all three major fishing nations indicating higher catches). Total catch in the West Atlantic subsequently declined steadily to 1,638 t in 2007 and then fluctuated without pronounced trend. The catch in 2016 was 1,901 t, 1,850 in 2017 and 2,027 t in 2018 (**BFTW-Figure 1**).

The Committee notes that the TAC in the West has not been caught for the last 6 years. Based on information received, the Committee considers that this is not due to low stock abundance but rather to market and operational conditions.

The most recent (2017) stock assessment used 10 CPUE and two survey indices up to and including 2015 (**BFTW-Figure 2**). Indices presented here are strict updates of these indices except as denoted with an asterisk where slight modifications to the data or model structure have been made.

The Committee was requested to annually evaluate whether the indicators support the TACs outlined in Rec. 17-06. To most effectively evaluate whether the indicators are in line with the assessment projections, and hence support the current TACs, the Committee compared updated indices with 80% prediction intervals from projection of the VPA model using observed catches in 2016-2018 (**BFTW-Figure 3**). The projection interval comparison serves as a means to evaluate whether the updated indicators are within the range of expectation for the models. To interpret the implications of points outside of the 80% intervals, 20% of the observations might fall outside of the interval by random chance. Of the 15 index values that were strict updates, 5 (33%) were outside of the prediction intervals. While higher than expected, given the lack of clear directionality of the departures (3 were high and 2 were lower), this does not warrant substantial concerns from the Committee.

Several indices exhibit trends that may be indicative of environmentally driven changes in availability. In 2017, the 2017 Stock Synthesis assessment reconciled the conflicting trends in the Canadian and United States indices under a hypothesis of environmentally mediated availability of fish to the two regions.

BFTW-3. State of the stock

The SCRS cautions that conclusions from the latest assessment (Anon. 2017c), using data through 2015, do not capture the full degree of uncertainty in the assessments and projections. The various major contributing factors to these uncertainties include mixing between the stocks, recruitment, age composition, age at maturity, and indices of abundance. The 2017 stock assessments made several important changes from previous assessments. First, the assessment incorporates many improvements to the input data and biological assumptions, including natural mortality, growth and age composition, spawning-at-age, total and fleet specific catch-at age, Canadian CPUE indices combined into a single index, Canadian acoustic survey, and the Japanese longline index split into two time series. Many of these products reflect substantial contributions of GBYP to the stock assessment. The 2017 assessment also applied two stock assessment platforms (VPA and Stock Synthesis (SS)) for management advice for the western stock.

Previous stock assessments determined stock status based on MSY-related reference points using two alternative recruitment potential scenarios: a 'low recruitment' scenario and a 'high recruitment' scenario. The 2017 assessment did not provide management advice based on MSY reference points. Instead, the focus was on giving short-term advice based on an $F_{0.1}$ reference point, a proxy for F_{MSY}, using recent recruitment assuming that near term recruitment will be similar to the recent past recruitment. Previous assessments also only considered a single maturity at age vector, whereas the 2017 assessment used two spawning fraction scenarios (a young age at spawning, consistent with the eastern stock and older age of spawning with 100% spawning contribution at age 15). Rather than presenting two series of spawning stock biomass (SSB) based on these two spawning fraction scenarios, total biomass is presented.

Results from the VPA indicate that total estimated stock biomass decreased sharply between 1974 and 1981, followed by more than two decades of stability (at about 50% of the 1974 biomass) across the turn of the century, and then by a gradual increase since 2004 to 69% of the 1974 biomass in 2015. Recruitment was high in the early 1970s, but subsequently fluctuated around a lower average until 2003 when there was a strong year class. Recruitment has shown a downward trend since.

Stock Synthesis gave a longer time series view of the population, capturing the higher recruitments estimated in the 1960s. In the recent time period, mean recruitment was similar to the VPA but the magnitude of the 1994 and 2003 year classes were estimated to be larger, resulting in lower fishing mortality and higher total biomass than in the VPA (**Figures-BFTW 4** and **BFTW 5**). Total biomass in 2015 was 18% of biomass in 1950 and 45% of biomass in 1974.

The Committee notes that further work is being conducted as part of the GBYP to collect more data on mixing, movement and stock of origin. As these data are being incorporated into the Management Strategy Evaluation they should help refine our understanding of stock mixing.

Summary

Both results from the VPA and SS were equally weighted to formulate advice. Using $F_{0.1}$ as a proxy for F_{MSY}, current F relative to the $F_{0.1}$ reference point was 0.72 (VPA) and 0.56 (Stock Synthesis) indicating that overfishing is not occurring. The SS biomass estimates suggest that historical biomass was considerably higher than currently (**BFTW-Figure 5**).

Management advice is based on fishing mortality reference points to project short term yield based on recent recruitment. $F_{0.1}$ was considered a reasonable proxy for F_{MSY}, although it can be higher or lower than F_{MSY} depending on the stock recruitment relationship, which in this case is poorly determined.

BFTW-4. Outlook

In 1998, the Commission initiated a 20-year rebuilding plan designed to achieve SSB_{MSY} with at least 50% probability. As indicated above, the Committee did not use biomass based reference points in formulating 2017 advice. The Committee is not evaluating if the stock is rebuilt because it has been unable to resolve the long term recruitment potential. If an $F_{0.1}$ strategy were to continue to be applied, over the longer term the resource would fluctuate around the true, but unknown value of $B_{0.1}$ whatever the future recruitment level. The $F_{0.1}$ strategy compensates for the effect of recruitment changes on biomass by allowing higher catches when recent recruitment is higher, and reducing catches when recent recruitments are lower. Under this strategy, biomass may decrease at times because the stock is above $B_{0.1}$ or following lower recruitments.

The 2017 short term-projections (2018-2020) were based on the average recruitment during 2007-2012 for both the VPA and the SS models. Fishing at $F_{0.1}$ in 2018 to 2020 implied increased catches in 2018 (2,691 t) followed by decreases in 2019 (2,568 t) and 2020 (2,446 t). The decreases in biomass were predicted due to the 2003 year-class having passed its peak biomass and below average recruitment in recent years. The expected changes in biomass under constant catch scenarios and one constant $F_{0.1}$ scenario, are shown respectively in **BFTW-Table 2** and **BFTW-Figure 6**. It should be noted that biomass is expected to decline for catches greater than 1,000 t.

The Committee reiterates that the effects of mixing and management measures on the eastern stock remains a considerable source of uncertainty for the outlook of the western stock. Consequently, change to an approach that takes explicit account of mixing is a high priority.

BFTW-5. Effect of current regulations

The 2017 assessment estimated that the biomass has increased during 2004 to 2015. The Committee noted that the TAC recommendation (Rec. 17-06) is expected to lead to decreases in the stock but not lead to overfishing (**BFTW-Table 1**) as noted in the 2017 advice (**BFTW-Table 2**).

BFTW-6. Management recommendations

The Commission recommended (Rec. 17-06) total allowable catches (TAC) of 2,350 t in 2018, 2019 and 2020. Projections indicate that these catches would be unlikely to lead to overfishing for this three-year time period. The evaluation of the fishery indicators in section 2 did not indicate a reason to alter current management advice as outlined in Rec. 17-06.

SUMMARY TABLE

Estimated recent fishing mortality rate (geometric mean of apical F for the period 2012 to 2014) relative to the F reference point, $F_{0.1}$ (a proxy for F_{MSY} based on recent recruitment estimates for the period 2007 to 2012). An 80% confidence interval of estimated Fs and projected catches are shown in parentheses.

WEST ATLANTIC BLUEFIN TUNA SUMMARY	
Current Catch including discards (2018)	2,027*
$F_{CURRENT}$ (2012-2014)	0.05 (0.04-0.10)
$F_{0.1}$	0.09 (0.08-0.12)
Ratio of recent F to $F_{0.1}$	0.59 (0.44-0.79)
Estimated probability of overfishing	0.002
Stock status[1]	Overfishing : No

Management Measures:	(Rec. 17-06) TAC of 2,350 t in 2018-2020, including dead discards.

* As of 26 September 2019.

[1] Biomass reference points to determine stock status were not estimated in the 2017 assessment due to uncertainty in recruitment potential.

BFT-Table 1. Estimated catches (t) of northern bluefin tuna (*Thunnus thynnus*) by area, gear and flag.

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL			48881	49751	54009	53545	52657	52772	52775	52784	53319	52305	52125	51756	51812	62638	26460	21798	13195	11781	12688	14725	14887	18042	21032	25466	29784
BFT-E			46769	47303	51497	51211	50000	50000	50000	50000	50000	50000	50000	50000	50000	61000	24460	19818	11338	9774	10934	13243	13261	16201	19131	23616	27757
	ATE		7054	9780	12098	16379	11630	10247	10061	10086	10347	7394	7402	9023	7529	8441	8243	6684	4379	3984	3834	4163	3918	4841	5968	7216	8157
	MED		39715	37523	39399	34831	38370	39753	39939	39914	39653	42606	42598	40977	42471	52559	16217	13133	6959	5790	7100	9080	9343	11360	13163	16401	19600
BFT-W	ATW		2113	2448	2512	2334	2657	2772	2775	2784	3319	2305	2125	1756	1811	1638	2000	1980	1857	2007	1754	1482	1627	1842	1901	1850	2027
Landings	ATE	Bait boat	2284	3093	5369	7215	3139	1554	2032	2426	2635	1409	1902	2282	1263	2436	2393	1260	725	636	283	243	95	172	1085	1195	692
		Longline	2311	4522	4212	4057	3789	3570	3736	3303	2896	2748	2064	2700	2033	1705	2491	1951	1194	1125	1139	1167	1194	1467	1829	2208	2730
		Other surf.	590	555	273	60	387	404	509	558	631	521	290	424	831	502	181	297	124	35	49	141	210	193	261	295	340
		Purse seine	213	458	323	828	700	726	661	153	887	490	1078	1197	408	0	0	2	1	0	0	2	0	0	42	49	11
		Sport (HL+RR)	25	0	0	237	28	33	126	61	63	109	89	11	99	11	12	11	44	51	53	46	43	104	35	101	118
		Traps	1630	1152	1921	3982	3586	3960	2996	3585	3235	2116	1978	2408	2895	3788	3166	3164	2292	2137	2311	2564	2376	2905	2716	3363	4258
	MED	Bait boat	0	206	5	4	11	4	38	28	1	9	17	5	0	0	0	38	1	0	2	2	9	25	0	50	56
		Longline	6993	8469	9856	7313	4117	3338	3424	4144	3234	3484	3036	3427	3408	3269	2376	1344	1242	962	587	605	588	776	1523	1184	1517
		Other surf.	776	545	417	282	284	228	728	354	340	198	197	175	81	85	0	0	1	1	1	20	29	3	37	90	34
		Purse seine	27948	23799	26021	24279	31792	33798	33237	33043	34044	37291	37869	36639	38363	48994	13540	11448	4986	4293	6172	7982	8184	9993	11315	14466	17119
		Sport (HL+RR)	2307	3562	2149	2340	1092	1533	1773	1167	1520	1404	1325	619	494	117	149	160	448	356	202	240	289	361	284	335	567
		Traps	1691	942	951	613	1074	852	739	1177	515	221	154	112	125	93	152	144	281	165	125	222	232	192	0	272	300
	ATW	Longline	539	491	545	382	764	915	858	610	729	186	644	425	565	420	606	366	529	743	478	470	498	553	562	559	664
		Other surf.	307	384	429	293	342	279	283	201	107	139	97	89	85	63	78	121	107	147	117	121	119	138	93	123	77
		Purse seine	301	249	245	250	249	248	275	196	208	265	32	178	4	28	0	11	0	0	2	29	38	34	0	0	
		Sport (HL+RR)	804	1114	1032	1181	1108	1125	1121	1650	2036	1399	1139	924	1005	1023	1134	1251	1009	888	917	692	810	1085	1204	1144	1264
		Traps	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	39	26	17	11	20	6	10	13	3
Discards	ATE	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7
	MED	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	
		Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	12	9	11	2	4	5	6
	ATW	Longline	83	138	167	155	123	160	222	105	211	232	181	131	149	100	159	207	174	202	224	145	139	19	29	10	16
		Other surf.	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	2
		Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	4	5	0	0	
		Sport (HL+RR)	0	0	0	14	3	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Landings	ATE CP	Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		China PR	0	0	0	0	85	103	80	68	39	19	41	24	42	72	119	42	38	36	36	38	37	45	54	64	79
		EU.Denmark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0**
		EU.España	3137	3819	6186	9519	4565	4429	3493	3633	4089	2172	2801	3102	2339	3680	3536	2409	1550	1483	1329	1553	1282	1655	1986	2509	2489
		EU.France	336	725	563	269	613	588	542	629	755	648	561	818	1218	629	253	366	228	135	148	223	212	254	343	350	461
		EU.Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Ireland	0	0	0	14	21	52	22	8	15	3	1	1	2	1	1	1	2	4	10	13	19	14	32	16	17
		EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
		EU.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.Portugal	363	169	199	712	323	411	441	404	186	61	27	82	104	29	36	53	58	180	223	235	243	263	327	429	450
		EU.Sweden	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.United Kingdom	0	1	0	1	1	12	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	**0**
		Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7
		Guinée Rep.	330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Iceland	0	0	0	0	2	27	0	0	1	0	0	0	0	0	0	0	0	2	5	4	30	37	6	0	**0**
		Japan	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	1155	1089	1093	1129	1134	1386	1578	1905	2262
		Korea Rep.	4	205	92	203	0	0	6	1	0	0	3	0	1	0	0	0	0	0	0	0	0	0	161	181	208
		Maroc	720	678	1035	2068	2341	1591	2228	2497	2565	1795	1953	2389	1923	2418	1947	1909	1348	1055	990	960	959	1176	1433	1703	2164
		Norway	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	44	51	12
		Panama	1	19	550	255	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	**0**

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Sierra Leone	0	0	0	0	0	0	93	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	NCC	Chinese Taipei	20	4	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	**0**
	NCO	Faroe Islands	0	0	0	0	67	104	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
		NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	68	189	71	208	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Seychelles	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MED	CP	Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	9	34	40	47	56	100
		Algerie	1560	156	638	829	1674	1760	2083	2098	2056	1504	1440	1500	1673	1489	1311	0	0	0	69	244	244	370	448	1038	1300
		China PR	97	137	93	49	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Croatia	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	834	619	389	371	369	384	385	456	515	630	738
		EU.Cyprus	10	10	10	10	21	31	61	85	91	79	105	149	110	1	132	2	3	10	18	17	18	22	59	110	133
		EU.España	2741	4607	2588	2209	2000	2003	2772	2234	2215	2512	2353	2758	2689	2414	2465	1769	1056	942	1064	948	1164	1238	1467	1688	2706
		EU.France	11843	9604	9171	8235	7122	6156	6794	6167	5832	5859	6471	8638	7663	10200	2670	3087	1755	805	791	2191	2216	2565	3054	3661	4360
		EU.Greece	886	1004	874	1217	286	248	622	361	438	422	389	318	255	285	350	373	224	172	176	178	161	195	218	235	267
		EU.Italy	6901	7076	10200	9619	4441	3283	3847	4383	4628	4981	4697	4853	4708	4638	2247	2749	1061	1783	1788	1938	1946	2273	2488	3196	3860
		EU.Malta	580	590	402	396	409	449	378	224	244	258	264	350	270	334	296	316	136	142	137	155	160	182	212	261	308
		EU.Portugal	306	313	274	37	54	76	61	64	0	2	0	0	11	0	0	0	0	0	0	0	0	0	0	0	**0**
		Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	77	77	155	99	124	181
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	**0**
		Japan	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18	0	0	0	0	0	0	0	0	**0**
		Korea Rep.	684	458	591	410	66	0	0	0	0	0	700	1145	26	276	335	102	0	0	77	80	81	0	0	0	**0**
		Libya	1422	1540	1388	1029	1331	1195	1549	1941	638	752	1300	1091	1327	1358	1318	1082	645	0	756	929	933	1153	1368	1631	1792
		Maroc	1092	1035	586	535	687	636	695	511	421	762	827	108	463	641	531	369	205	182	223	309	310	322	350	439	407
		Panama	1499	1498	2850	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	50	41	0	34	0	0	0	0	40	47	57	66
		Tunisie	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	2545	431	2679	1932	1042	852	1017	1057	1047	1248	1461	1755	2092
		Turkey	3466	4219	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	519	536	551	555	1091	1324	1515	1284
	NCC	Chinese Taipei	709	494	411	278	106	27	169	329	508	445	51	267	5	0	0	0	0	0	0	0	0	0	0	0	**0**
	NCO	ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	1	0	1	1	0
		Israel	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NEI (Flag related)	427	639	171	1058	761	78	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NEI (combined)	773	211	0	101	1030	1995	109	571	508	610	709	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NEI (inflated)	0	0	0	0	9471	16893	16458	15298	15880	18873	18376	14164	18343	28234	0	0	0	0	0	0	0	0	0	0	**0**
		Serbia & Montenegro	0	2	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Yugoslavia Fed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
ATW	CP	Brazil	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**0**
		Canada	392	576	597	503	595	576	549	524	604	557	537	600	733	491	575	530	505	474	477	480	463	531	466	472	508
		FR.St Pierre et Miquelon	0	0	0	0	0	1	0	0	3	1	10	5	0	4	3	2	8	0	0	0	0	9	0	0	**0**
		Japan	427	387	436	322	691	365	492	506	575	57	470	265	376	277	492	162	353	578	289	317	302	347	345	346	406
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	1	52	0	0	0	0	0	0	0	0	0	0	0	**0**
		Mexico	4	23	19	2	8	14	29	10	12	22	9	10	14	7	7	10	14	14	51	23	51	53	55	34	80
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		U.S.A.	1163	1311	1285	1334	1235	1213	1212	1583	1840	1426	899	717	468	758	764	1068	803	738	713	502	667	877	1002	986	1014
		UK.Bermuda	0	0	1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	NCC	Chinese Taipei	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	0	0	0	0	0	0	0	0	74	11	19	27	19	0	0	0	0	0	0	0	0	0	0	0	

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	0	0	0	0	0	429	270	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	43	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards	ATE	CP	Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7
	MED		Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	5	2	2	4	5	6
			EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	
			Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	0	0	0	0	
			Tunisie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	
			Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	
	ATW		Canada	0	0	0	6	16	11	46	13	37	14	15	0	2	0	1	3	25	36	17	0	0	3	8	1	3
			Japan	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
			U.S.A.	83	138	171	155	110	149	176	98	174	218	167	131	147	100	158	204	150	166	206	159	143	22	24	10	15

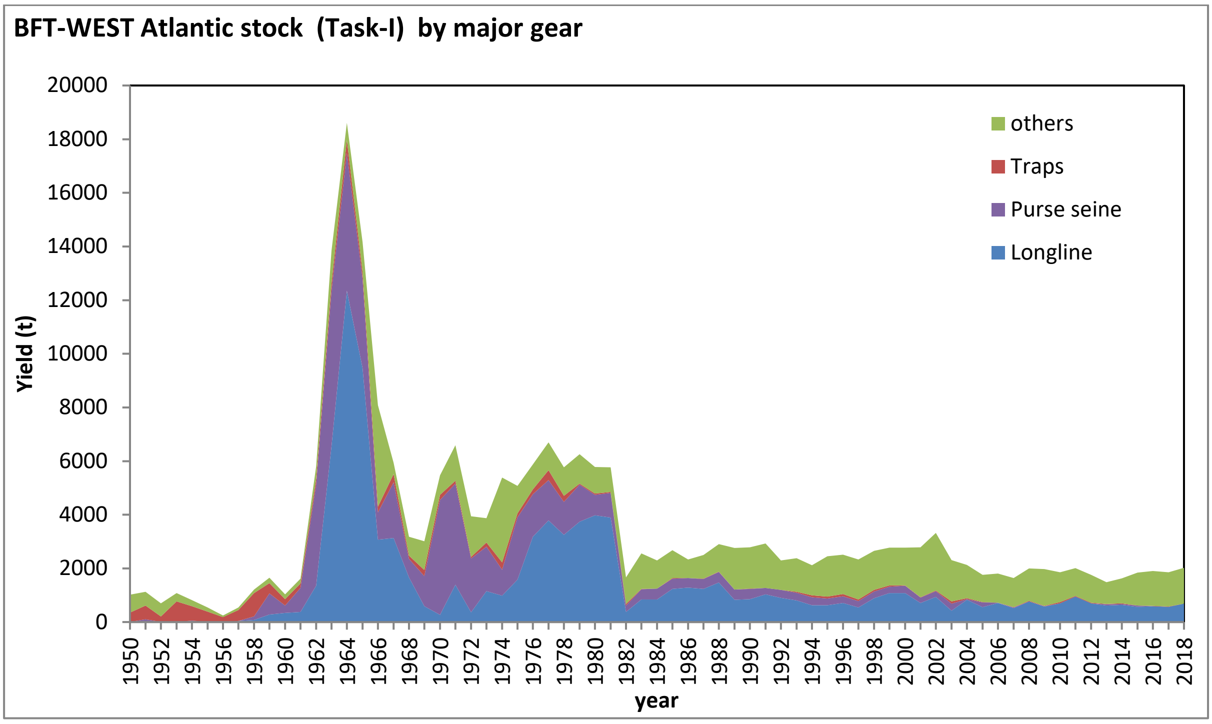
BFTW-Table 1. Kobe II matrix giving the probability that the fishing mortality rate (F) will be less than the F reference point ($F \leq F_{0.1}$, overfishing not occurring) over the next 3 years for alternative constant catches, based on results from the 2017 VPA and SS combined.

Catch	2018	2019	2020
1000	100%	100%	100%
1250	100%	100%	100%
1500	100%	100%	100%
1750	99%	98%	96%
2000	94%	90%	87%
2250	83%	80%	76%
2500	72%	69%	65%
2750	62%	54%	46%
3000	46%	33%	21%
3250	26%	15%	7%

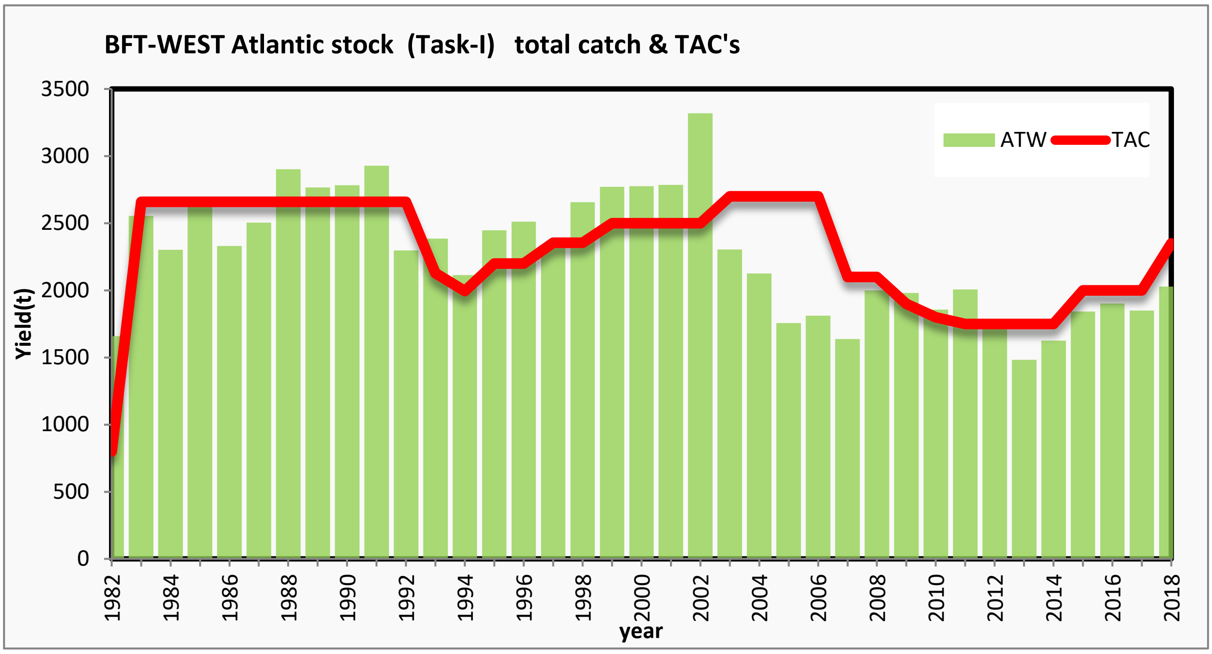
BFTW-Table 2. Relative change in total stock biomass relative to 2017 under alternative constant catch scenarios from the 2017 assessment.

Catch	2018	2019	2020
1000	-0.7%	-0.3%	0.4%
1250	-0.8%	-1.0%	-1.1%
1500	-0.9%	-1.8%	-2.6%
1750	-1.2%	-2.5%	-4.1%
2000	-1.5%	-3.3%	-5.6%
2250	-1.7%	-4.0%	-7.2%
2500	-1.7%	-4.8%	-8.7%
2750	-1.7%	-5.5%	-10.1%
3000	-1.7%	-6.2%	-11.5%
3250	-1.8%	-7.0%	-13.0%
F0.1	-1.7%	-5.0%	-9.0%

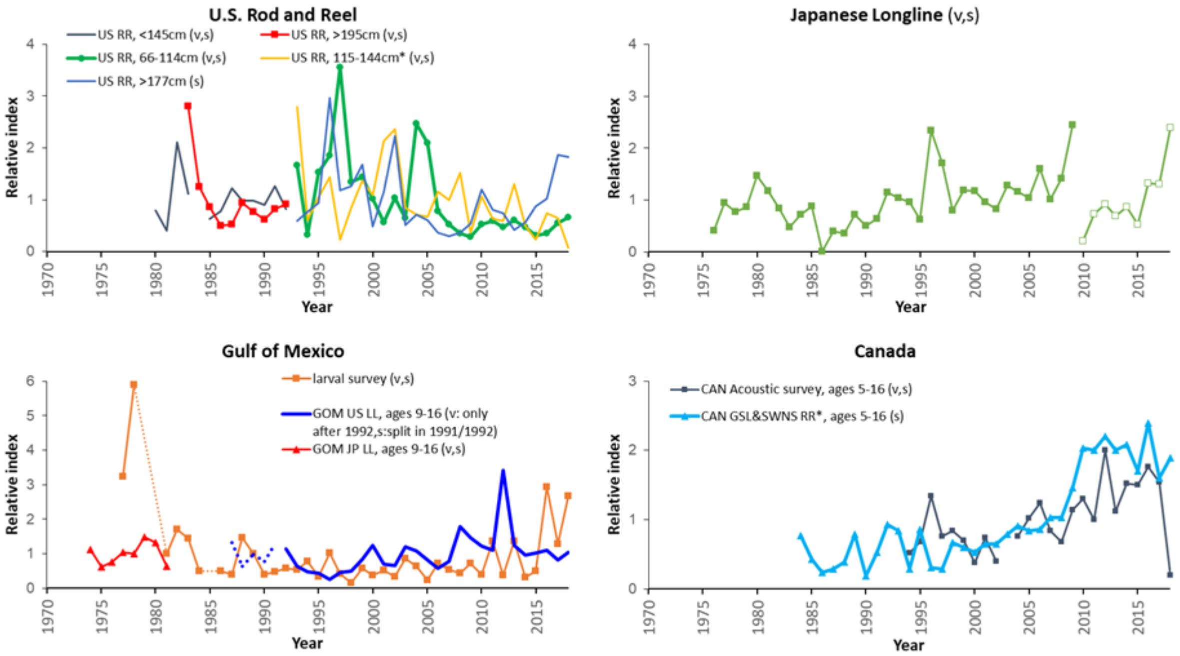
(a)



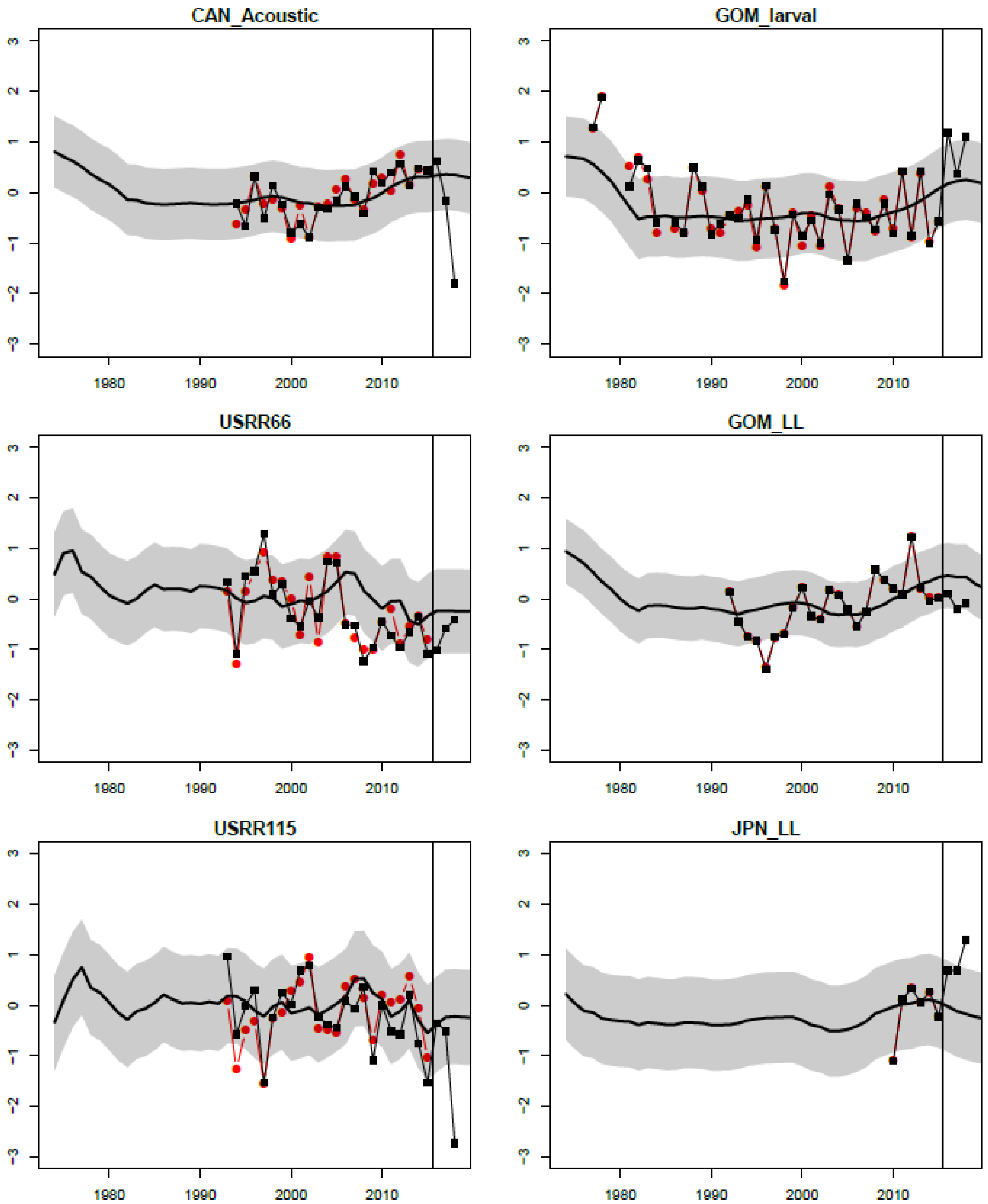
(b)



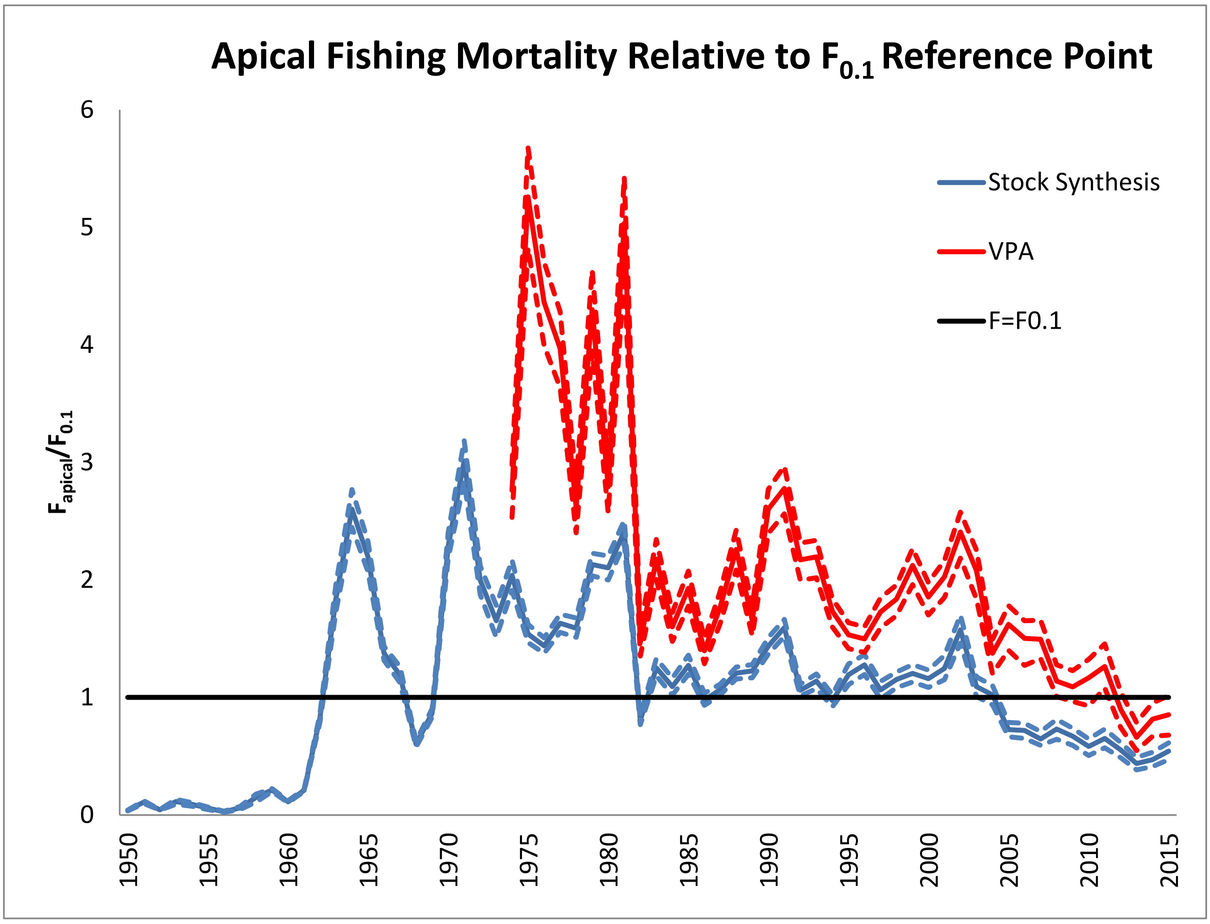
BFTW-Figure 1. Historical catches of western bluefin tuna: (a) by gear type and (b) in comparison to TAC levels agreed by the Commission.



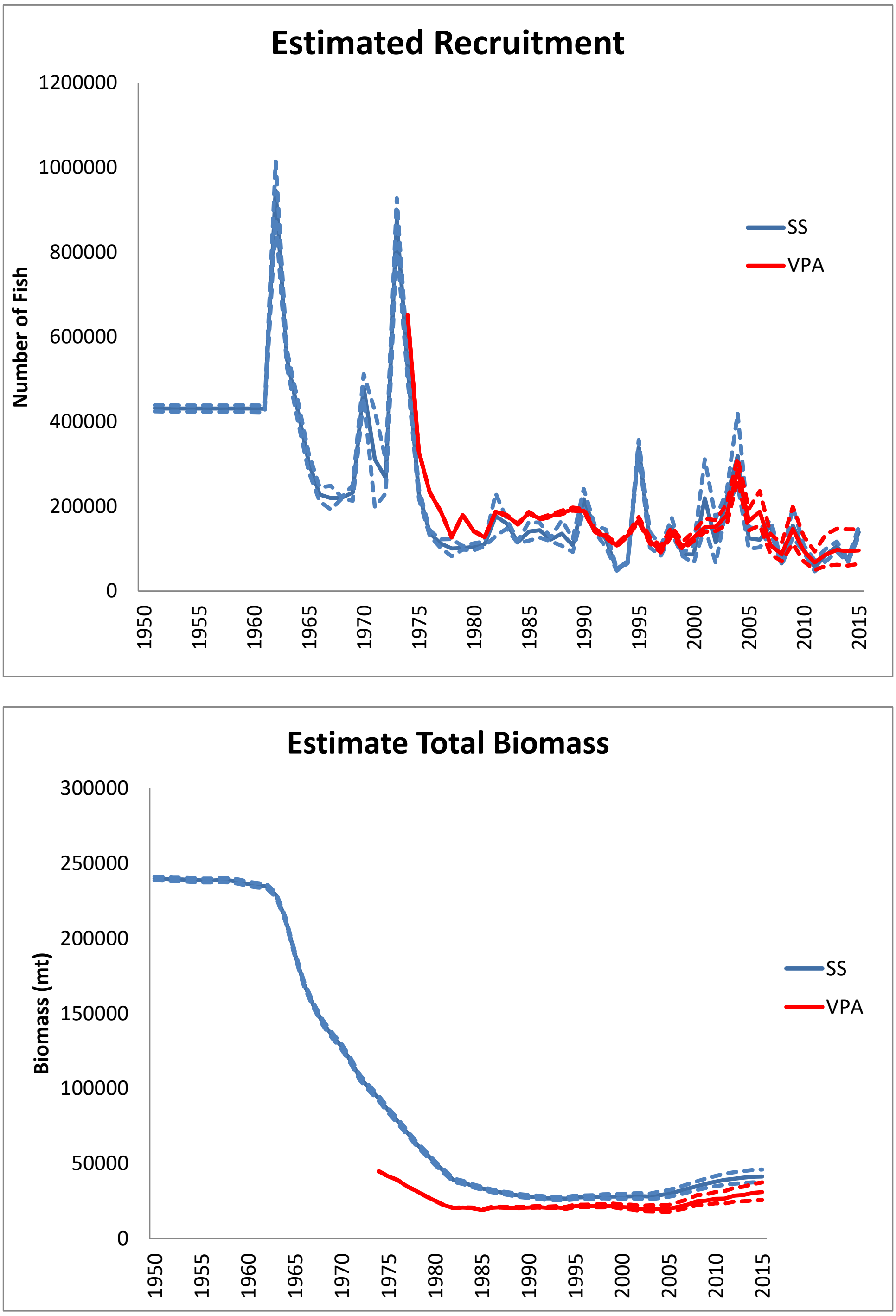
BFTW-Figure 2. Indices of relative abundance for western bluefin tuna. Indices denoted with "*" represent revised indices rather than strict updates of indices used in the 2017 stock assessment. Indices denoted with an "s" used in Stock Synthesis and indices with a "v" used in VPA.



BFTW-Figure 3. Updated indices (values post 2015, vertical black line) compared with 80% prediction intervals from the 2017 VPA projected forward with observed catches and 6-year average recruitment and older age at maturity. Red points are the indices used in the assessment and black points are the updated or revised index values. Thick black lines are the central tendency of the population component corresponding to the index. To interpret the implications of points outside of the 80% intervals, 20% of the observations might fall outside of the interval by random chance.

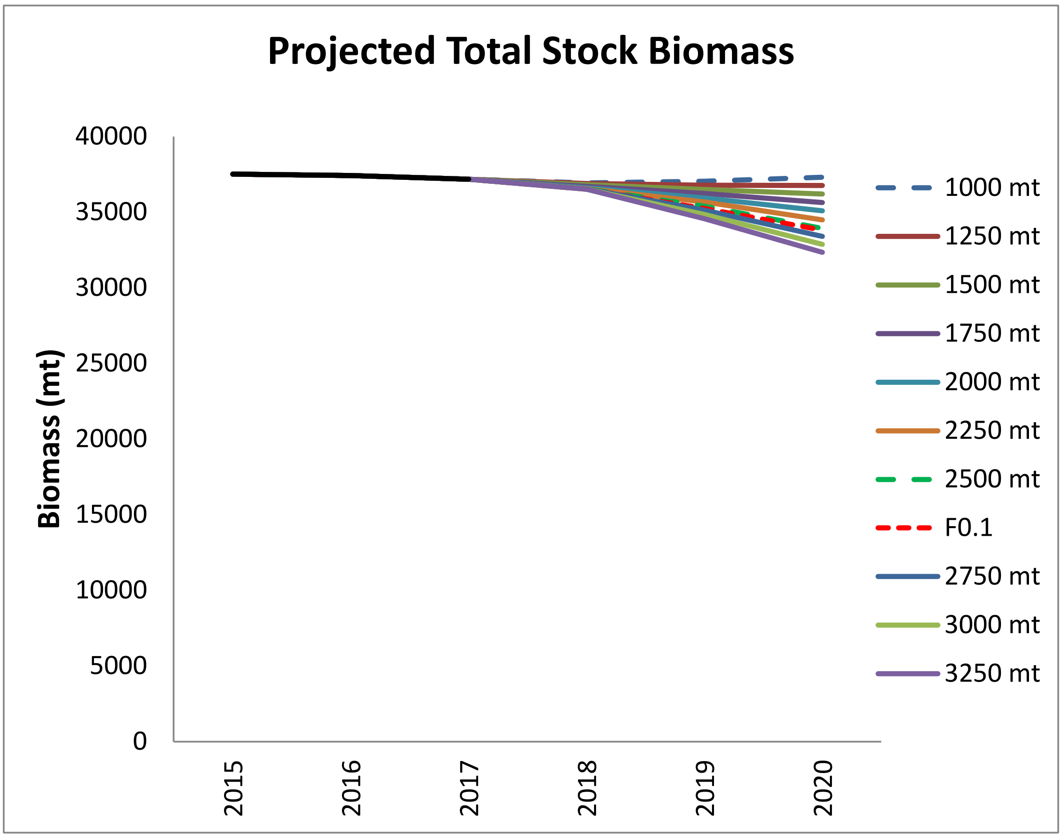


BFTW-Figure 4. Estimated fishing mortality relative to the $F_{0.1}$ reference point estimated by VPA (red) and SS (blue) from the 2017 assessment. The 80% confidence intervals are indicated with dashed lines.

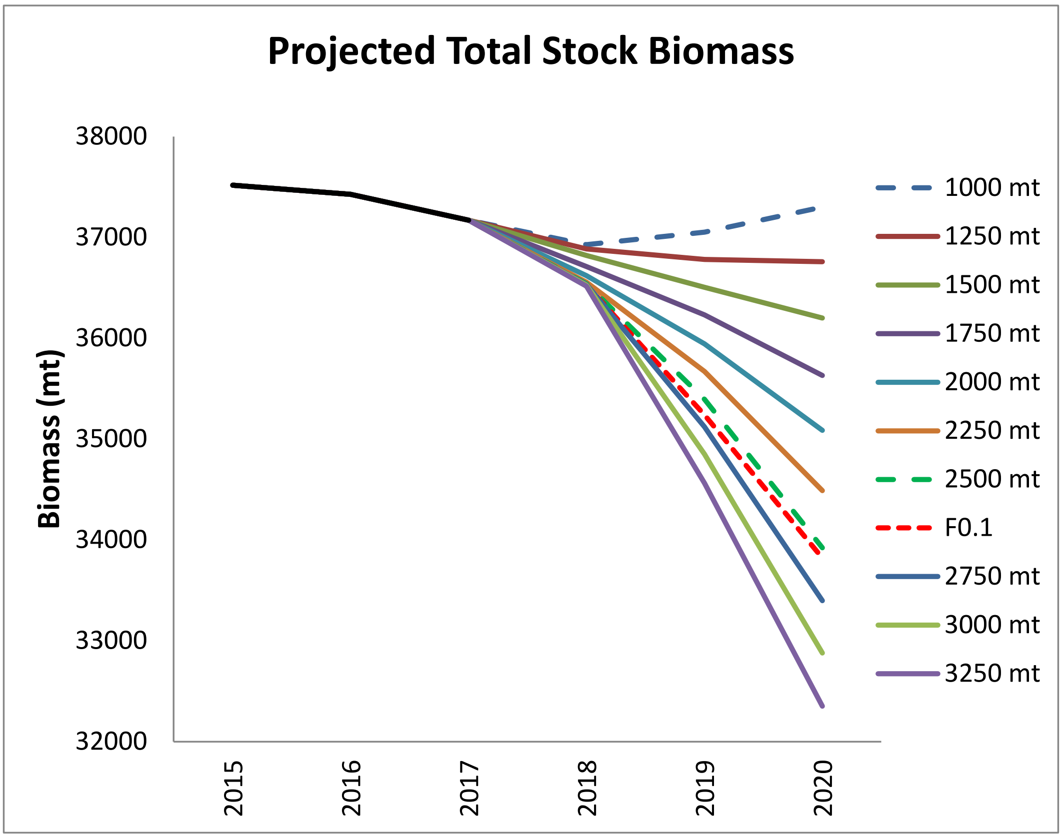


BFTW-Figure 5. Median estimates of recruitment and total stock biomass for the base VPA (red) and SS (blue) models from the 2017 assessment. The 80% confidence intervals are indicated with dashed lines. The recruitment estimates for the last three years of the VPA are considered unreliable and have been replaced by the average estimates from 2007 to 2012.

a)



b)



BFTW-Figure 6. Projected total stock biomass under alternative constant catch scenarios and a constant F scenario ($F=F_{0.1}$) for the 2017 base VPA and SS model results combined; a) showing full range on y-axis, and b) y-axis shown from 32,000 to 38,000 t. Current (2018-2020) TAC is 2,350 t.

9.6 BUM – BLUE MARLIN

The most recent assessment for blue marlin was conducted in 2018 through a process that included a data preparatory meeting in March 2018 (Anon. 2018c) and an assessment meeting in June 2018 (Anon. 2018d). The last year of fishery data used in the assessment was 2016.

BUM-1. Biology

The central and northern Caribbean Sea and northern Bahamas have historically been known as the primary spawning area for blue marlin in the western North Atlantic. Recent reports show that blue marlin spawning can also occur north of the Bahamas in an offshore area near Bermuda at about 32º-34º N. Ovaries of female blue marlin caught by artisanal vessel in Côte d'Ivoire show evidence of pre-spawning and post-spawning, but not of spawning. In this area females are more abundant than males (4:1 female/male ratio). Coastal areas off West Africa have strong seasonal upwelling, and may be feeding areas for blue marlin.

Atlantic blue marlin inhabit the upper parts of the open ocean. Blue marlin spend the majority of their time in the mixed surface layer (58% of daylight and 84% of nighttime hours), however, they regularly make short-duration dives to maximum depths of around 300 m, with some vertical excursions down to 800 m. They do not confine themselves to a narrow range of temperatures but most tend to be found in waters warmer than 17°C. The distribution of time at depth is significantly different between day and night. At night, the fish spent most of their time at or very close to the surface. During daylight hours, they are typically below the surface, often at 40 to 100+ m. These patterns, however, can be highly variable between individuals and also vary depending on the temperature and dissolved oxygen of the surface mixed layer. This variability in the use of habitat by blue marlin indicates that simplistic assumptions about habitat usage made during the standardization of CPUE data may be inappropriate.

BUM-2. Fishery indicators

The decadal geographic distribution of the catches is given in **BUM-Figure 1**. The Committee used Task I catches as the basis for the estimation of total removals (**BUM-Figure 2**). Total removals for the period 1990-2016 were obtained during the 2018 Blue Marlin Data Preparatory Meeting by modifying Task I values with the addition of blue marlin that the Committee estimated from catches reported as billfish unclassified. Additionally the reporting gaps were filled with estimated values for some fleets.

During the 2018 blue marlin assessment it was noted that catches from 2013, 2014, and 2016 had been above the recommended TAC, and this continues to be the case for 2017. Over the last 20 years, Antillean artisanal fleets have increased the use of Moored Fish Aggregating Devices (MFADs) to capture pelagic fish. Catches of blue marlin caught around MFADs are known to be significant and increasing in some areas, however reports to ICCAT on these catches are incomplete. Although historical catches from some Antillean artisanal fleets have been recently included in Task I there is still an unknown number of Antillean artisanal fleets that may have unreported catches of blue marlin caught around MFADs. It is important that the amount of these catches be documented. Recent reports from purse seine fleets in West Africa suggest that blue marlin is more commonly caught with tuna schools associated with FADs than with free tuna schools. Preliminary Task I catches of blue marlin (**BUM-Table 1**) in 2017 and 2018 were 2,134 t and 1,436 t, respectively. These catches are likely underestimated because few CPCs have reported discards.

A series of indices of abundance for blue marlin were presented and discussed during the 2018 Blue Marlin Data Preparatory meeting. Ten CPUE series were used in the assessment. The standard errors from the CPUE standardized series as weights was applied in all assessment models. All estimated standardized CPUE index for blue marlin showed a sharp decline during the period 1960-1975, and thereafter have fluctuated around lower levels (**BUM-Figure 3**).

BUM-3. State of the stocks

A full stock assessment was conducted for blue marlin in 2018, applying to the available data through 2016, using both surplus production and age-structured models. Both models estimated similar annual trends of biomass and fishing mortality (**BUM-Figure 4.1 and 4.2**). The results of the 2018 assessment indicated that the estimated B/B_{MSY} and F/F_{MSY} were such that the current stock status is overfished and undergoing overfishing. Since the mid-2000s, the biomass has ceased to decline and fishing mortality has shown a declining trend since its peak in 2003.

The 2018 results are similar to those of the 2011 assessment. The estimated MSY was determined to be 3,001 t with 10% and 90% confident limits of 2,399 to 3,537 t. The current status of the blue marlin stock is presented in **BUM-Figure 5.** The probability of being in the red quadrant of the Kobe plot was estimated to be 54%. The probability of the being in the yellow quadrants of the Kobe plot was estimated to be 42% and that of being in the green quadrant only 4%. However, the Committee recognizes the high uncertainty with regard to data and the productivity of the stock.

BUM-4. Outlook

A combination of projection results from the Bayesian Surplus Production model and the Age structure model was used to produce the advice outlook, including the Kobe strategy matrices. Projections were made by assuming the current reported catch for 2016 (2,036 t, estimate available at the time of the assessment) will have also been taken in 2017 and 2018. According to these projections the catches of 2,000 t (close to catches reported in 2015, 2016 and 2017) will only provide a 46% probability of being in the green quadrant by 2028. In contrast, a TAC of 1,750 t will allow the stock to rebuild with more than 50% probability by the year 2028 (**BUM-Figure 6; BUM-Table 2**).

BUM-5. Effect of current regulations

A 2006 recommendation (Rec. 06-09) established that the annual amount harvested by pelagic longline and purse seine vessels and retained for landing must be no more than 33% for white marlin and 50% for blue marlin of the 1996 or 1999 landing levels, whichever is greater. Furthermore, in 2012, the Commission established a TAC for 2013, 2014, and 2015 of 2,000 t (Rec. 12-04), placed additional catch and commerce restrictions in recreational fisheries for blue marlin and white marlin, and requested methods for estimating live and dead discards of blue marlin and white marlin/spearfish. In 2015, the Commission further strengthened the plan to rebuild blue marlin stock by extending for 2016, 2017, and 2018 the annual limit of 2,000 t for blue marlin (Rec. 15-05). However, the catches from 2013, 2014 and 2016 were above the recommended TAC. Furthermore, current assessment results indicate that catches need to be reduced below 2,000 in order to recover to Commission objectives.

The Committee is concerned with the significant increase in the contribution from non-industrial fisheries to the total blue marlin harvest and that the landings from these fisheries are not fully accounted for in the current ICCAT database. The Committee expressed its serious concern over this limitation on data for future assessments. Such data limitation impairs any analysis of the current regulations.

Currently, four ICCAT Contracting Parties (Brazil, Canada, Mexico, and the United States) mandate or encourage the use of circle hooks on their pelagic longline fleets. Recent research has demonstrated that in some longline fisheries the use of non-offset circle hooks resulted in a reduction of billfish mortality, while the catch rates of several of the target species remained the same or were greater than the catch rates observed with the use of conventional J hooks or offset circle hooks.

More countries have started reporting data on live releases since 2006. Additional information has come about, for some fleets, regarding the potential for modifying gears to reduce the by-catch and increase the survival of marlins. Such studies have also provided information on the rates of live releases for those fleets. However there is not enough information on the proportion of fish being released alive for all fleets, to evaluate the effectiveness of the ICCAT recommendation relating to the live release of marlins.

BUM-6. Management recommendations

The 2018 assessment confirms the advice provided in 2011 that catches of 2,000 t (current TAC) would have allowed the stock to increase in size. Because the catches have generally exceeded 2,000 t, the stock has not increased. The Committee recommends that the Commission should find ways to make sure that the catches are not allowed to exceed established TACs. Because the stock has not rebuilt catches need to be lower than the current TAC. Catches of 1,750 t or less are expected to provide at least a 50% chance of rebuilding by 2028.

The Committee recommends that if the Commission wants to further reduce fishing mortality and to reduce the chance of exceeding any established TAC, the Commission could consider doing so by modifying Rec. 15-05 (paragraph 2) so that fishermen are always required to release all marlins that are alive at haul back through methods that maximize their survival.

ATLANTIC BLUE MARLIN SUMMARY	
Maximum Sustainable Yield	3,056 t (2,384 – 3,536 t)[1]
Current (2018) Yield	1,436 t[2]
Relative Biomass (SSB_{2016}/SSB_{MSY})	0.69 (0.52 – 0.91)[1]
Relative Fishing Mortality (F_{2016}/F_{MSY})	1.03 (0.74 -1.50)[1]
Stock Status (2016)	Overfished: Yes Overfishing: Yes
Conservation and Management Measures in Effect:	Recommendation (Rec. 15-05, Rec 18-04). Landing limit of 2,000 t in 2016, 2017, 2018 and 2019.

[1] Combined Bayesian surplus production model and age structured assessment model results. Values correspond to median estimates, 80% confidence interval values are provided in parenthesis.

[2] 2018 yield should be considered provisional.

BUM-Table 1. Estimated catches (t) of Atlantic blue marlin (*Makaira nigricans*) by area, gear and flag.

			1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
TOTAL	A+M		4258	4230	5421	5737	5713	5408	5485	4474	3910	4419	3209	3579	3176	4364	3780	3345	3052	2901	2856	2162	2689	1930	2022	2134	1436
Landings		Longline	2966	2934	3786	4218	4165	3645	3658	2499	1743	2001	1666	1906	1739	2289	2162	1859	1773	1294	1198	1005	1534	1158	1229	1373	954
		Other surf.	870	871	1121	951	1035	1242	1306	1403	1463	1651	886	1128	828	1396	731	777	741	858	917	746	900	550	511	613	386
		Sport (HL+RR)	311	272	318	430	461	438	462	548	655	747	623	520	571	637	849	649	519	694	668	352	198	111	217	48	31
Discards		Longline	111	153	197	139	51	83	60	22	37	19	34	24	38	42	37	40	19	56	70	55	54	106	52	73	44
		Other surf.	0	0	0	0	1	0	0	2	11	0	1	1	0	0	1	20	1	0	2	4	3	5	13	27	21
Landings	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	**0**
		Barbados	19	31	25	30	25	19	19	18	11	11	0	0	25	0	0	0	9	13	14	11	12	34	11	24	21
		Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	3	3	7	47	19	8	5	13	1	6
		Brazil	81	180	331	193	486	509	467	780	387	577	195	612	298	262	182	150	130	63	48	114	105	89	79	64	37
		Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		China PR	62	73	62	78	120	201	23	92	88	89	58	96	99	65	13	77	100	99	61	45	40	44	50	40	42
		Curaçao	40	40	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	44
		Côte d'Ivoire	151	134	113	157	66	189	288	208	111	171	115	21	8	132	66	72	54	17	48	48	87	15	72	44	32
		EU.España	55	40	158	122	195	125	140	94	28	12	51	24	91	38	55	160	257	131	190	147	209	287	225	321	0
		EU.France	191	197	252	299	333	370	397	428	443	443	450	470	470	461	585	498	344	461	395	212	276	149	157	187	161
		EU.Portugal	11	10	7	3	61	20	22	18	8	32	27	48	105	135	158	106	140	54	55	25	23	46	50	57	74
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Gabon	2	0	304	5	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Ghana	441	471	422	491	447	624	639	795	999	415	470	759	405	683	191	140	116	332	234	163	236	88	44	162	60
		Grenada	52	50	26	47	60	100	87	104	69	72	45	42	33	49	54	32	69	53	32	63	63	0	0	0	**0**
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	23
		Japan	1523	1409	1679	1349	1185	790	883	335	267	442	540	442	490	920	1028	822	731	402	430	189	280	293	296	430	287
		Korea Rep.	56	56	144	56	2	3	1	1	0	0	1	6	33	64	91	36	85	57	34	24	10	3	26	25	25
		Liberia	0	87	148	148	701	420	712	235	158	115	188	304	162	274	76	56	46	133	94	178	293	35	127	10	1
		Maroc	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	4	7	82	**0**
		Mexico	13	13	13	13	27	35	68	37	50	70	90	86	64	91	81	93	89	68	106	86	67	72	66	60	68
		Namibia	0	0	0	0	0	0	0	0	3	0	5	9	57	0	50	2	23	10	0	8	36	8	32	57	84
		Panama	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21
		Philippines	0	0	0	0	7	71	38	0	0	0	0	0	0	0	8	0	3	4	1	2	2	0	0	0	
		Russian Federation	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		S. Tomé e Príncipe	28	33	36	35	33	30	32	32	32	32	9	21	26	66	68	70	72	74	76	78	81	11	10	13	11
		Senegal	9	0	2	5	0	0	0	11	24	32	11	1	5	91	114	61	41	64	164	45	72	10	82	39	25
		South Africa	0	0	0	0	0	0	0	1	4	0	0	0	0	2	0	0	1	0	0	0	1	1	0	0	**0**
		St. Vincent and Grenadines	2	2	1	1	0	1	0	0	20	0	0	0	0	1	3	2	1	0	0	2	0	0	0	2	2
		Trinidad and Tobago	16	28	14	50	16	20	51	17	16	9	11	7	14	16	34	26	22	25	46	48	48	35	19	0	**0**
		U.S.A.	88	43	43	46	50	37	24	16	17	19	26	16	17	9	13	6	4	6	14	9	1	9	19	13	20
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.Bermuda	15	15	15	3	5	1	2	2	2	2	2	2	2	2	2	0	1	2	2	3	3	3	2	1	2
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**0**
		UK.Sta Helena	0	2	2	1	2	4	4	3	4	1	1	2	2	3	4	2	2	2	12	2	1	1	0	0	0
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	**0**
		Uruguay	3	1	1	26	23	0	0	0	1	5	3	2	8	5	0	6	1	0	0	0	0	0	0	0	**0**

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Vanuatu	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	7	8	6	3	2	0	0	0	**0**
		Venezuela	122	117	148	142	226	240	125	84	88	120	101	160	172	222	130	120	151	116	143	111	139	150	185	97	144
	NCC	Chinese Taipei	663	467	660	1478	578	486	485	240	294	319	315	151	99	233	148	195	153	199	133	78	62	61	75	73	74
	NCO	Benin	5	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	39	85	43	53	12	38	55	56	34	3	4	7	7	0	0	0	0	0	0	0	0	0	0	0	
		Dominica	0	0	0	0	0	0	0	64	69	75	36	44	55	58	106	76	76	60	0	0	85	62	49	0	
		Dominican Republic	0	0	0	41	71	29	23	23	115	207	142	30	38	47	67	60	65	100	98	99	96	73	170	0	
		Jamaica	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Mixed flags (FR+ES)	133	126	96	82	80	83	147	151	131	148	171	150	136	135	139	164	178	186	181	191	173	176	0	0	
		NEI (BIL)	0	0	0	0	0	0	53	184	258	167	89	7	160	209	205	177	0	34	0	0	0	0	0	0	
		NEI (ETRO)	326	362	435	548	803	761	492	274	17	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	8	12
		Sta. Lucia	0	0	0	4	1	0	10	5	9	18	17	21	53	46	70	72	58	64	119	99	111	53	91	134	93
		Togo	0	0	0	23	0	73	53	141	103	775	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Ukraine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	
		Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
		EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	1	4	3	5	7	6	
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	11	12
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	1	0	0	
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
		U.S.A.	111	153	197	139	52	83	60	25	49	19	35	25	36	42	38	42	19	50	39	55	53	81	25	47	22
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0	24	27	26	16

BUM-Table 2. Kobe II matrices for Atlantic blue marlin giving the probability that $F<F_{MSY}$, $B>B_{MSY}$ and the joint probability of $F<F_{MSY}$ and $B>B_{MSY}$, between 2019 and 2028, with various constant catch levels based on Bayesian Surplus Production model and stock synthesis model base case model results.

a) Probability that $F<F_{MSY}$

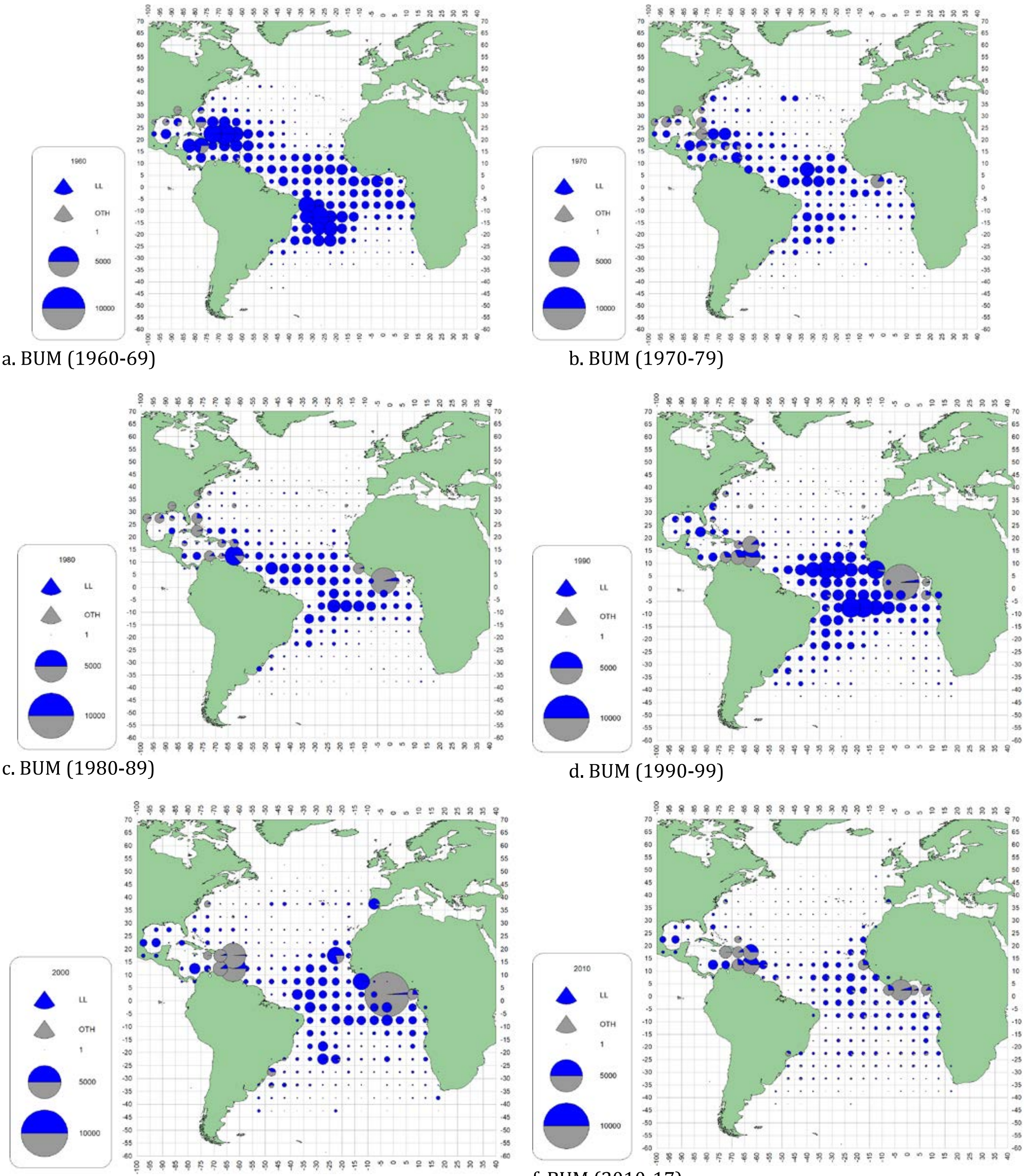
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
0	100	100	100	100	100	100	100	100	100	100
1000	98	98	98	98	98	98	98	98	98	98
1250	92	93	93	93	93	94	94	94	94	94
1500	84	85	85	86	87	87	87	88	88	89
1750	73	74	76	77	78	79	80	80	80	81
2000	60	62	64	66	67	69	70	71	72	73
2250	45	48	51	53	55	57	58	59	61	62
2500	33	36	38	40	42	44	46	48	49	51
2750	23	25	27	29	31	32	34	35	37	39
3000	15	17	18	20	21	23	24	26	27	30
3250	9	10	10	11	12	13	15	17	19	22
3500	6	7	7	7	9	10	12	14	17	19

b) Probability that $B>B_{MSY}$

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
0	11	21	34	47	59	68	75	80	84	86
1000	11	18	26	35	43	51	57	63	68	71
1250	11	16	24	31	39	46	52	57	61	66
1500	11	16	22	28	34	40	46	51	56	60
1750	11	15	20	26	31	36	41	46	49	53
2000	11	14	19	24	28	32	36	40	43	46
2250	11	14	17	21	24	27	31	34	37	39
2500	11	13	16	18	21	24	27	29	31	33
2750	11	12	14	17	18	20	21	23	24	26
3000	11	12	13	14	16	17	18	19	19	20
3250	11	11	12	12	13	14	14	14	15	15
3500	11	11	11	11	11	11	11	11	11	11

c) Probability that $F<F_{MSY}$ and $B>B_{MSY}$

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
0	11	21	34	47	59	68	75	80	84	86
1000	11	18	26	35	43	51	57	63	68	71
1250	11	16	24	31	39	46	52	57	61	66
1500	11	16	22	28	34	40	46	51	56	60
1750	11	15	20	26	31	36	41	46	49	53
2000	11	14	19	24	28	32	36	40	43	46
2250	11	14	17	20	24	27	31	34	36	39
2500	11	13	15	18	20	23	26	28	30	32
2750	11	12	13	15	17	19	20	22	23	25
3000	11	10	12	12	14	15	16	17	18	18
3250	9	8	8	9	10	10	11	11	12	12
3500	6	6	6	6	7	7	7	7	8	8



a. BUM (1960-69)

b. BUM (1970-79)

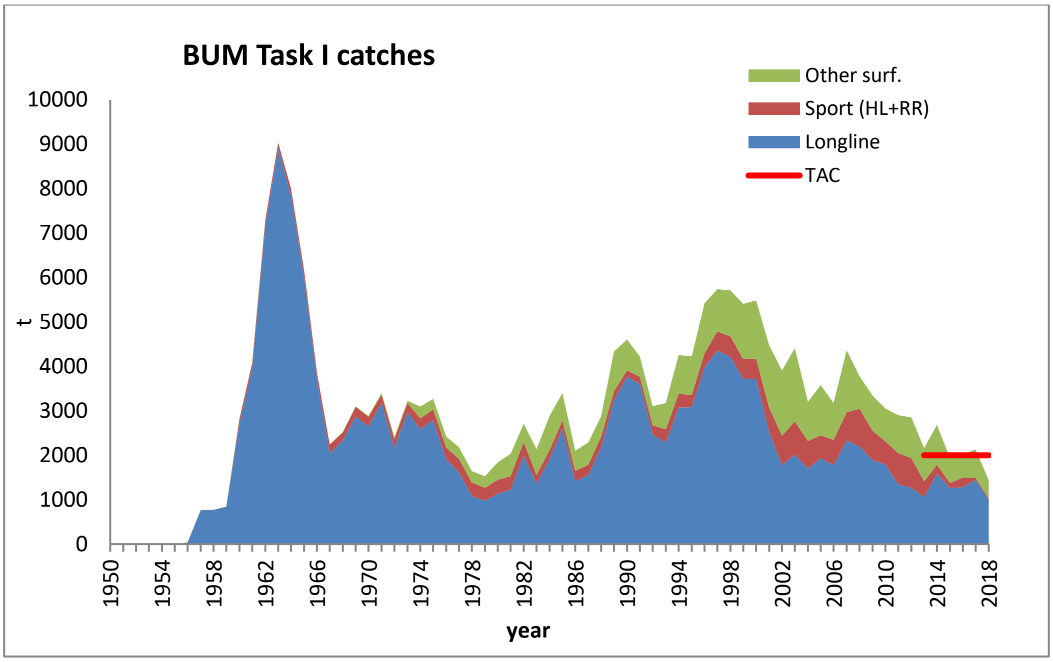
c. BUM (1980-89)

d. BUM (1990-99)

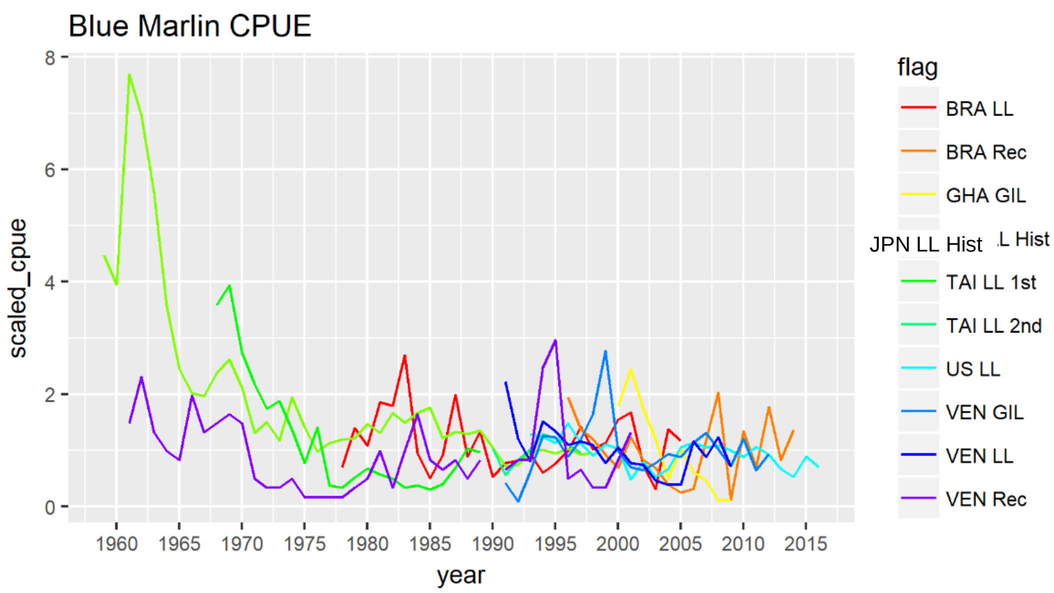
e. BUM (2000-09)

f. BUM (2010-17)

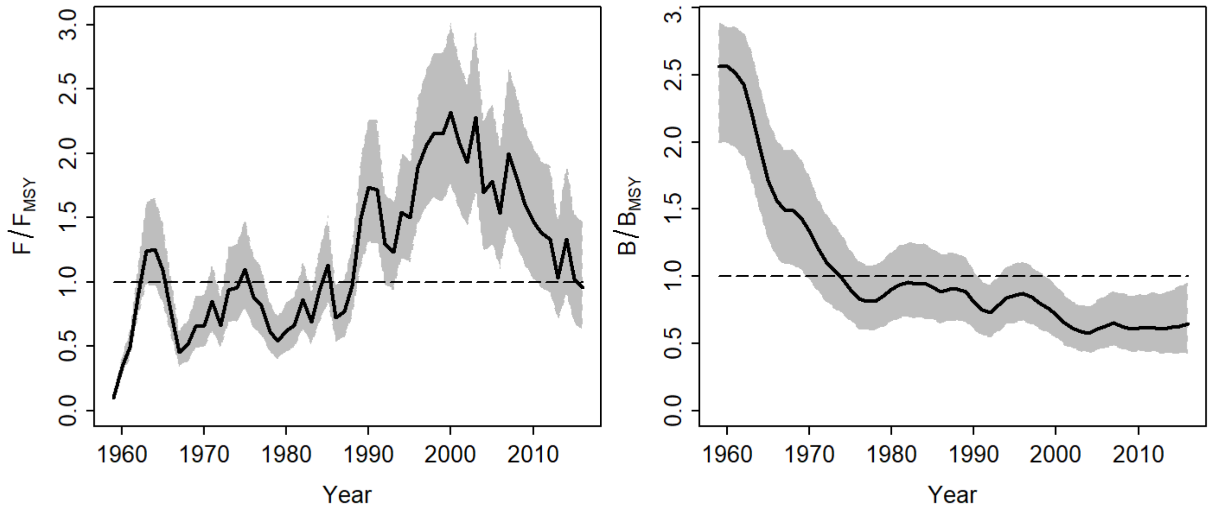
BUM-Figure 1. Geographic distribution of blue marlin total catches by decade (last decade only covers 8 years).



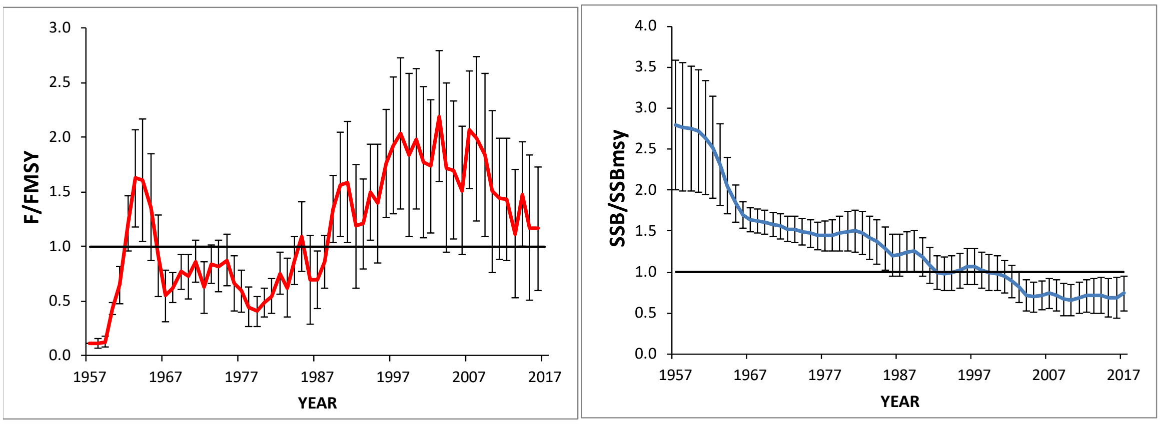
BUM-Figure 2. Atlantic blue marlin (*Makaira nigricans*) Task I catches (landings + dead discards) (t) by gear type between 1950 and 2018.



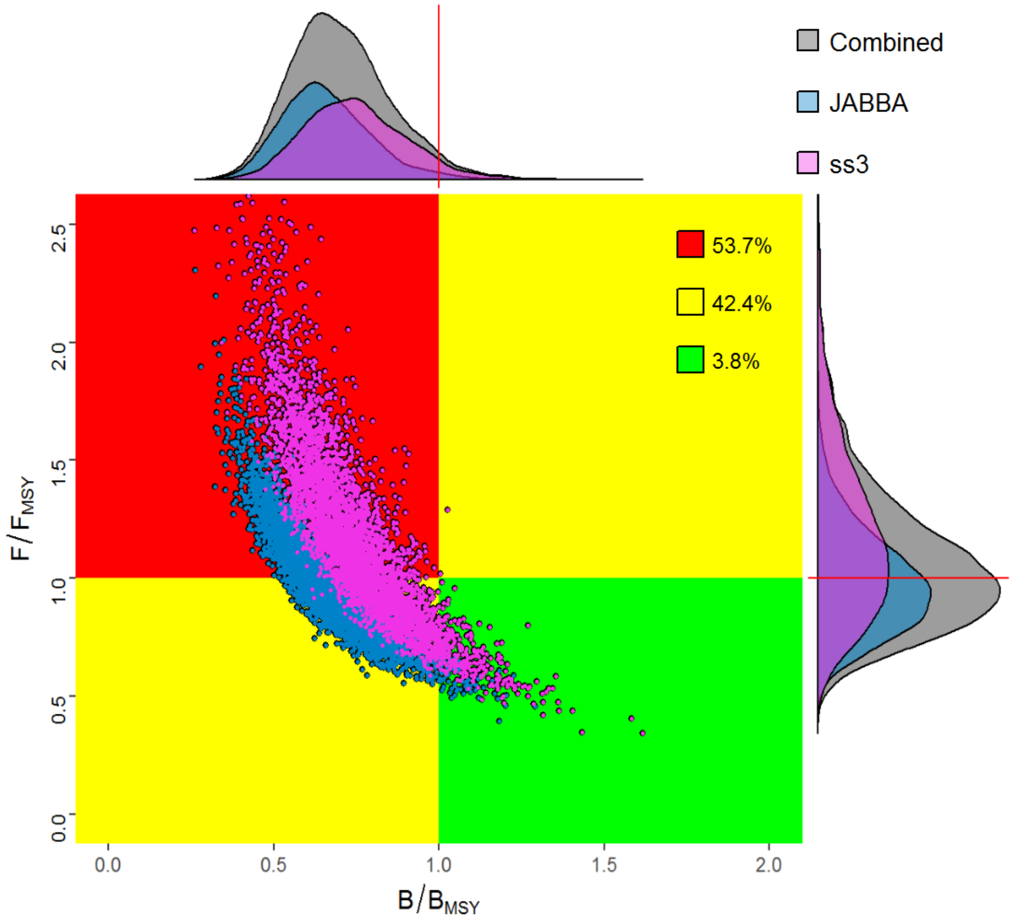
BUM-Figure 3. Plot of the indices of abundance used in the 2018 blue marlin stock assessment.



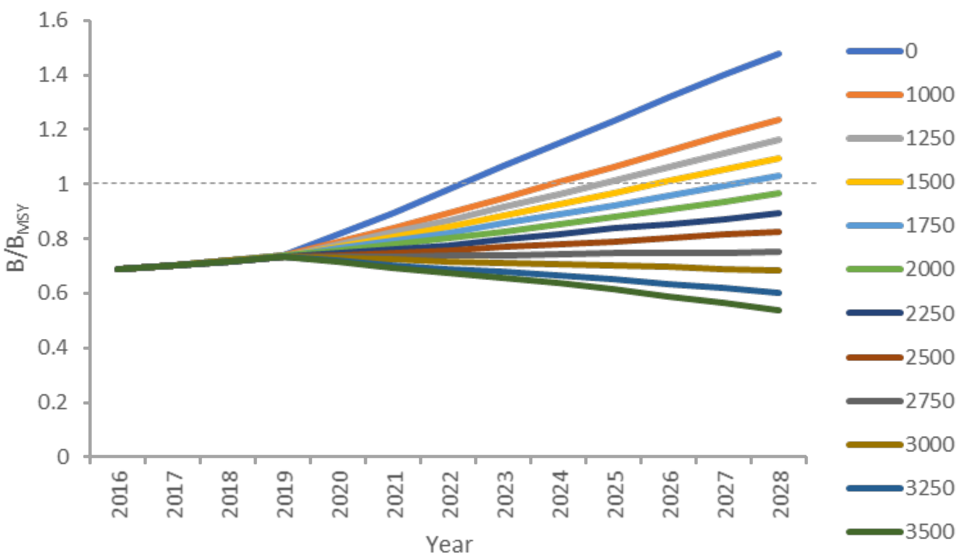
BUM-Figure 4.1. Trends in harvest rate relative to F_{MSY} and biomass relative to B_{MSY} for the Bayesian surplus production model (JABBA) fits to Atlantic blue marlin. Shaded grey area indicates 95% C.I.



BUM-Figure 4.2. Trend in SSB/SSB_{MSY} (top) and F/F_{MSY} for the stock synthesis model, including approximate 95% confidence intervals.



BUM-Figure 5. Combined Kobe plots for the final base cases of Bayesian Surplus Production model (JABBA, blue) and stock synthesis model (SS3, pink) models for the Atlantic blue marlin.



BUM-Figure 6. Combined results of projections of B/B$_{MSY}$ for Atlantic blue marlin for both the stock synthesis model and Bayesian Surplus Production model base case models under different constant catch scenarios.

9.7 WHM – WHITE MARLIN

The most recent assessment for white marlin was conducted in 2019 through a process that included a data preparatory meeting in March 2019 (Anon., 2019h) and an assessment meeting held in June 2019 (Anon., 2019i). The last year of fishery data used in the assessment was 2017.

WHM-1. Biology

White marlin spawning areas occur mainly in the tropical western North and South Atlantic, predominantly in the same offshore locations in their normal range. In the North Atlantic, spawning activity has been reported off eastern Florida (USA), the Windward Passage (between La Hispaniola and Cuba), and north of Puerto Rico. Seasonal spawning concentrations have been noted northeast of Hispaniola and Puerto Rico, and off the east coast of Hispaniola. Spawning activity has also been reported for the equatorial Atlantic (5°N-5°S) off northeastern Brazil, and in the South Atlantic off southern Brazil.

Previous reports have mentioned that spawning takes place during austral and boreal spring-summer. In the North Atlantic, reproduction events occur from April to July, with spawning activity peaking around April-May. In the equatorial Atlantic (5°N-5°S), spawning occurs during May to June, and in the South Atlantic, reproduction events take place from December to March.

White marlin inhabits the surface mixed layer of the open ocean. Although they spend about 50% of daylight hours and 81% of nighttime hours in the warmer waters of the mixed surface layer, they do explore temperatures ranging 7.8-29.6°C. However, a negligible amount of time is spent at temperatures less than 7 °C below the mixed surface layer. Information from pop-up satellite archival tag (PSAT) data indicated frequent short-duration dives extending to >300 m depths, although most dives ranged from 100 to 200 m. Two types of diving behavior have been identified for white marlin, (1) a shorter duration V-shaped dive, and (2) a U-shaped dive characterized as those confined to a specific depth range for a prolonged period. These patterns, however, can be highly variable between individuals and also vary depending on the temperature and dissolved oxygen of the surface mixed layer. Therefore, it is important to consider vertical habitat use and the environmental factors that influence it during the standardization of CPUE data.

All white marlin biological material sampled prior to the confirmation of the presence of roundscale spearfish (*T. georgii*) in 2006, are now presumed to contain an unknown proportion of roundscale spearfish. Therefore, reproductive parameters, growth curves and other biological studies previously thought to describe white marlin may not accurately represent this species. The Committee reviewed recent scientific nomenclature for billfish (Colette *et al*., 2006) and recommends adopting the scientific name of *Kajikia albida* (Poey 1860) for white marlin in ICCAT.

WHM-2. Fishery indicators

It has now been confirmed that white marlin landings reported to ICCAT include roundscale spearfish in significant numbers, so that historical statistics of white marlin most likely comprise a mixture of the two species. Studies of white marlin/roundscale spearfish ratios in the western Atlantic have been conducted, with overall estimated ratios between 23-27%, although they varied in time and space. Previously, these were thought to represent only white marlin. However, there is little information on these species ratios in the eastern Atlantic.

The decadal geographic distribution of the catches is given in **WHM-Figure 1**. The Committee used Task I catches as the basis for the estimation of total removals (**WHM-Figure 2**). Total removals for the period 1990-2017 were obtained during the 2019 White Marlin Stock Assessment Session by modifying Task I values with the addition of white marlin that the Committee estimated from catches reported as billfish unclassified. The dead discards were estimated for those longline fleets that have not reported dead discards (2010-2018) based on data from fleets that had reported dead discards.

Additionally, the reporting gaps for some fleets were completed using estimates based on catch values reported for years before and/or after the gap(s) years.

Preliminary Task I catches of white marlin and roundscale spearfish, as well as the combined WHM/RSP Task I used in the stock assessment is presented in **WHM-Table 1**. For combined white marlin and roundscale spearfish the catches in 2018 were 313 t, compared to 458 t reported for 2017. Landings for 2018 are preliminary. Due to the work conducted by the Committee and improved reporting by CPCs the amount of unclassified billfish in the Task I table has been minimized.

A series of indices of abundance for white marlin were presented and discussed during the 2019 data preparatory and assessment meetings. Following the guidelines developed by the SCRS Working Group on Stock Assessment Methods (WGSAM), 14 CPUE series were available and 13 selected for their inclusion in the final assessment models. In general, the indices showed no discerning trend during the latter part of the time series examined (**WHM-Figure 3**). During the 2019 assessment, all standardized CPUE index for white marlin showed a sharp decline during the period 1960-1991, and variables patterns and no consistent trend among indices thereafter (**WHM-Figure 3**).

WHM-3. State of the stock

A full stock assessment was conducted for the combined white marlin/roundscale spearfish in 2019, applying to the available data through 2017, using both surplus production and age-structured models, which included estimations of management benchmarks. As recommended by the working group in 2010, the model configuration was an effort to use all available data on white marlin, including lengths, dimorphic growth patterns, steepness and other biological data. Although it is believed that the modeling methods employed were relatively robust, the input data for the models were very likely less so. Perhaps the most important uncertainty was that associated with the catch data and some of the biological parameters of their life history. The uncertainty of the magnitude of the catch is especially a problem with the landings and discards data reported after 1998 when recommendations promoting or mandating the release of billfish that were alive at haulback. This led to a decrease in reported landings but not necessarily a decrease in fishing and/or release mortality. This apparent drop in landings led to a marked decrease in the estimates of F/F_{MSY} from 2002-present, however the Committee considers that this trend is likely overly optimistic due to unreported catch and unaccounted release mortality. The Group addressed this issue by including estimates of dead discards for the longline fisheries.

The results of the 2019 assessment indicated that the stock of Atlantic white marlin was overfished but not undergoing overfishing (**WHM-Figure 4**). The probability of being in the red quadrant of the Kobe plot was estimated to be 1%. The probability of being in the yellow quadrants of the Kobe plot was estimated to be 99% and that of being in the green quadrant less than 1%. The estimated MSY was determined to be 1,495 t with approximate 95% confidence intervals of 1,316 t - 1,745 t.

Generally, all models estimated similar annual trends and values of both B/B_{MSY} and F/F_{MSY}. Relative fishing mortality has been declining since the late 1990s and is now most likely to be below F_{MSY} (**WHM-Figure 5**). Relative biomass has probably stopped declining over the last ten years, but still remains well below B_{MSY} (**WHM-Figure 5**). There is considerable uncertainty in these results. These results are conditional on the reported catch being a true reflection of the fishing mortality experienced by white marlin. The Group reiterated that this evaluation is for both stocks of white marlin and roundscale spearfish, and that the presence of unknown quantities of roundscale spearfish in the catches and data used to estimate relative indices of abundance increases the uncertainty of white marlin stock status and outlook for this species.

WHM-4. Outlook

All assessment models estimated that the stock has been less productive than usual (e.g. lower recruitment) since the 1990s, which can be observed in **Figure 5** wherein relative biomass has not increased by much despite relative fishing mortality having declined considerably over that time period. Projections were carried out using the assessment models, but those projections assumed higher productivity into the future. This resulted in projections of the stock building quickly in the future, responding with much more productivity in the future than has been observed for the past two decades, even when the same levels of catch are assumed into the future as have been experienced by the stock in the past 20 years.

As such, the Group considered the projections to be overly optimistic and did not support their use to develop Kobe strategy matrices.

WHM-5. Effect of current regulations

A 2006 recommendation (Rec. 06-09) established that the annual amount harvested by pelagic longline and purse seine vessels and retained for landing must be no more than 33% for white marlin and 50% for blue marlin of the 1996 or 1999 landing levels, whichever is greater. Furthermore, in 2012, the Commission established a TAC for 2013, 2014, and 2015 of 400 t (Rec. 12-04), placed additional catch and commerce restrictions in recreational fisheries for blue marlin and white marlin, and requested methods for estimating live and dead discards of blue marlin and white marlin/spearfish. In 2015, the Commission further strengthened the plan to rebuild white marlin stock by extending for 2016, 2017, 2018 and 2019 the annual limit of 400 t for white marlin/spearfish (Rec. 15-05, Rec. 18-04).

The Committee is concerned with the significant increase in the contribution from fishing by artisanal and small-scale fleets to the total white marlin harvest and that these fisheries are not fully accounted for in the current ICCAT statistics. The Committee expressed its serious concern over this limitation on data for future assessments. Such data limitation precludes any analysis of the current regulations. In addition, the Committee expressed concern about the status of white marlin due to the misidentification of spearfishes in the white marlin catches. This situation adds uncertainty to the stock assessment results.

Currently, four ICCAT Contracting Parties (Brazil, Canada, Mexico, and the United States) mandate the use of circle hooks on their pelagic longline fleets. Research has demonstrated that in some longline fisheries the use of non-offset circle hooks resulted in a reduction of billfish mortality, while the catch rates of several of the target species remained the same or were greater than the catch rates observed with the use of conventional J hooks or offset circle hooks.

The Committee noted that more countries have started reporting data on live releases in 2006. However, there is not enough information on the proportion of fish being released alive to evaluate the effectiveness of the ICCAT recommendation, relating to the live release of white marlin.

WHM-6. Management recommendations

The Group notes that Rec. 15-05 states "An annual limit of [2,000 t for blue marlin and] 400 t for white marlin/spearfish". As written, this text implies the annual limit of 400 t applies to all species of spearfish. This is inconsistent however with the scientific advice, which includes only white marlin and round scale spearfish and not all species of spearfish. It is recommended that future management recommendations be written such as to be consistent with the scientific advice by explicitly stating only white marlin and round scale spearfish.

In 2012, the Commission adopted Rec. 12-04, intended to reduce the total harvest to 400 t in 2013-2015 to allow the rebuilding of the white marlin stock from the overfished condition. Subsequently, the Commission extended the 400 t annual catch limit to 2016-2018 (Rec. 15-05), and 2019 (Rec. 18-04). Although there is some evidence of slow rebuilding in recent years, the Group noted that catches have exceeded the 400 t TAC in every year since its initial implementation and warns that if catches continue to exceed the TAC, the rebuilding of the stock will proceed more slowly, or be put at risk of further declines. Further reductions in fishing mortality are likely to speed up the rebuilding of the stock. Unfortunately, the inability to accurately estimate fishing mortality will continue to compromise the Group's ability to predict and monitor the stock's recovery period. This is due to the inadequate reporting of discards, as well as the lack of reports from some artisanal and recreational fisheries that take marlin species.

- Measures should be taken to ensure that monitoring and reporting of all landings and discards, including live releases, are appropriate, accurate, and complete. This will likely require improvements to the observer programs of many CPCs, as well as the implantation of discard estimation methods using those data.

- Efforts should be made, building on previous work, to fully account for the catches of artisanal and all recreational fisheries.

Given the overfished status of the stock and the uncertainties in the data, including for both total removals and indices of abundance:

- the Commission, at the minimum, should ensure that catches do not exceed current TAC until the stock has fully recovered.

Given that experimental research has demonstrated that in longline fisheries the use of circle hooks resulted in a reduction of marlin catch rates and haulback mortality, and noting that they have different impacts on both target and by-catch species; then to reduce the chance of exceeding any established TAC, the Commission should consider:

- the use of non-offset circle hooks.
- the release of all marlins that are alive at haul back in ways that maximize their survival.

ATLANTIC WHITE MARLIN/ROUNDSCALE SPEARFISH SUMMARY

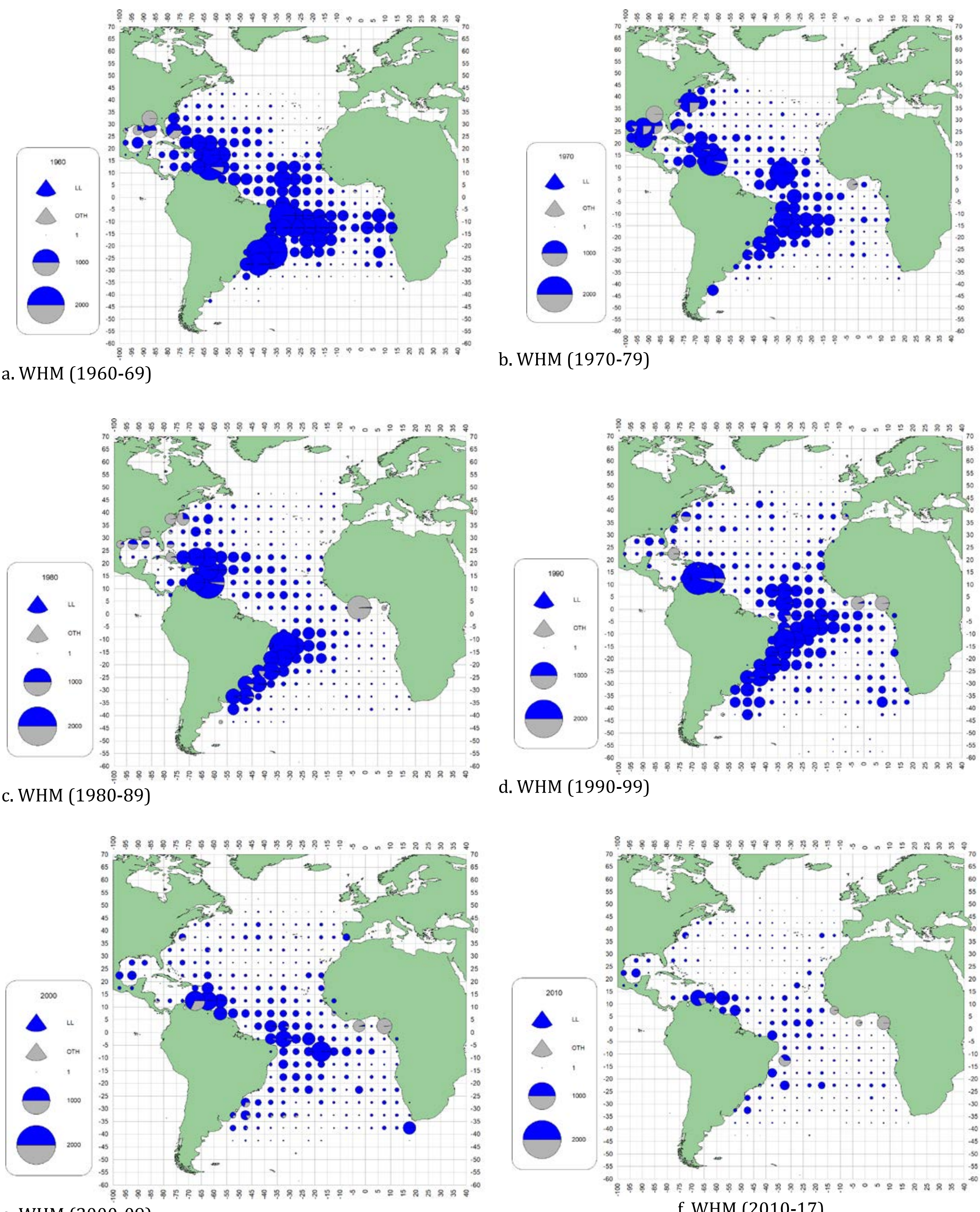
MSY	1,495 (1,316 – 1,745) t[1]
Current (2018) Yield	314 t [2]
Relative Biomass: B_{2017}/B_{MSY}	0.58 (0.27-0.87)[1]
Relative Fishing Mortality: F_{2017}/F_{MSY}	0.65 (0.45-0.93)[1]
Stock Status (2017)	Overfished: Yes Overfishing: Not
Conservation and Management Measure in Effect:	Recommendations (Rec. 15-05) and (Rec. 18-04) Landing limit of 400 t in 2016 - 2019

[1] Median of combined estimates from 2 Stock Synthesis models and 1 JABBA model with approximate 95% confidence intervals.
[2] 2018 yield should be considered provisional.

WHM/RSP -Table 1. Estimated catches (t) of Atlantic white marlin (*Tetrapturus albidus*) and Roundscale spearfish (Tetrapturus georgii) by area, gear and flag.

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
WHM+RSP	TOTAL	A+M		2202	1880	1679	1513	1945	1786	1535	1078	1012	845	841	768	612	748	714	755	506	530	465	647	452	491	465	459	314
	Landings	A+M	Longline	2065	1720	1535	1367	1717	1638	1403	970	834	756	757	689	532	629	607	632	419	414	372	464	373	444	419	400	255
			Other surf.	64	36	56	62	189	85	89	86	139	71	55	60	65	81	84	95	68	85	62	56	61	34	33	41	40
			Sport (HL+RR)	30	22	24	14	6	6	2	4	6	1	1	1	2	1	2	2	6	4	6	116	7	3	4	5	10
	Discards	A+M	Longline	43	101	65	70	32	57	41	17	29	17	27	17	12	36	21	24	12	27	24	11	11	10	9	12	8
			Other surf.	0	0	0	0	1	0	0	1	4	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0
RSP	TOTAL	A+M		0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	2	0	1	8	16	12	22	36	9
	Landings	A+M	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	1	0	1	7	16	11	22	36	9
			Sport (HL+RR)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Landings	A+M CP	EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	0	1	5	5	11	7	8	9
			South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	
			U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	11	0	16	28	
WHM	TOTAL	A+M		2202	1880	1679	1513	1945	1786	1535	1078	1012	845	841	768	612	748	711	753	504	530	464	640	436	480	442	422	304
	Landings	A+M	Longline	2065	1720	1535	1367	1717	1638	1403	970	834	756	757	689	532	629	603	630	418	414	371	456	357	433	396	364	246
			Other surf.	64	36	56	62	189	85	89	86	139	71	55	60	65	81	84	95	68	85	62	56	61	34	33	41	40
			Sport (HL+RR)	30	22	24	14	6	6	2	4	6	1	1	1	2	1	2	2	6	4	6	116	7	3	4	5	10
	Discards	A+M	Longline	43	101	65	70	32	57	41	17	29	17	27	17	12	36	21	24	12	27	24	11	11	10	9	12	8
			Other surf.	0	0	0	0	1	0	0	1	4	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0
	Landings	A+M CP	Barbados	26	43	15	41	33	25	25	24	15	15	18	16	33	22	24	26	6	3	5	6	6	10	14	17	22
			Belize	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Brazil	91	105	75	105	217	158	106	172	407	266	80	244	90	52	55	53	35	75	71	352	102	121	67	47	62
			Canada	4	4	8	8	8	5	5	3	2	1	2	5	3	2	2	1	2	1	2	3	5	3	1	2	1
			China PR	9	11	9	11	15	30	2	20	23	8	6	9	6	10	5	9	8	3	4	2	0	0	0	3	2
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
			Côte d'Ivoire	0	0	1	2	1	5	1	2	2	3	1	1	1	1	3	2	1	1	0	1	1	1	1	1	1
			EU.España	26	36	151	93	101	119	186	61	6	22	64	58	51	46	32	16	111	4	34	37	93	113	89	110	0
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0
			EU.Portugal	0	0	0	0	1	1	0	0	1	5	19	30	22	2	35	40	11	18	25	10	9	7	11	13	**0**
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Gabon	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Ghana	1	2	1	3	7	6	8	21	2	1	1	1	0	1	4	4	3	1	1	1	1	1	1	0	**0**
			Grenada	0	0	0	0	0	0	1	15	8	14	33	10	12	11	17	14	0	0	0	0	0	0	0	0	**0**
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Honduras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Japan	92	57	112	58	56	40	83	56	16	33	36	34	39	21	34	43	41	31	42	24	6	8	9	10	6
			Korea Rep.	43	23	59	23	35	39	0	0	0	11	40	7	0	113	96	78	43	43	0	0	0	0	0	0	**0**
			Liberia	0	0	1	1	3	8	4	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Mexico	7	11	3	1	3	6	11	13	16	15	28	25	16	14	14	19	20	28	36	30	20	26	20	12	16
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Philippines	0	0	0	0	1	12	0	0	0	0	0	0	0	0	1	1	2	2	1	2	2	0	0	0	

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			S. Tomé e Príncipe	21	21	30	45	40	36	37	37	37	37	21	33	29	35	36	37	38	39	40	41	42	17	15	13	15
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			South Africa	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			St. Vincent and Grenadines	0	0	0	0	0	0	0	1	0	44	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8
			Trinidad and Tobago	11	18	8	32	10	13	4	2	5	12	6	6	5	12	10	11	15	14	39	33	38	32	20	0	**0**
			U.S.A.	13	7	12	8	5	5	1	3	6	1	1	1	1	0	2	2	2	2	1	4	2	2	1	2	2
			U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			UK.Bermuda	1	1	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
			UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**0**
			Uruguay	3	0	1	24	22	16	21	20	1	9	2	5	9	3	6	5	5	0	0	0	0	0	0	0	**0**
			Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Venezuela	236	286	270	177	310	228	178	182	215	168	136	156	190	131	63	128	116	160	121	75	89	119	172	165	152
		NCC	Chinese Taipei	1350	907	566	441	506	465	437	152	178	104	172	56	44	54	38	28	20	28	15	7	7	10	10	5	6
			Costa Rica	0	0	0	0	0	3	14	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cambodia	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Mixed flags (FR+ES)	11	9	7	7	9	8	12	13	12	13	13	11	10	9	10	12	12	37	0	0	0	0	0	0	
			NEI (BIL)	0	0	0	0	0	0	34	77	4	30	134	42	37	170	204	199	0	11	0	0	0	0	0	0	
			NEI (ETRO)	214	237	285	359	526	498	322	180	11	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	0	1	1
			Togo	0	0	0	0	0	1	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards	A+M	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	2	19	1	0	0	0	0	0	0	0	0	0	
			Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	
			Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			U.S.A.	42	100	65	70	33	58	41	18	33	17	27	17	10	8	10	14	8	23	21	10	11	8	3	5	2
			UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	2	1
		NCO	NEI (BIL)	1	1	0	0	0	0	1	0	0	0	0	0	1	10	11	11	2	2	2	1	0	0	4	6	3



a. WHM (1960-69)

b. WHM (1970-79)

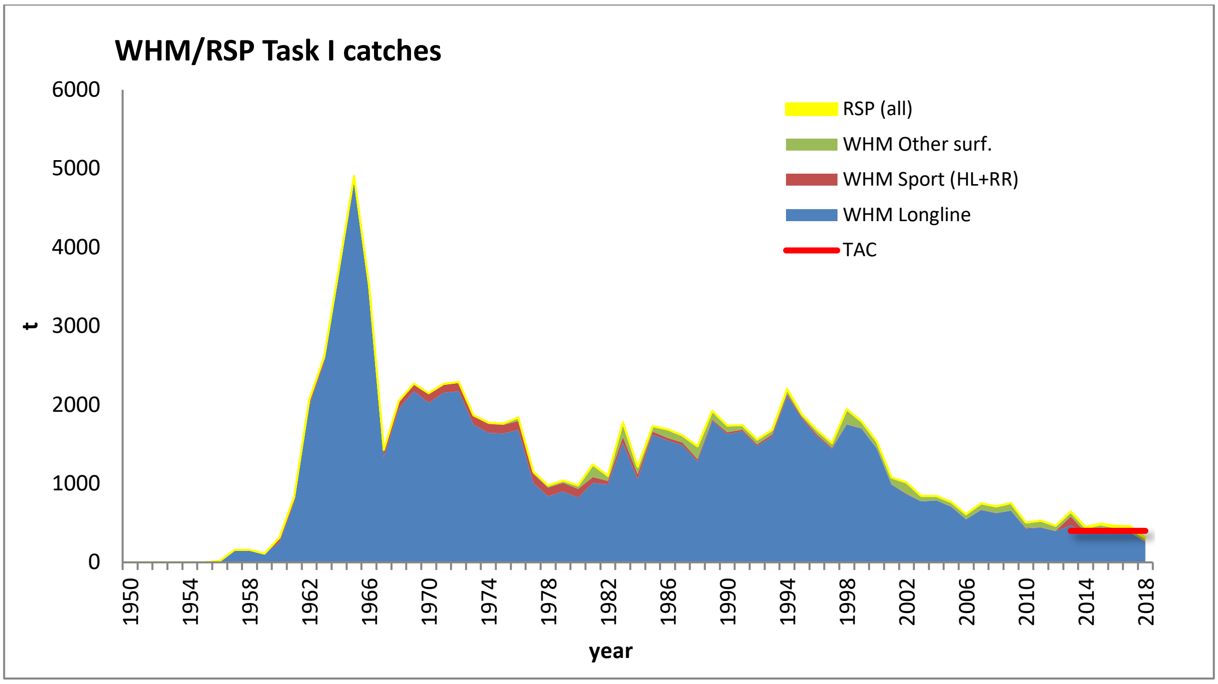
c. WHM (1980-89)

d. WHM (1990-99)

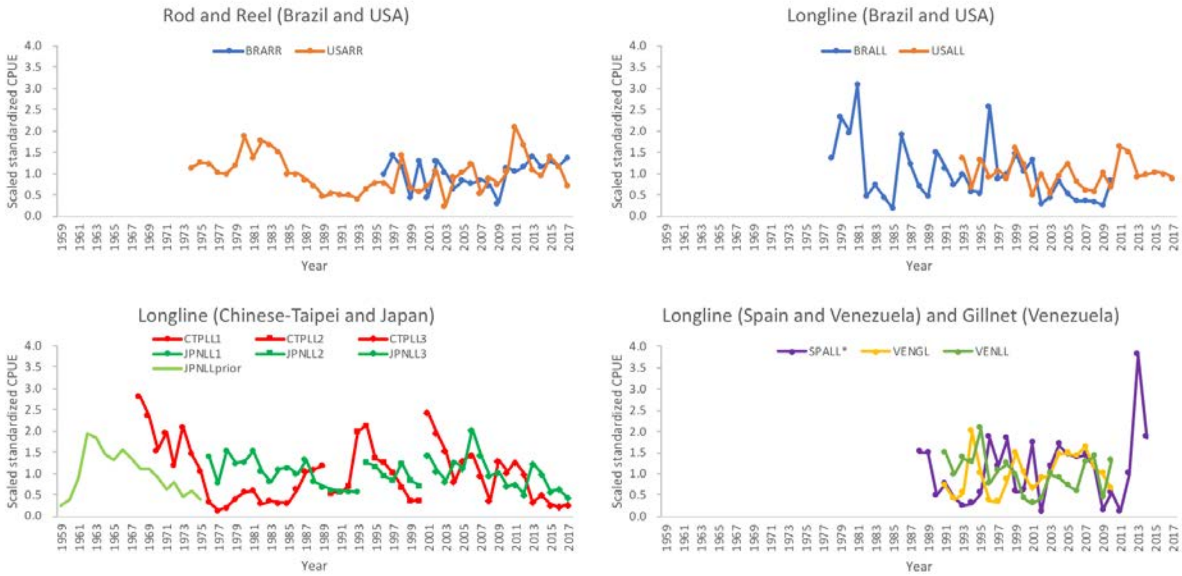
e. WHM (2000-09)

f. WHM (2010-17)

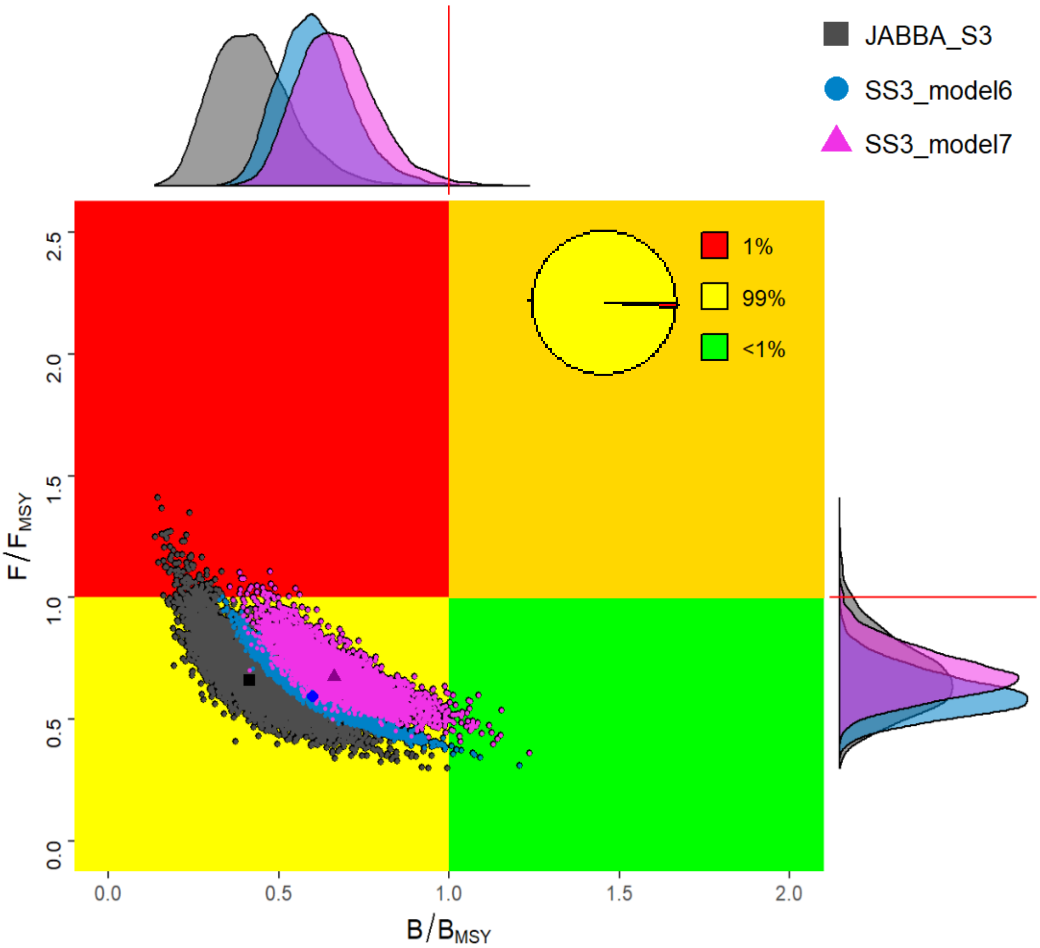
WHM-Figure 1. Geographic distribution of white marlin total catches by decade (last decade only covers 8 years).



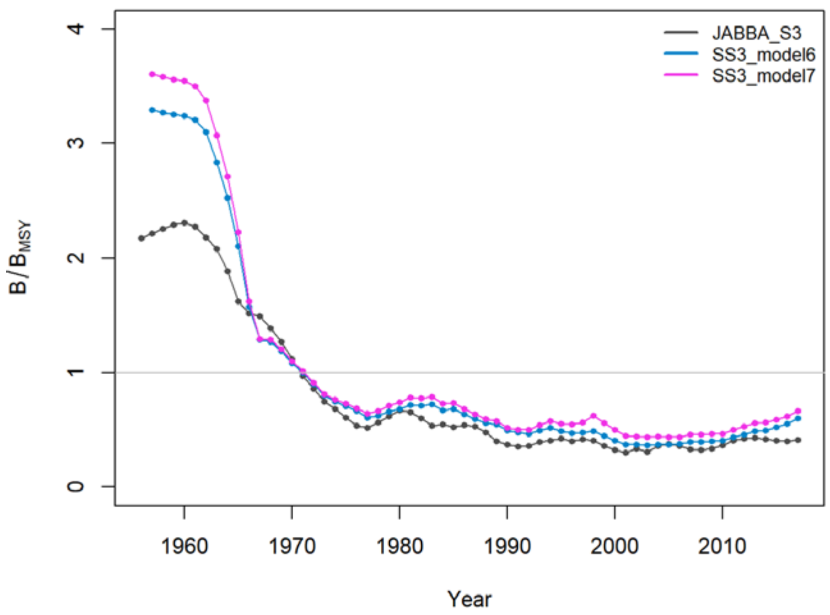
WHM-Figure 2. Total catch of white marlin and roundscale spearfish reported in Task I for the period 1956-2018.

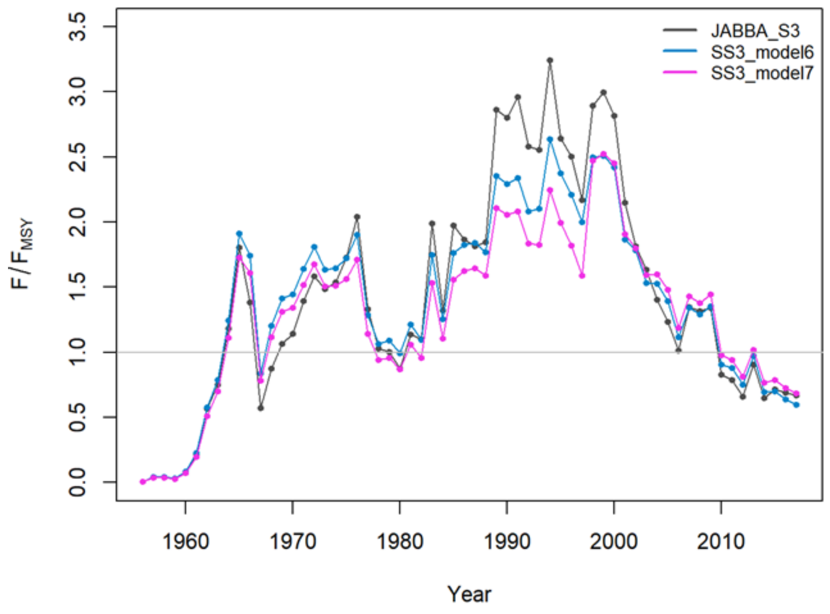


WHM-Figure 3. Standardized CPUE series used in the 2019 White Marlin stock assessment. Spanish longline index* is used only for sensitivity analysis by JABBA.



WHM-Figure 4. Combined Kobe phase plots and pie chart from 2 Stock Synthesis runs (models 6 and 7, blue and pink, respectively) and 1 JABBA run (grey) in 2019 Atlantic white marlin stock assessment. The green quadrant corresponds to the stock not being overfished and no overfishing occurring and the red quadrant to the stock being overfished and overfishing occurring. The marginal densities plots for stock relative to B_{MSY} and harvest rate relative to F_{MSY} are also shown (top and right of large panel) are individual probabilities of Stock Synthesis and JABBA runs overlaid.





WHM-Figure 5. Historical estimates of biomass over biomass at MSY ratio (upper panel) and fishing mortality overfishing mortality at MSY ratios (lower panel) for the final base cases of JABBA (S3, black) and Stock Synthesis (models 6 and 7, blue and pink, respectively) models for the Atlantic white marlin.

9.8 SAI – SAILFISH

The most recent stock assessments for East and West sailfish were conducted in 2016 (Anon. 2017d) using catch data available to 2014, through a process that included meetings for data preparatory, and a catch rate standardization workshop in May. The previous sailfish stock assessments were conducted in 2009 (Anon. 2010a).

SAI-1. Biology

Sailfish have a mainly pan-tropical distribution in the Atlantic Ocean, with occasional catches reported from temperate waters. Based on life history information, migration rates and geographic distribution of catch, ICCAT has established two management units for sailfish, eastern and western Atlantic stocks (**SAI-Figure 1**). However, a recent preliminary study investigating genetic differentiation among groups of Atlantic sailfish suggests genetic stock structure between both the eastern and western Atlantic, and northern and southern hemispheres, suggesting the need for further investigations to elucidate and confirm the presence of additional stock structure that may influence future assessments.

Sailfish is more coastally oriented than other billfish species. Conventional tagging data suggests they move shorter distances than the other billfish (**SAI-Figure 2**). Temperature preferences for adult sailfish appear to be in the range of 25-28°C. Sailfish generally seek out the warmest water available, and electronic tagging studies indicate that about 96% of darkness, 86% of twilight, and 82% of daylight hours are spent near the surface (Hoolihan *et al*., 2011). Vertical habitat use is more complex however, with frequent short duration excursions to deeper depths in excess of 100 m, with some dives as deep as 350 m.

Sailfish grow rapidly and reach a maximum size of 160 cm for males and 220 cm for females, with a mean maximum age of at least 12 years. A new length at 50% maturity (L50) has been estimated for West Atlantic female sailfish (146.12 cm LJFL); while the previous L50 value used for western sailfish males remains at 135.7 cm LJFL. No values are currently available for eastern Atlantic sailfish.

Sailfish spawn over a wide area and year around. For the western stock, evidence of spawning has been detected in the Straits of Florida, and off the Venezuelan, Guyanese and Surinamese coasts. In the southwestern Atlantic, spawning has been confirmed off the southern coast of Brazil between 20° and 27°S. Additional spawning areas occur in the eastern Atlantic off Senegal and Côte d'Ivoire. Timing of spawning can differ between regions; from the Florida Straits to the areas off Guyana western Atlantic sailfish spawn in the second and third quarter of the year, while in the southwestern Atlantic they spawn during the austral summer.

SAI-2. Fisheries indicators

Sailfish are targeted by coastal artisanal and recreational fleets and are captured to a lesser extent as by-catch in longline and purse seine fisheries (**SAI-Figure 3**). Historically, catches of sailfish were reported together with spearfish by many longline fleets. In 2009 these catches were separated by the Committee (**SAI-Table 1**).

East Atlantic

The eastern stock is exploited by surface fisheries, mainly artisanal gillnet and troll, and to a lesser degree by purse seine, as well as longline and recreational fisheries. The main surface fisheries are carried out by the artisanal fleets of Côte d'Ivoire, Ghana and Senegal followed by the EU mixed flags fleets (France and Spain) in the Gulf of Guinea and in the waters of the tropical eastern Atlantic. The main longline fleets are EU-Spain, Japan and Chinese Taipei fleets which operate in the central, eastern and western Atlantic. Total reported landings, increased abruptly after 1973, to peak above 5,000 t in 1975-1976, remaining relatively high (>2000 t), largely due to the incorporation of artisanal fishing effort by the traditional surface (gillnet and troll) fisheries (**SAI-Table 1**; **SAI-Figure 3a**). A generally decreasing trend in catch is apparent since 2008, mainly due to a decreased catch by the surface fisheries (gillnet and purse seine) (**SAI-Figure 3a**). Preliminary Task I catches of sailfish east in 2018 were 1,183 t, compared to 1,650 t reported for 2017 (**SAI-Table 1**).

West Atlantic

The western stock is exploited by longline, recreational fisheries, and by surface fisheries, mainly artisanal drift-gillnet. The main longline fleets include Brazil, EU-Spain, Venezuela and Grenada, which operate in the western and central Atlantic. The main surface fisheries are carried out by the artisanal fleets of Grenada and Venezuela in the Caribbean Sea and waters of the tropical western Atlantic.

Total reported landings steadily increased since 1960 to peak 2,060 t in 2002 (**SAI-Figure 3b**). A steep decreasing trend of catch is observed from 2005, mainly due to a decreased catch by the surface (artisanal drift-gillnet) fisheries. Preliminary Task I catches of sailfish west in 2018 were 1,250 t, compared to 1,080 t reported for 2017 (**SAI-Table 1**).

Although there has been some progress, historical catches of unclassified billfish continue to be reported to the Committee, confounding sailfish catch estimates. Catch reports from countries that have historically been known to land sailfish continue to suffer from gaps and there is increasing *ad hoc* evidence of unreported landings in some other countries. These considerations provide support to the idea that the historical catch of sailfish has been under-reported, especially in recent times where more and more fleets encounter sailfish as by-catch or direct targeting.

Several standardized CPUE data series were used in 2016 for the Atlantic sailfish stock assessment. For the eastern Atlantic stock, the eight indices of abundance used were: Côte d'Ivoire, Ghana, and Senegal artisanal, Chinese Taipei longline, Japan longline (early and late), EU-Portugal longline, and EU-Spain longline; for the western Atlantic stock, the eleven indices used were: Brazilian longline, Brazilian rod & reel, Chinese Taipei longline, Japanese longline (early and late), EU-Spain longline, US longline observer, US rod & reel, Venezuelan longline, Venezuelan rod & reel, and Venezuelan artisanal (**SAI-Figure 4**). For both stocks, the available CPUE time series showed a mixture of both decreasing and increasing trends, which demonstrated a potential conflict in the indicators of stock abundance. For this reason, CPUE time series were put into two groups, each based on the similarity of their indication of stock abundance (i.e., increasing or decreasing). In the assessment, these CPUE groups were considered as alternatives for the surplus production and Stock Synthesis models.

SAI-3. State of the stocks

Important progress was made on the integration of new data sources, in particular standardized catch rate data, size data, and modeling approaches, in the 2016 assessment of the status of the stocks of Atlantic sailfish. For both stocks (East and West), uncertainty in data inputs and model configuration was explored through sensitivity analysis. They revealed that results were sensitive to structural assumptions of the models. The production model formulations and the Stock Synthesis model (applied for the western stock) had varying degrees of difficulty fitting the decreasing or increasing trends in the CPUE series. Overall, assessment results were uncertain and should be interpreted with caution.

East Atlantic

The Bayesian surplus production model, the production and the Stock Reduction Analysis models showed similar trends in biomass trajectories and fishing mortality levels; trends in abundance suggest that the stock suffered their greatest declines in abundance prior to 1990. Different model runs indicate a declining/increasing trend in recent years depending on the CPUE series selected. All the scenarios considered for advice using the surplus production models indicated that the stock is overfished (0.27-0.71 B_{MSY}), but overfishing status is uncertain (0.33-2.85 F_{MSY}) (**SAI-Figure 5**).

West Atlantic

The production and the Bayesian surplus production models examined were heavily influenced by the priors used in the models. Neither model could provide stock status due to the large uncertainty in benchmark estimates, and generally poor model convergence. The point estimates of both Stock Synthesis models indicated that the stock is neither overfished nor experiencing overfishing (**SAI-Figure 6**). In contrast, the Stock Reduction Analysis model indicated that the stock was overfished with overfishing occurring (0.23-0.61 B_{MSY}; 0.69-2.45 F_{MSY}). However, due to the large degree of uncertainty in the Stock Reduction Analysis results, the Stock Synthesis models were used for management recommendations.

SAI-4. Outlook

Both the eastern and western sailfish stocks may have been reduced to stock sizes below B_{MSY}. There is considerable uncertainty on the level of reduction. The results for the eastern stock were more pessimistic than those for the western stock in that more of the results indicated recent stock biomass below B_{MSY}. Therefore, there is particular concern over the outlook for the eastern stock.

Due to the difficulty of determining current status for both the eastern and western Atlantic stocks, the Committee considered that it was not appropriate to conduct quantitative projections of future stock condition based on the range of scenarios considered at the stock assessment meeting.

SAI-5. Effect of current regulations

In 2016, the Commission established catch limits for both sailfish stocks (Rec. 16-11), and included several provisions that would allow the Committee to enhance data collection initiatives to reduce fishing mortality estimates and overcome data gap issues in all fisheries.

East Atlantic

It was established in Rec 16-11 that if the total catch harvested any year exceeds 1,271 t (67% of the average estimate of the Maximum Sustainable Yield), the Commission shall review the recommendation and effectiveness of this, while the catch in 2017 did exceed this amount, preliminary catches in 2018 did not.

West Atlantic

It was established in Rec 16-11 that if the total catch harvested any year exceeds 1,030 t (67% of the average estimate of the Maximum Sustainable Yield), the Commission shall review the recommendation and effectiveness of this, the current catch levels in 2017 and preliminary catches in 2018 have exceeded this level.

In line with other ICCAT conservation measures, some countries have established domestic regulations to limit the catch of sailfish. Among these regulations are: the requirement of releasing all billfish from longline vessels, minimum size restrictions, use of circle hooks and catch and release strategies in sport fisheries.

Currently, four ICCAT Contracting Parties (Brazil, Canada, Mexico, and the United States) mandate or encourage the use of circle hooks on their pelagic longline fleets. Recent research has demonstrated that in some longline fisheries the use of non-offset circle hooks resulted in a reduction of billfish mortality, while the catch rates of several of the target species remained the same or were greater than the catch rates observed with the use of conventional J hooks or offset circle hooks.

SAI-6. Management recommendations

Considerable uncertainty still remains in the assessments of both the eastern and western stocks. Available abundance indices demonstrate conflicting trends for both stocks, and there are concerns that reported catches, including dead discards, may be incomplete. Nevertheless, it should be noted that there have been significant improvements since the last assessment. There were more abundance indices available, and the standardizations have seen general improvement, fostered in part by the CPUE workshop held in advance of this meeting. As was the case during the 2009 Sailfish Stock Assessment Session (Anon. 2010a), the results for the eastern stock were more pessimistic than the western stock in that more of the results indicated recent stock biomass below B_{MSY}.

East Atlantic

The eastern Atlantic sailfish stock appears to have declined markedly since the 1970s, reaching a low in the early 1990s. There is broad agreement across model results that the stock is currently overfished. Since 2010, catches appear to have declined substantially. However, models disagree whether overfishing is occurring and whether the stock is recovering.

The Committee has not new management recommendation.

West Atlantic

The Committee has not new management recommendation.

ATLANTIC SAILFISH SUMMARY

	West Atlantic	East Atlantic
Maximum Sustainable Yield (MSY)	1,438-1,636 t [1,2]	1,635-2,157 t [3]
Current Yield (2018)	1,250 t[4]	1,183 t[4]
SSB_{2014}/SSB_{MSY}	1.81 (0.51-2.57)[1] 1.16 (0.18-1.69)[2]	
B_{2014}/B_{MSY}		0.22-0.70 [3]
F_{2014}/F_{MSY}	0.33 (0.25 – 0.57)[1] 0.63 (0.42 – 2.02)[2]	0.33-2.85 [3]
Overfished	Not likely	YES
Overfishing	Not likely	Possibly
Management Measures in Effect:	Recommendation (Rec. 16-11). Limit Atlantic sailfish catches of either stock to the level of 67% of MSY.	

[1] Stock Synthesis estimate utilizing increasing CPUE trends, with approximate 95% confidence intervals.
[2] Stock Synthesis estimate utilizing decreasing CPUE trends, estimate with approximate 95% confidence intervals.
[3] Range obtained of plausible estimates from bootstrapped Production Bayesian surplus, production, and Stock Reduction Analysis models.
[4]2018 yield should be considered provisional.

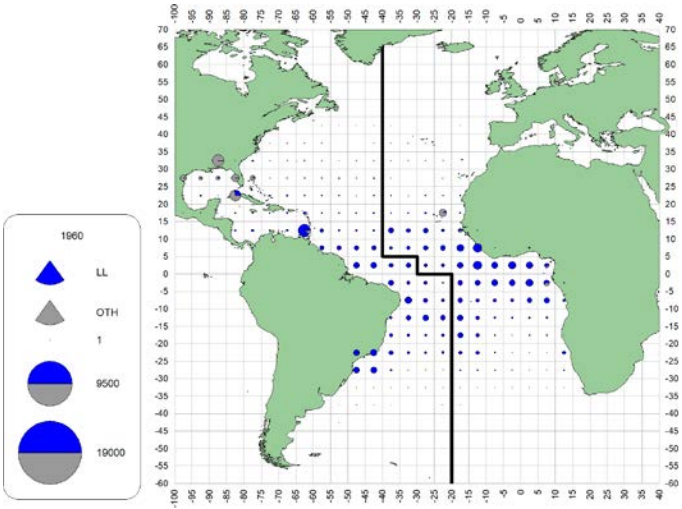
SAI-Table 1. Estimated catches (t) of Atlantic sailfish (*Istiophorus albicans*) by area, gear and flag.

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL				2292	2445	3023	2604	2978	2922	3976	4603	4411	4137	4339	4059	3854	4137	3962	3753	3082	2888	2866	2324	2022	2144	2636	2730	2434
	ATE			1171	1231	1880	1347	1363	1342	1980	2805	2351	2639	2612	2220	1916	2577	2229	2129	1853	1553	1591	1339	1163	1246	1422	1650	1183
	ATW			1121	1214	1143	1257	1615	1580	1996	1797	2060	1498	1727	1839	1939	1561	1733	1624	1229	1335	1275	985	859	898	1214	1080	1250
Landings	ATE		Longline	234	261	729	216	275	273	198	568	756	497	335	319	580	590	628	622	514	546	543	457	423	436	338	375	497
			Other surf.	871	836	970	644	859	883	1231	1470	1496	1860	2057	1758	1289	1798	1493	932	900	870	985	754	730	749	1082	1175	682
			Sport (HL+RR)	67	135	182	488	228	186	551	767	98	282	219	143	46	189	108	575	439	136	58	128	10	56	0	94	1
	ATW		Longline	651	581	453	641	1033	1102	1711	1660	1636	1161	1271	1704	1737	1299	1406	1153	1131	1213	1081	880	730	884	1184	1052	1231
			Other surf.	225	256	390	209	287	244	163	66	311	331	449	131	194	248	310	457	92	102	154	86	107	1	8	10	9
			Sport (HL+RR)	217	348	230	350	267	163	76	60	106	0	0	0	2	6	7	4	2	10	19	7	12	5	15	11	4
Discards	ATE		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	6	1	4	2
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1
	ATW		Longline	28	29	69	57	27	72	45	11	7	5	7	3	5	8	9	10	4	10	20	12	11	7	7	7	7
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Landings	ATE	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	19	**0**
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			China PR	3	3	3	3	5	9	4	5	11	4	4	8	16	8	1	4	5	2	4	1	1	2	2	4	2
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
			Côte d'Ivoire	54	66	91	65	35	80	45	47	65	121	73	93	78	52	448	74	24	108	192	80	99	55	38	405	35
			EU.España	8	13	42	48	15	20	8	195	245	197	169	202	214	227	239	318	206	197	257	229	302	333	225	236	277
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	11	8
			EU.Portugal	1	2	1	2	27	53	13	4	10	13	19	31	137	43	49	131	170	121	72	109	33	41	30	27	123
			EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
			Gabon	3	110	218	2	0	0	0	0	0	4	4	1	0	0	0	0	0	0	0	0	4	0	0	5	**0**
			Ghana	450	353	303	196	351	305	275	568	592	566	521	542	282	420	342	358	417	299	201	220	191	99	238	267	82
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1	3	0	0	0
			Honduras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Japan	45	52	47	19	58	16	26	6	20	22	70	50	62	144	199	94	115	143	157	71	59	36	52	45	47
			Korea Rep.	5	5	11	4	0	0	0	0	0	0	0	0	0	0	0	1	0	10	1	6	10	2	6	15	9
			Liberia	0	33	85	43	136	122	154	56	133	127	106	122	118	115	0	0	0	0	0	0	0	0	0	59	11
			Maroc	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
			Russian Federation	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			S. Tomé e Príncipe	88	92	96	139	141	141	136	136	136	136	515	346	292	384	114	119	121	124	127	131	134	312	212	219	248
			Senegal	162	167	240	560	260	238	786	953	240	673	567	463	256	737	446	630	484	174	247	165	37	60	586	301	313
			Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	**0**
			South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	4	0	0	0	1	5	0	0	0	0	0	0	0	0	0	2	**0**
			U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	38	58	24	56	44	66	45	50	62	49	15	25	36	109	121	80	21	52	54	42	17	21	23	26	21
		NCO	Benin	20	20	19	6	4	5	5	12	2	2	5	3	3	4	0	0	0	0	0	0	0	0	0	0	
			Cuba	83	72	533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Mixed flags (FR+ES)	160	128	97	110	138	131	353	400	365	413	336	264	274	205	251	308	265	275	275	275	275	275	0	0	
			NEI (BIL)	0	0	0	0	0	0	28	269	408	213	55	1	105	43	20	11	0	44	0	0	0	0	0	0	
			NEI (ETRO)	51	57	69	86	127	120	77	43	3	2	16	7	8	10	0	0	0	0	0	0	0	0	0	0	

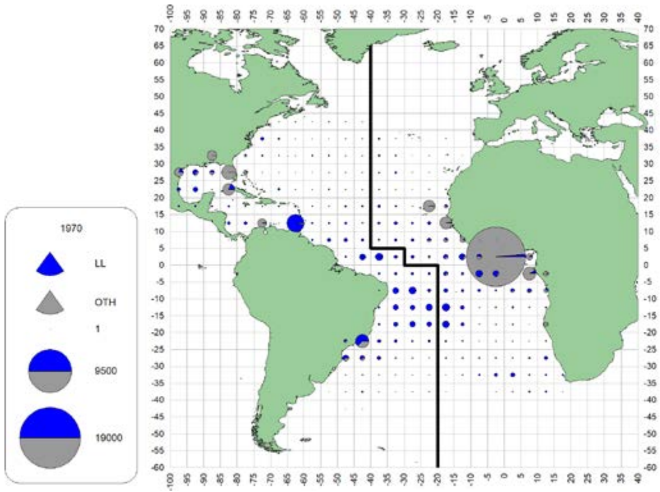
				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Togo	0	0	0	9	22	36	23	62	55	95	135	47	31	71	0	0	0	0	0	0	0	0	0	0	
	ATW	CP	Barbados	46	74	25	71	58	44	44	42	26	27	26	42	58	42	0	0	18	36	36	39	44	54	56	42	20
			Belize	0	0	0	0	0	0	0	0	0	0	0	5	0	12	0	0	52	8	7	4	3	0	11	0	62
			Brazil	129	245	310	137	184	356	598	412	547	585	534	416	139	123	268	433	71	138	108	76	57	72	59	39	43
			China PR	3	3	3	3	3	9	4	3	1	0	1	0	0	0	1	2	1	1	1	0	1	1	3	6	2
			Curaçao	15	15	15	15	15	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	19	36	5	20	42	7	14	309	414	183	160	89	134	214	361	412	275	190	184	203	244	311	207	454	256
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			EU.Portugal	0	0	0	0	0	0	4	0	0	12	12	110	18	53	101	20	19	9	2	0	0	0	0	1	37
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Grenada	151	119	56	83	151	148	164	187	151	171	112	147	159	174	216	183	191	191	191	191	191	191	0	0	
			Japan	8	2	4	17	3	10	12	3	3	10	5	22	4	1	33	43	36	12	16	7	11	12	13	7	3
			Korea Rep.	4	4	12	4	0	0	0	0	0	0	0	0	0	0	0	1	0	40	3	1	1	0	0	0	**0**
			Mexico	19	19	10	9	65	40	118	36	34	45	51	55	41	46	45	48	34	32	51	63	42	35	47	51	24
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	415	0	461
			St. Vincent and Grenadines	4	2	1	3	2	1	0	2	164	3	86	73	59	18	13	8	7	4	4	3	4	1	85	8	10
			Trinidad and Tobago	2	1	4	10	25	37	3	7	6	8	10	9	17	13	32	16	16	38	72	34	29	51	53	63	51
			U.S.A.	180	348	232	349	267	163	76	58	103	0	0	0	0	0	3	3	0	0	7	3	2	2	3	3	3
			UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Venezuela	223	180	255	279	515	367	261	249	277	327	509	607	1042	549	382	416	498	590	543	341	210	152	246	387	262
		NCC	Chinese Taipei	117	19	19	2	65	17	11	33	31	13	8	21	5	14	10	11	6	8	26	6	3	6	5	5	5
		NCO	Aruba	10	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	46	37	37	40	28	196	208	68	32	18	50	72	47	56	0	0	0	0	0	0	0	0	0	0	
			Dominica	0	0	0	0	0	0	0	5	3	0	1	0	3	3	4	2	0	2	0	0	5	3	3	0	
			Dominican Republic	90	40	40	101	89	27	67	81	260	91	144	165	133	147	0	0	0	0	0	0	0	0	0	0	
			NEI (BIL)	0	0	0	0	0	0	297	268	0	0	0	0	68	81	252	17	0	21	0	0	0	0	0	0	
			NEI (ETRO)	27	30	36	46	67	64	41	23	1	1	9	4	4	6	0	0	0	0	0	0	0	0	0	0	
			Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Seychelles	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	2	3	2	3	1	1	4	2
Discards	ATE	CP	Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	6	1	4	2
	ATW	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			U.S.A.	28	29	69	57	27	72	45	11	7	5	7	4	5	7	10	10	4	10	19	11	11	6	7	6	6
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

SPF-Table 1. Estimated catches (t) of longbill spearfish (*Tetrapturus pfluegeri*) by area, gear and flag.

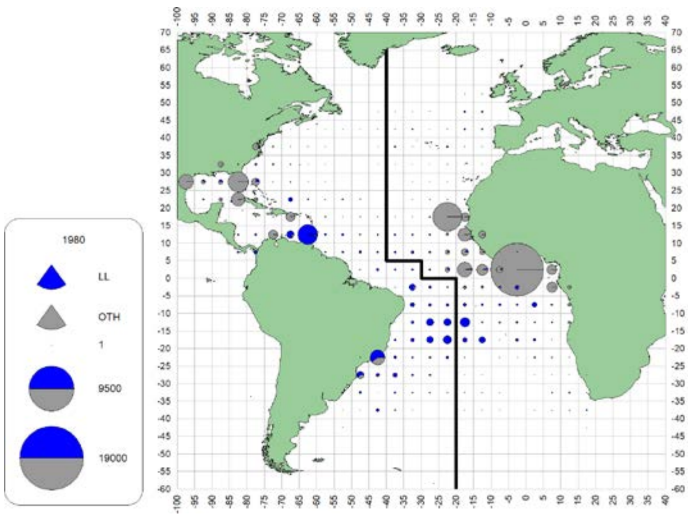
				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL				320	240	165	201	266	306	278	188	179	133	188	169	340	167	166	140	245	153	229	447	52	80	76	350	163
	ATE			198	207	128	194	192	257	181	81	84	54	51	68	84	66	60	78	128	73	170	95	16	18	15	29	36
	ATW			122	33	37	7	74	50	97	107	95	79	137	101	256	102	106	62	117	80	58	352	36	62	62	321	127
Landings	ATE		Longline	100	129	69	126	106	176	121	81	84	54	51	68	84	66	60	78	128	73	170	95	16	18	14	29	23
			Other surf.	98	78	59	68	86	81	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ATW		Longline	122	26	34	7	74	50	97	107	95	79	137	101	256	102	106	62	117	80	58	337	30	59	61	320	127
			Other surf.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sport (HL+RR)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	6	0	0	0	
Discards	ATE		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATW		Longline	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1
Landings	ATE	CP	China PR	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			EU.España	0	5	1	1	9	31	17	9	6	5	0	3	3	0	2	7	32	12	10	9	13	17	10	13	13
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	24	8	2	6	25	9	20	0	0	0	0	1	4
			Japan	36	26	25	30	22	33	29	20	16	25	36	40	21	36	53	59	49	39	134	85	3	0	4	2	4
			Korea Rep.	1	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	**0**
			South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	**0**
		NCC	Chinese Taipei	63	97	41	94	73	112	75	52	62	25	15	25	37	22	2	6	16	9	6	0	0	1	0	1	2
		NCO	Mixed flags (FR+ES)	98	78	59	68	86	81	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (BIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	
	ATW	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	3	0	0	0	0	0	0	**0**
			Brazil	0	0	0	0	0	0	27	56	39	3	0	0	5	4	0	0	0	24	4	325	6	6	0	0	**0**
			China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
			EU.España	0	1	0	0	0	22	47	20	5	21	0	5	14	0	2	5	0	10	10	9	11	19	14	259	19
			EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	26	15	44	10	10	0	1	0	0	0	0	0	19
			Japan	2	3	4	1	8	11	11	3	12	40	41	58	54	25	45	26	57	12	13	3	1	0	0	0	0
			Korea Rep.	4	4	10	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Mexico	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	2
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	82	0	135	23	13	7	8	5	4	3	3	1	7	52	84
			Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			U.S.A.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Venezuela	0	0	1	0	1	0	0	4	0	3	3	17	5	15	3	14	24	12	24	11	13	32	35	6	
		NCC	Chinese Taipei	116	19	18	2	64	16	11	24	39	12	11	20	17	20	0	0	5	12	3	1	3	1	1	1	1
		NCO	Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
			NEI (BIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	
Discards	ATE	CP	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	ATW	CP	U.S.A.	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1



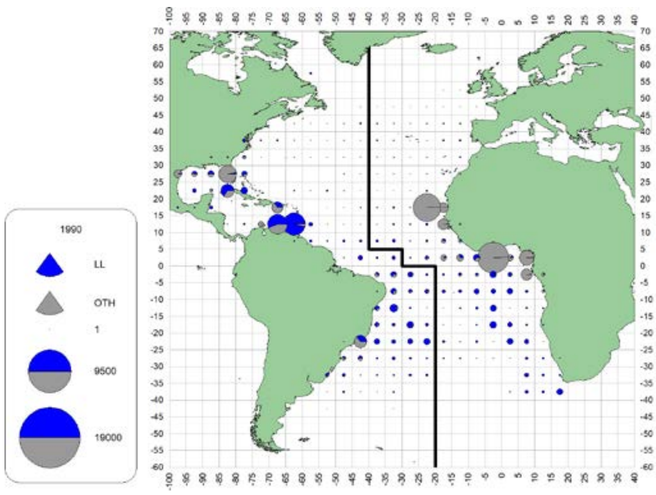
a. SAI (1960-69)



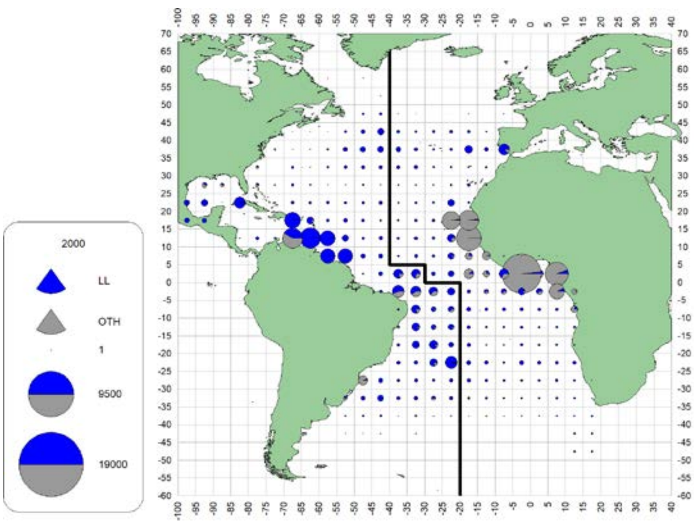
b. SAI (1970-79)



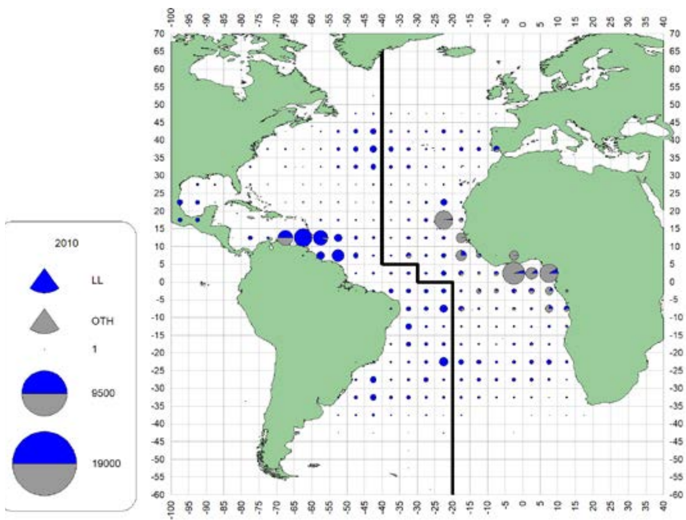
c. SAI (1980-89)



d. SAI (1990-99)

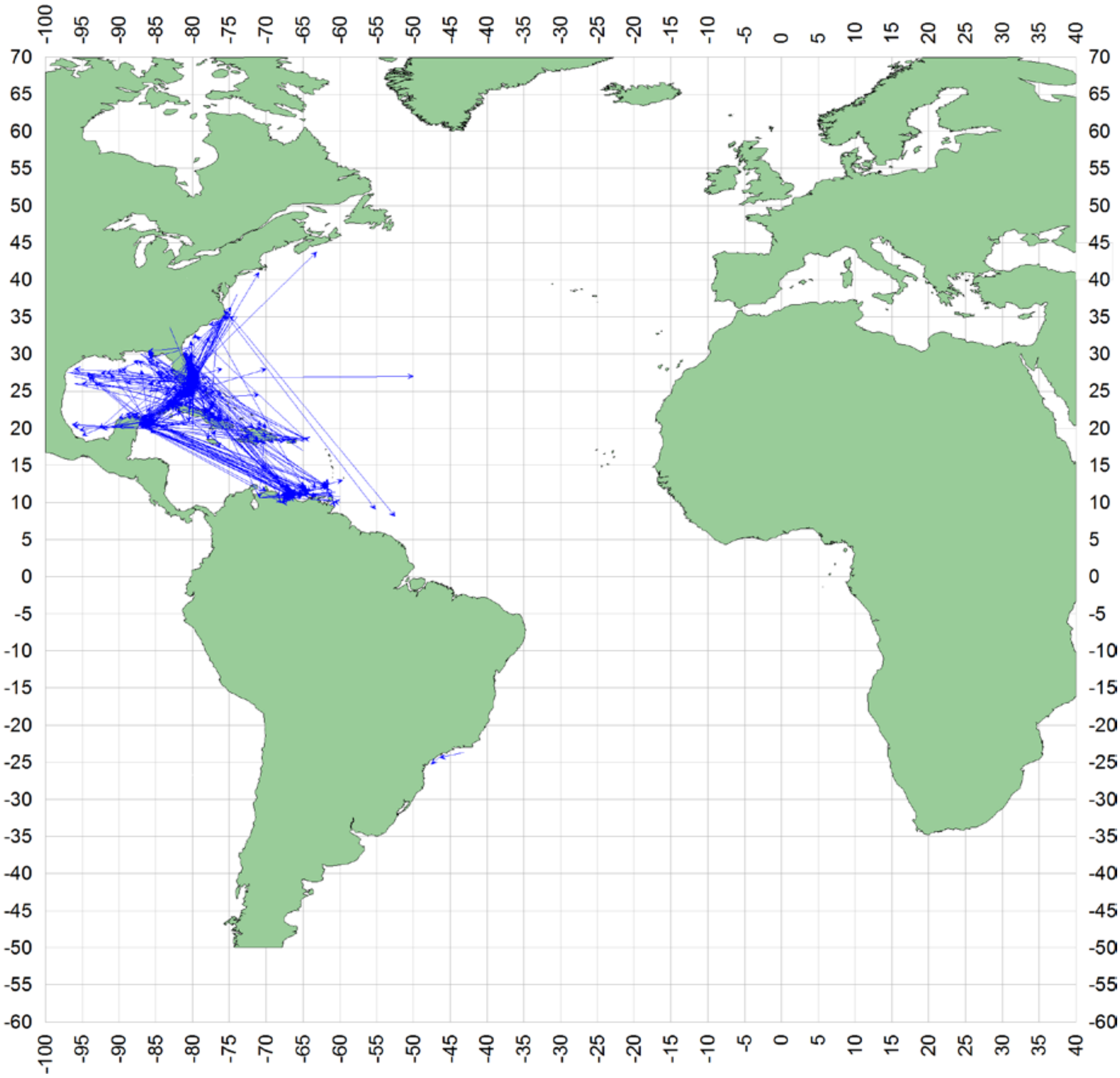


e. SAI (2000-09)

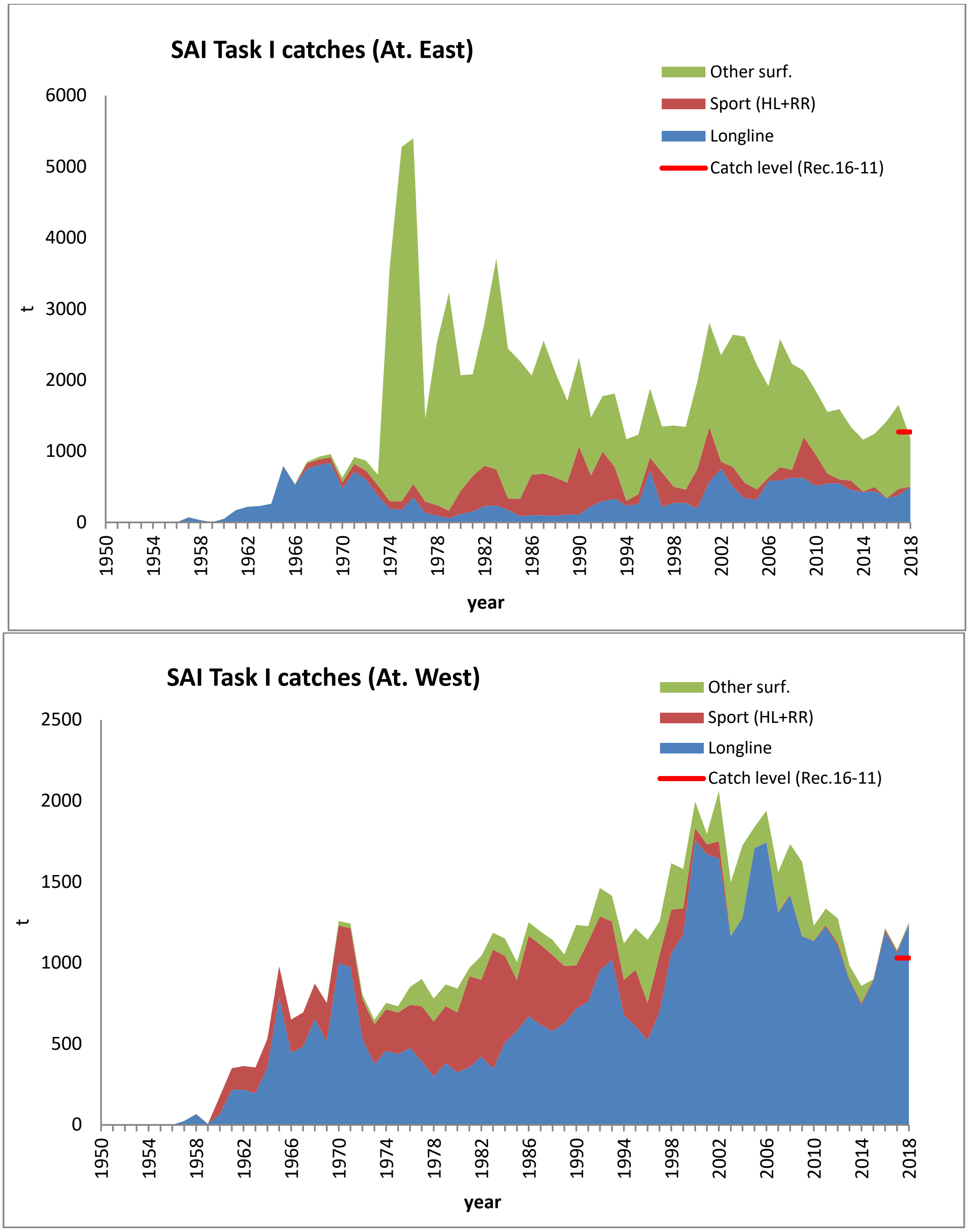


f. SAI (2010-17)

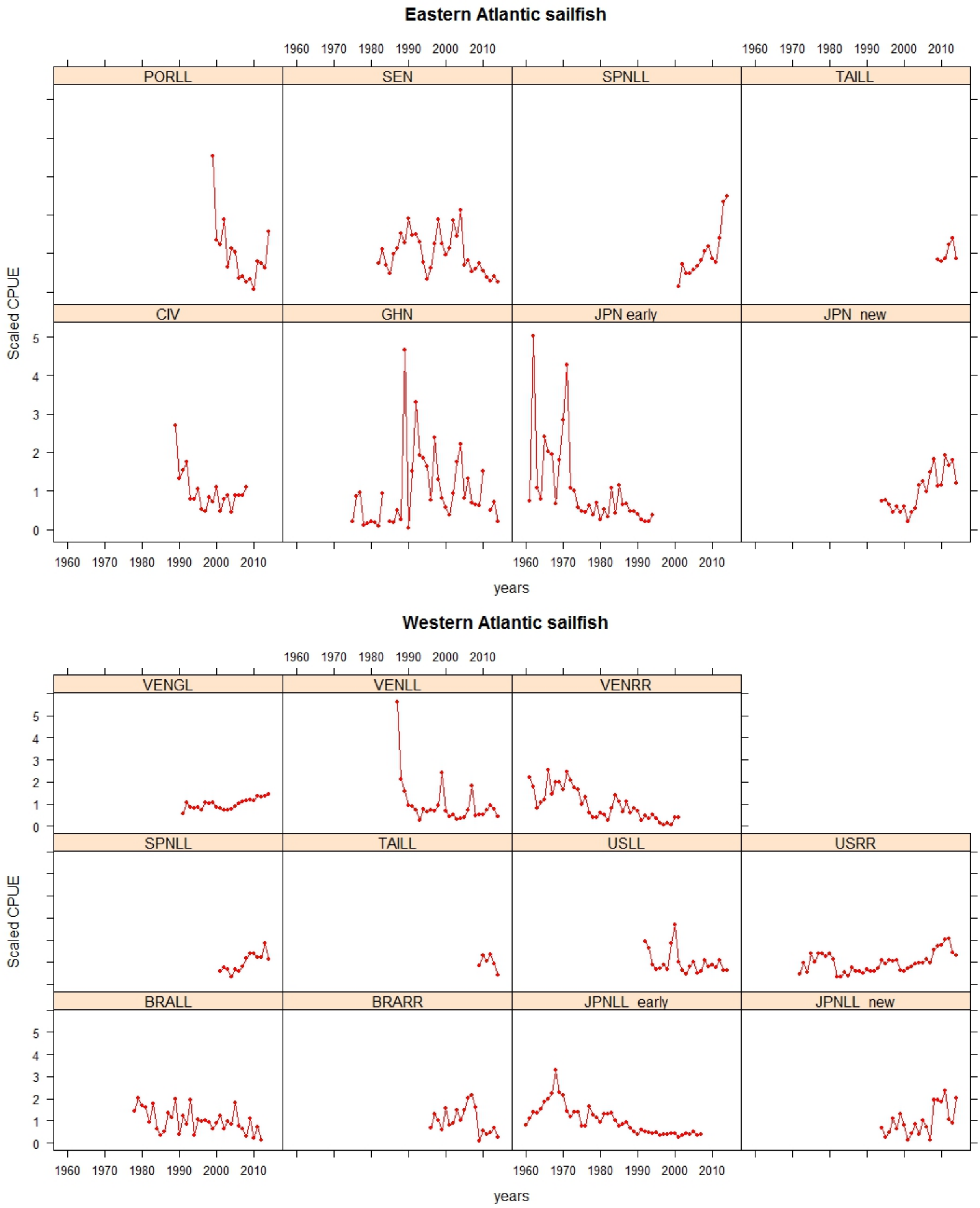
SAI-Figure 1. Geographic distribution of sailfish total catches by decade (last decade only covers 8 years). The dark line denotes the separation between stocks.



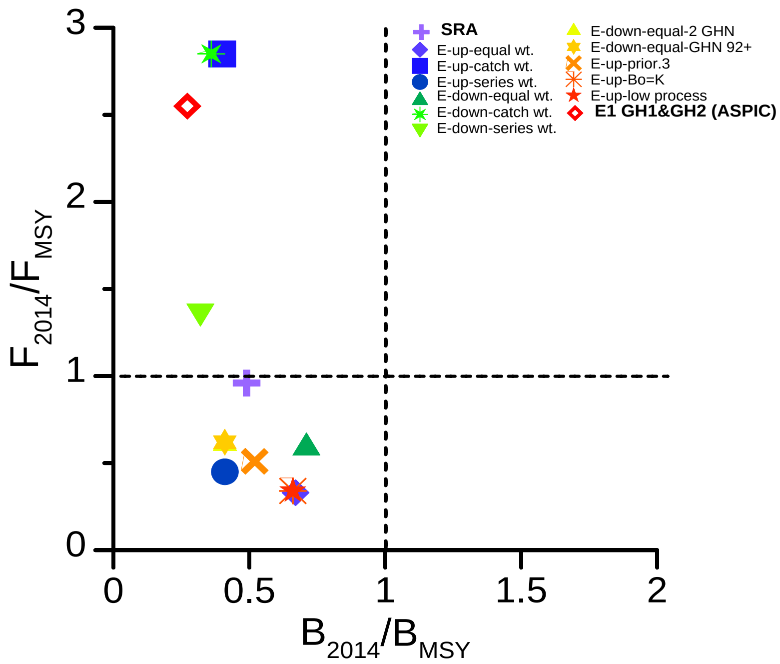
SAI-Figure 2. Conventional tag returns for Atlantic sailfish. Lines join the locations of release and recapture.



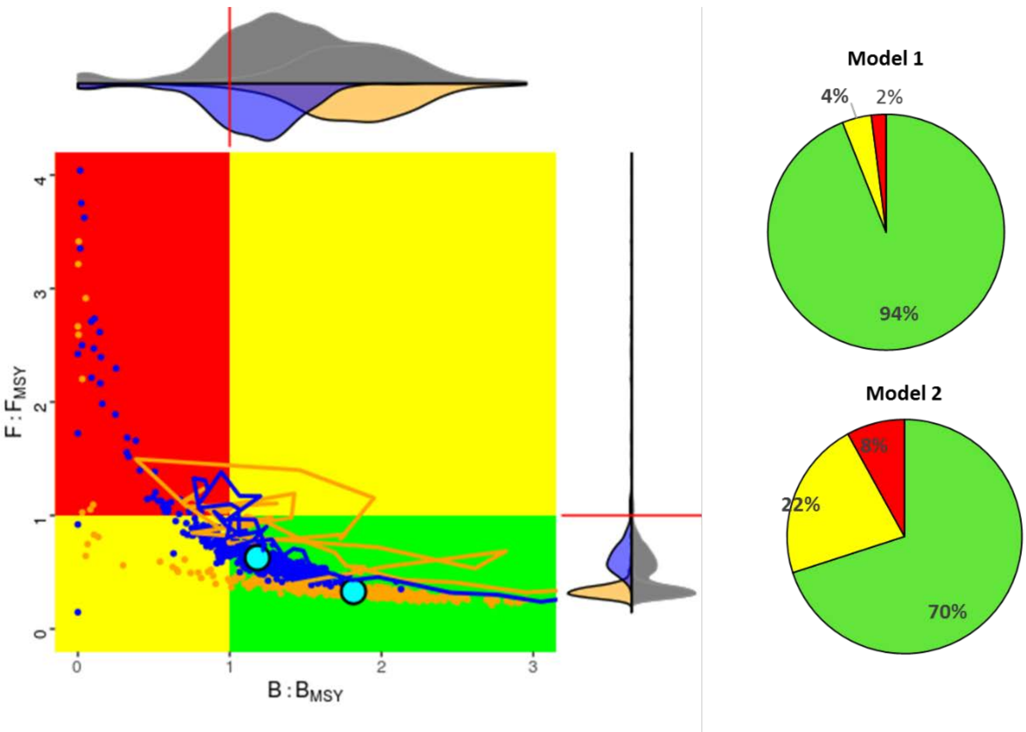
SAI-Figure 3. Task I catches of sailfish for each of the two Atlantic stocks, East and West. In 2017 catch levels of 1271 t and 1030 t that triggers the review of Rec 16-11 were implemented, for East and West stocks, respectively.



SAI-Figure 4. Relative abundance indices used in the assessments of eastern and western Atlantic sailfish stocks. All indices were scaled to the mean of each series prior to graphing.



SAI-Figure 5. Phase plot summarizing scenario outputs for the current (2014) stock status of sailfish east (SAI_east). Stock Reduction Analysis; E-up-equal wt to E-up-low process are Bayesian surplus production model runs, E1 GH1&GH2 is Production base case model run.



SAI-Figure 6. Kobe plot (left) summarizing stock status of Sailfish_west based on Stock Synthesis models with increasing CPUE trends (Model 1) and with decreasing CPUE trends (Model 2). The estimated trajectories and uncertainty points for Model 1 are shown in golden yellow, and in blue for Model 2. The marginal densities plots for stock relative to B_{MSY} and harvest rate relative to F_{MSY} are also shown (top and right of large panel); the upper part (grey) are combined probabilities for both Stock Synthesis models, and the lower part (colored) are individual probabilities of Model 1 and Model 2. The red lines represent the benchmark levels (ratios equal to 1.0). Pie charts showing summary of current stock status estimates for the Sailfish_west stock based on Stock Synthesis models.

9.9 SWO-ATL – ATLANTIC SWORDFISH

The status of the North and South Atlantic swordfish stocks was assessed in 2017, by means of applying statistical modelling to the available data up to 2015. Complete information on the data availability and assessment can be found in the Report of the 2017 ICCAT Atlantic Swordfish Data Preparatory Meeting (Anon. 2017e) and the Report the 2017 ICCAT Atlantic Swordfish Stock Assessment Session (Anon. 2017f). Other information relevant to Atlantic swordfish is presented in the Report of the Sub-committee on Statistics, included as **Appendix 12** to this SCRS Report, and recommendations pertinent to Atlantic swordfish are presented in Item 18.

SWO-ATL-1. Biology

Swordfish (*Xiphias gladius*) are members of the family Xiphiidae and are in the suborder Scombroidei. They can reach a maximum weight in excess of 500 kg. They are distributed widely in the Atlantic Ocean and Mediterranean Sea. In the ICCAT Convention area, the management units of swordfish for assessment purposes are a separate Mediterranean group, and North and South Atlantic groups separated at 5°N. New genetic information was reviewed that indicated that the existing stock boundaries should be refined for the Atlantic and Mediterranean stocks. While recognizing the importance of the work, the Committee noted that the stock boundaries are approximations, and the possible impacts of seasonal changes and oceanographic processes in resource distribution need to be fully understood.

Swordfish feed on a wide variety of prey including groundfish, pelagic fish, deep-water fish, and invertebrates. They are believed to feed throughout the water column, and from electronic tagging studies, undertake extensive diel vertical migrations.

Swordfish mostly spawn in the western warm tropical and subtropical waters throughout the year, although seasonality has been reported in some of these areas. They are found in the colder temperate waters during summer and fall months. Young swordfish grow very rapidly, reaching about 140 cm LJFL (lower-jaw fork length) by age three, but grow slowly thereafter. Females grow faster than males and reach a larger maximum size. Tagging studies have shown that some swordfish can live up to 15 years. Swordfish are difficult to age, but about 50% of females were considered to be mature by age five, at a length of about 180 cm. However, the most recent information indicates a smaller length and age at maturity.

The analysis of the horizontal movements evidences seasonal patterns, with fish generally moving south by winter and returning to the temperate foraging grounds in spring. Broader areas of mixing between some eastern and western areas were also suggested. These new results obtained by pop-up satellite tags also fully confirm the previous knowledge that was available from fishery data: deep longline settings catch swordfish during the day-time as a by-catch, while shallow setting longliners target swordfish at night closer to the surface.

SWO-ATL-2. Fishery indicators

Due to the broad geographical distribution of Atlantic swordfish (**SWO-ATL-Figure 1**) in coastal and off-shore areas (mostly ranging from 50ºN to 45ºS), this species is available to a large number of fishing countries. **SWO-ATL-Figure 2** shows total estimated catches for North and South Atlantic swordfish. Directed longline fisheries from Canada, EU-Spain, and the United States have operated since the late 1950s or early 1960s, and harpoon fisheries have existed at least since the late 1800s. Other directed swordfish fisheries include fleets from Brazil, Morocco, Namibia, EU-Portugal, South Africa, Uruguay, and Venezuela. The primary by-catch or opportunistic fisheries that take swordfish are tuna fleets from Chinese Taipei, Japan, Korea and EU-France. The tuna longline fishery started in 1956 and has operated throughout the Atlantic since then, with substantial catches of swordfish that are produced as a bycatch of tuna fisheries. The largest proportion of the Atlantic catches is made using surface-drifting longline. However, many additional gears are used, including traditional gillnets off the coast of western Africa.

Trends by area (NE vs. NW Atlantic) in the CPUE indexes were consistent with the seasonal movement patterns observed in the electronic tagging data, as well as in the catches and sex-ratio distributions. Relationships observed for the eastern Atlantic were opposite to those in the western Atlantic. This pattern was correlated with the decadal cycling of the AMO as well as that of the North Atlantic Oscillation

(NAO). Including the AMO as a covariate to area specific catchability within the assessment model helped reduce the conflicting directions of the various CPUE trends. Further analysis and hypothesis testing was recommended to determine if the relationship was due to a swordfish temperature preference, a change in prey distribution, or perhaps both. To support this hypothesis testing the Group encouraged a group of swordfish scientists to work towards uniting the available North Atlantic swordfish CPUE data into a single dataset so that a more refined, area specific CPUE analyses could be conducted.

For both the North and South Atlantic some of the indices of abundance were affected by changes in gear technology and management that could not be accounted for in the CPUE standardization, and therefore had to be split.

Total Atlantic

The total Atlantic estimated catch (landings plus dead discards) of swordfish (North and South, including reported dead discards) in 2018 (19,262 t) was 7.1% lower than the reported catch of 2017 (20,726 t). As a small number of countries have not yet reported their 2018 catches and because of unknown unreported catches, this value should be considered provisional and subject to further revision.

The trends in mean fish weight taken in the North and South Atlantic fisheries are shown in **SWO-ATL-Figure 3**.

North Atlantic

For the past decade, the North Atlantic estimated catch (landings plus dead discards) has averaged about 11,245 t per year (**SWO-ATL-Table 1**). The catch in 2018 (8,858 t) represents a 56.2% decrease since the 1987 peak in North Atlantic landings (20,238 t). These reduced landings have been attributed to ICCAT regulatory recommendations and shifts in fleet distributions, including the movement of some vessels in certain years to the South Atlantic or out of the Atlantic. In addition, some fleets, including at least the United States, EU-Spain and EU-Portugal have changed operating procedures to opportunistically target tuna and/or sharks, taking advantage of market conditions and higher relative catch rates of these species previously considered as by-catch in some fleets. Recently, socio-economic factors may have also contributed to the decline in catch.

Available catch per unit effort (CPUE) series were evaluated by the Committee and certain indices were identified as suitable for use in the assessment models (Canada, EU-Portugal, EU-Spain, Japan, Morocco, and USA). Trends in standardized CPUE series by fleets contributing to the stock assessment models are shown in **SWO-ATL-Figure 4**. Most of the series have an increasing trend since the late 1990s, but show a decrease in the more recent years. There have been some recent changes in United States regulations that may have impacted catch rates. The combined index used as the continuity model from the previous assessment is shown in **SWO-ATL-Figure 5**.

South Atlantic

The historical trend of catch (landings plus dead discards) can be divided in two periods: before and after 1980. The first one is characterized by relatively low catches, generally less than 5,000 t (with an average value of 1,700 t). After 1980, landings increased continuously up to a peak of 21,930 t in 1995, levels that are comparable to the peak of North Atlantic harvest (20,238 t in 1987). This increase of landings was, in part, due to progressive shifts of fishing effort to the South Atlantic, primarily from the North Atlantic, as well as other waters. Expansion of fishing activities by southern coastal countries, such as Brazil and Uruguay, also contributed to this increase in catches. The reduction in catch following the peak in 1995 resulted from regulations and was partly due to a shift to other oceans and target species. In 2018, the 10,404 t of reported catch was about 53% lower than the 1995 reported level (**SWO-ATL-Table 1**). The SCRS received reports from Brazil and Uruguay over the last years that they have reduced their fishing effort directed towards swordfish in recent years. Uruguay recently received increased albacore quotas that may allow increased effort for swordfish in the near future.

Available catch per unit effort (CPUE) series for the south Atlantic swordfish were evaluated by the Committee and certain indices were identified as suitable for use in assessment models (Brazil, EU-Spain, Japan, South Africa, Uruguay). The available indices are illustrated in **SWO-ATL-Figure 6**.

Discards

Since 1991, very few fleets have reported dead discards (see **SWO-ATL-Table 1**). For the North Atlantic the volume of reported discards has ranged from a minimum of 157 t in 2009 to a maximum of 1,138 t in 2000, with 150 t reported for 2018. For the South Atlantic the volume of reported discards has ranged from a minimum of 1 t in several years to a maximum of 147 t in 2010, with 27 t reported for 2018. The Committee continued to express concerns due to the low percentage of fleets that have reported annual dead discards (in t) in recent years and that what has been reported is not necessarily scaled to the entire fishery.

SWO-ATL-3. State of the stocks

North Atlantic

Three stock assessment platforms were used to provide estimates of stock status for the North Atlantic swordfish stock, a Surplus Production Model (ASPIC - *A Stock Production Model Incorporating Covariates*), a Bayesian Surplus Production Model with process error (BSP2 - *Bayesian Surplus Production 2*) and an Integrated Age Structured Model (SS - *Stock Synthesis*). Stock status was determined from the Integrated Age Structured and Bayesian Surplus Production models, while the Surplus Production Model was used mainly to provide continuity with the previous assessments.

The final base case Age Structured model estimated that B_{2015} was above B_{MSY} (median = 1.13, 95% CIs = 0.81-1.45) and F_{2015} was lower than F_{MSY} (median = 0.75, 95% CIs = 0.57-0.92) (**SWO-ATL-Figure 7**). The final base case Bayesian Surplus Production model estimated that current biomass (B_{2015}) was near B_{MSY} (median = 0.99, 95% CIs = 0.77-1.24) and current F_{2015} was lower than F_{MSY} (median = 0.81, 95% CIs = 0.61-1.10) (**SWO-ATL-Figure 8**). Both models agreed that overfishing is not occurring and that biomass is either higher or very close to B_{MSY} (**SWO-ATL-Figure 9**). The estimate of stock status in 2017 is slightly more pessimistic than the estimated status in the previous 2009 and 2013 assessments, and suggests that in 2015 there was a 61% probability that the stock is at or above MSY reference levels. The results obtained in this evaluation are not strictly comparable with those obtained in the last assessments due to the incorporation of more data sources, and using joint probabilities from two base case models, and updated catch and CPUE information.

The most recent estimates of stock productivity are lower than the previous estimates. Compared with the previous 2009 and 2013 Surplus Production base case models, the trajectory of biomass are similar until the late 1990s, thereafter the current model predicted considerable lower relative biomass (**SWO-ATL-Figure 10**). It is particularly noteworthy that the CPUE series have been decreasing since 2012, causing biomass trends to adjust to a lower minimum compared to the previous assessments.

The Committee noted that the 2017 assessment represents a significant improvement in the understanding of current stock status for North Atlantic swordfish using updated information and integration of the new data sources. The Committee therefore recommends that management advice for North Atlantic swordfish, including stock status and projections, should be based on Bayesian Surplus Production and Age Structured models.

South Atlantic

In 2017, evaluation of the status of the South Atlantic swordfish stock was assessed using two Bayesian biomass dynamics production models with process error (BSP2 and JABBA - *Just Another Bayesian Biomass Assessment*). Stock status and projections were determined from JABBA, while BSP2 was used mainly to provide several sensitivity analyses.

The results from both models for the South Atlantic swordfish were consistent. The final base case BSP2 model estimated that current biomass (B_{2015}) was lower than B_{MSY} (median = 0.64, 95% CIs = 0.43-1.00) and current F_{2015} was higher than F_{MSY} (median = 1.15; 95% CIs = 0.61-1.82) (**SWO-ATL-Figure 11**). The final base case JABBA model estimated that B_{2015} was also below B_{MSY} (median = 0.72, 95% CIs = 0.53-1.01) while F_{2015} was very close to F_{MSY} (median = 0.98, 95% CIs = 0.70-1.36) (**SWO-ATL-Figure 12**).

Both models agreed that the southern swordfish stock biomass is overfished, and that overfishing is either occurring or current F is very close to F_{MSY}. The Committee agreed that either one of the Bayesian Production Models could be used for management advice, but given that both are very similar in structure and use of information only one should be used. Given that JABBA is written in open-source software with more capabilities for future evolutions, the Committee agreed that the management advice, including stock status and projections, should be based on that model (**SWO-ATL-Figure 13**).

The results obtained in this assessment are not comparable with those obtained in the last assessment (2013) due to the use of individual CPUEs compared to the use of a single CPUE combined across indices in the previous assessment. There was also an informative prior for K based on values from the North Atlantic in the 2013 assessment, but not in the current assessment. In 2013, the Committee noted that it was unknown whether it was possible to obtain higher yields from the stock as the Bayesian Production Model suggested, or whether the stock was already fully exploited as the Surplus Production Model suggested. In 2017, with the possibility of incorporating individual CPUEs series and without the need to establish strong assumptions in productivity based in the North Atlantic stock, it was possible to provide specific quantitative advice for this stock.

SWO-ATL-4. Outlook

North Atlantic

Results from the previous 2013 assessment indicated that there was a greater than 90% probability that the northern swordfish stock had rebuilt to or above B_{MSY}. However, given the new estimates of biomass and lower productivity, the stock status now shows a 61% probability of being above B_{MSY}.

Based on the currently available information to the Committee, both the Bayesian Production and Age Structured base models were projected to the year 2028 under constant TAC scenarios of 8 to 19 thousand tons. Projections used reported catch as of July, 2017 for 2016. For those CPCs whose reported catch was not available, their catch was assumed to be the average of the last three years (2013-2015), giving a total catch of 11,296 t.

For the final base case Bayesian Production Model, projections incorporated process error and the predicted trajectories are therefore more realistic of the future uncertainty in the stock status. MSY is estimated to be around 13,400 t, and taking into account current stock status and process error catches around 13,000 t are expected to allow the population to remain at or above B_{MSY} throughout the projected time period (**SWO-ATL-Figure 14**).

For the final base case Integrated Age Structured model, projections of stock status at various levels of future catch are shown in **SWO-ATL-Figure 14**. Given the current status of the stock being quite close to the MSY benchmarks, values of catches around 13,000 t are also projected to maintain biomass above B_{MSY} during the projected time frame.

South Atlantic

Projections were conducted for the final base case Bayesian Production model under constant TAC scenarios of 4 to 16 thousand tons. Projections used reported catch as of July 2017 for 2016. For those CPCs whose reported catch was not yet available, it was assumed that their catch was the average of the last three years (2013-2015), giving a total catch of 10,002 t.

Although the median MSY was around 14,600 t, the 2015 biomass depletion level at B/B_{MSY} = 0.72 would require catches be reduced to a level at or below 14,000 t to rebuild the population to biomass levels that can produce MSY by the end of the projection period in 2028 (**SWO-ATL-Figure 15**).

SWO-ATL-5. Effect of current regulations

New catch regulations were implemented on the basis of Rec. 06-02, which entered into effect in 2007 (Rec. 08-02 extended the provisions of Rec. 06-02 to include 2009). Rec. 09-02 came into effect in 2010 and extended most of the provisions of Rec. 06-02 for one year only. Rec. 10-02 came into effect in 2011, and again extended those provisions for one year only, but with a slight reduction in total allowable catch (TAC). For the North and South Atlantic, the most recent recommendations can be found in Recs. 17-02 and 17-03.

Catch limits

The total allowable catch in the North Atlantic during the 2007 to 2009 period was 14,000 t per year. The reported catch during that period averaged 11,811 t and did not exceed the TAC in any year. In 2010, the TAC was reduced to 13,700 t and in 2018 it was reduced to 13,200 t. The reported catch since 2010 averaged 11,197 t and exceeded the TAC in one year (2012, 13,868 t).

The total allowable catch in the South Atlantic for the years 2007 through 2009 was 17,000 t. The reported catch during that period averaged 13,675 t, and did not exceed the TAC in any year. In 2010, the TAC was reduced to 15,000 t and in 2017 it was reduced to 14,000. The reported catch since 2010 averaged 10,658 t and did not exceed the TAC in any year.

Minimum size limits

There are two minimum size options that are applied to the entire Atlantic: 125 cm LJFL with a 15% tolerance, or 119 cm LJFL with zero tolerance and evaluation of the discards.

In 2017, the Committee provided information on the effectiveness of existing minimum size regulations. Since the implementation of the minimum landing sizes in 2000, the estimate of percentage of swordfish less than 125 cm LJFL reported landed (in number) has been generally decreasing in the North Atlantic and stable in the South. In the North Atlantic, the estimate was 33% in 2000 and decreased to 23% in 2015. In the South Atlantic the estimate was 18% in 2000, had a maximum of 19% in 2006 and decreased to 13% in 2015. The Committee notes that these estimations have high levels of substitutions for a significant portion of the total catch and are highly unreliable and biased unless CPCs fully report size samples from the entire catch.

The Committee also noted high values of hooking mortality (ranging between 78-88%) on small swordfish (<125 cm LJFL) in some surface longline fisheries targeting swordfish, with the post-release mortality of specimens discarded alive unknown. Recommending and evaluating other strategies to protect juvenile swordfish will require completeness of datasets on fishing effort and size data over the entire Atlantic and should take into account the effects on other species. In view of the Commission objective to protect small swordfish, the Committee therefore recommends that future work should be carried out to determine more precisely the spatial distribution and magnitude of fishing effort, size and sex distribution of undersized swordfish in the Atlantic, using high resolution observer data.

SWO-ATL-6. Management recommendations

North Atlantic

SWO-ATL-Tables 2, 3 and 4 show, respectively, the probabilities of maintaining the stock in the green quadrant of the Kobe plot, maintaining $B>B_{MSY}$ and maintaining $F<F_{MSY}$, over a range of TAC options for North Atlantic swordfish over a period of 10 years. The current TAC of 13,700 t has a 36% probability of maintaining the North Atlantic swordfish stock in the green quadrant of the Kobe plot by 2028, whereas a TAC of 13,200 t would have a 50% probability, and would also result in the biomass being above B_{MSY} with a probability greater than 50%, consistent with Rec. 16-03 (**SWO-ATL-Table 3**).

The Committee also recognizes that the above advice does not account for removals associated with the actual mortality of unreported dead and live discards, quota carryovers (15% in the North Atlantic), quota transfers across the North and South stock management boundaries nor the total cumulative quota, which includes that allocated to "other CPCs" and would fall above the TAC if achieved. The Committee emphasizes the importance of this uncertainty particularly given that the current (2015) estimated biomass is close to B_{MSY}.

Noting the progress done towards North Atlantic SWO MSE, the Committee recommends that the Commission continues to support this process.

South Atlantic

SWO-ATL-Tables 5, 6 and 7 show, respectively, the probabilities of maintaining the stock in the green quadrant of the Kobe plot, maintaining $B>B_{MSY}$ and maintaining $F<F_{MSY}$, over a range of TAC options for South Atlantic swordfish over a period of 10 years. The current TAC of 15,000 t has a 26% probability of rebuilding the South Atlantic swordfish stock to within MSY reference levels by 2028, whereas a TAC of 14,000 t would have a 50% probability of rebuilding the stock.

The Committee also recognizes that the above advice does not account for removals associated with the actual mortality of unreported dead and live discards, quota carryovers (30% in the South Atlantic) nor quota transfers across the North and South stock management boundaries. The Committee emphasizes the importance of this uncertainty particularly given that the current (2015) estimated biomass is lower than B_{MSY} for the South Atlantic stock.

ATLANTIC SWORDFISH SUMMARY

	North Atlantic	***South Atlantic***
Maximum Sustainable Yield	13,059 (11,840-14,970)[1]	14,570 (12,962-16,123)[2]
Current (2018) Yield[3]	8,858 t	10,404 t
Yield in last year used in assessment (2015)[4]	10,668 t	10,227 t
B_{MSY}	82,640 t (51,580-132,010)[5]	52,465 t (35,119-80,951) [2]
SSB_{MSY}	21,262 t (14,797-27,728)[6]	Unknown
F_{MSY}	0.17 (0.10-0.27) [1]	0.28 (0.17-0.44) [2]
Relative Biomass (B_{2015}/B_{MSY})	1.04 (0.82 - 1.39) [7]	0.72 (0.53 - 1.01) [8]
Relative Fishing Mortality (F_{2015}/F_{MSY})	0.78 (0.62-1.01)[7]	0.98 (0.70 - 1.36) [8]
Stock Status (2015)	Overfished: NO	Overfished: YES
	Overfishing: NO	Overfishing: NO
Management Measures in Effect	TAC (2018-2021): 13,200 t [Rec. 17-02] 125/119 cm LJFL minimum size	TAC (2018-2021): 14,000 t [Rec. 17-03] 125/119 cm LJFL minimum size

[1] Average from base case BSP2 and SS models; range corresponding to the lowest and highest 95% CIs from the two models.
[2] From base case JABBA model with 95% CIs.
[3] Provisional and subject to revision.
[4] Based on catch data available in July 2017 for the stock assessment session.
[5] From base case BSP2 model, with 95% CIs.
[6] From base case SS model, with 95% CIs.
[7] Median and 95% quantiles from base case SS and BSP2 models.
[8] Median and 95% quantiles from base case JABBA model.

SWO-ATL-Table 1. Estimated catches (t) of Atlantic swordfish (*Xiphias gladius*) by gear and flag.

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL				34459	38803	33511	31567	26251	27123	27180	25139	23758	24077	25149	25536	25715	27932	23596	24930	24251	23978	24554	21238	20634	21011	21034	20726	19262
	ATN			15501	16872	15222	13025	12223	11622	11453	10011	9654	11442	12068	12373	11470	12302	11050	12081	11553	12523	13868	12069	10678	10673	10376	10169	8858
	ATS			18958	21930	18289	18542	14027	15502	15728	15128	14104	12634	13081	13163	14245	15630	12546	12848	12698	11455	10686	9169	9956	10338	10658	10556	10404
Landings	ATN		Longline	14365	15850	13819	12203	10961	10715	9921	8676	8799	10333	11407	11528	10838	11475	10341	11439	10964	11610	12955	11344	10059	10121	9514	9233	8343
			Other surf.	428	496	815	371	778	377	394	433	240	486	341	512	409	546	465	485	437	511	512	526	463	386	758	787	365
	ATS		Longline	17839	21584	17859	18299	13748	14823	15448	14302	13576	11714	12488	12915	13723	14967	11761	12106	11920	10833	10255	8958	9736	10047	10518	10308	10351
			Other surf.	1119	346	429	222	269	672	278	825	527	920	593	248	522	572	779	743	630	548	291	210	175	248	139	137	26
Discards	ATN		Longline	708	526	562	439	476	525	1137	896	607	618	313	323	215	273	235	151	148	392	391	199	156	167	105	149	150
			Other surf.	0	0	26	12	9	4	1	6	8	5	7	10	8	8	9	7	5	9	10	0	0	0	0	0	
	ATS		Longline	0	0	1	21	10	6	1	0	0	0	1	0	0	91	6	0	147	74	140	0	46	43	2	111	26
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Landings	ATN	CP	Barbados	0	0	33	16	16	12	13	19	10	21	25	44	39	27	39	20	13	23	21	16	21	29	20	21	18
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	112	106	184	141	142	76	1	3	59	145
			Brazil	0	0	0	0	0	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Canada	1676	1610	739	1089	1115	1119	968	1079	959	1285	1203	1558	1404	1348	1334	1300	1346	1551	1489	1505	1604	1579	1548	1188	782
			China PR	86	104	132	40	337	304	22	102	90	316	56	108	72	85	92	92	73	75	59	96	60	141	135	81	86
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	30	0	0	0	0	0	27	21	**0**
			EU.Denmark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	6185	6953	5547	5140	4079	3996	4595	3968	3957	4586	5376	5521	5448	5564	4366	4949	4147	4889	5622	4084	3750	4013	3916	3588	3186
			EU.France	46	84	97	164	110	104	122	0	74	169	102	178	92	46	14	15	35	16	94	44	28	66	90	79	80
			EU.Ireland	0	0	15	15	132	81	35	17	5	12	1	1	3	2	2	1	1	2	5	2	3	15	15	10	13
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**0**
			EU.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.Portugal	1599	1617	1703	903	773	777	732	735	766	1032	1320	900	949	778	747	898	1054	1203	882	1438	1241	1420	1460	1871	1691
			EU.Rumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.United Kingdom	3	1	5	11	0	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	**0**
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	10	3	36	48	0	82	48	17	90	1	0	18	3	0	0	0	**0**
			Grenada	0	1	4	15	15	42	84	0	54	88	73	56	30	26	43	0	0	0	0	0	0	0	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	**0**
			Iceland	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Japan	933	1043	1494	1218	1391	1089	161	0	0	0	575	705	656	889	935	778	1062	523	639	300	545	430	379	456	325
			Korea Rep.	16	16	19	15	0	0	0	0	0	0	0	51	65	175	157	3	0	0	0	64	35	0	9	19	9
			Liberia	26	28	28	28	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	95	5
			Maroc	36	79	462	267	191	119	114	523	223	329	335	334	341	237	430	724	963	782	770	1062	1062	850	900	900	950
			Mexico	14	0	22	14	28	24	37	27	34	32	44	41	31	35	34	32	35	38	40	33	32	31	36	64	44
			Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Panama	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Philippines	0	0	0	0	0	0	0	1	4	44	5	0	8	0	22	28	0	17	36	9	14	0	0	0	
		Russian Federation	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	28	11	1	44	43	49	78	52	51	44
		Sierra Leone	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		St. Vincent and Grenadines	0	4	3	1	0	1	0	22	22	7	7	7	0	51	7	34	13	11	8	4	40	102	33	46	26
		Trinidad and Tobago	180	150	158	110	130	138	41	75	92	78	83	91	19	29	48	30	21	16	14	16	26	17	13	36	3
		U.S.A.	3366	4026	3559	2987	3058	2908	2863	2217	2384	2513	2380	2160	1873	2463	2387	2730	2274	2551	3393	2824	1809	1581	1408	1294	1137
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.Bermuda	0	1	1	5	5	3	3	2	0	0	1	1	0	3	4	3	3	3	1	1	1	1	2	0	**0**
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	4	4	7	0	3	0	0	4	0	0	0	0	0	0	**0**
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	17	0	0	0	**0**
		Vanuatu	0	0	0	0	0	0	0	0	0	0	35	29	14	0	0	0	10	23	15	2	4	7	0	0	**0**
		Venezuela	69	54	85	20	37	30	44	21	34	45	53	55	22	30	11	13	24	18	25	24	24	29	53	52	
	NCC	Chinese Taipei	507	489	521	509	286	285	347	299	310	257	30	140	172	103	82	89	88	192	166	115	78	115	148	78	162
		Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	10	
	NCO	Cuba	50	86	7	7	7	7	0	0	10	3	3	2	2	0	0	0	0	0	0	0	0	0	0	0	
		Dominica	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
		Faroe Islands	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
		Seychelles	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Sta. Lucia	1	0	0	0	0	0	0	0	0	0	2	3	0	0	2	0	0	0	0	0	0	0	0	1	
ATS	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	18	0	0	13	**0**
		Belize	0	1	0	0	0	17	8	0	0	0	0	0	0	120	32	111	121	207	197	136	45	111	176	166	115
		Brazil	1571	1975	1892	4100	3847	4721	4579	4082	2910	2920	2998	3785	4430	4153	3407	3386	2926	3033	2833	2384	2892	2599	2935	2406	2798
		China PR	0	0	0	0	29	534	344	200	423	353	278	91	300	473	470	291	296	248	316	196	206	328	222	302	355
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Côte d'Ivoire	20	19	26	18	25	26	20	19	19	43	29	31	39	17	159	267	156	145	88	110	55	42	25	17	57
		EU.Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.España	7937	11290	9622	8461	5832	5758	6388	5789	5741	4527	5483	5402	5300	5283	4073	5183	5801	4700	4852	4184	4113	5059	4992	4654	4404
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
		EU.Lithuania	794	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Portugal	0	380	389	441	384	381	392	393	380	354	345	493	440	428	271	367	232	263	184	125	252	236	250	466	369
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	49	0	0	3	0	0	0	0	0	0	0	0	**0**
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Gabon	0	0	0	0	0	0	0	0	0	9	2	1	0	0	0	2	0	0	0	0	0	0	0	0	**0**
		Ghana	51	103	140	44	106	121	117	531	372	734	343	55	32	65	177	132	116	60	54	37	26	56	36	55	6
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Guinea Ecuatorial	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Honduras	0	6	4	5	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	4699	3619	2197	1494	1186	775	790	685	833	924	686	480	1090	2155	1600	1340	1314	1233	1162	684	976	659	637	915	640
		Korea Rep.	164	164	7	18	7	5	10	0	2	24	70	36	94	176	223	10	0	0	42	47	53	5	19	11	18

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Namibia	22	0	0	0	0	730	469	751	504	191	549	832	1118	1038	518	25	417	414	85	129	395	225	466	600	881
			Nigeria	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Panama	0	0	0	0	29	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Philippines	0	0	0	0	0	0	0	6	1	8	1	1	4	58	41	49	14	35	15	35	58	0	0	0	
			S. Tomé e Príncipe	190	178	166	148	135	129	120	120	120	120	126	147	138	138	183	188	193	60	84	60	94	145	77	65	
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	77	138	195	180	264	162	178	143	97	173	160	92
			Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	**0**
			South Africa	1	4	1	1	240	143	328	547	649	293	295	199	186	207	142	170	145	97	50	171	152	218	164	189	189
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	10	7	16	4	3	2	2	19	0	5	9	4
			U.S.A.	0	0	171	396	160	179	142	43	200	21	15	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			UK.Sta Helena	0	0	0	0	0	0	0	20	4	2	2	0	0	0	0	0	0	0	0	5	6	2	0	0	**0**
			Uruguay	165	499	644	760	889	650	713	789	768	850	1105	843	620	464	370	501	222	179	40	103	0	0	0	0	**0**
			Vanuatu	0	0	0	0	0	0	0	0	0	0	0	11	26	6	3	0	3	1	3	0	1	1	0	0	**0**
		NCC	Chinese Taipei	2829	2876	2873	2562	1147	1168	1303	1149	1164	1254	745	744	377	671	727	612	410	424	379	582	406	511	478	416	446
		NCO	Argentina	24	0	0	0	0	38	0	5	10	8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
			Benin	25	24	24	10	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cambodia	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	452	778	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Mixed flags (FR+ES)	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Seychelles	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Togo	14	14	64	0	0	0	0	0	0	0	9	10	2	0	0	0	0	0	0	0	0	0	0	0	
Discards	ATN	CP	Canada	0	0	0	5	52	35	50	26	33	79	45	106	38	61	39	9	15	8	111	59	12	8	11	21	5
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Japan	0	0	0	0	0	0	598	567	319	263	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	170	46	19	0	2	0	0	
			Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
			U.S.A.	708	526	588	446	433	494	490	308	263	282	275	227	185	220	205	148	138	223	217	120	137	137	90	111	138
			UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	7	18	4	18	7
	ATS	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	91	6	0	0	0	0	0	0	0	0	0	
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147	70	23	0	0	0	0	0	
			South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			U.S.A.	0	0	1	21	10	6	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	117	0	45	43	2	111	26

SWO-ATL-Table 2. Estimated probabilities (%) that fishing mortality is below F_{MSY} for North Atlantic swordfish from the Bayesian Surplus Production and Age Structured final base models.

Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
12000	83	83	83	83	83	83	83	83	83	83	83
12200	81	81	80	80	80	80	80	80	80	79	79
12400	78	77	78	77	77	76	77	76	75	75	75
12500	77	75	76	75	75	75	74	74	73	73	73
12600	76	74	74	74	74	73	72	72	71	71	70
12700	74	72	72	72	72	70	71	69	69	69	67
12800	72	71	71	70	70	69	68	67	67	65	64
12900	71	70	68	68	68	66	65	65	63	63	61
13000	70	68	67	66	65	64	62	62	61	60	58
13100	68	66	65	64	63	61	60	58	58	56	56
13200	67	65	63	62	60	59	58	56	55	54	52
13300	65	64	61	61	58	56	55	53	52	50	50
13400	64	63	60	58	56	53	52	51	49	48	46
13500	62	61	58	57	54	51	49	47	46	44	43
13600	61	59	56	54	52	49	47	45	43	42	41
13700	60	57	55	52	50	47	45	43	41	38	37
13800	58	55	52	50	47	45	42	40	38	36	35
14000	54	51	48	46	43	41	38	35	33	32	30

SWO-ATL-Table 3. Estimated probabilities (%) that biomass is above B_{MSY} for North Atlantic swordfish from the Bayesian Surplus Production and Age Structured final base models.

Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
12000	74	74	75	75	76	77	77	78	77	78	78
12200	74	74	74	74	75	75	75	76	76	75	75
12400	74	73	73	73	73	73	73	73	73	73	72
12500	74	73	73	73	73	72	72	72	71	71	70
12600	74	73	72	72	72	71	71	71	70	70	69
12700	74	73	71	71	71	70	70	69	69	68	67
12800	74	73	71	71	70	69	69	68	67	66	65
12900	74	73	71	70	69	68	68	66	65	64	63
13000	73	72	70	70	68	67	66	65	64	63	61
13100	73	72	70	69	67	66	65	64	62	61	59
13200	73	71	69	68	66	65	64	62	60	59	57
13300	73	71	69	67	65	64	62	61	59	58	55
13400	73	71	69	67	65	63	61	59	57	55	53
13500	73	71	68	66	64	62	60	57	55	53	51
13600	73	71	68	66	63	60	58	56	53	51	49
13700	73	71	68	65	62	59	57	55	51	48	47
13800	73	70	67	64	61	58	55	53	49	47	44
14000	73	69	66	63	60	56	53	49	46	43	40

SWO-ATL-Table 4. Estimated probabilities (%) that both the fishing mortality is below F_{MSY} and biomass is above B_{MSY} for North Atlantic swordfish from the Bayesian Surplus Production and Age Structured final base models.

Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
12000	73	73	75	74	76	76	77	77	77	78	77
12200	72	72	72	73	74	74	74	74	74	74	74
12400	71	71	71	71	71	72	72	71	71	71	70
12500	71	70	70	70	70	70	70	70	69	69	68
12600	70	69	69	69	69	68	68	68	67	67	66
12700	69	68	68	68	67	66	66	66	65	64	64
12800	68	67	67	67	66	65	64	64	63	62	61
12900	67	66	65	65	64	63	62	62	60	59	59
13000	66	65	64	63	62	61	60	59	58	57	56
13100	66	64	62	62	60	59	57	57	56	55	53
13200	64	63	61	60	58	57	55	54	53	52	50
13300	64	62	60	58	56	54	53	51	50	49	48
13400	62	61	58	57	55	52	50	49	47	46	45
13500	61	59	57	55	53	50	48	46	45	43	42
13600	60	57	55	53	51	48	46	44	43	41	39
13700	59	56	54	51	49	46	44	42	40	38	36
13800	57	54	52	49	47	44	42	40	37	36	34
14000	54	51	48	46	43	40	37	35	33	31	29

SWO-ATL-Table 5. Estimated probabilities (%) that fishing mortality is below F_{MSY} for South Atlantic swordfish from the Bayesian Surplus Production final base model.

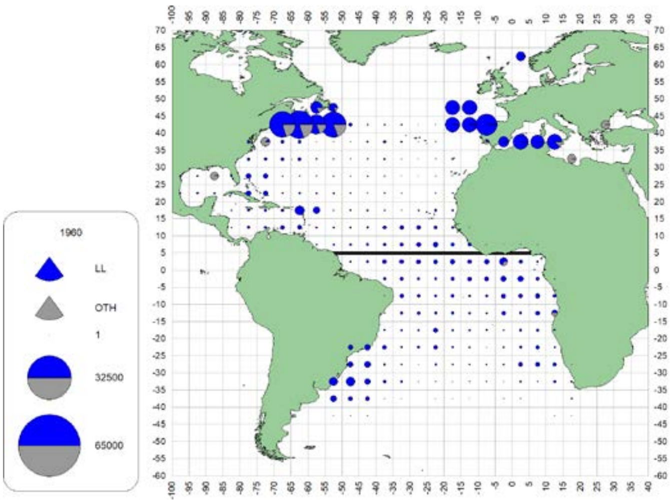
Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
10000	86	90	92	94	95	96	96	97	97	97	97
10500	83	87	90	91	93	94	94	95	95	96	96
11000	78	83	86	88	90	91	92	93	93	93	94
11500	73	78	81	84	86	87	88	89	90	91	92
12000	68	73	76	79	81	83	84	86	86	87	88
12500	62	66	70	73	75	77	78	79	80	81	82
13000	56	60	63	66	68	70	71	72	73	74	75
13200	53	56	59	62	64	66	67	68	69	70	71
13400	51	54	57	60	61	63	64	65	66	66	67
13600	48	51	53	56	57	59	60	61	62	63	63
13700	47	50	52	54	55	57	58	59	60	60	61
13800	46	48	50	52	53	55	56	57	57	58	58
13900	44	46	49	50	52	53	53	54	55	56	56
14000	44	45	47	49	50	51	52	52	53	53	54
14500	38	38	39	39	40	40	40	41	41	41	41
15000	32	32	31	30	30	30	29	29	28	28	27
15500	26	25	24	22	20	20	18	17	17	16	16
16000	22	19	17	15	13	12	11	10	9	8	7

SWO-ATL-Table 6. Estimated probabilities (%) that biomass is above B_{MSY} for South Atlantic swordfish from the Bayesian Surplus Production final base model.

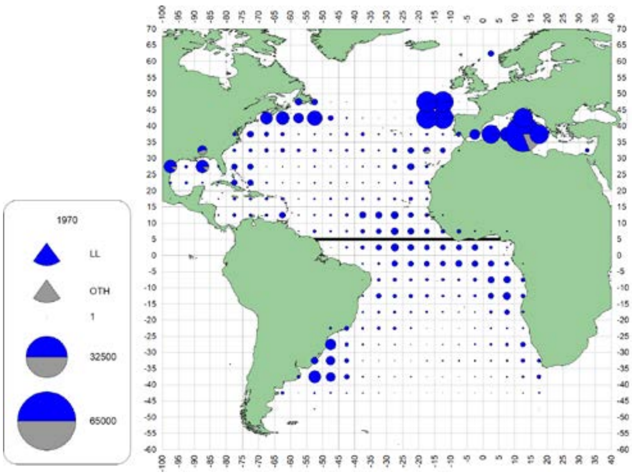
Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
10000	35	51	65	75	81	85	88	90	92	93	95
10500	35	51	63	72	78	82	86	88	90	91	92
11000	35	49	59	67	74	79	82	85	87	88	90
11500	36	47	57	64	70	75	78	81	83	85	86
12000	36	46	54	60	66	70	74	77	79	81	83
12500	36	44	51	56	60	65	68	71	73	75	76
13000	36	42	47	52	56	59	62	65	66	68	70
13200	36	41	46	50	54	57	59	61	63	65	66
13400	36	41	45	49	52	54	56	58	60	61	62
13600	35	39	43	46	49	51	53	55	56	58	59
13700	35	39	43	45	48	50	52	53	54	56	57
13800	35	38	41	44	46	49	50	51	53	54	55
13900	35	38	41	43	45	47	48	50	51	52	52
14000	36	38	41	43	44	46	47	48	49	50	51
14500	36	36	37	38	38	39	39	39	40	39	40
15000	36	35	34	33	32	32	31	31	30	29	29
15500	35	33	31	28	26	24	23	21	20	19	18
16000	35	31	27	24	21	18	16	14	12	11	10

SWO-ATL-Table 7. Estimated probabilities (%) that both the fishing mortality is below F_{MSY} and biomass is above B_{MSY} for South Atlantic swordfish from the Bayesian Surplus Production final base model.

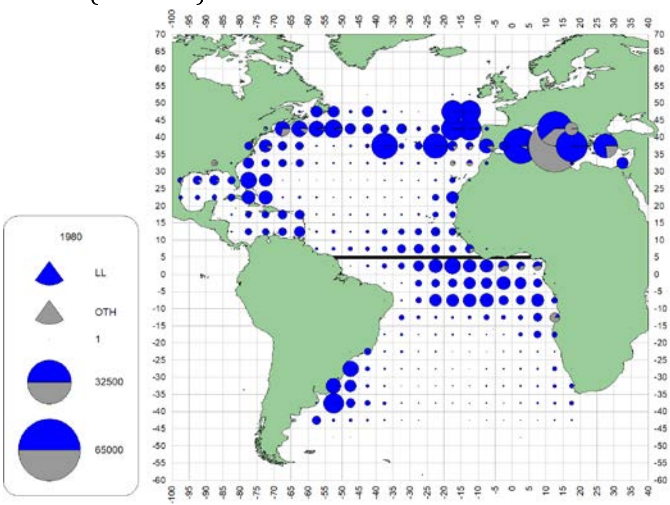
Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
10000	35	51	65	75	81	85	88	90	92	93	95
10500	35	51	63	72	78	82	86	88	90	91	92
11000	35	49	59	67	74	79	82	85	87	88	90
11500	36	47	57	64	70	75	78	81	83	85	86
12000	36	46	54	60	66	70	74	77	79	81	83
12500	36	44	51	56	60	65	68	71	73	75	76
13000	36	42	47	52	56	59	62	65	66	68	70
13200	36	41	45	50	53	57	59	61	63	65	65
13400	35	40	45	49	51	54	56	58	59	61	62
13600	35	39	43	46	49	51	52	55	56	57	58
13700	35	39	42	45	47	50	52	53	54	56	57
13800	35	38	41	44	46	48	50	51	53	53	54
13900	34	37	40	43	45	46	48	49	50	52	52
14000	35	37	40	42	44	46	47	48	48	49	50
14500	33	34	35	36	36	37	38	38	38	38	39
15000	30	30	30	29	29	28	28	28	27	27	26
15500	26	25	23	22	20	19	18	17	16	16	15
16000	22	19	17	15	13	12	11	9	8	8	7



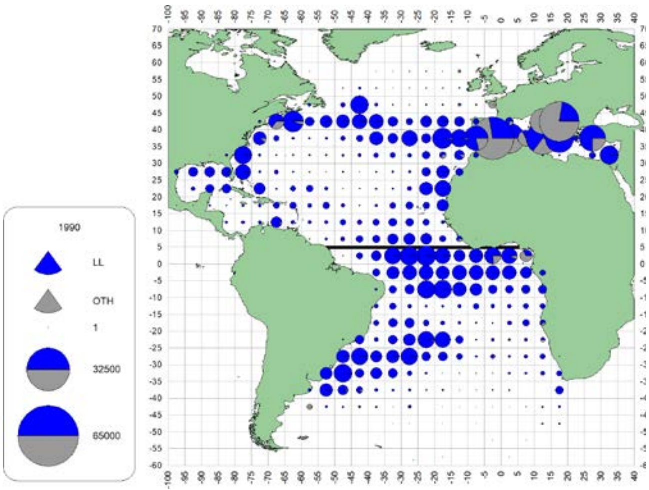
a. SWO (1960-69)



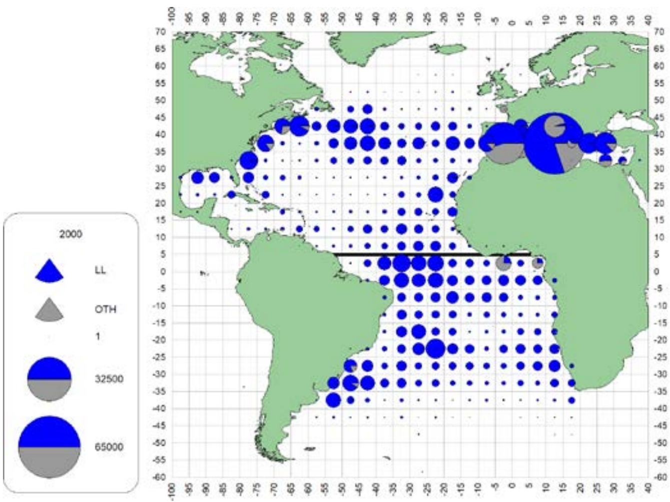
b. SWO (1970-79)



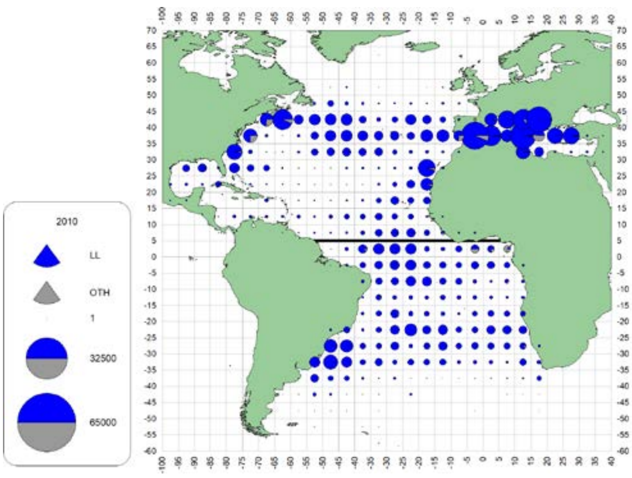
c. SWO (1980-89)



d. SWO (1990-99)

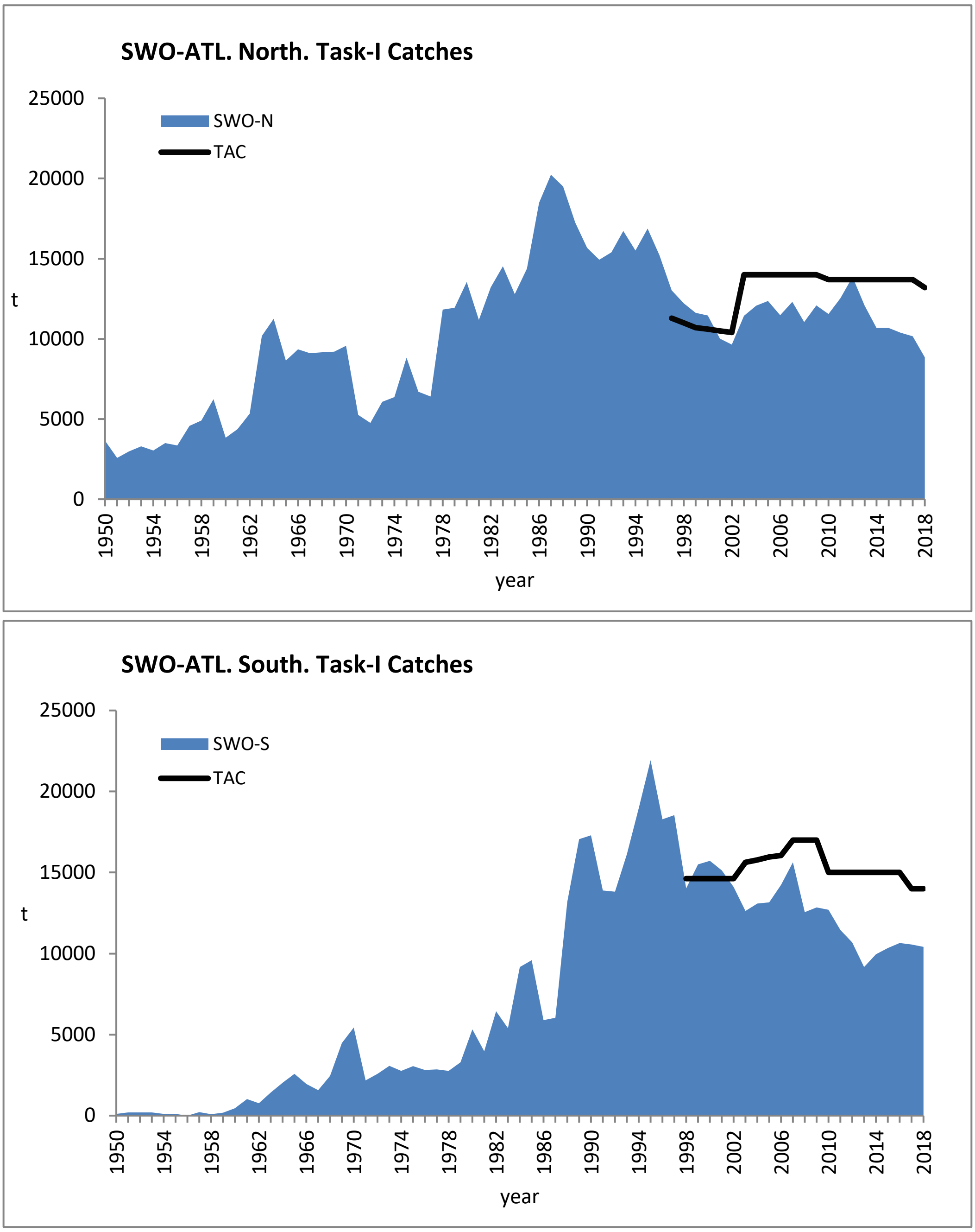


e. SWO (2000-09)

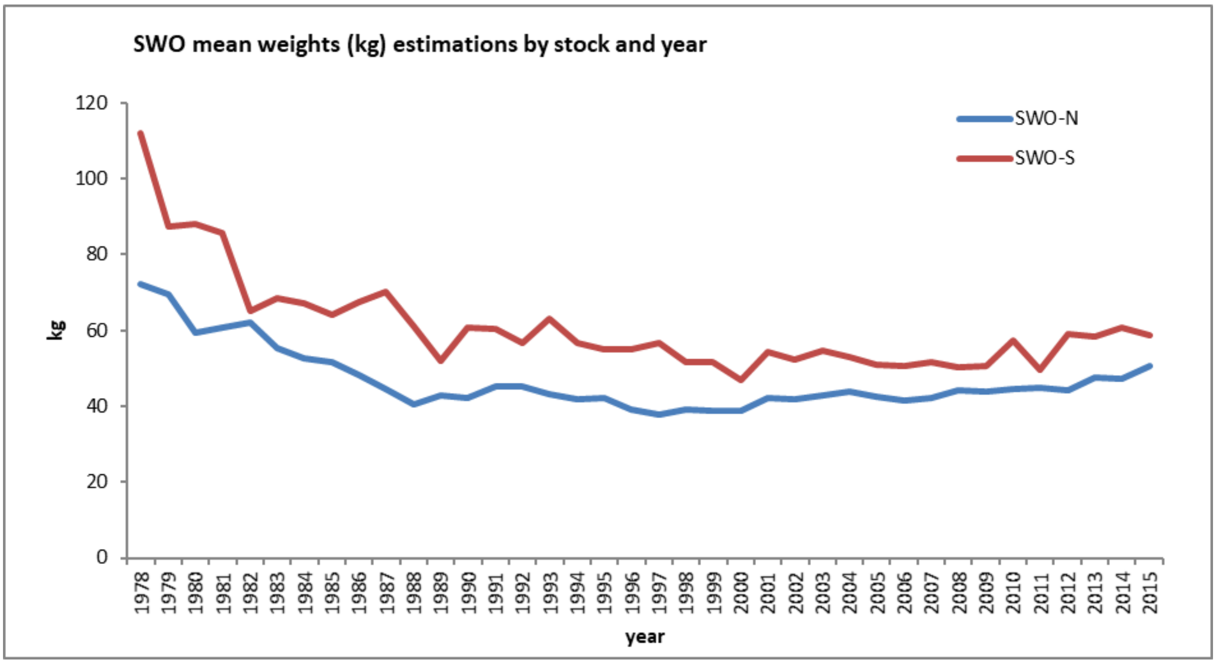


f. SWO (2010-17)

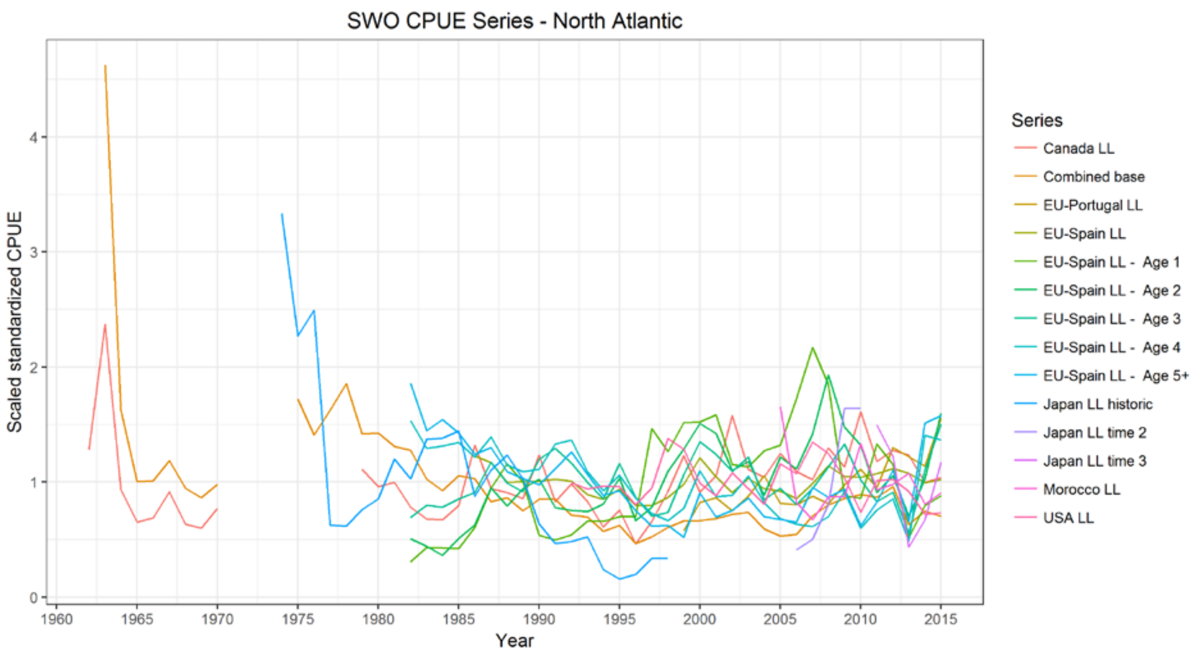
SWO-ATL-Figure 1. Geographic distribution of swordfish cumulative catch (t) by gear, in the Convention area, shown on a decadal scale. The maps are scaled to the maximum catch observed during 1960-2017 (the last decade only covers 8 years).



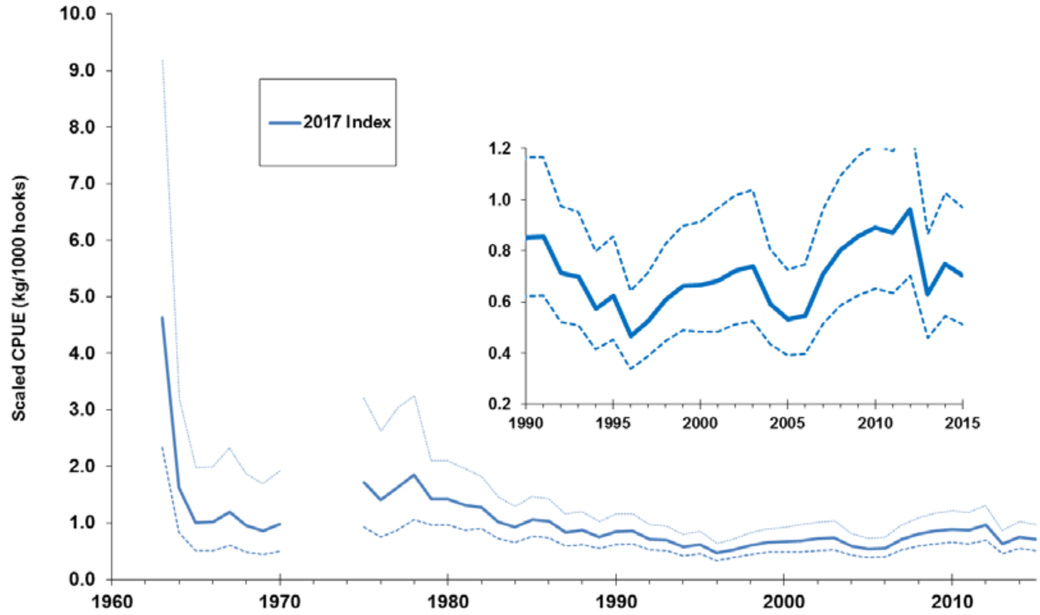
SWO-ATL-Figure 2. North and South Atlantic swordfish catches and TAC (t), for the period 1950-2018.



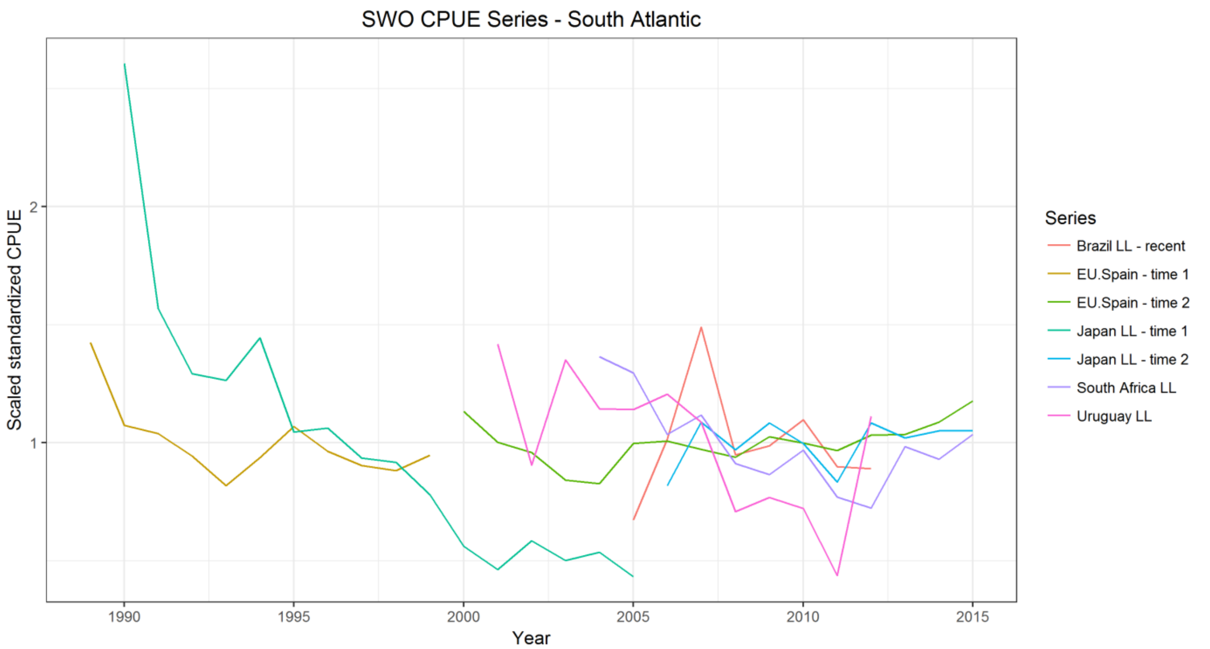
SWO-ATL-Figure 3. Trends in mean weight (kg) for the North and South Atlantic swordfish stocks.



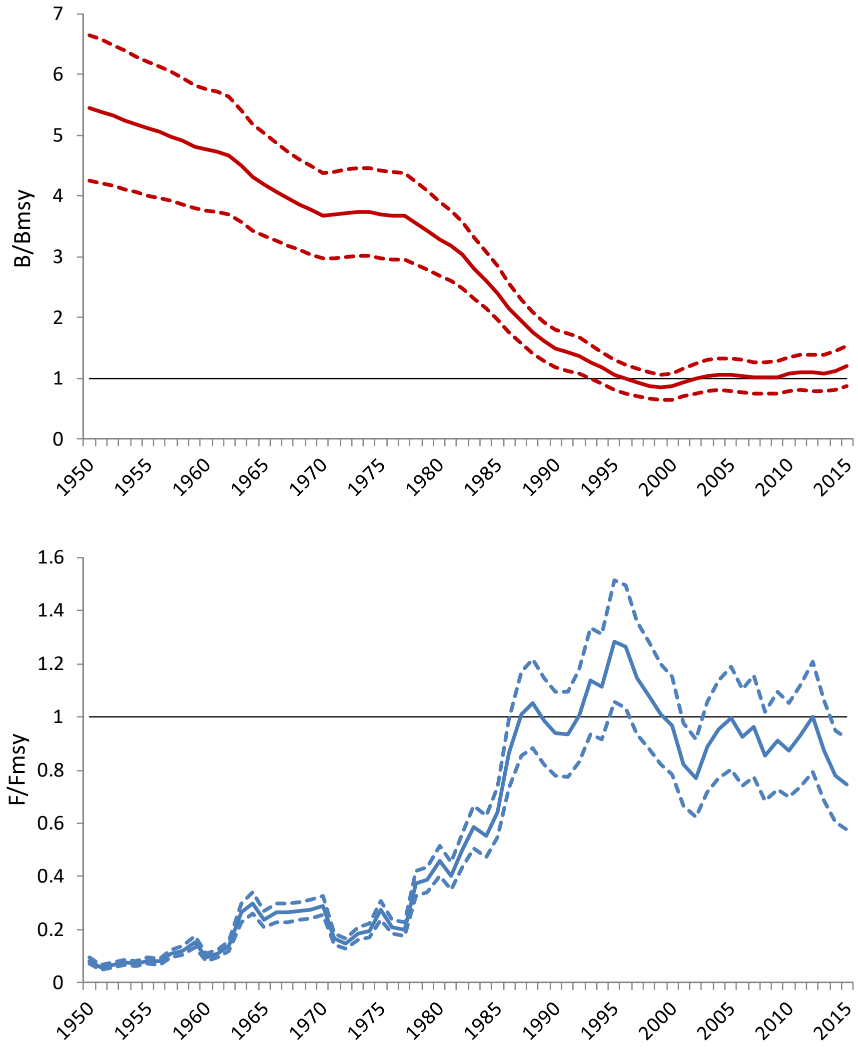
SWO-ATL-Figure 4. Standardized CPUEs series provided by CPCs for the North Atlantic swordfish and the combined index for the base continuity production model. The CPUE series were scaled to their mean for comparison purposes.



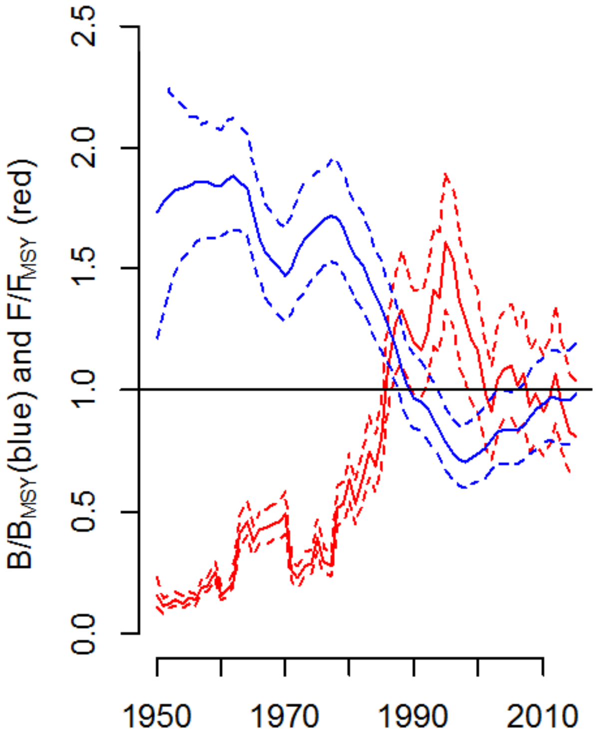
SWO-ATL-Figure 5. Standardized combined biomass CPUE index for North Atlantic and 95% confidence intervals, used as the continuity run for the Surplus Production model. The inset plot shows the detail of the index trend since 1990.



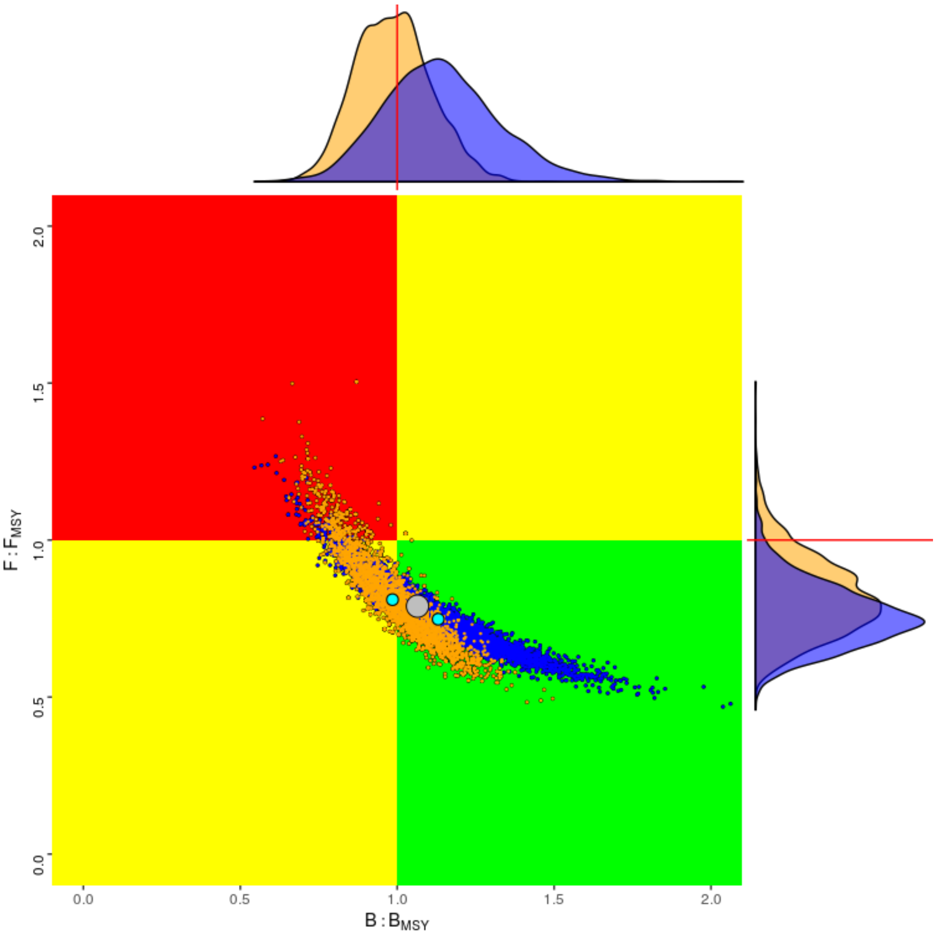
SWO-ATL-Figure 6. Standardized CPUEs series provided by CPCs for South Atlantic swordfish. The CPUE series were scaled to their mean for comparison purposes.

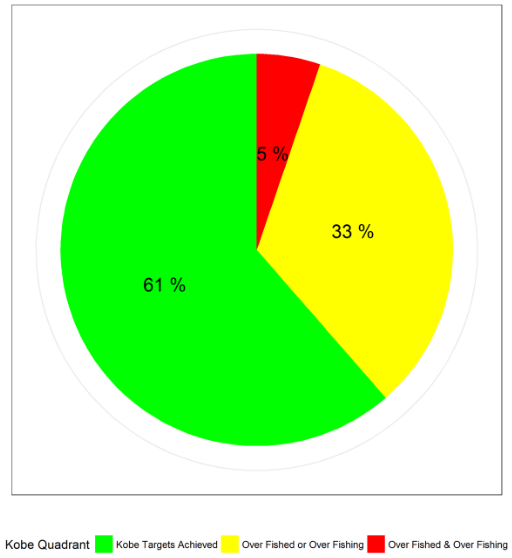


SWO-ATL-Figure 7. Results from the North Atlantic swordfish base case Age Structured Model: trends in relative biomass (top) and fishing mortality (bottom). Dashed lines represent lower and upper 95% CIs.

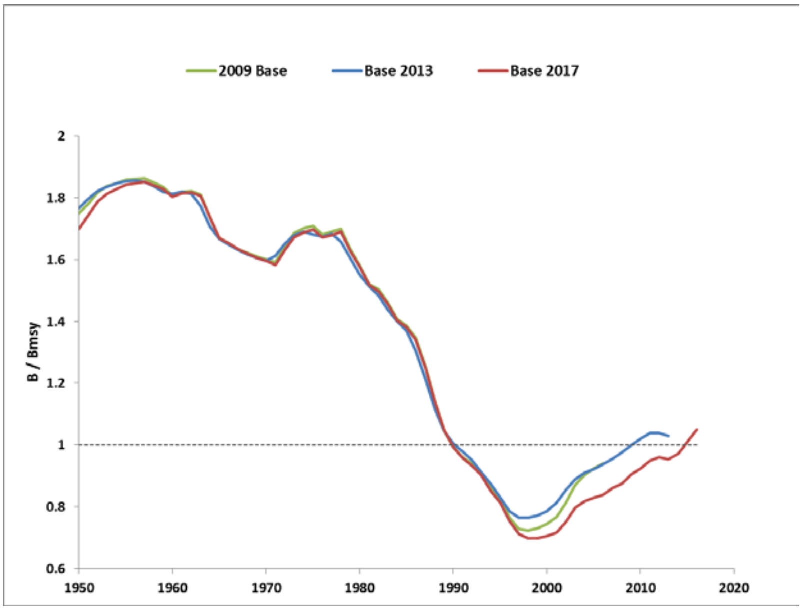


SWO-ATL-Figure 8. Results from the North Atlantic swordfish base case Bayesian Surplus Production Model: trends in relative biomass and fishing mortality. Dashed lines represent lower and upper 90% CIs.

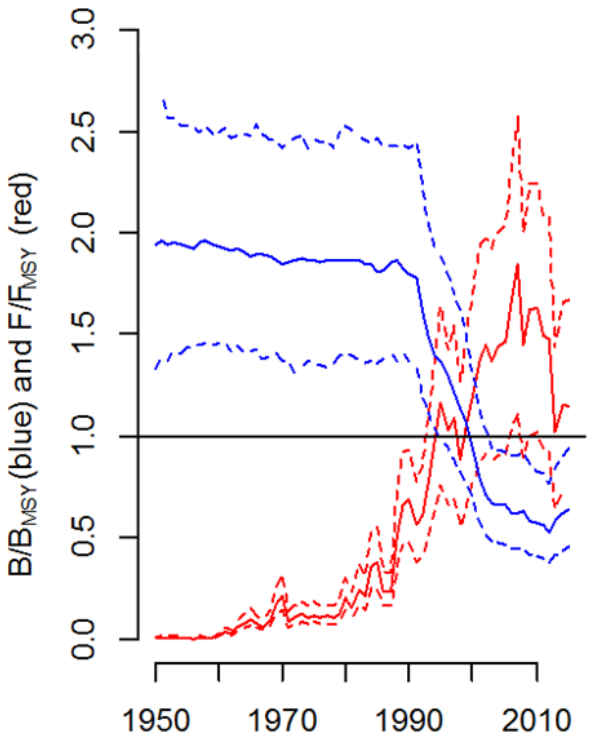




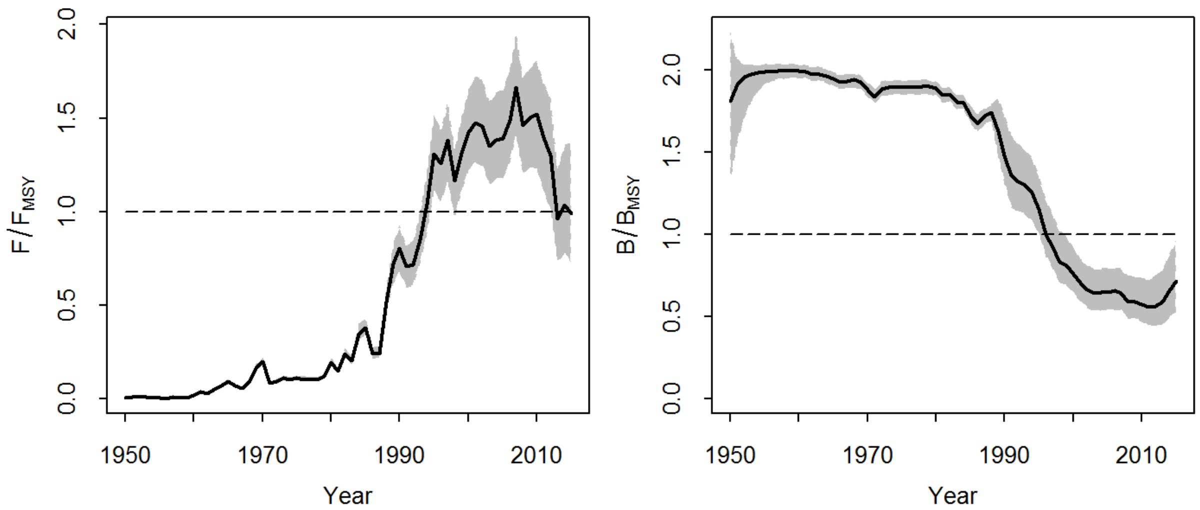
SWO-ATL-Figure 9. North Atlantic swordfish stock status terminal points (2015) from the final base Age Structured and Bayesian Surplus Production Models. The solid light blue circle is the estimated median point with the respective uncertainties from each model (Bayesian Surplus Production Model in orange and Age Structured model in dark blue). The larger light grey circle is the estimated overall median from both models. The pie chart below represents the probabilities of stock being in the different color quadrants combined form both models (red 5%, yellow 33%, green 61%).



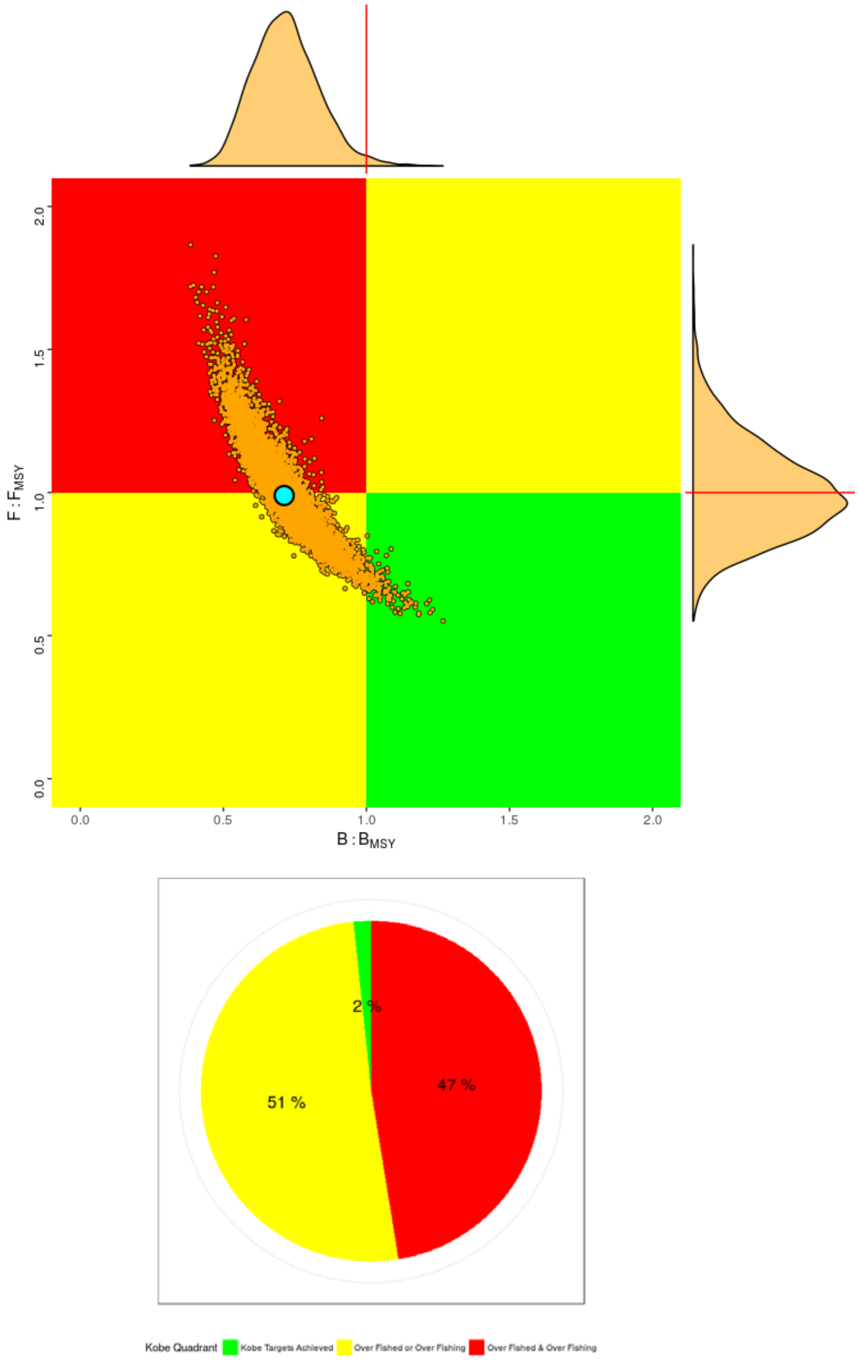
SWO-ATL-Figure 10. Comparison of relative biomass trends estimated by the Surplus Production base case model for the 2009, 2013 and 2017 North Atlantic swordfish stock assessments.



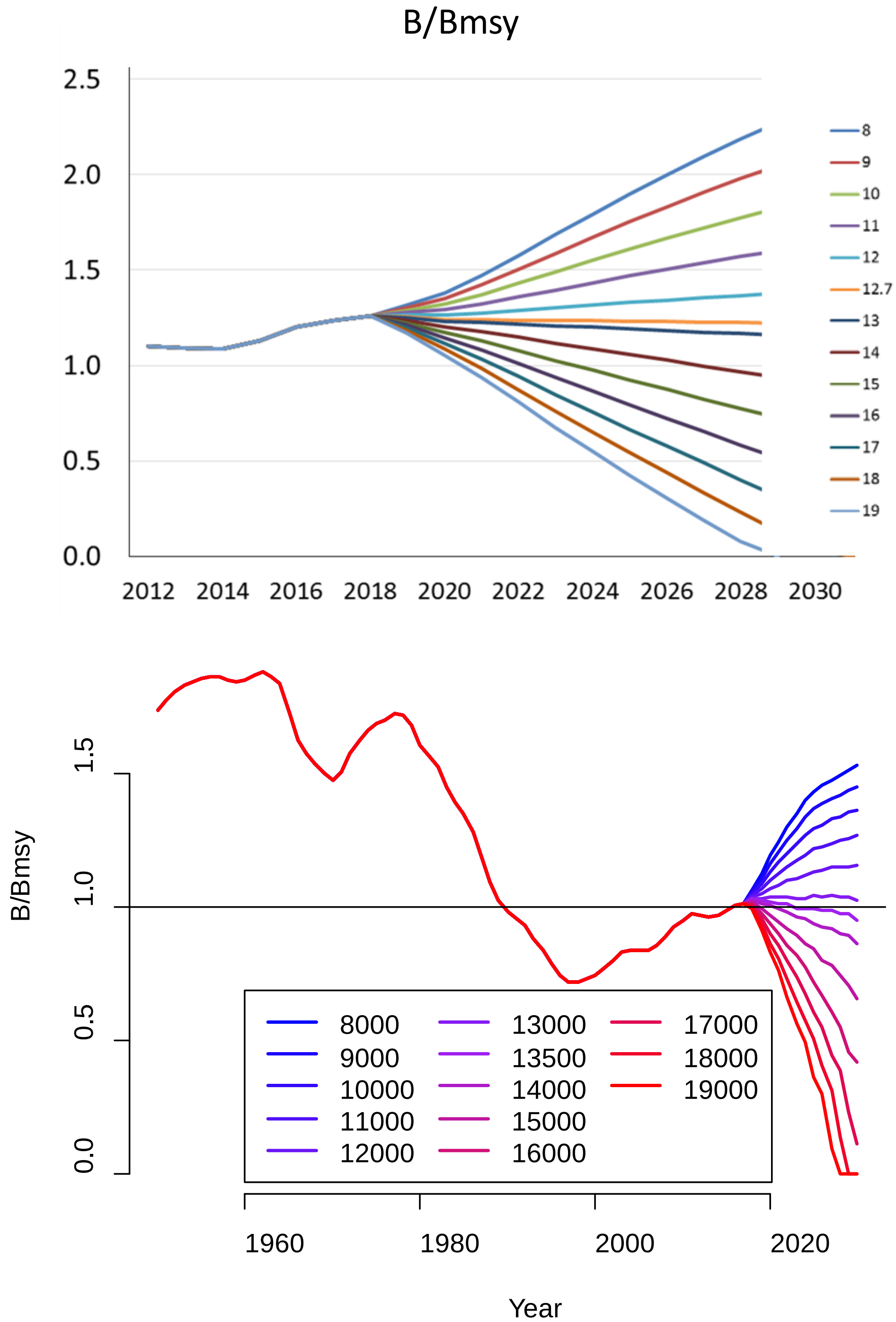
SWO-ATL-Figure 11. South Atlantic swordfish biomass and fishing mortality rates relative to MSY levels, from a Bayesian Surplus Production model (BSP2). Dashed lines represent lower and upper 90% CIs.



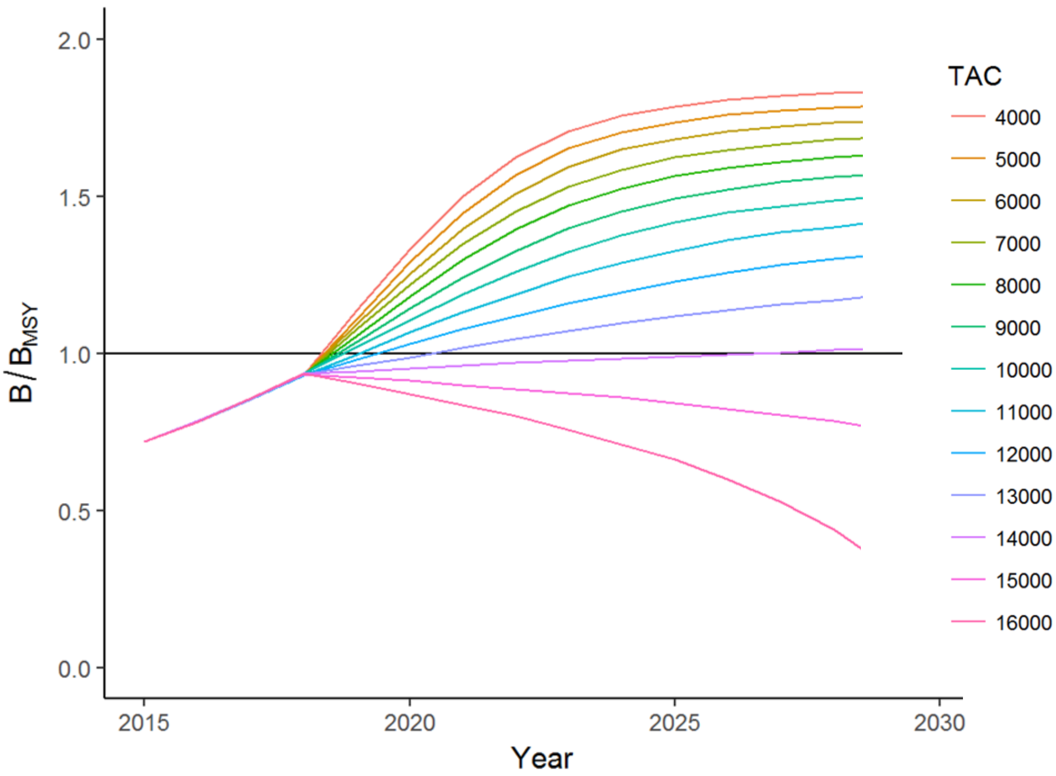
SWO-ATL-Figure 12. South Atlantic swordfish biomass and fishing mortality rates relative to MSY levels, from the Bayesian Surplus Production base case model (JABBA). Grey areas represent lower and upper 95% CIs.



SWO-ATL-Figure 13. Kobe plots for the Bayesian Surplus Production Model (JABBA) reference base case model for southern Atlantic swordfish. The solid blue circle is the estimated median point with the respective uncertainties in the terminal year (2015). The pie chart below represents the probabilities of stock being in the different color quadrants (red 47%, yellow 51%, green 2%).



SWO-ATL-Figure 14. Median trends of relative biomass (B/B_{MSY}) for the projected North Atlantic swordfish stock based on the final Age Structured (top) and Bayesian Surplus Production (BSP2, bottom) base case models under different constant catch scenarios (thousand tons).



SWO-ATL-Figure 15. Median trends of relative biomass (B/B_{MSY}) for the projected South Atlantic swordfish stock based on the Bayesian Surplus Production (JABBA) base case model under different constant catch scenarios (thousand tons).

9.10 SWO-MED – MEDITERRANEAN SWORDFISH

In 2018 the Mediterranean swordfish landings were the lowest observed since the full development of the fisheries in the mid-1980s. The most recent assessment of the stock was conducted in 2016, making use of the available catch, effort and size information through 2015. The present report summarizes assessment results and readers interested in more detailed information on the state of the stock should consult the report of the latest stock assessment session (Anon. 2017g).

SWO-MED-1. Biology

Research results based on genetic studies have demonstrated that Mediterranean swordfish compose a unique stock separated from the Atlantic ones, although there is incomplete information on stock mixing and boundaries. Although mixing between stocks is believed to be low and generally limited to the region around the Strait of Gibraltar, past biological and genetic studies have suggested the possible occurrence of mixing between the Mediterranean and North Atlantic stocks west of the 05°W boundary separating the two stocks. It is very likely that an important fraction of fish caught in this area belongs to the Mediterranean stock but further studies are needed to identify the degree of mixing among stocks. A brief review of past tagging experiments indicated that the existing results cannot provide robust information about mixing patterns and confirmed that further work is needed on this aspect.

According to previous knowledge, the Mediterranean swordfish have different biological characteristics compared to the Atlantic stock. The growth parameters are different, and the sexual maturity is reached at younger ages than in the Atlantic.

In the western Mediterranean, mature females as small as 110 cm LJFL have been observed and the estimated size at which 50% (L50) of the female population is mature occurs at about 140 cm. According to the growth curves used by the SCRS, these two sizes correspond to 2 and 3.5 year-old fish, respectively. An even lower L50 rate (131 cm) for females has been estimated for the central Mediterranean. Males reach sexual maturity at smaller sizes and mature specimens have been found at about 90 cm LJFL. Based on the fish growth pattern and the assumed natural mortality rate of 0.2, the maximum yield would be obtained through instantaneous fishing at age 6, while current catches are dominated, in terms of number, by fish less than 4 years old.

Estimates of new length-weight relationships were presented, based on data from the Italian fisheries. The Committee has suggested further analysis to allow comparisons with the currently adopted equations and weight conversion factors.

SWO-MED-2. Fishery indicators

Mediterranean swordfish landings showed an upward trend from 1965-1972, stabilized between 1973-1979, and then resumed an upward trend reaching a peak in 1988 (20,365 t; **SWO-MED-Table 1**, **SWO-MED-Figure 1**). The sharp increase between 1983 and 1988 may be partially attributed to improvement in the national systems for collecting catch statistics; thus earlier catches may be higher than those appearing in Task I tables. Since 1988 and up to 2011, the reported landings of swordfish in the Mediterranean Sea have declined fluctuating mostly between 12,000 to 16,000 t. In the last seven years (2012-2018), following the implementation of the three-month fishery closure and the establishment of the list of authorized vessels, overall fishing effort has been decreased and catches are around 7-10,000 t. In general, these catch levels are relatively high and similar to those of bigger areas such as the North Atlantic. This could be related to higher recruitment levels in the Mediterranean than in the North Atlantic, different reproduction strategies (larger spawning areas in relation to the area of distribution of the stock) and the lower abundance of large pelagic predators (e.g. sharks) in the Mediterranean. Updated information on Mediterranean swordfish catch by gear type is provided in **SWO-MED-Table 1** and **SWO-MED-Figure 1**.

The provisional Task I catch for 2015 that was used in the assessment was 9,966 t, which is among the lowest annual catches since 1983. The biggest producers in the recent years of the assessment (2003-2015) are EU-Italy (45%), EU-Spain (13%), EU-Greece (10%), Morocco (13%), and Tunisia (7%). Also, Algeria, EU-Cyprus, EU-Malta and Turkey have fisheries targeting swordfish in the Mediterranean. Minor catches of swordfish have also been reported by Albania, EU-Croatia, EU-France, Japan, and Libya.

In the recent years (2003-2018), the main fishing gears used are longlines (on average, representing around 85% of the annual catch) and gillnets. Since 2012, gillnets have been officially eliminated following ICCAT recommendations for a general ban of driftnets in the Mediterranean. Minor catches are also reported from harpoon, trap and fisheries targeting other large pelagic species (e.g. albacore). From 2007-2010 a mesopelagic longline gear has been gradually introduced and nowadays has partially replaced the surface longline gear in several Italian, French and Spanish swordfish fleets. This is particularly noteworthy, as these fisheries are among the largest within the stock area, and the changes have implications for the use of catch rates as indices of abundance in the stock assessments.

Standardised CPUE series from different longline fisheries targeting swordfish that were used in the 2016 stock assessment session, did not reveal any overall trend over time (**SWO-MED-Figure 2**). It should be noted that CPUE series did not cover the earlier years of the reported landings. No trend over the past 30 years was identified regarding the mean fish weight in the catches (**SWO-MED-Figure 3**).

SWO-MED-3. State of the stocks

It should be noted that the assessment results and projections presented here are based on the results of the 2016 assessment, including data up to 2015 that were available at the time of the assessment (July 2016).

Under different assumptions about natural mortality rates and reporting levels of undersized fish in the catch, age-structured analysis indicated that current SSB levels are much lower than those in the 80s, although no trend appears since then.

Results from the age structured model runs indicate that recruitment shows a declining trend in the last decade, while stock biomass remains stable at low levels that are about 1/3 of that in the mid-1980s (**SWO-MED-Figure 4**). There appears to have been a recent decline in F in the last decade.

Results of equilibrium yield analyses based on the age structured model assessment indicated that the stock is both overfished and subject to overfishing, with a 100% probability. Current (2015) SSB is less than 15% of B_{MSY} and F is almost twice the estimated F_{MSY} (**SWO-MED-Figure 5**). Results indicate that the stock is overfished throughout the whole period considered in the age-structured model assessment (1985-2015).

The Committee again noted the large catches of small size swordfish, i.e. less than 3 years old (many of which have probably never spawned) and the relatively low number of large individuals in the catches. Fish less than three years old usually represent 50-70% of the total yearly catches in terms of numbers (**SWO-MED-Figure 6**). A reduction of the volume of juvenile catches would improve yield per recruit and spawning biomass per recruit levels.

SWO-MED-4. Outlook

The assessment of Mediterranean swordfish indicates that the stock is overfished and suffering overfishing. The stock has been in this state since the late 1980s because of the large catches in the 1980s and the selection pattern which captures many immature fish. Catches of immature fish remain high and the greatest mortality is suffered by fish of age 3. Recruitment has been declining for the last 10 years, and recent recruitments have been lower than the level expected to be available given recent levels of SSB.

Based on the stock status estimates, once the stock is rebuilt, a reduction of current F to the F_{MSY} level would result in a substantial (about five times) long term increase in SSB. The above findings, however, should be faced with caution as there is considerable uncertainty in regards to the possible levels of future recruitment given the assumed high steepness of the S/R relationship. It is unclear whether the most recent low levels are associated with a change in stock productivity, if they are an artefact of the estimation process, or if they are due to a temporary reduction in recruitment that could be reverted naturally by a series of positive recruitment anomalies. It is worth mentioning that the estimated SSB_{MSY} levels are twice as much higher than the SSB values estimated before the full expansion of the fishery. Correspondingly, the estimated F_{MSY} is lower than all historical F values. Given the uncertainties on optimum SSB level estimates and the rapid fishery expansion in the 1980s, which resulted in severe stock biomass declines, the SSB levels before the expansion of the fisheries may be also considered as a B_{MSY} proxy for the stock. These levels are around 30,000 t, more than 50% lower than the currently estimated B_{MSY} value. (~63,000 t).

Projections of 20% fishing mortality reductions based on highly-aggregated data derived from the age-structured assessment assuming the current exploitation pattern and the assumption of reverting recruitment to the 1980s levels, according to estimated S/R relationship, are forecast to be beneficial in moving the stock condition closer to the Convention objective, resulting in substantial SSB increases in the medium-long term (8-12 years) and bringing SSB to the late 80s' levels. Projection results are summarized in **SWO-MED-Figure 7.**

SWO-MED-5. Effect of current regulations

ICCAT imposed a Mediterranean-wide one month fishery closure for all gears targeting swordfish in 2008, followed by a two-month closure since 2009. Through Recommendations 11-03 and 13-04 the Commission has adopted additional management measures intended to bring the stock back to levels that are consistent with the ICCAT Convention objective. Those measures include an additional one month closure accompanied by minimum catching size regulations, a list of authorized vessels, and specifications on the technical characteristics of the longline gear. Recently, through Rec. 16-05, which replaced Rec. 13-04, a 15-year recovery plan has been adopted. In addition, increased catching size, and fishing capacity limitations were established, accompanied by TACs (10,500 t in 2017 Rec. 16-05, with a 3% annual reduction over the period 2018-2020) and a seasonal closure of the albacore fishery to reduce juvenile swordfish by-catches. The European Union introduced a driftnet ban for highly migratory species in 2002 and in 2003 ICCAT adopted a recommendation for a general ban of this gear in the Mediterranean (Rec. 03-04). Rec. 04-12 forbids the use of various types of nets and longlines for sport and recreational fishing for tuna and tuna-like species in the Mediterranean.

After the adoption of the aforementioned recommendations, reported catches have decreased significantly from the 2000s' level, being the catches of the period 2012-2018 among the lowest of the last three decades. In addition, reported catches of undersized swordfish have also decreased more than 50%, compared with the levels of the decade of 2000s. Importantly, based on observations onboard, the recent increase of the minimum catching size from 90 to 100 cm has resulted in discard increases (up to 600%) in some fisheries. Both hooking and post-release mortality are unknown for this stock. However, for the Atlantic very high values of hooking mortality (ranging between 78-88%) have been reported for small swordfish (<125 cm LJFL), and it is possible that similar high values also occur in the Mediterranean. The Committee showed concern that such discards are not being fully reported and reiterated that all dead discards should be reported in Task I NC for all fisheries. The additional measures foreseen under Rec. 16-05 have only recently been adopted and their effects cannot be fully evaluated.

SWO-MED-6. Management recommendations

Over the last 25 years biomass levels appear to be rather stable at low levels. This situation has remained the same since the previous assessment of 2014. However, fishing mortality levels have shown a declining trend since 2010. Assessment of stock status and reference points were done under the assumption that recruitment levels can come back up to the levels seen in the past (1980s and 1990s). Under such assumption the stock is currently overfished and suffering overfishing. According to the Commission objectives the stock requires rebuilding and fishing mortality has to be reduced in accordance with Rec. 11-13. The level of the stock to be rebuilt, is contingent on the assumption on future recruitment which is highly uncertain. In order for rebuilding to start taking place there will be a need for substantial reductions in harvest (**SWO-MED-Tables 2-3**). Current quotas correspond to fishing mortality levels that are higher than F_{MSY}. Additionally, for the SCRS to be able to reduce uncertainty in regards to future recruitment, there will be a need to increase monitoring of landings and discards, also taking into account that since the establishment of minimum catching sizes, the discard levels of undersized swordfish may have increased. Further information regarding differences in the exploitation pattern among the different longline gears is also essential for improving assessment estimates and management scenario evaluations.

MEDITERRANEAN SWORDFISH SUMMARY

Maximum Sustainable Yield	19,683 t[1]
Current (2018) Yield	7,079 t[2]
SSB_{MSY}	63,426 t[1]
F_{MSY}	0.25 [1]
Relative Spawning Biomass (SSB_{2015}/SSB_{MSY})	0.12[1]
Relative Fishing Mortality	
F_{2015}/F_{MSY}	1.85[1]
$F_{2015}/F_{0.1}$	2.64[1]
Stock Status (2015)	Overfished: Yes[1]
	Overfishing: Yes[1]
Management Measures in Effect:	Driftnet ban (Rec. 03-04)
	Three-month fishery closure, gear specifications (number and size of hooks and length of gear), minimum catching size, regulations, list of authorized vessels, fishing capacity restrictions, TAC 10,500 t in 2017 (Rec. 16-05), corresponding to 10,185 t in 2018 (3% annual reduction).

[1] Estimates based on the age structured model and equilibrium analyses (see text for details).
[2] Estimates for 2018 are considered preliminary.

SWO-MED-Table 1. Estimated catches (t) of swordfish (Xiphias gladius) in the Mediterranean by gear and flag.

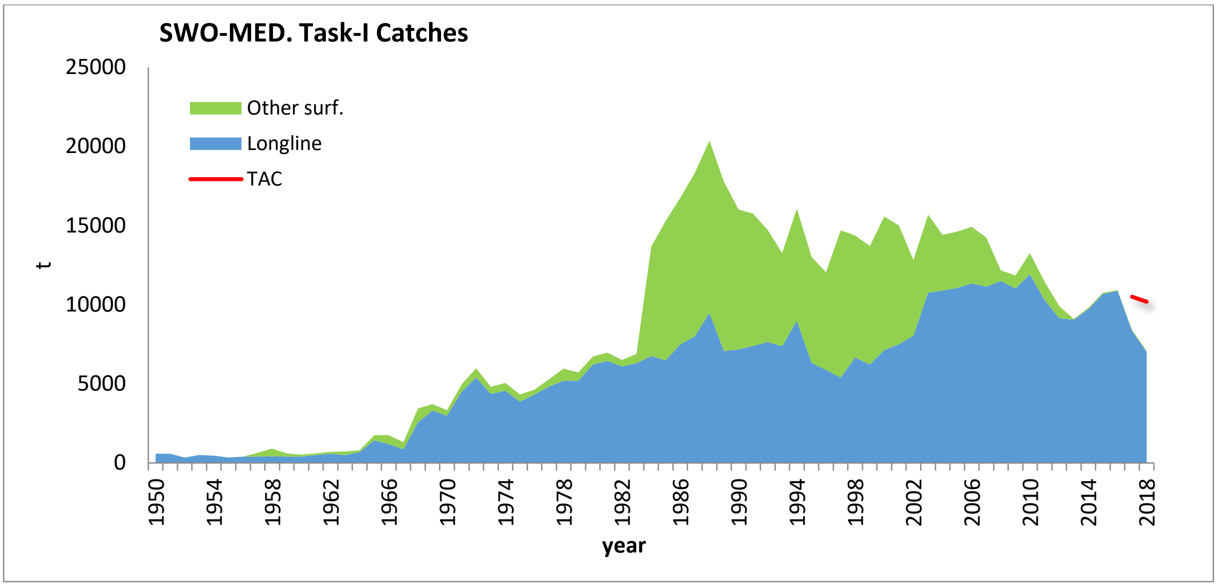
			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL	MED		16082	13015	12053	14693	14369	13699	15569	15006	12814	15694	14405	14622	14915	14227	12164	11840	13265	11450	9913	9096	9801	10751	10921	8402	7079
Landings		Longline	8985	6319	5884	5389	6674	6223	7129	7498	8042	10748	10877	10954	11323	11113	11479	11020	11918	10288	9131	9047	9718	10666	10868	8345	6934
		Other surf.	7097	6696	6169	9304	7695	7476	8440	7508	4772	4945	3519	3555	3576	3094	658	819	1347	1162	782	49	83	78	53	57	61
Discards		Longline	0	0	0	0	0	0	0	0	0	0	9	113	16	19	27	0	0	0	0	0	0	7	0	0	84
Landings	CP	Albania	0	0	13	13	13	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Algerie	600	807	807	807	825	709	816	1081	814	665	564	635	702	601	802	468	459	216	387	403	557	568	671	550	528
		EU.Croatia	0	0	0	0	10	20	0	0	0	0	0	0	0	0	4	3	6	6	4	10	16	10	25	20	28
		EU.Cyprus	159	89	40	51	61	92	82	135	104	47	49	53	43	67	67	38	31	35	35	51	59	45	43	50	45
		EU.España	1503	1379	1186	1264	1443	906	1436	1484	1498	1226	951	910	1462	1697	2095	2000	1792	1744	1591	1607	2073	2283	1733	1487	1387
		EU.France	0	0	0	0	0	0	0	12	27	20	19	22	20	14	14	16	78	81	12	66	127	182	179	113	86
		EU.Greece	2520	974	1237	750	1650	1520	1960	1730	1680	1230	1120	1311	1358	1887	962	1132	1494	1306	877	1731	1344	761	761	392	350
		EU.Italy	7765	7310	5286	6104	6104	6312	7515	6388	3539	8395	6942	7460	7626	6518	4549	5016	6022	5274	4574	2862	3393	4272	3946	2987	1779
		EU.Malta	47	72	72	100	153	187	175	102	257	163	195	362	239	213	260	266	423	532	503	460	376	489	410	330	308
		EU.Portugal	0	0	0	0	0	0	13	115	8	1	120	14	16	0	0	0	0	0	0	0	0	0	0	0	**0**
		Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**0**
		Japan	2	4	5	5	7	4	2	1	1	0	2	4	0	3	1	1	0	0	0	0	0	0	0	0	**0**
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0**
		Libya	0	0	0	0	11	0	8	6	0	10	2	0	16	0	0	0	0	0	0	0	0	585	960	30	70
		Maroc	2654	1696	2734	4900	3228	3238	2708	3026	3379	3300	3253	2523	2058	1722	1957	1587	1610	1027	802	770	770	480	1110	1000	1013
		Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	37	28	0	0	0	9	4	0	0	0	0	**0**
		Tunisie	298	378	352	346	414	468	483	567	1138	288	791	791	949	1024	1011	1012	1016	1040	1038	1036	1030	1034	1007	1003	974
		Turkey	533	306	320	350	450	230	370	360	370	350	386	425	410	423	386	301	334	190	80	97	56	35	77	441	427
	NCC	Chinese Taipei	1	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	NCO	NEI (MED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards	CP	EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	84
		EU.Greece	0	0	0	0	0	0	0	0	0	0	9	113	16	19	27	0	0	0	0	0	0	0	0	0	

SWO-MED-Table 2. Kobe II Strategy matrix showing probabilities (%) of being in the green quadrant by year for each level of fishing mortality. Fsq refers to the current F (2015).

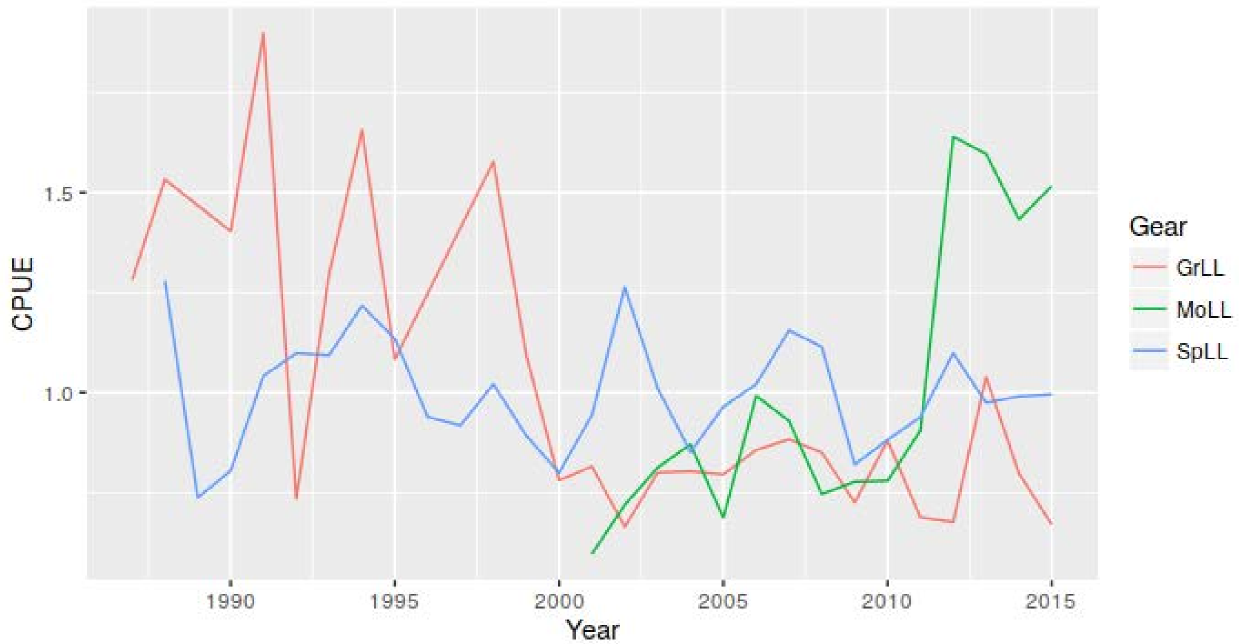
F multiplier		*F/Fsq*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*
0	F_{MSY}	0	0	0	0	0	100	100	100	100	100	100
0.25	F_{MSY}	0.14	0	0	0	0	7	100	100	100	100	100
0.5	F_{MSY}	0.29	0	0	0	0	0	10	69	96	98	100
0.75	F_{MSY}	0.43	0	0	0	0	0	1	3	20	53	72
1	F_{MSY}	0.57	0	0	0	0	0	0	0	2	4	8
1	F_{sq}	1	0	0	0	0	0	0	0	0	0	0
0.8	F_{sq}	0.8	0	0	0	0	0	0	0	0	0	0

SWO-MED Table 3. Catches correspond to F levels in **SWO-MED-Table 2.** Fsq refers to current F (2015). Note that catch levels in this table need to be examined in conjunction with **SWO-MED-Table 2**, which expresses the probability of meeting the Convention objectives.

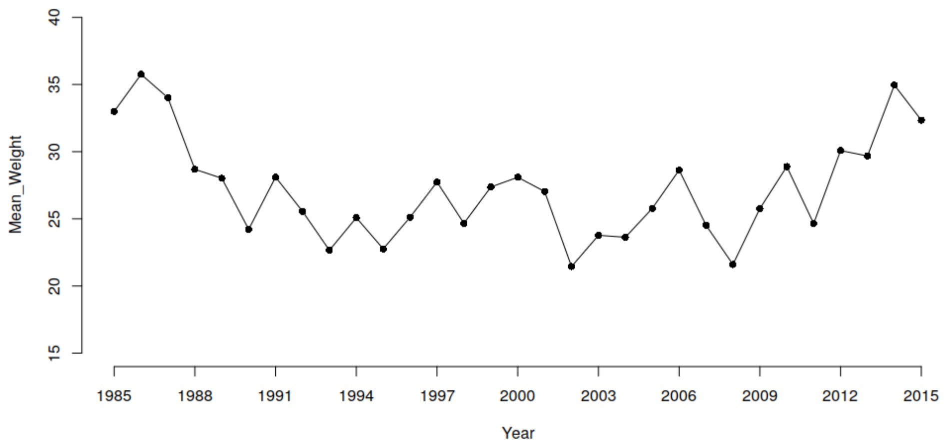
F multiplier		*F/Fsq*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*
0	F_{MSY}	0	0	0	0	0	0	0	0	0	0	0
0.25	F_{MSY}	0.14	1684	2306	3011	3843	4723	5666	6550	7409	8217	8865
0.5	F_{MSY}	0.29	3278	4275	5374	6640	7937	9299	10597	11752	12860	13771
0.75	F_{MSY}	0.43	4786	5949	7203	8639	10028	11505	12962	14164	15353	16151
1	F_{MSY}	0.57	6214	7363	8594	10006	11300	12734	14198	15309	16406	17106
1	F_{sq}	1	10624	11198	12670	13577	14439	14924	15801	16242	16468	16352
0.8	F_{sq}	0.8	8826	9939	11786	13204	14464	15287	16465	17206	17746	17711



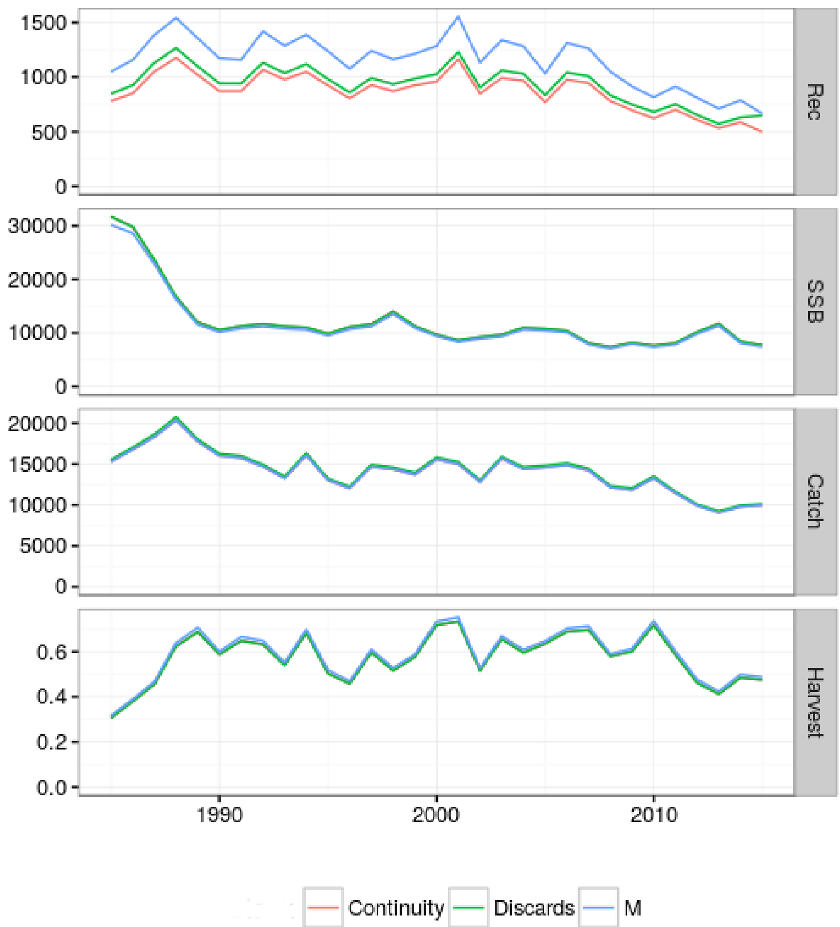
SWO-MED-Figure 1. Estimates of Task I swordfish catches (t) in the Mediterranean by major gear types, for the period 1950-2018. Misreporting may occur in the earlier period (up to the middle 1980s).



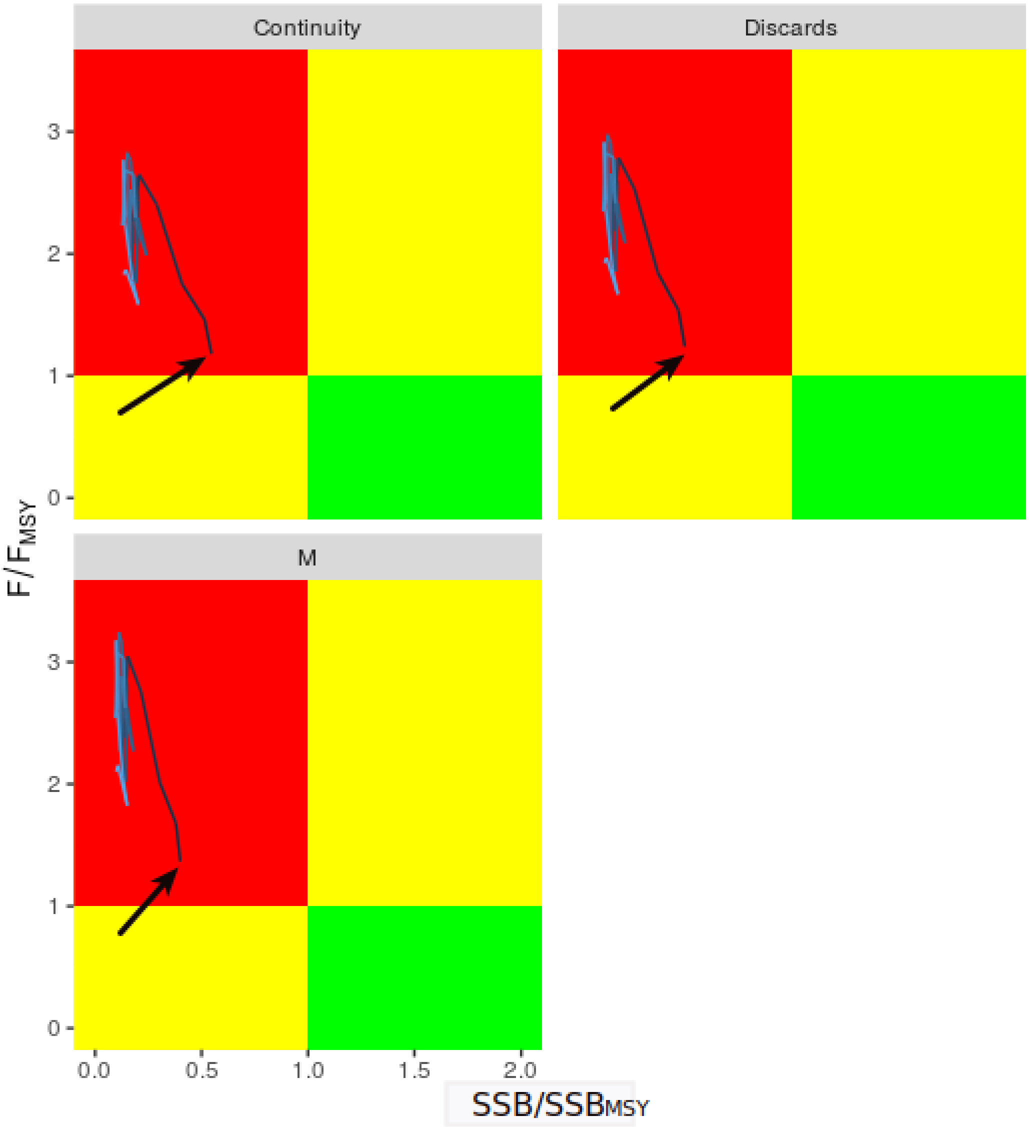
SWO-MED-Figure 2. Relative abundance indices used in the assessment of the Mediterranean swordfish. All indices are scaled to their individual means to facilitate comparison of trends and relative degree of variability. GrLL=Greek longlines, SpLL=Spanish longlines, MoLL=Moroccan longlines.



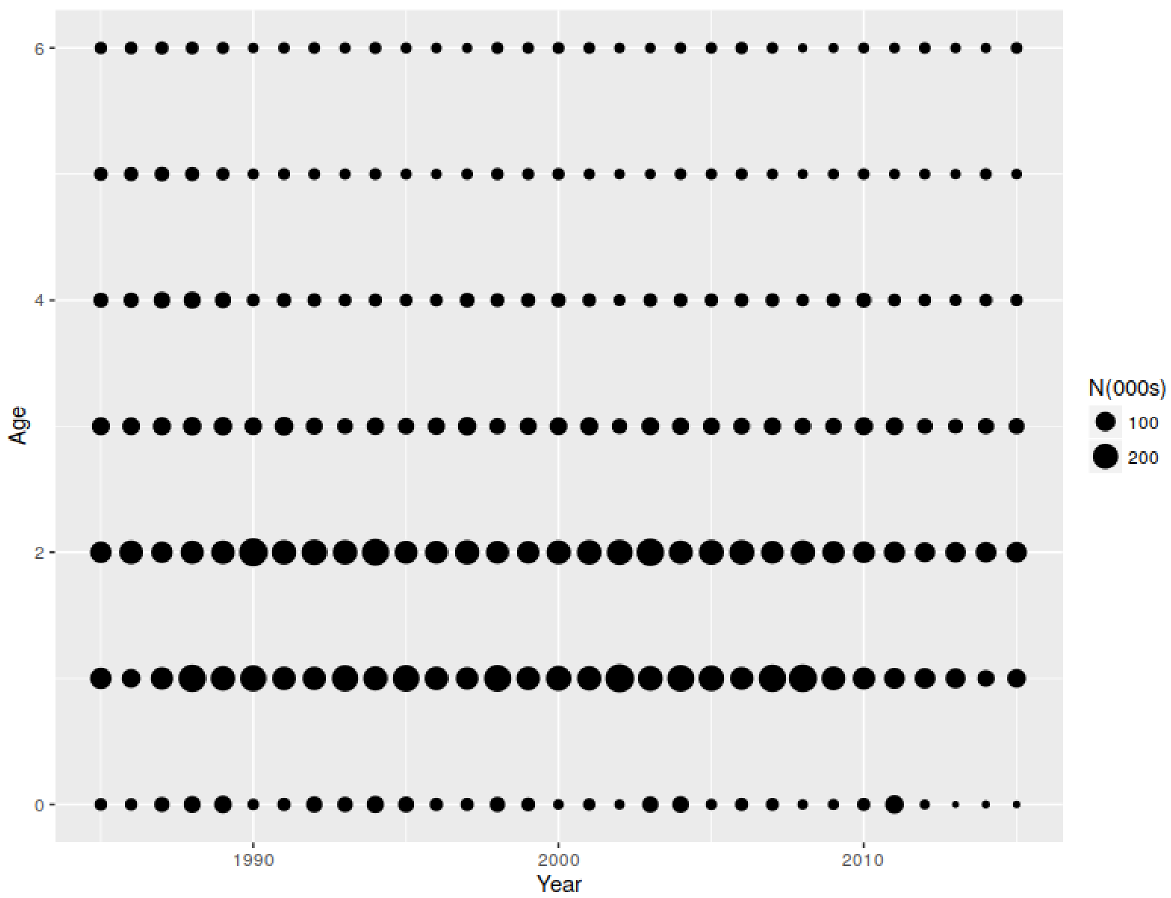
SWO-MED-Figure 3. Time series of mean fish weight (kg) in the catches.



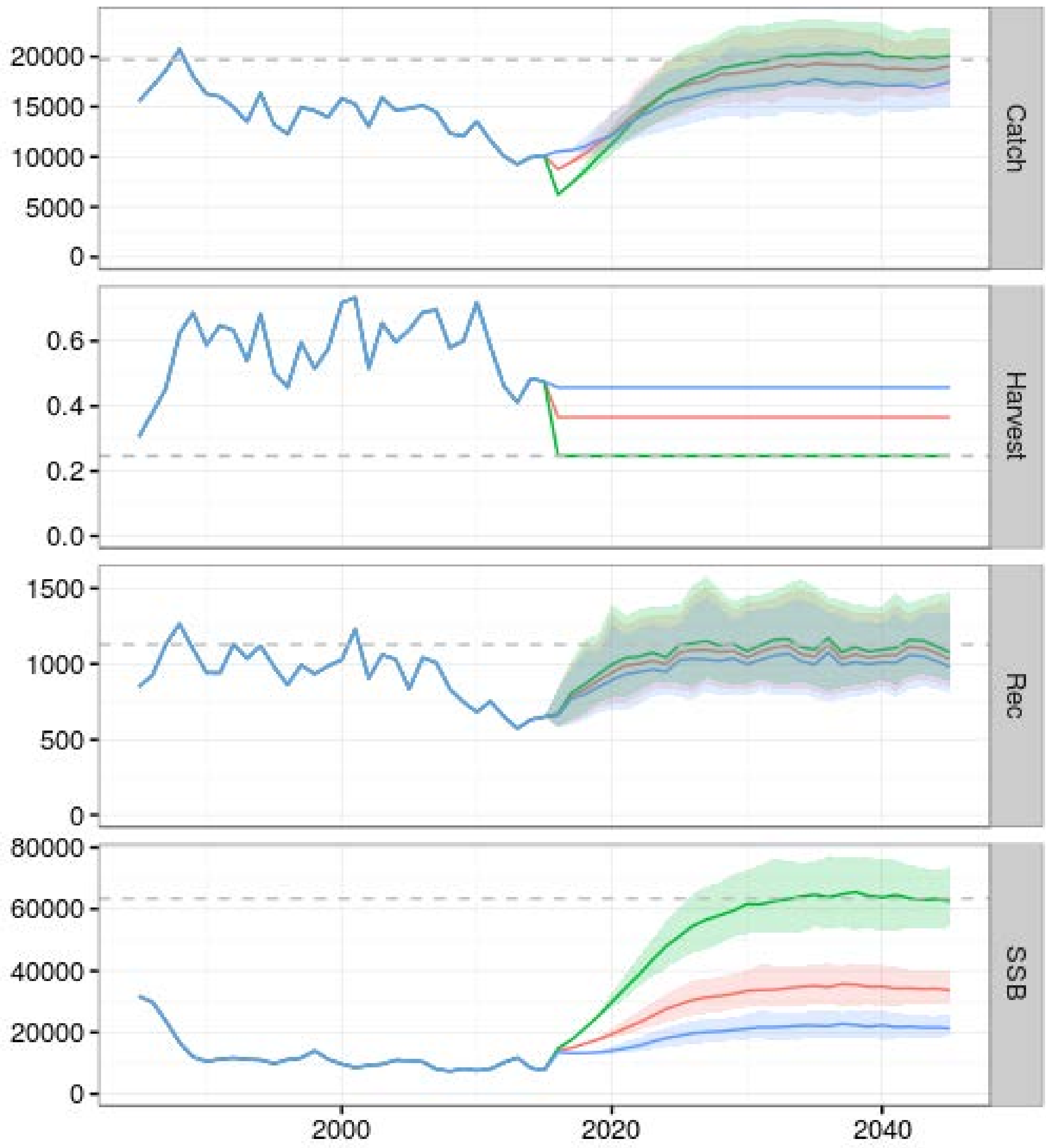
SWO-MED-Figure 4. Estimates of historic time series of recruitment (thousands of fish), SSB (t), catch (t) and average fishing mortality (harvest) of ages 2-4 from the three age structured model runs (Continuity=constant natural mortality, Discards=assuming discard rate of 4 zero-age fish/t, M=natural mortality varies with age).



SWO-MED-Figure 5. Time trends for stock status (SSB/SSB$_{MSY}$ and F/F$_{MSY}$) derived from the three Age structured model runs. (Continuity=constant natural mortality, Discards=assuming discard rate of 4 zero-age fish/t, M=natural mortality varies with age). Arrows indicate the ratio estimates at the beginning of the studied period.



SWO-MED-Figure 6. Catch numbers at age by year.



SWO-MED-Figure 7. Projections based on the current selection pattern and three different F (harvest) levels: status quo (blue), 80% of current F (red) and F_{MSY} (green). Estimates are based on the Age structured model assessment assuming a discard rate of 4 zero-age fish/t. Lines correspond to median estimates and ribbons to inter-quartiles.

9.11 SBF – SOUTHERN BLUEFIN TUNA

The Commission for the Conservation of Southern Bluefin Tuna (CCSBT) is charged with assessing the status of southern bluefin tuna. Each year the SCRS reviews the CCSBT report in order to know the research on southern bluefin tuna and the stock assessments carried out. The reports are available from the CCSBT.

9.12 SMT – SMALL TUNAS

SMT-1. Generalities

The species under the Small Tunas Species Group include the following tuna and tuna-like species:

–	BLF	Blackfin tuna (*Thunnus atlanticus*)
–	BLT	Bullet tuna (*Auxis rochei*)
–	BON	Atlantic bonito (*Sarda sarda*)
–	BOP	Plain bonito (*Orcynopsis unicolor*)
–	BRS	Serra Spanish mackerel (*Scomberomorus brasiliensis*)
–	CER	Cero (*Scomberomorus regalis*)
–	FRI	Frigate tuna (*Auxis thazard*)
–	KGM	King mackerel (*Scomberomorus cavalla*)
–	LTA	Little tunny (*Euthynnus alletteratus*)
–	MAW	West African Spanish mackerel (*Scomberomorus tritor*)
–	SSM	Atlantic Spanish mackerel (*Scomberomorus maculatus*)
–	WAH	Wahoo (*Acanthocybium solandri*)
–	DOL	Dolphinfish (*Coryphaena hippurus*)

Knowledge on the biology and fishery of small tunas is very fragmented. Furthermore, the quality of the knowledge varies according to the species concerned. This is due in large part to the fact that these species are often perceived to have little economic importance compared to other tunas and tuna-like species, and owing to the difficulties in conducting sampling of the landings from artisanal fisheries, which constitute a high proportion of the fisheries exploiting small tuna resources. The large industrial fleets often discard small tuna catches at sea or sell them on local markets mixed with other by-catches, especially in Africa. The amount caught is rarely reported in logbooks; however observer programs from purse seine fleets have recently provided estimates of catches of small tunas.

Small tuna species can reach high levels of catches and values in some years and have a very high relevance from a social and economic point of view, because they are important for many coastal communities in all areas and a main source of food. Their social and economic value is often not evident because of the underestimation of the total landing figures, due to the difficulties in data collection mentioned above. Several statistical problems are also caused by misidentification.

Scientific collaboration between ICCAT, Regional Fisheries Organizations (RFOs) and countries in the various regions is imperative to advance understanding of the distribution, biology and fisheries of these species.

SMT-2. Biology

Small tuna species are widely distributed in the tropical and subtropical waters of the Atlantic Ocean and several are also distributed in the Mediterranean Sea and the Black Sea. Some species extend their range even into colder waters, like the North and South Atlantic Ocean. They often form large schools with other small sized tunas or related species in coastal and high seas waters.

Generally, the small tuna species have a varied diet with a preference for small pelagics (e.g. clupeids, mullets, carangids, etc.). Small tunas are the prey of large tunas, marlins, sharks and marine mammals which at the same time are predators of small pelagics. The reproduction period varies according to species and areas and spawning generally takes place near the coast in oceanic areas, where the waters are warmer. A study conducted on the eastern coast of Tunisia has shown that the spawning area of the bullet tuna is offshore at the limit of the continental shelf and related to the high abundance of the zooplankton. A study recently carried out along the Gulf of Gabes (Ionian Sea-Mediterranean) indicated that the larvae of the bullet tuna were mainly concentrated between the isobaths 50 and 200 m, and the spawning grounds of this species were mainly offshore.

The growth rate currently estimated for these species is very rapid for the first two or three years, and then slows as they reach size-at-first maturity. Most small tuna species matures at small sizes, mostly between 30 and 50 cm, except wahoo for which size at first maturity varies between 92 and 110 cm. Information on the migration patterns of small tuna species is very limited, due to low tagging levels of these species. However, a new genetic study showed that there is a clear genetic heterogeneity for the bullet tuna among different geographical locations in the Mediterranean, suggesting that the population structure of this species in the Mediterranean is more complex than initially expected. In a recent preliminary genetic study conducted within SMTYP for the little tunny, it was observed a strong population structure, separating into two clades the individuals from EU-Portugal and Tunisia, and those from Senegal and Côte d'Ivoire. Also, recent studies of the population structure of Atlantic bonito in three areas - MD (Tunisia and EU-Spain); AT-NE (EU-Portugal and Morocco) and AT-SE (Senegal and Côte d'Ivoire) - showed clear differential structure, being the location of Côte d'Ivoire the most genetically differentiated location.

Within ICCAT AOTTP, a total of nearly 8,000 little tunny were tagged off West Africa and western Atlantic between August 2016 and April 2019, with nearly 600 tags being recovered. This converts to a 7% tag recovery rate. Both tag-releases and recoveries of little tunny have occurred in 'coastal' waters between Mauritania and Côte d'Ivoire. The longest "time at liberty" observed (700 days) and migrated 929 NMs. Little tunny have been tagged on both sides of the tropical Atlantic; however no cross-Atlantic movement has yet been reported, indicating rather coastal associated movements.

In 2018 and 2019, the open database provided in the 2016 Small Tunas Species Group Intersessional Meeting (Anon 2017h) (Juan-Jordá *et al*., 2016) with a thorough review of the Scombridae life history parameters was considered as a starting point for a meta-database of the Atlantic small tunas species, and the Group considered this proposal for updating and sharing parameters and useful references. The Group determined the main life history parameters to be compiled (L_{INF}, k, t0, L50, A50, L_{MAX}, a (L-W), b (L-W), batch fecundity) and, that the areas defined by ICCAT previously (ICCAT Statistical Areas Map 4) were adequate for SMT and studies should be carried based on such spatial unities.

The updated database, available for all participants and stored in the ICCAT Owncloud, allowed for data mining, based on the most reliable parameters by region for each species and, spatial visualization of current status and data gaps in the life history parameters of SMT species were provided (**SMT-Table 2**). This information will be used to assess future research needs and for running Data Limit Models, when applicable.

SMT-3. Fisheries indicators

Small tunas are exploited mainly by coastal and artisanal fisheries, substantial catches are also made as target species and as by-catch by purse seine, mid-water trawl (i.e. pelagic fisheries of West Africa-Mauritania), handline and small-scale gillnets. Unknown quantities of small tuna also comprise the incidental catches of some longline fisheries. The increasing importance of FAD fisheries in the eastern Caribbean and in other areas has improved the efficiency of artisanal fisheries in catching small tunas. Various species are also caught by the sport and recreational fisheries.

Despite the scarce monitoring of various fishing activities in some areas, all the small tuna fisheries have high social and economic relevance for most of the coastal countries concerned and for many local communities, particularly in the Mediterranean Sea, in the Caribbean region and in West Africa.

SMT-Table 1 shows historical landings of small tunas for the 1990 to 2018 period although the data for the last years are preliminary. This table does not include species reported as "mixed" or "unidentified", as was the case in the previous years, since these categories include large tuna species. Of the total 13 species included in the Small Tunas Species Group, the seven most important represent about 91% of Task I nominal catches between 1950 and 2018. These are: BON (33%), LTA (14%), FRI (13%), SSM (11%), KGM (10%), and, BRS and BLT (5% each). In 1980, there was a marked increase in the reported landings compared to previous years, reaching a first peak of 145,075 t in 1988 (**SMT-Figure 1**). Reported landings for the 1989-1995 period decreased to approximately 95,100 t in 1995, and then an oscillation in the values in the following years, with a minimum of 68,297 t in 2008 and a maximum of 162,392 t in 2016. The annual trend in the total catches by species are shown in **SMT-Figure 2**. Overall trends in the small tuna catch may mask declining trends for individual species because annual landings are often dominated by the landings of single species. These fluctuations seem to be related to unreported catches, as these species generally comprise part of the by-catch and are often discarded, and therefore do not reflect the real catch.

A preliminary estimate of the total nominal landings of small tunas in 2018 is 125,497 t. The Committee pointed out the relative importance of small tuna fisheries in the Mediterranean and the Black Sea, which account for about 27% of the total reported small tuna catches (1950 to 2018) in the ICCAT area.

Despite the recent improvements in the statistical information provided to ICCAT by several countries, the Committee noted that uncertainties remain regarding the accuracy and completeness of reported landings in all areas. There is a general lack of information on the mortality of these species as by-catch.

However, after the adoption of the ICCAT Small Tunas Research Programme (SMTYP) in 2012, significant historical catches, catch and effort and size data from the artisanal fisheries in the west of Africa (Senegal, Côte d'Ivoire and Morocco) and from the Mediterranean Sea (EU-Spain and EU-Italy) were recovered and made available to the Secretariat.

SMT-4. State of the stocks

In 2017, a Productivity and Susceptibility Analysis (PSA) was carried for the small tuna caught by longline and purse seine fisheries in the Atlantic. The study found that the top 3 stocks at risk in the Atlantic Ocean that should deserve most of the managers' attention were *E. alleteratus*, *A. solandri* and *S. cavalla*. This first analysis was very important in order to define priority species for stock assessment and biological data collection. However, this analysis will be improved by considering the 5 statistical ICCAT areas and the relevant fishing gears for each stock.

Also as an initial attempt to provide stock status of the SMT, the lengths distributions and the reference points obtained from length frequencies for the small tuna species in the Task II database, pooled by species, year and considering the South and North Atlantic are plotted in **SMT-Figure 3**. To avoid growth overfishing, catch length compositions should consist of fish at a size at which the highest yield from a cohort occurs (Lopt). While to avoid recruitment overfishing, catches should comprise almost exclusively mature individuals (i.e. fish be >L50, the length at which 50% of fish are mature). Two reference points were used, i.e. Popt and P50, the proportion of individuals in the catch size data that are greater than Lopt and L50, respectively. However, Lopt is based on a per recruit analysis which ignores recruitment dynamics, for example the age/size structure and the distribution of a population which all determine productivity and hence sustainability and the formulation of robust management advice.

These data are replotted in **SMT-Figure 4** as an example of how they could be used as indicators of growth and recruitment overfishing. For example, if Lopt is used as a target with a probability of 0.5 and a tolerance of ±0.25 to allow limited fluctuations around the target; then in **SMT-Figure 4a** green indicated that length compositions meet this target and red when exceeded. For recruitment overfishing, if 0.6 is used as a limit for P50, then any catches where less than 40% are mature fish are colored red (**SMT-Figure 4b**).

The plots show that in most cases poor yield optimization is occurring, but that recruitment overfishing is not. Although in two cases (WAH in the southern Atlantic and LTA in the North Atlantic) recruitment overfishing has increased in the recent period.

In 2018, preliminary results on the implementation of data-limited approaches for small tunas using simulation testing were provided and improved in 2019, when different approaches for the stock assessment of Atlantic and Mediterranean small tunas were carried out. Catch-based assessment models (Depletion Based Stock Reduction Analysis – DBSRA – and Simple Stock Synthesis – SSS) and Length based models (Length-based Spawning potential ratio – LSPR and Length-based integrated mixed effects model – LIME) were applied for 10 and 6 stocks, respectively. Also, the integrated assessment LIME, which used catch and length data, were applied for 6 small tuna stocks. Only LTA in the South East and WAH in the North West would show signs of overfishing for most of the models applied, deserving special attention in the future (**SMT-Table 3**).

Catch data are still incomplete for some species, regions and fleets, hampering the use of catch-based methods. At the moment, length-based methods show a more promising applicability for small tunas, although representative length distributions are still limited for some stocks. The use of length-based methods depends on how representative is the length data distribution by stock, since the size data available in T2SZ comes from different fleets with different gear selectivity. To deal with this issue, the Group recommended using length-data from all gears combined in order to get a better representation of the length distribution of the population, assigning equal weight to each fishing gear. It is important for all CPCs to report size data from all gears in order to get a representation of the length distribution of the entire population. Other length data, ideally from fishery independent surveys, could complement this information and improve the assessments.

A data-limited Management Strategy Evaluation (MSE) was also performed as preliminary exercise for WAH in the North West only. The MSE pointed out that management procedures based on catch-based methods are the most acceptable with respect a variety of performance metrics, while simulations for the length-based and fishing effort control methods did not present as satisfactory results (**SMT-Table 4**). The results from this initial exercise must be interpreted with caution because of considerable uncertainty in the parametrization of the operating model, which might strongly influence the performance of MPs.

The Group noted that PSA, Length-based model and, mainly MSE are good options in a data limited framework and that these approaches should be applied for the stocks which the assessment was not carried out yet and improve those already conducted when better data is available.

SMT-5. Outlook

There is no projection made by the Committee.

Additional work is being carried out under the SMTYP to address knowledge gaps as regards size data, stock identification and biological parameters, which are necessary for their assessment.

The Committee notes that the Atlantic Ocean Tropical tuna Tagging Programme adopted by ICCAT continued successfully tagging LTA, but more WAH should be tagged given that only one individual was recovered. The Committee also notes the need for an increase in the collection of information on recaptures of tagged fish by enhancement awareness campaigns, focusing on artisanal fisheries, particularly gillnet, small purse-seine, longline and handline.

As part of its 2020 workplan, the Committee will improve Data-Limit assessment also identifying potential management procedures and management performance measures for high-priority small tuna stocks.

SMT-6. Effect of current regulations

There are no ICCAT regulations in effect for small tunas. Several regional and national regulations are in place.

SMT-7. Management recommendations

The provision of robust management advice by the SCRS relies on accurate reporting of Task I and II data and life history parameters. However, due to the nature of small tuna fisheries (i.e. multi-gear, multi-species, artisanal fisheries, etc.), information on fisheries data is difficult to collect, however proper monitoring programs should be implemented by the CPCs. Therefore, although the Group has improved in applying a range of Data-limited models, the robustness still needs to be evaluated before they can be used to provide management advice to the Commission. Also, although the Group recognize that the use of Data-Limit models are important for small tunas as the first step for stock assessment, given the importance of some of species in terms of catches, more robust methods, such as those used for data rich species, should be applied in a near future, when more complete data are available.

SMT-Table 1. Reported landings (t) of small tuna species, by area and flag

					1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BLF	TOTAL	A+M			2719	4051	4488	3258	3395	3203	2483	4034	4756	1303	1926	1031	1937	1927	1669	1442	1548	1533	1529	1226	1152	1306	1920	1334	1497
	Landings		All gears		2719	4051	4488	3258	3395	3203	2483	4034	4756	1303	1926	1031	1937	1927	1669	1442	1548	1533	1529	1226	1152	1306	1920	1334	1497
	Discards		All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Landings		CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Brazil	38	153	649	418	55	55	38	149	1669	1	118	91	242	233	266	10	9	46	124	110	299	325	228	192	392
				Curaçao	60	50	45	45	45	45	45	45	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.France	1330	1370	1040	1040	1040	1040	1040	1040	1040	0	0	0	0	0	0	0	32	19	26	0	14	12	14	14	6
				Grenada	189	123	164	126	233	94	164	223	255	335	268	306	371	291	290	291	291	291	291	291	0	0	0	0	
				Mexico	0	0	0	0	0	0	0	12	0	10	9	10	10	12	6	7	6	9	5	4	4	4	5	4	4
				St. Vincent and Grenadines	19	20	18	22	17	15	23	24	24	0	0	0	0	0	0	0	0	0	0	11	0	0	0	5	**0**
				Trinidad and Tobago	0	0	0	0	0	0	0	0	0	5	5	5	5	5	5	5	5	5	5	5	5	0	5	5	5
				U.S.A.	492	582	447	547	707	617	326	474	334	414	675	225	831	422	649	619	622	417	599	418	585	761	1265	946	1074
				UK.Bermuda	7	4	5	4	6	6	5	4	5	9	4	5	8	7	6	7	9	8	11	11	15	20	17	17	16
				UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	**0**
				UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Venezuela	21	624	758	498	1034	1192	696	1902	1211	319	732	225	237	777	231	293	331	473	237	191	88	81	197	33	
			NCO	Cuba	223	156	287	287	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Dominica	19	30	0	0	0	79	83	54	78	42	20	38	47	29	37	45	41	37	39	37	39	24	34	0	
				Dominican Republic	239	892	892	231	158	18	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Jamaica	0	0	148	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Sta. Lucia	82	47	35	40	100	41	45	108	96	169	96	126	182	151	179	165	203	229	192	147	104	80	156	119	
	Discards		CP	Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLT	TOTAL	A+M			5300	4301	5909	3070	2309	2646	3912	5796	6041	3794	6223	4231	4090	5459	6825	5557	7952	9484	6234	7653	3916	5571	4003	3348	4055
	Landings		All gears		5300	4301	5909	3070	2309	2646	3912	5796	6041	3794	6223	4231	4090	5459	6825	5557	7952	9484	6234	7653	3916	5566	4003	3339	4043
	Discards		All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	9	12
	Landings		CP	Algerie	306	230	237	179	299	173	225	230	481	0	391	547	586	477	1134	806	970	1119	1236	577	1025	1984	1592	231	799
				Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	406	0	133	131	34	72
				Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	222	0	1	0
				EU.Croatia	22	28	26	26	26	26	0	0	0	0	0	0	0	0	0	0	8	13	9	10	12	15	15	25	37
				EU.España	1124	1472	2296	604	487	669	1024	861	493	495	1009	845	1101	3083	3389	726	3812	3227	1620	2654	749	1241	1081	2175	778
				EU.France	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**0**
				EU.Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	121	14
				EU.Greece	1400	1400	1426	1426	0	0	196	125	120	246	226	180	274	157	620	506	169	129	118	155	108	311	207	181	294
				EU.Italy	531	531	229	229	229	462	462	462	2452	1463	1819	866	0	0	342	732	574	653	613	892	0	0	0	0	966
				EU.Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**0**
				EU.Malta	1	2	3	6	1	3	1	1	0	2	8	4	11	14	12	7	11	23	3	85	14	14	11	9	12
				EU.Portugal	0	0	0	0	28	263	494	208	166	231	299	580	867	602	311	436	654	387	55	38	0	0	0	0	**0**
				Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Maroc	1726	621	1673	562	1140	682	763	256	621	246	326	50	199	35	83	336	525	237	194	237	171	811	200	0	442
				Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Russian Federation	100	0	0	0	0	0	408	1028	460	122	102	139	22	0	23	48	67	119	366	703	352	345	336	62	125
				Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	99	75	87	81	84	83	83	0	0	0	0	**0**
				Tunisie	13	14	13	32	93	45	15	2300	932	989	1760	0	0	0	0	0	0	940	935	938	920	13	23	26	136
				Turkey	77	0	0	0	0	316	316	316	316	0	284	1020	1031	993	836	1873	1081	2552	907	863	562	476	407	474	367
				U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	
			NCO	Serbia & Montenegro	0	2	6	6	6	7	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Yugoslavia Fed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Discards		CP	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	9	12
BON	TOTAL				21719	21219	25134	24417	45253	37312	27151	27637	23925	14424	15832	78767	41398	15018	16814	23710	28921	36660	48232	24823	27993	15704	54867	21259	44841
		ATL	All gears		6037	6030	7939	10340	15523	9143	5179	5400	8208	3307	4584	4391	9648	6381	6772	13691	16337	22219	8911	6458	4640	6711	10928	9462	9350
		MED	All gears		15682	15189	17195	14078	29730	28170	21972	22237	15717	11117	11248	74376	31751	8637	10042	10019	12584	14442	39321	18365	23352	8993	43938	11798	35491
	Landings	ATL	All gears		6037	6030	7939	10340	15523	9143	5179	5400	8208	3307	4584	4391	9648	6381	6772	13691	16337	22219	8911	6458	4640	6711	10928	9461	9350
		MED	All gears		15682	15189	17195	14078	29730	28170	21972	22237	15717	11117	11248	74376	31751	8637	10042	10019	12584	14442	39321	18365	23352	8993	43938	11798	35491
	Discards	ATL	All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		MED	All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Landings	ATL	CP	Angola	20	9	39	32	0	2	118	118	118	0	0	138	0	931	0	1962	1997	131	267	1134	2	3	3	2	**0**
				Barbados	0	0	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	10
				Brazil	142	137	0	0	0	0	0	0	0	0	0	90	0	0	0	0	0	171	0	38	0	1	2	1	23
				Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	539	539	539	539	0	0	0	0	**0**

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	3	0	3	0	3	13	755	3	0	26	3	16	6	3510	42
		EU.Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Denmark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		EU.España	3	2	2	1	0	12	12	10	5	23	9	2	15	14	13	36	45	57	7	44	28	10	31	18	16
		EU.Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.France	990	990	610	610	610	24	32	0	18	0	0	0	0	122	59	25	208	241	102	245	288	333	422	290	195
		EU.Germany	0	0	714	0	0	0	0	0	38	0	0	0	0	0	0	0	0	0	0	0	6	0	4	89	14
		EU.Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Ireland	0	0	0	0	0	0	0	0	0	0	48	0	0	0	0	56	125	91	108	100	0	0	0	0	**0**
		EU.Latvia	3	19	301	887	318	0	416	396	639	0	0	0	0	0	0	0	1019	2231	34	48	29	0	0	0	
		EU.Lithuania	0	0	0	0	0	0	0	0	793	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	686
		EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	344	539	539	0	2047	104	1075	54	11	124	79	39
		EU.Poland	0	0	225	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.Portugal	56	78	83	49	98	98	162	47	61	40	50	38	318	439	212	124	476	461	321	184	22	25	570	368	257
		EU.Rumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.United Kingdom	0	0	287	0	0	0	0	0	0	0	0	0	35	0	0	30	71	113	4	0	0	0	0	0	0
		Gabon	0	0	0	0	0	0	0	0	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Ghana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Grenada	0	0	24	6	14	16	7	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	59	32	0	3
		Maroc	584	699	894	1259	1557	1390	2163	1700	2019	928	989	1411	1655	1053	1419	2523	109	145	235	89	90	174	850	1417	4081
		Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	1303	839	1850	2384	6890	9463	3193	514	1052	2543	4951	52	60
		Mexico	674	1144	1312	1312	1632	1861	1293	1113	1032	1238	1066	654	1303	1188	1113	1063	1046	1080	1447	1534	1115	1110	1188	1361	1440
		Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Panama	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Russian Federation	0	0	0	0	4960	0	0	574	1441	461	16	79	316	259	52	368	1042	2293	848	125	416	308	850	666	573
		S. Tomé e Príncipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	147	149	153	158	162	267	207	211	
		Senegal	814	732	1012	1289	2213	2558	286	545	621	195	183	484	2304	1020	1380	4029	1677	2876	1453	514	1217	1711	1581	1226	1696
		Sierra Leone	0	0	0	0	0	0	11	245	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	15	18	0	16	23	27	15	6	20	0	0	0	0	0	0	**0**
		Trinidad and Tobago	703	169	266	220	30	117	117	56	452	188	280	81	7	16	38	68	68	14	9	16	16	0	16	16	16
		U.S.A.	128	116	156	182	76	83	142	120	139	44	70	68	40	97	47	50	46	66	46	50	101	96	61	62	197
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	**0**
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Uruguay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Venezuela	1661	1651	1359	1379	1659	1602	2	0	61	13	0	16	18	19	12	38	10	21	7	4	9	0	0	0	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	29	40	20	12	**0**
	NCO	Argentina	4	138	108	130	12	68	19	235	1	129	269	110	0	0	0	220	59	6	33	0	0	0	0	0	
		Benin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	0	0	0	0	230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Dominica	0	0	0	0	0	0	0	0	0	0	0	6	16	16	9	4	0	0	0	0	1	2	7	0	
		Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Germany Democratic Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Jamaica	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2
		Sta. Lucia	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Togo	254	145	197	197	197	197	0	0	0	0	1583	1215	2298	0	0	0	0	0	0	0	0	0	0	0	
		Ukraine	0	0	342	2786	1918	1114	399	231	656	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MED	CP	Albania	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Algerie	418	506	277	357	511	475	405	350	597	0	609	575	684	910	1042	976	1009	355	353	614	504	716	452	593	811
		EU.Bulgaria	0	25	33	16	51	20	35	35	35	0	0	0	0	0	0	0	16	8	96	6	5	8	68	13	23
		EU.Croatia	70	0	0	0	25	120	0	0	0	0	0	0	0	0	0	0	59	41	31	56	56	34	20	22	28
		EU.Cyprus	0	0	0	0	0	0	14	0	10	10	6	4	3	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.España	344	632	690	628	333	433	342	349	461	544	272	215	429	531	458	247	518	574	442	881	585	519	358	314	321
		EU.France	0	0	0	0	0	0	0	0	27	0	0	0	0	15	34	20	23	13	12	30	25	103	60	217	52
		EU.Greece	1581	2116	1752	1559	945	2135	1914	1550	1420	1538	1321	1390	845	1123	587	476	531	798	733	960	678	691	700	399	641
		EU.Italy	1828	1512	2233	2233	2233	4159	4159	4159	4579	2091	2009	1356	0	0	1323	1131	964	1197	472	1245	1053	750	697	540	605
		EU.Malta	0	0	2	7	2	2	1	0	1	0	1	1	11	7	7	3	6	1	3	2	0	2	3	0	2
		EU.Rumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Egypt	648	697	985	725	724	1442	1442	1128	1128	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	705	780	82	75
		Maroc	93	37	67	45	39	120	115	5	61	85	78	38	89	87	142	131	57	12	1	0	8	26	50	46	28
		Tunisie	305	413	560	611	855	1350	1528	1183	1112	848	1251	0	0	0	0	0	0	1425	1415	1413	1407	867	1290	1993	1986
		Turkey	10093	8944	10284	7810	24000	17900	12000	13460	6286	6000	5701	70797	29690	5965	6448	7036	9401	10019	35764	13158	19032	4573	39460	7578	30920
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCO	NEI (MED)	300	300	300	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

					1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
				Serbia & Montenegro	2	6	10	12	12	14	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Yugoslavia Fed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Discards	ATL	CP	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		MED	CP	EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BRS	TOTAL	A+M			7161	7006	8435	8004	7923	5754	4785	4553	7750	5137	3410	3712	3587	2253	3305	2681	1590	1055	613	853	698	389	1124	1032	696
	Landings	All gears	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
				Brazil	1149	1308	3047	2125	1516	1516	988	251	3071	2881	814	471	1432	563	1521	1042	0	3	0	6	2	1	1	1	1
				Grenada	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Trinidad and Tobago	2130	1816	1568	1699	2130	1328	1722	2207	2472	1867	2103	2720	1778	1414	1472	1498	1498	936	489	695	695	0	695	695	695
				Venezuela	3882	3882	3609	3609	3651	1766	1766	1766	1766	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	29	29	**0**
				Guyana	0	0	211	571	625	1143	308	329	441	389	494	521	377	277	312	141	92	116	124	151	0	387	399	308	
DOL	TOTAL	A+M			334	334	307	295	363	349	234	303	347	564	2632	2772	1295	4753	1042	5381	4798	7187	3647	5005	12806	16322	12695	11793	15486
	Landings		All gears		334	334	307	295	363	349	234	303	347	564	2632	2772	1295	4753	1042	5381	4798	7187	3394	4779	12625	16314	12695	11784	15480
	Discards		All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	253	226	181	7	0	9	6
	Landings		CP	Barbados	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	185	155
				Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	11	**0**
				Brazil	0	0	0	0	0	0	0	0	0	2	2159	2311	761	4270	472	4400	2899	4379	641	775	762	1218	1461	1996	1228
				Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	7	26	5
				Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	199	34	24	1482	4141
				EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	54	73	73	0	85	166	113	102	161	64	71	57
				EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	372	819	1737	1360	1474	1473	1566	2	452	985
				EU.Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	700	525	1133	971	484	546
				EU.Malta	334	334	307	295	363	349	234	303	347	507	473	447	517	274	399	395	530	349	181	385	208	334	238	243	414
				EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	18
				El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
				Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
				Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	0	0	0	0	0	0	0	0	0	**0**
				Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	0	2	6	4
				St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	155	56	118	72	96	84	86	48	0	6	105	126
				Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1	24	21	8	6
				Tunisie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	426	482	625
				U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	479	503	578	366	8093	10957	8735	5717	7092
				UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	4	3	4	5
				Venezuela	0	0	0	0	0	0	0	0	0	55	0	14	16	0	0	24	0	38	40	42	29	39	41	44	
			NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	343	307	245	0	0	0	**0**
				Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	515	0	0	0	0	**0**
			NCO	Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	278	295	186	0	
				Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	63	64	68
				Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	407	505	435	403	
	Discards		CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	9	6
				Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	253	226	181	0	0	0	
FRI	TOTAL	ATL			13332	11816	13871	13968	14332	10589	8680	10151	5738	5936	8832	6154	8429	9789	7861	12384	14215	15471	18284	17597	17149	19426	23631	15325	12142
	Landings		All gears		5300	5617	6631	8992	9531	4992	3054	4505	3889	2935	5086	2933	5918	6019	5296	8237	8633	10515	9732	11829	10941	11534	14847	11016	12082
	Landings(FP)		All gears		8031	6200	7240	4976	4801	5597	5627	5646	1849	3001	3746	3221	2511	3770	2565	4147	5582	4956	8552	5768	6208	7751	8784	4231	
	Discards		All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	0	78	60
	Landings		CP	Angola	6	21	29	12	31	2	38	38	38	0	0	0	0	95	0	63	19	59	39	22	47	2	1	0	**0**
				Belize	0	0	0	0	33	0	115	87	0	0	0	0	0	0	0	0	0	0	0	0	36	266	824	586	552
				Brazil	906	558	527	215	162	166	106	98	1117	860	414	532	603	202	149	313	204	347	259	227	293	308	271	445	282
				Cape Verde	86	13	6	22	191	154	81	171	278	264	344	300	318	378	574	1312	711	853	1811	2461	5418	3556	2324	1795	4988
				Curaçao	0	0	590	1157	1030	1159	1134	1006	713	507	497	0	150	106	485	364	0	235	238	481	1456	1151	1124	1576	1414
				Côte d'Ivoire	0	0	0	0	3	0	1	821	2	31	1356	4	354	541	14	813	161	297	38	2837	261	141	311	81	2
				EU.Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.España	297	386	947	581	570	23	17	722	438	635	34	166	73	278	631	1094	950	877	1708	1234	1200	1682	2537	1608	1033
				EU.Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.France	105	126	161	147	146	0	91	127	91	0	168	47	6	98	24	24	91	147	246	233	147	258	1201	773	715
				EU.Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	169	528	0	
				EU.Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	9	150	90	0	164	5	85	119	6	90	45	233
				EU.Portugal	0	0	0	1	31	5	9	28	5	4	7	212	3	250	13	0	0	0	0	0	0	1	2	3	1
				EU.Rumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	26	0	0	0	0	0	0	**0**

					1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
				El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	435	793	895	1157
				Ghana	0	0	0	0	33	221	118	39	31	0	3	0	2577	2134	1496	2786	3604	2295	2469	2382	0	0	0	0	**0**
				Grenada	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	98	74	81	78	48	63	0	26	0	71	63	311
				Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	1
				Guinée Rep.	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	96	94	332	503	236	0	0	0	
				Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Maroc	190	707	716	2717	2315	764	629	486	591	236	696	227	52	135	179	9	19	862	554	55	21	90	125	200	3
				Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	269	169	377	492	1420	1953	661	101	211	806	996	2	2
				Panama	341	328	240	91	0	0	0	0	0	0	394	975	970	1349	411	439	425	339	463	504	905	292	1356	1572	707
				Russian Federation	405	456	46	500	2433	477	12	25	308	56	56	63	6	6	12	113	270	912	113	217	139	249	545	389	430
				S. Tomé e Príncipe	37	48	79	223	197	209	200	200	200	200	234	215	290	0	275	149	153	298	307	315	324	636	536	467	
				Senegal	319	309	0	101	0	7	0	4	0	13	288	151	83	119	383	15	217	201	341	16	22	1407	1133	391	249
				St. Vincent and Grenadines	0	0	0	17	65	0	0	208	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Trinidad and Tobago	0	56	199	368	127	138	245	0	0	0	414	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
				Venezuela	2609	2601	3083	2839	2164	1631	210	444	34	113	182	42	165	52	48	54	215	508	85	150	71	64	70	115	
			NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	14	8	11	**0**
			NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Benin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Germany Democratic Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				NEI (ETRO)	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Ukraine	0	0	0	0	0	36	48	0	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Landings(FP)		CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	154	71	86	78	107	0	0	0	
				Cape Verde	0	0	0	0	0	0	0	0	0	0	0	144	84	200	189	188	428	130	271	256	268	0	0	0	
				Curaçao	0	0	0	0	0	0	0	0	0	0	0	29	55	29	36	225	233	139	214	149	224	0	0	0	
				Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	177	81	236	0	0	0	
				EU.España	3990	3903	4495	3449	3154	3762	3385	3580	1074	1942	2450	1327	1423	2585	1685	2636	3117	3023	5770	2792	3289	2396	2391	0	
				EU.France	4041	2297	2745	1527	1648	1836	2242	2066	775	1059	1296	1138	644	612	222	684	1214	815	1183	1466	1486	1342	1277	0	
				Guatemala	0	0	0	0	0	0	0	0	0	0	0	142	75	69	99	53	105	25	150	42	65	0	0	0	
				Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	168	0	24	37	0	174	518	542	672	441	0	0	0	
				Panama	0	0	0	0	0	0	0	0	0	0	0	274	230	251	297	261	157	230	158	234	92	0	0	0	
			NCO	Mixed flags (EU tropical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4014	5117	4231	
	Discards		CP	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	0	78	60
KGM	TOTAL	A+M			14777	14930	17782	19815	16394	17717	16342	15408	17258	15863	12830	11766	8252	17936	7344	7826	7123	6539	5862	6018	6976	5785	6379	6710	6941
	Landings	All gears	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	914	0	0	0	**0**
				Brazil	1365	1328	2890	2398	3595	3595	2344	1251	2316	3311	247	202	316	33	0	0	1	1	0	0	0	0	0	0	0
				Grenada	0	0	2	4	28	14	9	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8
				Mexico	3097	3214	4661	4661	3583	4121	3688	4200	4453	4369	4564	3447	4201	3526	3113	3186	3040	3130	3090	3335	3019	3281	3130	3233	3825
				St. Vincent and Grenadines	0	0	0	0	0	0	137	0	0	0	0	0	67	0	0	7	9	0	0	0	0	0	0	0	**0**
				Trinidad and Tobago	0	471	1029	875	746	447	432	410	1457	802	578	747	661	567	1043	1001	1001	720	393	495	496	1	494	494	494
				U.S.A.	7831	7360	7058	8720	7373	6453	6780	6603	6061	6991	7129	7123	2837	13482	3013	3541	3011	2610	2283	1948	2544	2143	2436	2784	2613
				UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	**0**
				Venezuela	2484	2558	2140	2139	340	2424	2424	2424	2424	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	2	2	4	5	**0**
				Guyana	0	0	0	270	440	398	214	239	267	390	312	245	168	326	174	91	59	75	90	99	0	358	314	192	
			NCO	Antigua and Barbuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Dominica	0	0	0	0	0	36	35	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Dominican Republic	0	0	0	589	288	230	226	226	226	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Jamaica	0	0	0	155	0	0	44	48	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Sta. Lucia	0	0	1	4	0	0	9	1	1	0	1	1	1	2	0	1	3	4	1	1	0	0	0	0	
LTA	TOTAL				14399	12276	11569	14405	15719	12281	15319	16943	16723	16997	16357	11915	9925	18159	14213	16270	22428	24673	19574	20501	14224	26226	32599	31769	21884
		ATL	All gears		13202	10381	9453	12804	12804	9405	11830	13955	14080	16313	14918	10873	8320	16472	11954	14170	20258	21005	15389	15868	10619	19652	22811	16623	15001
		MED	All gears		1197	1894	2116	1601	2914	2876	3489	2988	2643	684	1439	1042	1605	1687	2259	2100	2170	3668	4186	4633	3605	6574	9788	15147	6883
	Landings	ATL	All gears		10906	9655	8779	11910	11732	8670	10258	11566	13476	14947	13352	10172	7417	13962	10137	12137	16781	16837	11770	12117	7968	10958	12391	9979	14936
		MED	All gears		1197	1894	2116	1601	2914	2876	3489	2988	2643	684	1439	1042	1605	1687	2259	2100	2170	3668	4186	4633	3605	6574	9788	15147	6883
	Landings(FP)	ATL	All gears		2296	726	675	894	1073	735	1571	2389	604	1366	1566	702	903	2510	1817	2033	3477	4168	3619	3751	2651	8490	10420	6536	
	Discards	ATL	All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	204	0	107	64
		MED	All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Landings	ATL	CP	Angola	121	117	235	75	406	118	132	132	132	0	0	2	0	4365	0	128	1759	3455	1905	1085	10	6	1	4	3
				Brazil	1225	1059	834	507	920	930	615	615	615	0	320	280	0	0	0	0	0	22	581	0	0	0	0	0	34

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Cape Verde	23	72	63	86	110	776	491	178	262	143	137	81	123	292	250	357	185	102	131	131	131	131	218	113	105
			Curaçao	0	0	0	0	0	0	0	0	5	9	0	0	0	0	0	0	38	38	76	57	0	0	0	0	**0**
			Côte d'Ivoire	251	253	250	155	136	9	123	1	0	0	153	287	427	2159	1791	1446	1631	50	1062	1433	152	102	111	1881	7583
			EU.España	0	10	55	27	110	6	2	22	8	1	489	50	16	0	38	35	136	168	71	52	112	381	477	185	148
			EU.Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.France	54	59	22	215	21	696	631	610	613	0	10	27	12	0	1	50	35	5	30	27	6	29	217	359	268
			EU.Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	14	69	8	0	18	1	9	0	0	0	0	**0**
			EU.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Portugal	72	72	218	320	171	14	50	0	2	16	19	21	24	43	10	6	5	14	4	18	0	0	7	31	35
			EU.Rumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	15	23	38	0	0	0	0	0	**0**
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46
			Gabon	0	0	182	0	18	159	301	213	57	173	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Ghana	994	513	113	2025	359	306	707	730	4768	8541	7060	5738	783	1335	745	1692	1465	1001	1274	1138	0	0	0	0	**0**
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120	15	45
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	10
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	673	256	176	101	78	151	212	2
			Maroc	43	230	588	195	189	67	101	87	308	76	91	33	0	40	2	63	5	57	10	11	3	0	11	12	**0**
			Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	670	423	943	1222	3549	4878	1634	252	529	1287	2478	1	1
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Russian Federation	189	96	49	0	88	0	0	0	74	13	0	0	0	0	0	0	268	11	208	399	255	136	547	433	698
			S. Tomé e Príncipe	40	43	40	50	39	37	33	33	33	33	178	182	179	0	183	188	193	198	203	209	214	182	122	249	
			Senegal	4536	3613	1972	4174	4715	1607	3546	5176	2866	4394	3508	2699	3826	3885	5108	5683	6371	4910	2769	5912	3774	5065	4855	3841	3672
			South Africa	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	15	**0**
			Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			U.S.A.	1142	1312	2230	2015	1546	1623	1209	1451	1366	1492	1382	765	1351	1401	963	1244	1120	1201	1507	1191	2661	3537	3019	2577	2286
			U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			UK.Bermuda	6	6	7	6	5	4	2	1	5	4	5	7	5	5	4	3	4	5	6	3	3	4	2	1	1
			Venezuela	2115	2115	1840	1840	2815	2247	2247	2247	2254	50	0	0	0	0	30	4	2	8	4	1	4	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	16	54	48	**0**
		NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Benin	60	58	58	196	83	69	69	69	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	15	27	23	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	
			Germany Democratic Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Israel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (ETRO)	20	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	0	0	0	2	2	2	0	1	10	1	0	0	1	0	0	0	0	0	0	1	0	2	0	1	
	MED	CP	Algerie	459	552	554	448	384	562	494	407	148	0	158	116	187	96	142	119	131	98	6	157	341	204	268	444	298
			EU.Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Croatia	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	28	25	44	37	43	31	19	42
			EU.Cyprus	23	10	19	19	19	16	19	19	19	0	0	0	0	6	5	4	0	0	0	0	0	0	0	0	**0**
			EU.España	0	15	18	9	15	0	8	82	32	0	41	262	116	202	212	86	299	488	441	235	300	456	384	486	289
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	42	0	0	0	1	0	0	**0**
			EU.Greece	0	0	0	0	0	0	195	125	132	0	0	112	69	72	183	148	165	301	276	363	289	271	501	299	489
			EU.Italy	0	0	0	0	0	0	0	0	16	24	38	34	0	0	486	243	365	304	669	557	442	0	992	930	1032
			EU.Malta	0	0	0	0	0	0	0	0	1	1	1	1	3	2	5	3	7	5	21	9	4	7	1	6	6
			Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	849	712	0	0	0	**0**
			Libya	0	0	0	45	52	0	5	4	4	0	0	0	0	0	0	0	0	0	0	0	0	102	1100	48	80
			Maroc	0	1	0	1	14	8	0	0	3	1	0	9	0	331	19	24	1	0	0	0	0	0	3	0	**0**
			Syria	156	155	270	350	417	390	370	370	330	0	0	0	0	193	133	163	148	155	304	229	0	0	0	0	**0**
			Tunisie	204	696	824	333	1113	752	1453	1036	960	657	633	0	0	0	0	0	0	810	800	803	798	5165	6323	12434	4032
			Turkey	0	0	0	0	500	750	750	750	750	0	568	507	1230	785	1074	1309	1046	1437	1645	1386	682	326	184	480	617
		NCO	Israel	119	215	119	119	119	119	119	119	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (MED)	200	200	200	200	200	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Palestine	0	0	90	59	61	60	60	60	129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Serbia & Montenegro	21	35	22	18	20	18	16	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Yugoslavia Fed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings(FP)	ATL	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	223	51	238	144	133	0	0	0	
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	45	76	265	214	189	262	266	179	438	178	0	0	0	
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	39	42	50	160	185	167	209	284	284	0	0	0	
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	162	56	12	0	0	0	

					1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
				EU.España	1127	454	284	353	295	194	751	1197	209	656	508	206	213	1253	944	1181	1320	2067	1105	732	1182	2095	2065	0	
				EU.France	1169	272	391	540	777	541	821	1192	396	710	1058	367	205	262	122	241	901	1061	675	693	565	673	1169	0	
				Guatemala	0	0	0	0	0	0	0	0	0	0	0	35	178	92	118	17	121	43	126	145	64	0	0	0	
				Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	15	0	21	2	0	358	260	666	1186	202	0	0	0	
				Panama	0	0	0	0	0	0	0	0	0	0	0	35	191	577	368	228	106	250	259	72	30	0	0	0	
			NCO	Mixed flags (EU tropical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5722	7187	6536	
	Discards	ATL	CP	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	204	0	107	64
			NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		MED	CP	EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MAW	TOTAL	A+M			1278	1953	2910	1475	1496	971	1321	881	1393	646	352	480	571	847	616	684	2384	1333	1128	3016	1460	1242	3206	1286	7066
	Landings	All gears	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	1650	249	221	1247	0	3	1	2	1
				Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	2	0	66	0	0	1	0	0	0	90	35	47	76	122	5827
				EU.Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	**0**
				EU.Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1717	0	**0**
				EU.Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				EU.Lithuania	0	0	0	0	0	0	0	0	298	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	10	0	0	0	0	0	0	**0**
				Gabon	140	145	79	60	85	61	102	53	48	82	67	37	87	93	17	22	30	34	46	42	13	37	21	56	87
				Ghana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	207	319	176	203	275	193	152	110	434	493	524	164	191
				Russian Federation	0	0	0	0	14	0	0	0	0	15	0	0	1	0	0	0	0	0	0	0	4	0	0	0	**0**
				S. Tomé e Príncipe	6	6	8	7	8	5	6	6	6	6	21	12	13	0	91	93	96	98	100	102	105	13	11	72	
				Senegal	938	1614	2635	1046	878	700	987	617	794	532	262	431	196	435	329	278	331	749	610	1426	870	649	856	870	961
				U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NCO	Benin	194	188	188	362	511	205	205	205	205	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Germany Democratic Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Ukraine	0	0	0	0	0	0	21	0	42	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SSM	TOTAL	A+M			14490	13697	16571	15403	8877	9837	8220	8383	9414	9793	8119	10472	6308	6118	5900	6199	5994	5940	5190	5473	3883	4091	3848	3727	4331
	Landings	All gears	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	**0**
				EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	3	14	18	11	16	6	4
				EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	1	26	16	0	2	20	7	2	0	0	0	1	0	**0**
				Gabon	0	0	0	0	0	0	0	0	265	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Grenada	2	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Mexico	8300	7673	11050	11050	5483	6431	4168	3701	4350	5242	3641	5723	3856	3955	4155	4251	4128	4026	3321	3581	3857	4077	3820	3701	4321
				Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				U.S.A.	4380	3363	2866	3509	2968	3282	3893	4524	4613	4552	4477	4747	2425	2147	1746	1946	1846	1896	1864	1877	7	1	5	7	6
			NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	11	**0**
			NCO	Colombia	69	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Cuba	409	548	613	613	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Dominican Republic	1330	2042	2042	231	191	125	158	158	158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Sta. Lucia	0	0	0	0	0	0	0	1	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
WAH	TOTAL	A+M			2143	2408	2516	3104	2497	2972	2035	2318	2226	2067	2613	2467	1829	2581	2176	2354	2086	2500	3716	5396	3526	2552	17315	6871	6431
	Landings		All gears		2143	2408	2516	3104	2497	2972	2035	2318	2226	2067	2613	2110	1650	2296	1604	1883	1816	2023	3527	5289	3439	2546	17315	6856	6416
	Landings(FP)		All gears		0	0	0	0	0	0	0	0	0	0	0	357	179	285	572	471	269	477	85	0	0	0	0	0	
	Discards		All gears		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	104	108	86	6	0	14	15
	Landings		CP	Barbados	82	42	35	52	52	41	41	0	0	34	45	26	41	36	27	17	30	29	22	21	17	10	11	10	7
				Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	29
				Brazil	26	1	16	58	41	0	0	0	0	405	519	449	111	75	76	70	19	357	213	477	153	312	404	322	150
				Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Cape Verde	361	408	503	603	429	587	487	578	500	343	458	449	555	524	351	472	470	470	445	445	445	445	490	228	298
				Curaçao	250	230	230	230	230	230	230	230	230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	16	3	1	11	0	5	5	12	9	95	1	25	1	1	1
				EU.España	20	15	25	25	29	28	32	38	46	48	305	237	110	66	38	73	53	87	35	50	41	50	59	51	79
				EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	46	45	38	159	61
				EU.Portugal	0	0	0	0	0	0	0	0	0	0	1	0	3	0	4	3	9	8	10	2	0	0	0	0	0
				EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Grenada	46	49	56	56	59	82	51	71	59	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	14	21	9	0	11
				Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6
				Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	0	0	0	0	0	0	0	**0**
				Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	263	48	1591	46	122	13678	4271	4975
				Mexico	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	16	12	18	15	12
				Panama	0	0	0	0	0	0	0	0	0	0	0	0	91	240	120	86	111	99	210	373	228	0	109	0	77
				S. Tomé e Príncipe	39	46	80	52	56	62	52	52	52	52	94	88	76	0	131	235	241	247	254	260	266	100	70	172	

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Senegal	0	0	1	0	0	5	0	0	0	5	0	1	1	0	0	2	6	0	11	24	0	3	7	0	0
		South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		St. Vincent and Grenadines	28	16	23	10	65	52	46	311	17	40	60	0	241	29	24	31	40	31	5	32	24	9	11	126	82
		Trinidad and Tobago	0	0	0	1	1	1	2	1	9	7	6	6	7	6	6	5	5	7	9	9	9	9	10	8	7
		U.S.A.	391	764	608	750	614	858	640	633	846	789	712	558	89	1123	495	522	358	240	399	207	1027	1153	2060	1204	530
		UK.Bermuda	50	93	99	105	108	104	61	56	91	87	88	83	86	124	117	101	81	100	88	75	76	86	95	92	68
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	0	4	1	1	0	0	**0**
		UK.Sta Helena	26	25	23	19	10	15	15	22	25	18	17	11	20	13	18	29	19	31	12	16	16	10	15	16	9
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Venezuela	542	540	487	488	360	467	4	17	13	9	7	16	13	33	9	25	28	23	38	32	27	30	64	51	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1132	1012	810	0	0	0	**0**
		Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
		Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	588	415	0	0	0	0	**0**
	NCO	Antigua and Barbuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Aruba	125	40	50	50	50	50	50	50	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Benin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Dominica	59	58	58	58	58	50	46	11	37	10	6	8	15	14	16	10	13	13	0	0	20	10	10	0	
		Dominican Republic	0	0	0	325	112	31	35	35	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	7	6	7	0	0	0	0	0	0	0	0	0	6	9	14	13
		Sta. Lucia	98	80	221	223	223	310	243	213	217	169	238	169	187	0	171	195	199	0	0	148	155	87	147	110	
Landings(FP)	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	40	0	0	0	0	0	0	
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	92	9	55	60	22	29	25	4	0	0	0	0	0	
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	13	7	31	57	23	78	9	0	0	0	0	0	
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	
		EU.España	0	0	0	0	0	0	0	0	0	0	0	92	63	44	224	262	136	240	56	0	0	0	0	0	
		EU.France	0	0	0	0	0	0	0	0	0	0	0	28	10	3	16	26	26	17	0	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	68	11	21	28	7	0	8	0	0	0	0	0	0	
		Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	10	0	8	15	7	0	0	0	0	0	0	0	0	
		Panama	0	0	0	0	0	0	0	0	0	0	0	39	44	104	102	65	13	66	15	0	0	0	0	0	
	NCO	Mixed flags (EU tropical)	0	0	0	0	0	0	0	0	0	0	0	28	30	44	97	26	39	0	0	0	0	0	0	0	
Discards	CP	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	14	15
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	104	108	86	0	0	0	

SMT-Table 2. Three 3 color classification indicating the missing parameters by species and areas. Grey squares represent the area where the species does not occur or is not exploited.

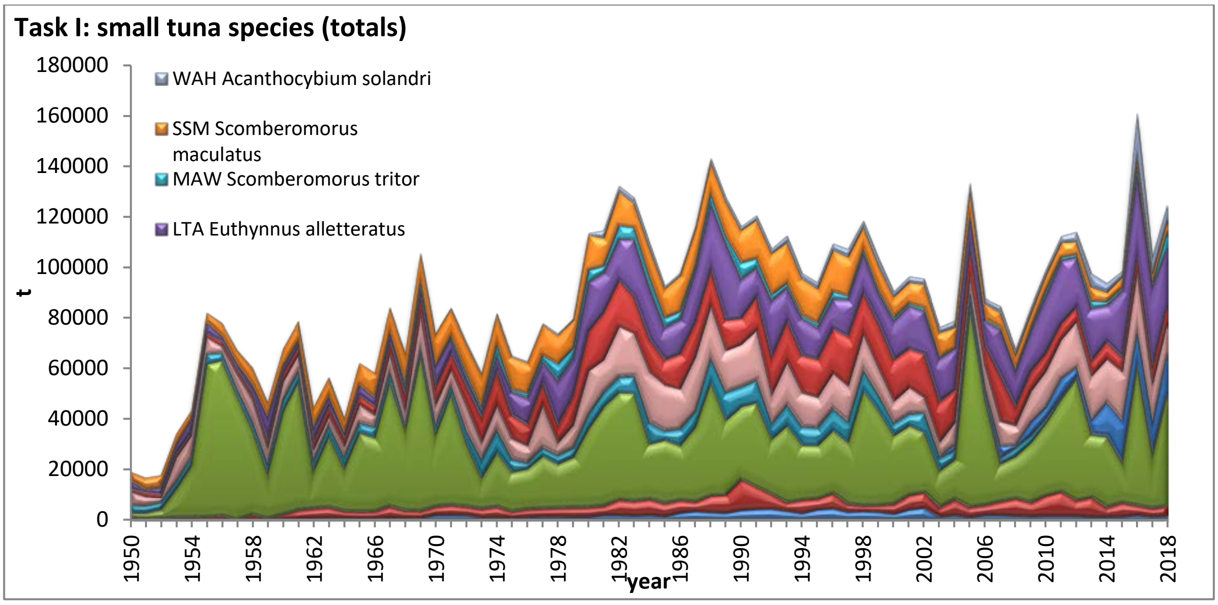
Species code	Areas				
	MEDI	NE	SE	NW	SW
BLF	out of range	out of range	out of range	Miss Tmax, T50 and Fmb	Miss Tmax, T50 and Fmb
BLT	Have all	miss L50, T50 and Fmb	miss a,b, Lmax Fmb	Miss all	Miss all
FRI	Miss all	Miss everything except Lmax and a,b,	Miss Lmax, L50, T50 and Fmb, a e b	Miss all	miss: Linf, K, t0, Tmax, T50, L50, Fmb
LTA	Have all	Miss T50, fmb	Miss all	Miss Fmb and T50	miss: Lmax, Linf, K, t0, Tmax, T50, L50, Fmb
BON	Have all	Miss T50, fmb	Miss all	Miss all	miss: Lmax, Linf, K, t0, Tmax, T50, L50, Fmb
BOP	Miss Fmb	miss: Linf, K, t0, Tmax, T50, L50, Fmb, a e b	Miss all	out of range	out of range
WAH	out of range	nf, K, t0, Tmax,	Miss all	Have all	miss: Linf, K, t0, Tmax, T50
BRS	out of range	out of range	out of range	Miss Fmb	Miss Fmb and T50
KGM	out of range	out of range	out of range	Have all	Miss Fmb
SSM	out of range	out of range	out of range	Miss Fmb	Miss all
CER	out of range	out of range	out of range	miss: Linf, K, t0, Tmax, T50, Fmb	Miss all
MAW	Miss all	miss: t0, Tmax, T50, Fmb	Miss all except Lmax	out of range	out of range
DOL	Miss Lmax, T50 and Fmb	Miss all except a and b	Miss all except Linf and k	Miss Lmax, T50 and Fmb	Miss L50, a,b, max, T50 and Fmb

SMT-Table 3. Summary of the current state of knowledge on the current stock status for small tunas in the Atlantic Ocean and the Mediterranean. Results taken from Pons *et al.* 2019. Red indicates values below reference levels (overfished) and green above reference values (not overfished).

Data limited Assessments							
	Last year assessed	Length based			Catch based		Catch+Length
		LBSPR	LIME	LBSPR	DBSRA	SSS	LIME
		Pons et al (2019a)		Baibat et al. (2019)	Pons et al. (2019b)		
		SPR	SPR		B/BMSY	B/BMSY	B/BMSY
LTA_SE	2014-2016	0.13	0.27	--	0.69	0.94	1.83
BON_NE	2014-2016	0.23	0.71	0.34	1.63	1.98	2.02
WAH_NW	2014-2016	0.37	0.29	--	1.02	1.34	0.86
WAH_NE	2014-2016	0.55	0.38	--	--	--	--
BON_Med	2014-2016	0.59	0.22	--	--	--	--
LTA_Med	2014-2016	0.66	0.62	--	1.88	2.33	1.08
LTA_NW	2014-2016	0.66	0.48	--	--	--	--
FRI_SE	2014-2016	0.79	0.53	--	1.79	2.65	1.10
FRI_NE	2014-2016	0.83	0.46	--	1.64	2.50	1.29
LTA_NE	2014-2016	0.90	1.00	--	--	--	--

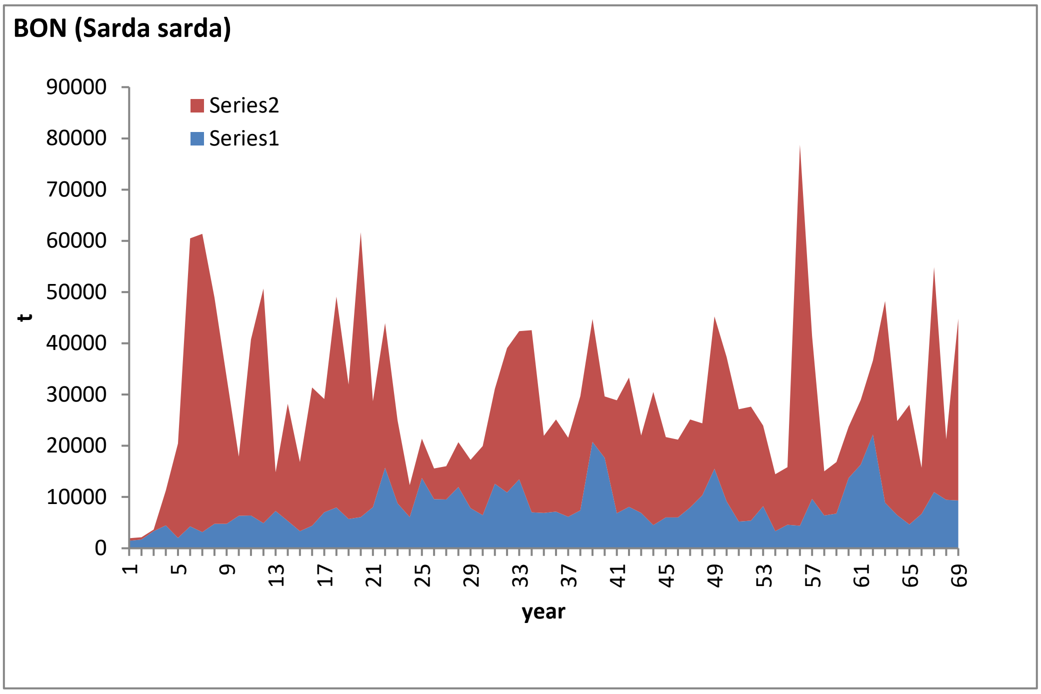
SMT-Table 4. Summary of the Northwest Atlantic wahoo management strategy evaluation results for selected MPs using the DLMtool package (Anon. 2019f). Color cells coding is used to denote if the particular MP falls within acceptable performance metric criteria (green – acceptable and red – not satisfied). Probability of not overfishing (**PNOF**; $F<F_{MSY}$); probability of spawning biomass being higher than half of spawning biomass at maximum sustainable yield (**P50**; SB>0.5 SB_{MSY}); probability of spawning biomass being higher than spawning biomass at maximum sustainable yield (**P100**; SB>SB_{MSY});probability of average annual variability in yield being lower than 20% (**AAVY**; Prob. AAVY < 20%); probability of average yield being higher than half of reference yield (**LTY**; Prob. Yield > 0.5 Ref. yield). Acceptable management procedures were defined as those that supported **PNOF**>70%, **P50**>90%, **P100**>70%, **AAVY**>50% and **LTY**>50%.

Management Procedures	PNOF	P50	P100	AAVY	LTY
Length-based methods					
LBSPR	0.74	0.93	0.65	0.120	0.86
minlenLopt1	0.75	0.95	0.72	0.110	0.83
matlenlim	0.75	0.96	0.74	0.095	0.81
Catch-based methods					
AvC	0.70	0.95	0.76	0.630	0.78
CC1	0.71	0.95	0.76	0.640	0.76
SPMSY	0.81	0.98	0.86	0.110	0.43
DBSRA	0.61	0.98	0.81	0.450	0.74
Fishing effort control methods					
curE	0.75	0.93	0.66	0.130	0.85
curE75	0.87	0.97	0.78	0.150	0.80

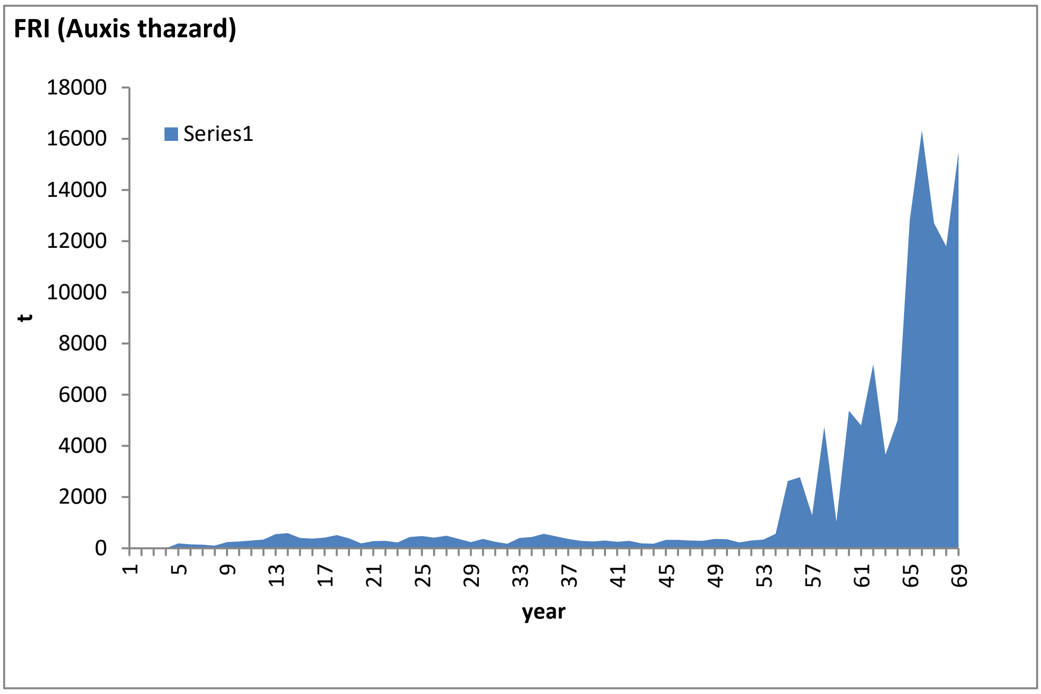


SMT-Figure 1. Estimated landings (t) of small tunas (combined) in the Atlantic and Mediterranean, 1950-2018. The data for the last three years are incomplete.

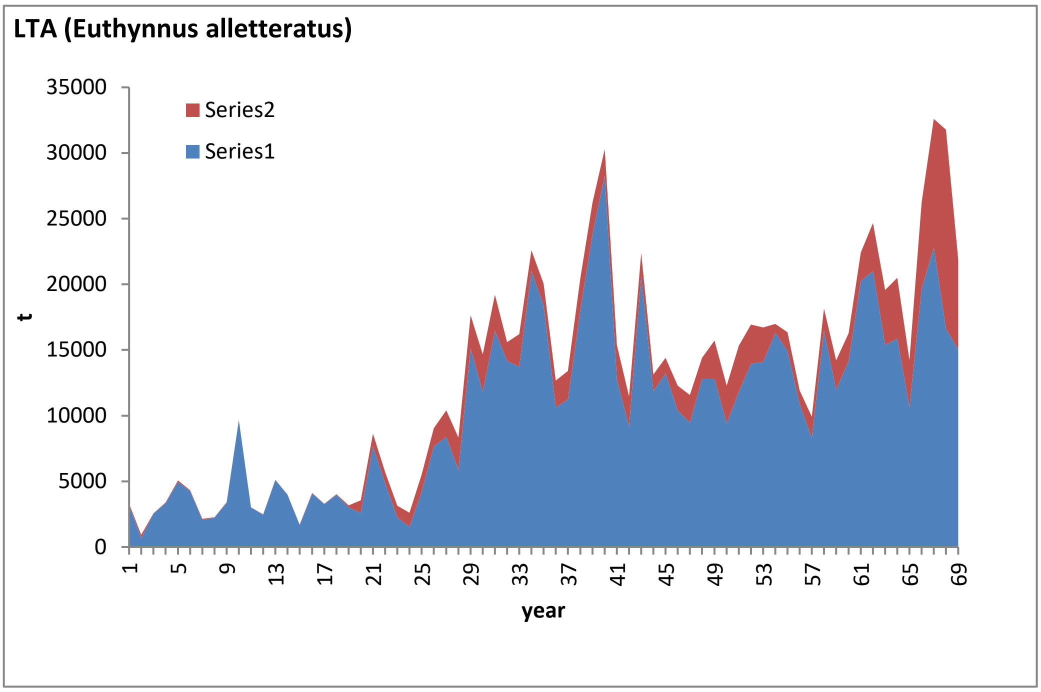
a)

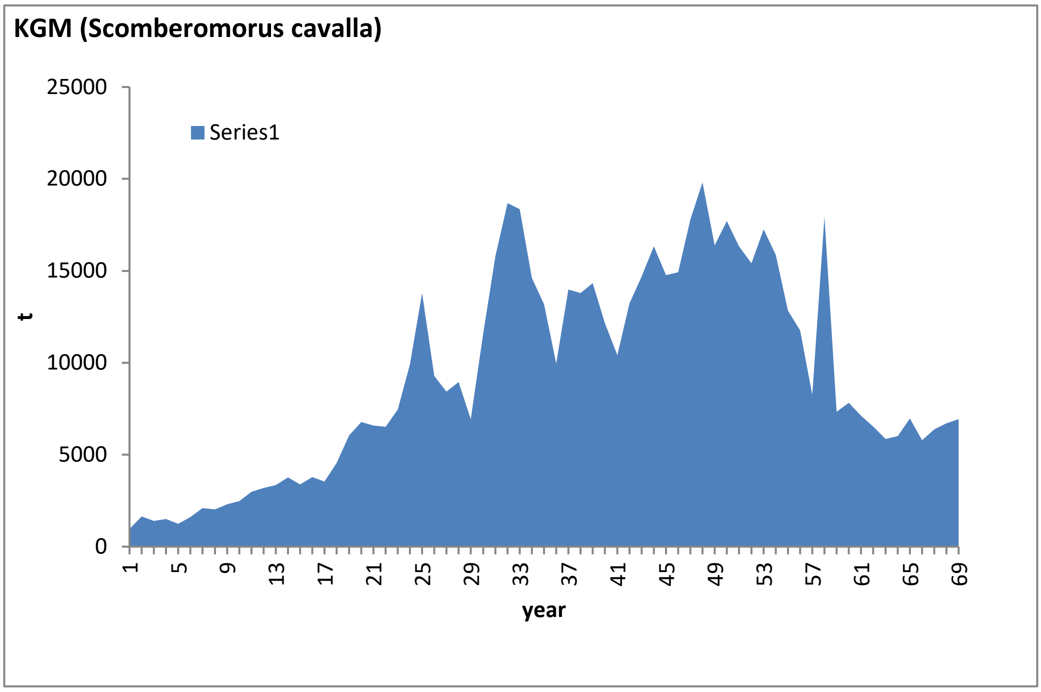


b)



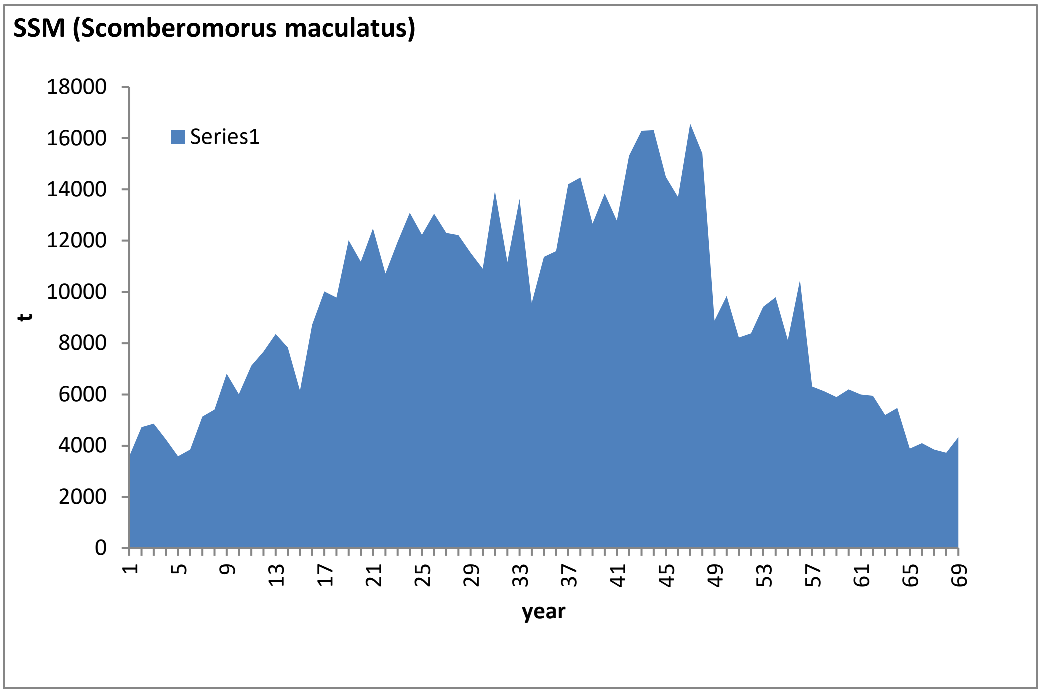
SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2018. The data for the last years are incomplete.

c)


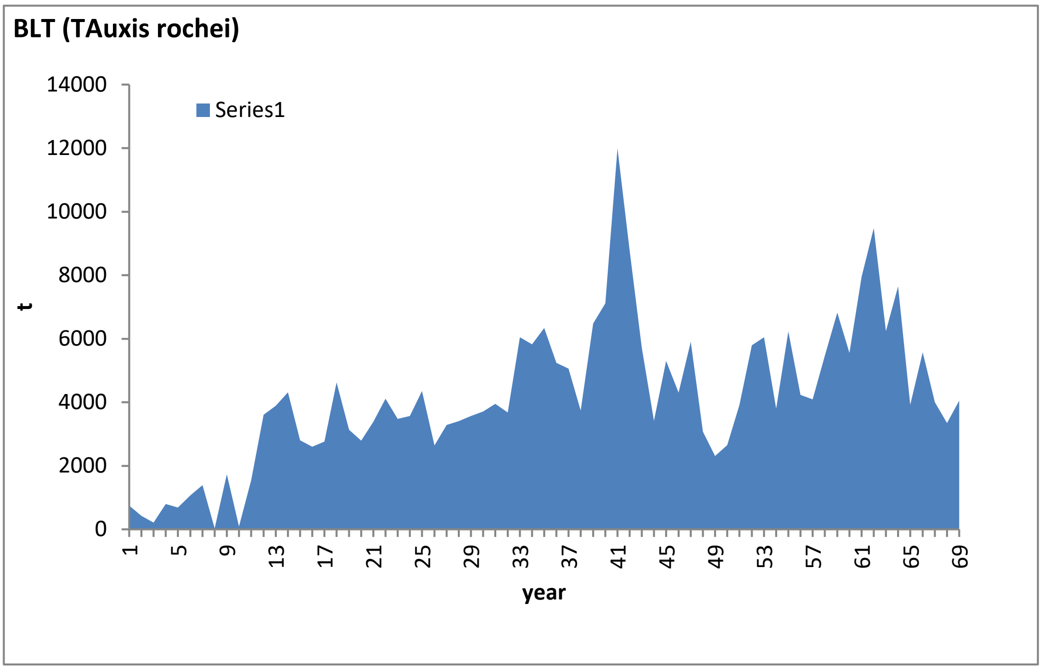
d)


SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2018. The data for the last years are incomplete.

e)

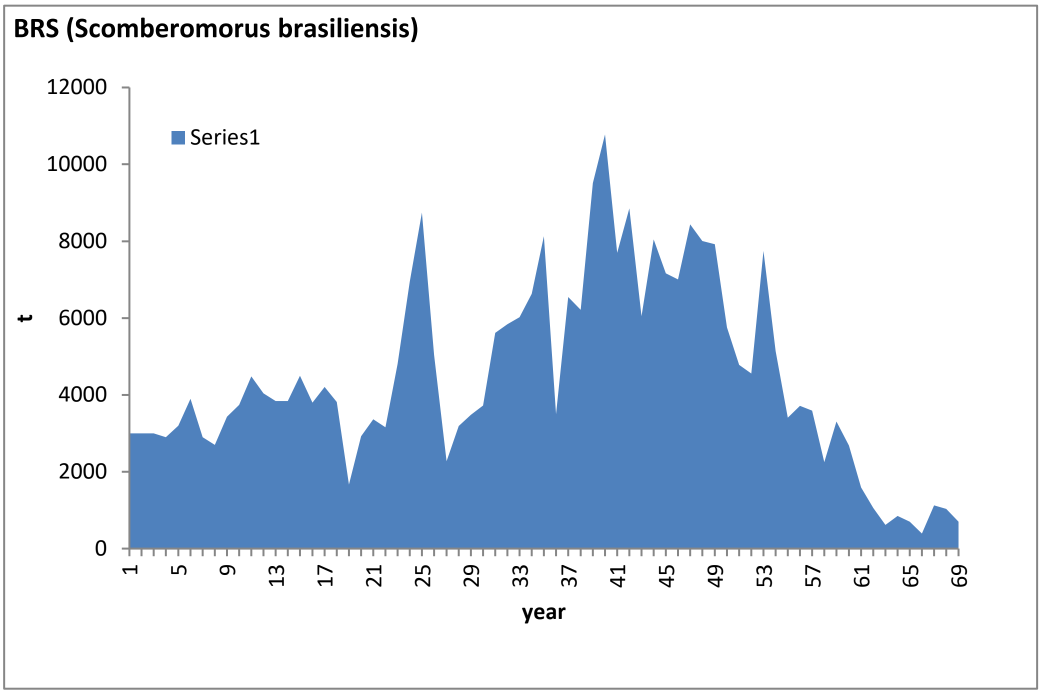


f)

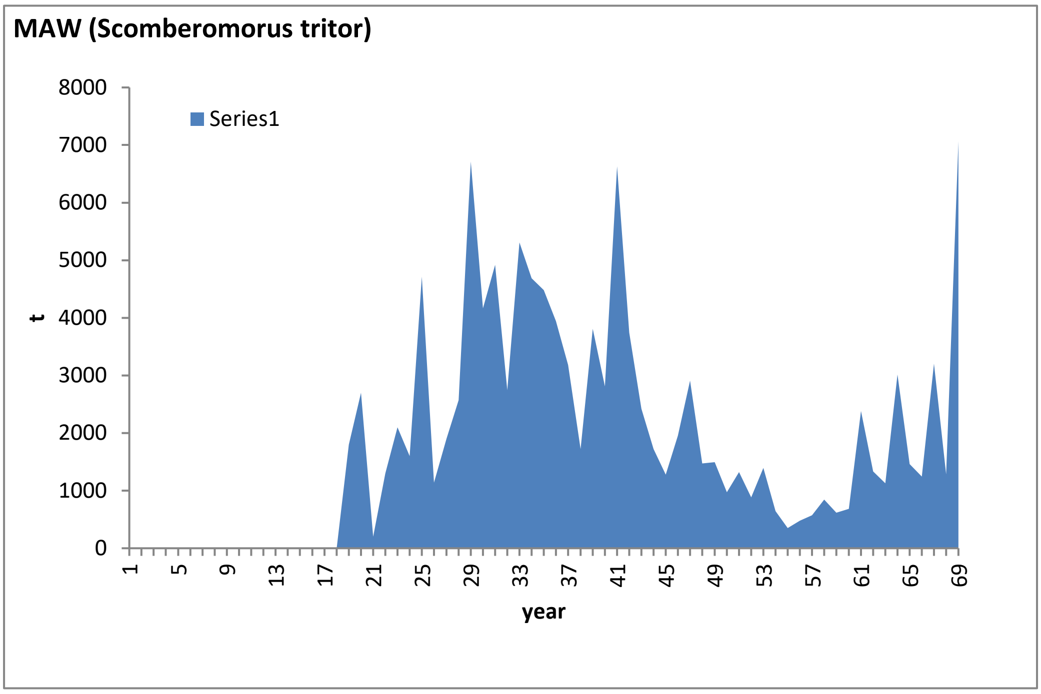


SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2018. The data for the last years are incomplete.

g)

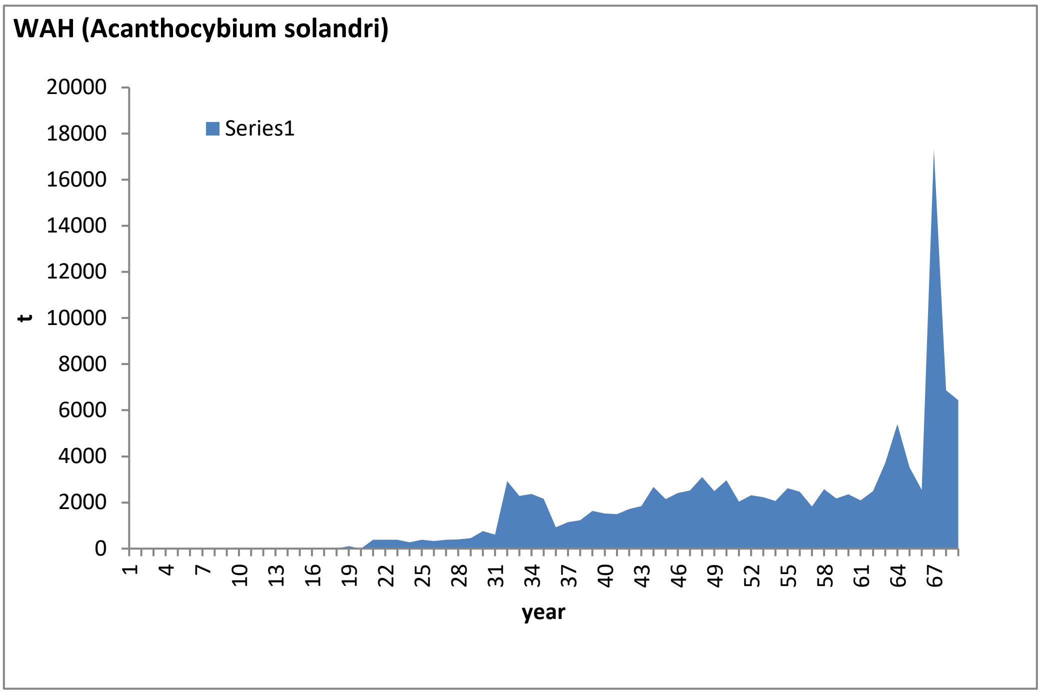


h)

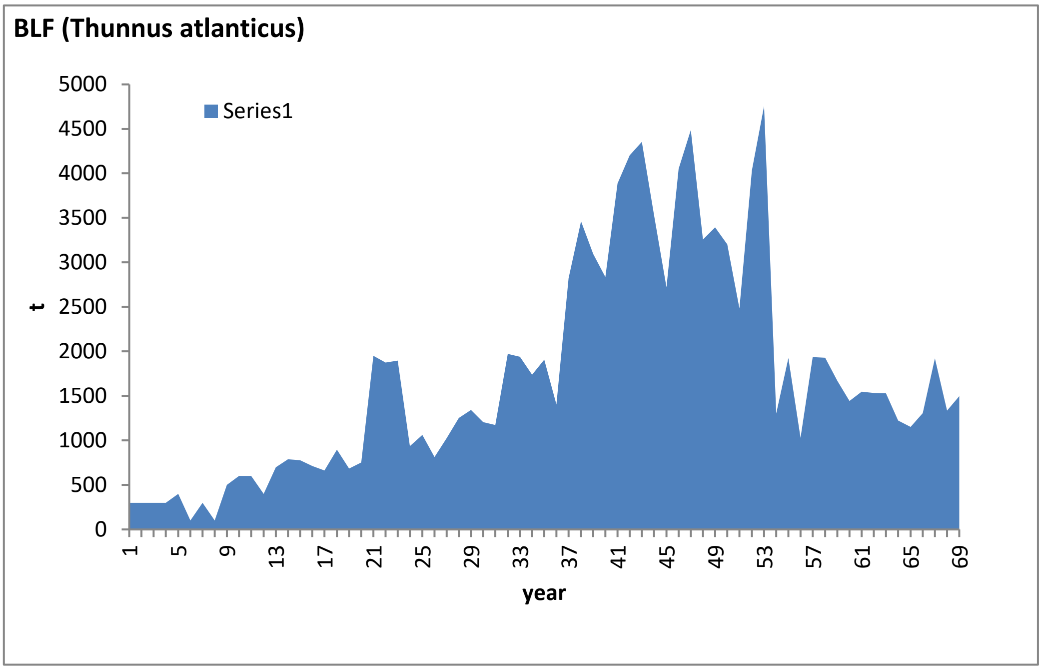


SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2018. The data for the last years are incomplete.

i)

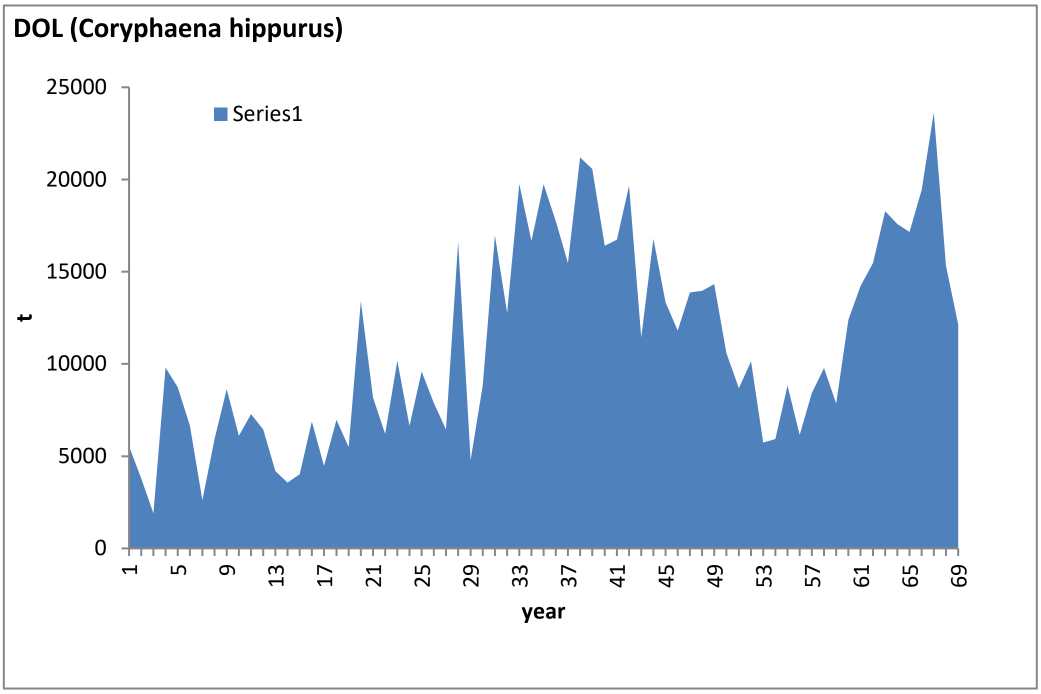


j)

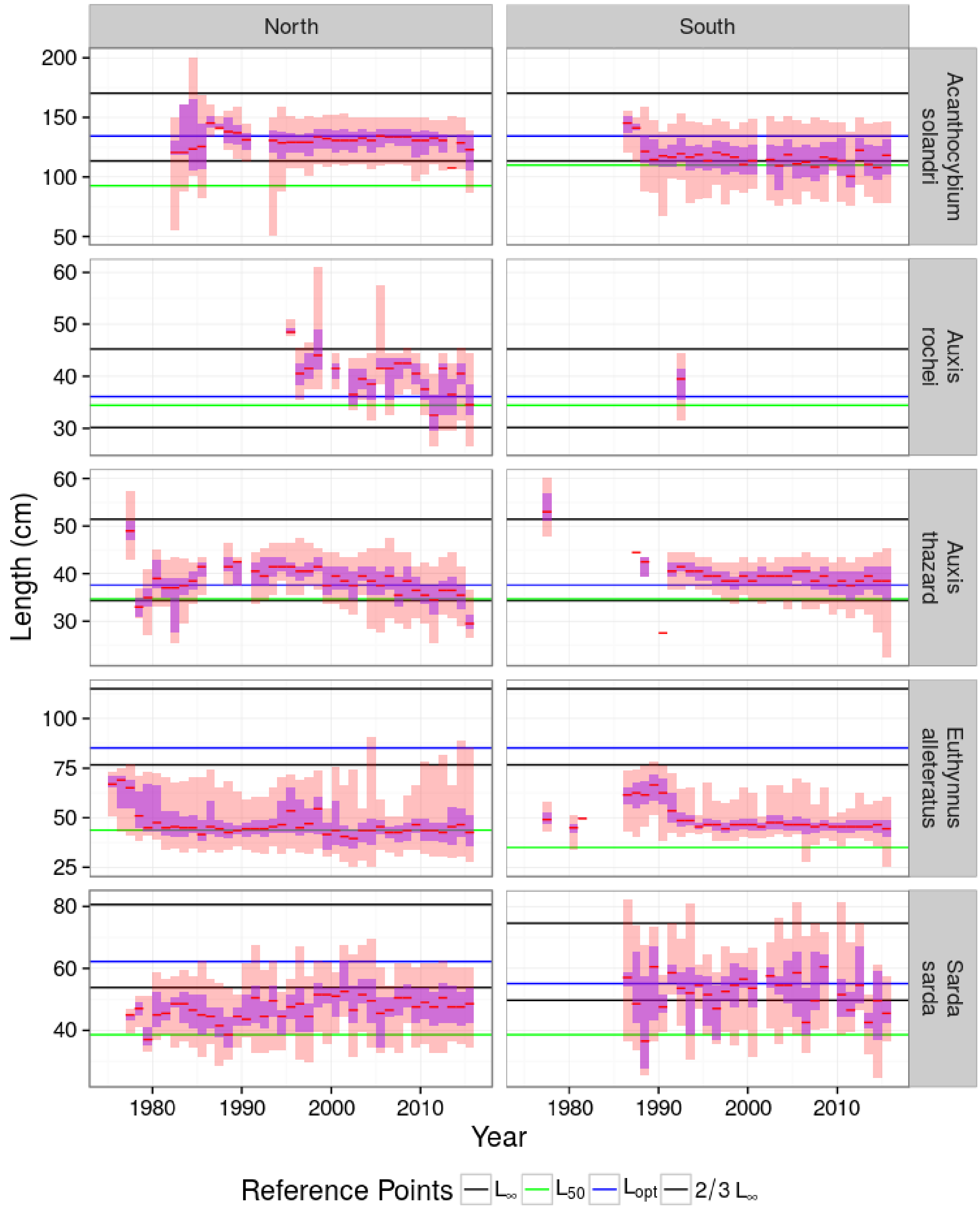


SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2018. The data for the last years are incomplete.

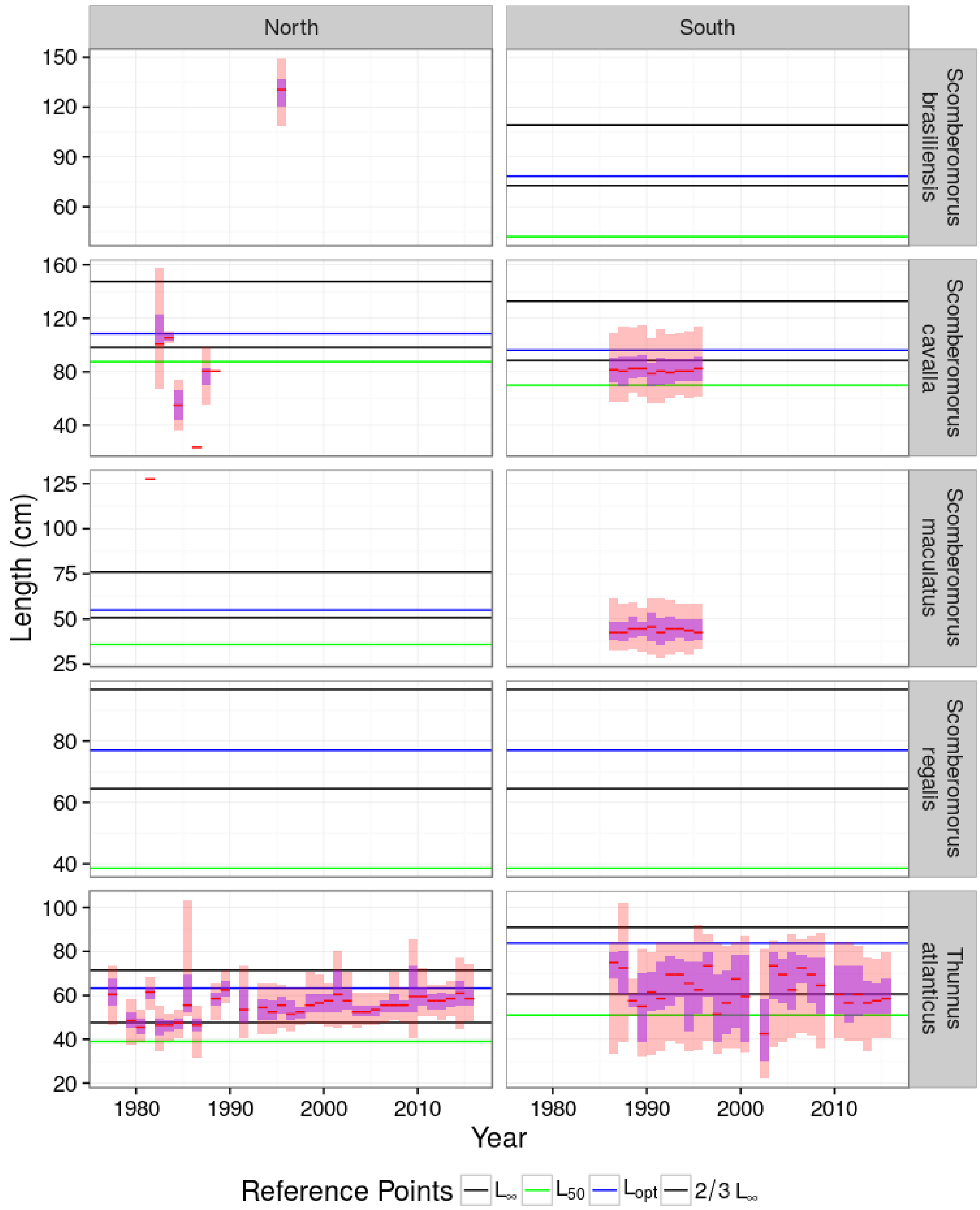
k)



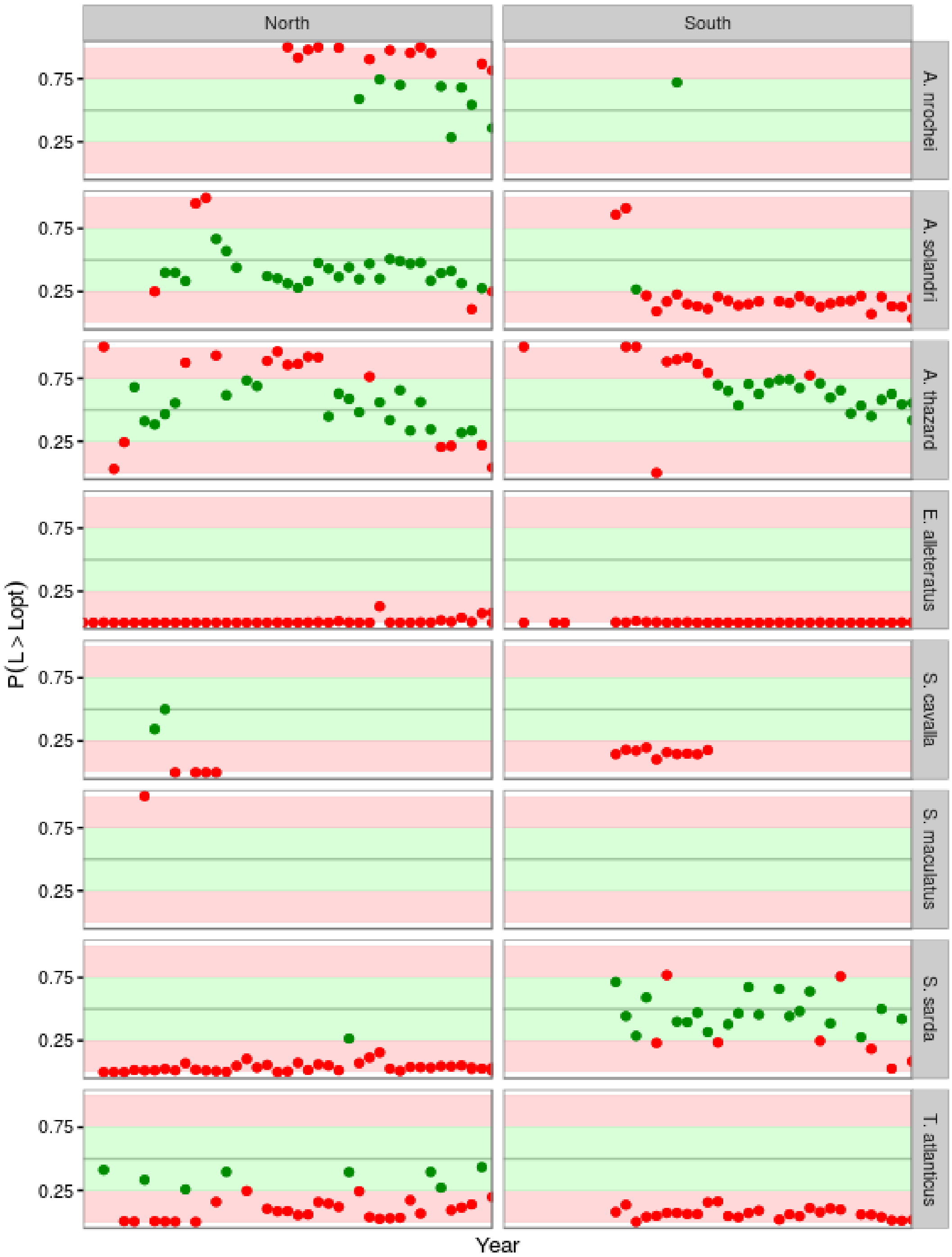
SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2018. The data for the last years are incomplete.



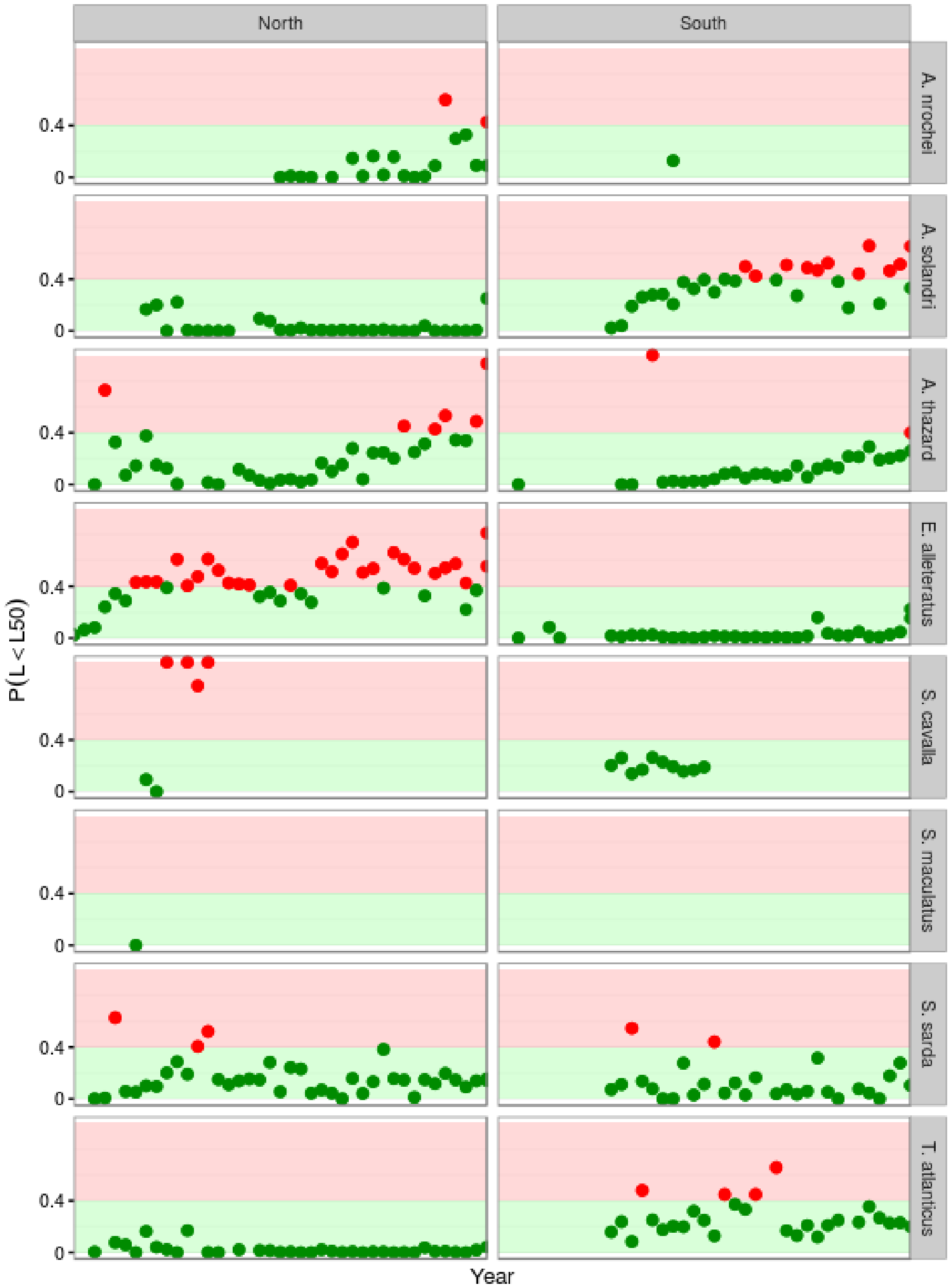
SMT-Figure 3a. Length distributions and reference points by species and Atlantic region for version 4 of Task II size data. The horizontal lines show the reference points i.e. asymptotic length (L_∞), length at 50% mature (L_{50}) and two estimates of the size at which a cohort reaches its maximum biomass (L_{opt}) and its proxy ($2/3 \sim L_\infty$). The bars show the length distributions, i.e. median, interquartiles (5%, 95%).



SMT-Figure 3b. Length distributions and reference points by species and Atlantic region for version 4 of Task II size data. The horizontal lines show the reference points i.e. asymtopic length (L_∞)), length at 50% mature (L_{50}) and two estimates of the size at which a cohort reaches its maximum biomass (L_{opt}) and its proxy ($2/3 \sim L_\infty$). The bars show the length distributions, i.e. median, interquartiles (5%, 95%).



SMT-Figure 4a. Proportion of length distributions greater than L_{opt} by species and Atlantic region. 50% is used as a target reference point and so catches where the proportions of individuals greater than L_{opt} is >25% and <75% are coloured green.



SMT-Figure 4b. Proportion of length distributions less than L_{50} by species and Atlantic region; 40% is used as a limit reference point and so when the proportion of individuals less than L_{50} is >40% is coloured red.

9.13 SHK – SHARKS

An intersessional meeting was held from May 20-24 2019 in Madrid (Anon. 2019g) to update projections on the North Atlantic shortfin mako (*Isurus oxyrinchus*) stocks based on the 2017 assessment (Anon. 2017i), information about the status of the blue shark (*Prionace glauca*) is available in the 2015 report of the assessment (Anon. 2016b), while information about the status of the porbeagle (*Lamna nasus*) stock is available in the SCRS 2009 report of the assessment of that species (Anon. 2010b). An Ecological Risk Assessment had also been conducted for 16 shark species (20 stocks), which is detailed in the Report of the 2013 Intersessional Meeting of the Sharks Species Group (Anon. 2014).

SHK-1. Biology

A great variety of shark species are found within the ICCAT Convention area, from coastal to oceanic species. Biological strategies of these sharks are very diverse and are adapted to the needs within their respective ecosystems where they occupy a very high position in the trophic chain as active predators. Therefore, generalization as regards to the biology of these very diverse species results in inevitable inaccuracies, as would occur for teleosts. To date, ICCAT has prioritized the biological study and assessment of the major sharks of the epipelagic system as these species are more susceptible to being caught as by-catch by oceanic fleets targeting tuna and tuna-like species. Among these shark species there are some of special prevalence and with an extensive geographical distribution within the oceanic-epipelagic ecosystem, such as the blue shark and shortfin mako shark, and others with less or even limited prevalence, such as porbeagle, hammerhead sharks, thresher sharks, and white sharks.

Blue shark, shortfin mako and porbeagle are large pelagic sharks that show a wide geographic distribution; the first two from tropical to temperate waters worldwide, while the porbeagle has a distribution associated with cold-temperate waters. Shortfin mako and porbeagle have an aplacental viviparity with an oophagy reproductive system, which limits their fecundity but increases the probability of survival of their young. The blue shark is placental viviparous and has an average litter size of 35 individuals, while the shortfin mako has an average litter size of around 12 and the porbeagle a litter size of usually just four individuals. Although high uncertainty regarding their biology remains, available life history traits (slow growth, late maturity and small litter size) indicate that they are vulnerable to overfishing. A behavioral characteristic of these species is their tendency to segregate temporally and spatially by size and/or sex, during feeding, mating-reproduction, gestation and birth processes. Tagging studies have suggested that they exhibit large-scale migratory behaviour and periodic vertical movement, but the lack of information on some components of the populations precludes a complete understanding of their distribution/migration pattern by ontogenetic stage and in some cases identifying their pupping/mating grounds. Numerous aspects of the biology of these species are still poorly understood or completely unknown, particularly for some regions, which contributes to increased uncertainty in quantitative and qualitative assessments.

SHK-2. Fishery indicators

Earlier reviews of the shark database resulted in recommendations to improve data reporting on shark catches. Though global statistics on shark catches included in the database have improved, they are still insufficient to permit the Committee to provide quantitative advice on stock status for most stocks with sufficient precision to guide fishery management toward optimal harvest levels. While reported and estimated catches for blue shark, shortfin mako and porbeagle are still generally subject to higher levels of uncertainty than the major tuna stocks, they have been considered sufficiently complete for the purpose of quantitative stock assessment, and are provided in **SHK-Table 1** and **SHK-Figures 1 and 2**.

Multiple standardized CPUE data series for blue shark were used in 2015 for both the North and South Atlantic stocks. For the North Atlantic stock eight indices of abundance were used. For both stocks, the series were generally flat or showed increasing trends, which conflicted with the also increasing catch tendencies, especially for the South Atlantic stock (**SHK-Figure 3**).

The CPUE series available for the 2017 shortfin mako stock assessments showed decreasing trends since approximately 2010 for the North Atlantic stock and generally increasing trends since approximately 2008 for the South Atlantic stock. (**SHK-Figures 4-5**).

During the porbeagle assessment in 2009, standardized CPUE data were presented for three of the four stocks (NE, NW and SW) (**SHK-Figure 6**). These series when referring to fisheries targeting porbeagle may not reflect the global abundance of the stock and where they refer to sharks caught as by-catch they could be highly variable.

With regard to the 16 species (20 stocks) included in the 2012 ERA, the Committee believes that, in spite of existing uncertainties, results are more robust than those obtained in the 2008 ERA. With this information the Committee considers it easier to identify those species that are most vulnerable and to prioritize research and management measures (**SHK-Table 2**) on those. These ERAs are conditional on the biological parameters used to estimate productivity as well as the susceptibility values for the different fleets. The Committee highlights the higher participation of scientists from diverse CPCs, who provided valuable data for this ERA.

SHK-3. State of the stocks

Stock assessments and Ecological Risk Assessments carried out for elasmobranchs within the ICCAT Convention area have focused only on Atlantic stocks, and not on shark stocks in the Mediterranean Sea, to date. The 2012 ERA conducted by the Committee was a quantitative assessment consisting of a risk analysis to evaluate the biological productivity of these stocks and a susceptibility analysis to assess their propensity to capture and mortality in pelagic longline fisheries. Three metrics were used to calculate vulnerability (Euclidean distance, a multiplicative index, and the arithmetic mean of the productivity and susceptibility ranks). The five stocks with the lowest productivity were the bigeye thresher (*Alopias superciliosus*), sandbar (*Carcharhinus plumbeus*), longfin mako (*Isurus paucus*), night (*Carcharhinus signatus*), and South Atlantic silky shark (*Carcharhinus falciformis*). The highest susceptibility values corresponded to shortfin mako (*Isurus oxyrinchus*), North and South Atlantic blue sharks (*Prionace glauca*), porbeagle (*Lamna nasus*), and bigeye thresher. Based on the results, the bigeye thresher, longfin and shortfin makos, porbeagle, and night sharks were the most vulnerable stocks. In contrast, North and South Atlantic scalloped hammerheads (*Sphyrna lewini*), smooth hammerhead (*Sphyrna zygaena*), and North and South Atlantic pelagic stingray (*Pteroplatytrygon violacea*) had the lowest vulnerabilities. The Committee observed that the data regarding night shark distribution was considered to be incomplete and therefore the results with regard to this species should be considered preliminary.

SHK-3.1 Blue shark

Considerable progress was made on the integration of new data sources, in particular size data, and modelling approaches, particularly model structure, in the 2015 assessment of the status of the stock of North Atlantic blue shark. For both the North and South Atlantic stocks, uncertainty in data inputs and model configuration was explored through sensitivity analysis. Although sensitivity analyses did not cover the full range of possible uncertainty, they revealed that results were sensitive to structural assumptions of the models. All the production model formulations had difficulty fitting the flat or increasing trends in the CPUE series combined with increasing catch trends. Overall, assessment results were uncertain (e.g. the absolute abundance varied by an order of magnitude between models with different structures) and should be interpreted with caution.

For the North Atlantic stock, all scenarios considered with the Bayesian surplus production model and the integrated model (SS3) indicated that the stock was not overfished and that overfishing was not occurring, as was also concluded in the 2008 stock assessment (**SHK-Figure 7**). However, the Committee acknowledged that there still remained a high uncertainty in data inputs and model structural assumptions, by virtue of which the possibility of the stock being overfished and overfishing occurring could not be ruled out. The Committee identified a better definition of fleets for SS3 and a more in-depth historical catch reconstruction, especially discard estimates, as some of the main sources of uncertainty that may help to improve model fit and provide a more certain stock status in the future.

For the South Atlantic stock, all scenarios with the Bayesian surplus production model estimated that the stock was not overfished and that overfishing was not occurring, as concluded in the 2008 stock assessment. Estimates obtained with the Bayesian state-space surplus production model formulation should be considered more reliable than other Bayesian production models. These were less optimistic, predicting that the stock could be overfished and overfishing could be occurring (**SHK-Figure 8**). Acknowledging the high uncertainty of the results, the Committee cannot rule out that the stock is overfished and experiencing overfishing.

SHK-3.2 Shortfin mako shark

The 2017 assessment of the status of North and South Atlantic stocks of shortfin mako shark was conducted with updated time series of relative abundance and annual Task I catches (C1), life history, and with the inclusion of length composition data. An alternative series of catch data based on ratios of shark catches to catches of the main target species (C2) was also estimated and used in the assessments. The results obtained in this evaluation are not comparable to those obtained in the last assessment conducted in 2012 because the input data and model structures have changed significantly: the catch time series are different (1950-2015 for the 2017 assessment and 1971-2010 for the 2012 assessment) and were derived using different assumptions; the CPUE series in the North have been decreasing since 2010 (the last year in the 2012 assessment models); some of the biological inputs have changed (growth curve, natural mortality at age) and some are now sex specific for the North; with the new biological inputs the intrinsic rate of population growth (r_{MAX}) for the North Atlantic used to construct prior distributions is now about half that used in the 2012 assessment; and additional length composition data also became available for the North. Additionally, in 2012 only a Bayesian production model (BSP1) and a catch-free age-structured production (CFASPM) model were used, whereas more modeling platforms that more fully use the data available were explored in the current assessment (BSP2JAGS [Just Another Gibbs Sampler emulating the Bayesian production model], JABBA [Just Another Bayesian Biomass Assessment], CMSY [Catch at MSY], and SS3 [Stock Synthesis 3]). It is the Committee's view that the 2017 stock assessment represents a significant improvement in our understanding of current stock status, for North Atlantic shortfin mako in particular. In particular, the production models assuming both observation and process errors fit the indices of abundance considerably better than models assuming only observation errors as used in the 2012 stock assessment.

For the North Atlantic stock, results of nine stock assessment model runs were selected to provide stock status and management advice. Although all results indicated that stock abundance in 2015 was below B_{MSY}, results of the production models (BSP2JAGS and JABBA) were more pessimistic (B/B_{MSY} deterministic estimates ranged from 0.57 to 0.85) and those of the age-structured model (SS3), which indicated that stock abundance was near MSY (SSF/SSF_{MSY} = 0.95 where SSF is spawning stock fecundity), were less pessimistic. F was overwhelmingly above F_{MSY} (**SHK-Figure 9**), with a combined 90% probability from all the models of being in an overfished state and experiencing overfishing (**SHK-Figure 10**).

For the South Atlantic stock, 4 assessment model runs (2 BSP2JAGS runs and 2 CMSY runs) were considered to provide stock status and management advice. The combined probability of the stock being overfished was 32.5% and that of experiencing overfishing was 41.9% (**SHK-Figure 11**). The combined probabilities from all the models of being in the red, yellow, and green quadrants of the Kobe plot are provided in **SHK-Figure 12**. Based on the diagnostics of model performance, the estimates of unsustainable harvest rates appear to be fairly robust at this stage whereas the biomass depletion and B/B_{MSY} estimates must be treated with caution. The Committee considers results for the South Atlantic to be highly uncertain owing to the conflict between catch and CPUE data. For both stocks, the CPUE series generally showed a trend similar to that of the catches, particularly the South Atlantic stock, which was problematic for the stock assessments based on production models.

SHK-3.3 Porbeagle shark

In 2009, the Committee attempted an assessment of the four porbeagle stocks in the Atlantic Ocean: Northwest, Northeast, Southwest and Southeast. In general, data for Southern hemisphere porbeagle are too limited to provide a robust indication on the status of the stocks. For the Southwest, limited data indicate a decline in CPUE in the Uruguayan fleet, with models suggesting a potential decline in porbeagle abundance to levels below MSY and fishing mortality rates above those producing MSY (**SHK-Figure 13**). However, catch and other data are generally too limited to allow definition of sustainable harvest levels. Catch reconstruction indicates that reported landings grossly underestimate actual landings. For the Southeast, information and data are too limited to assess their status. Available catch rate patterns suggest stability since the early 1990s, but this trend cannot be viewed in a longer-term context and thus are not informative on current levels relative to B_{MSY}.

The Northeast Atlantic stock has the longest history of commercial exploitation. A lack of CPUE data for the peak of the fishery adds considerable uncertainty in identifying the status relative to virgin biomass. Exploratory assessments indicate that biomass is below B_{MSY} and that recent fishing mortality is near or above F_{MSY} (**SHK-Figure 14**). Recovery of this stock to B_{MSY} under no fishing mortality is estimated to take ca. 15-34 years. The 2009 EU TAC of 436 t in effect for the Northeast Atlantic may have allowed the stock to remain stable, at its depleted biomass level, under most credible model scenarios. Since 2010 the EU TAC has been set at zero.

The Canadian assessment of the Northwest Atlantic porbeagle stock indicated that biomass is depleted to well below B_{MSY}, but recent fishing mortality is below F_{MSY} and recent biomass appears to be increasing. Additional modelling using a surplus production approach indicated a similar view of stock status, i.e. depletion to below B_{MSY} and fishing mortality rates also below F_{MSY} (**SHK-Figure 15**). The Canadian assessment projected that with no fishing mortality, the stock could rebuild to B_{MSY} in approximately 20-60 years, whereas surplus-production based projections indicated 20 years would suffice. Under the Canadian strategy of a 4% exploitation rate, the stock was expected to recover in 30 to 100+ years according to the Canadian projections.

During the 2009 porbeagle assessment, both porbeagle stocks in the northwest and northeast Atlantic were estimated to be overfished, with the northeastern stock being more highly depleted. In addition, porbeagle received a high vulnerability ranking in the 2008 and 2012 ERAs. The main source of fishing mortality on these stocks was from directed porbeagle fisheries which are not under the Commission's direct mandate.

SHK-4. Outlook

SHK-4.1 Blue shark

Due to the difficulty of determining current status (2013) for both the North and South Atlantic stocks of blue shark, in particular absolute population abundance, the Committee in 2015 considered that it was not appropriate to conduct quantitative projections of future stock condition based on the range of scenarios considered at the stock assessment meeting.

SHK-4.2 Shortfin mako

In 2017, projections could only be carried out with the BSP2JAGS production model for the North Atlantic and no projections could be conducted for the South Atlantic due to the uncertainty in stock status. The Committee noted that the Kobe II strategy matrices presented in 2017 may not reflect the full range of uncertainty in the outlook because projections were not carried out with SS3 due to technical reasons and because the model was still under development. In 2019, projections for the North Atlantic were carried out with Stock Synthesis only. The Committee noted that because the fishery mainly focuses on juvenile animals, the production models (BSP2JAGS and others) are only tracking juvenile abundance and thus the projections are not informative about trends in the mature population, which would lag behind the trends in the exploitable population by the number of years it takes new recruits to reach maturity.

The Committee combined the Stock Synthesis status results from two runs that were reflective of different productivity hypotheses (run 1 and run 3) for making projections (**SHK Figure 16**). Projections were carried out to 2070 because they incorporate two generation times. Run 1 was added because the Committee recognized that it incorporates another hypothesis on the productivity of the stock (expressed through a different stock-recruit relationship) more in line with some of the production model estimates of productivity, but unlike production models, it can incorporate the necessary time lag effects caused by gear selectivity and the maturity of the stock. The projection results from the combined models showed that (**SHK-Table 3**): i) a zero TAC will allow the stock to be rebuilt and without overfishing (in the green quadrant of the Kobe plot) by 2045 with a 53% probability; ii) regardless of the TAC, the spawning stock fecundity will continue to decline until 2035 before any increases can occur owing to the time it takes juveniles to reach maturity; iii) to be in the green quadrant of the Kobe plot with at least 60% probability by 2070, the realized TAC has to be 300 t or less; and iv) a TAC of 700 t would end overfishing immediately with a 57% probability, but it would only have a 41% probability of rebuilding the stock by 2070. Although there is large uncertainty in the future productivity assumption for this stock, the projections show that there is a long lag time (ca. 20 years) between when management measures are implemented and when stock size starts to rebuild due to the biology of the species.

SHK-4.3 Porbeagle

Projections for porbeagle were not conducted in the 2009 assessment because of the great uncertainty in determining stock status for any of the stocks.

In 2017, ICCAT scientists participated in the Areas Beyond National Jurisdiction (ABNJ) Southern Hemisphere assessment for porbeagle. In December 2017, the Common Oceans ABNJ Tuna Project released its assessment of Southern Hemisphere porbeagle sharks, noting complications associated with lack of information on catches and biological characteristics. The risk assessment evaluates whether current fisheries impacts exceed a maximum impact sustainable threshold (MIST) based on population productivity. Although available data indicate very low risk that the Southern Hemisphere porbeagle shark is subject to overfishing, the study recommends data improvement through liaison between regional fishery bodies, including ICCAT.

SHK-5. Effect of current regulations

SHK-5.1 Shortfin mako

The Commission adopted Rec. 17-08, which aims to reduce the fishing mortality to end overfishing of the northern stock of shortfin mako. It does this by strengthening data collection (including collection of statistics on discards, biological parameters, weight of landing products,…) and establishing regulatory options (including promoting fish releases in a manner that increases survival, establishing minimum sizes,…) for ICCAT CPCs. In response to this recommendation several CPCs have adopted national regulations. Rec. 17-08 will be reviewed by the Commission in 2019.

The Committee conducted projections incorporating different hypotheses about stock productivity which suggested that the stock could rebuild to the biomass that supports MSY with a 60% probability if the TAC=0 by 2050. Additionally, the Committee also reviewed the probability of success of several of the measures contemplated in ICCAT Rec. 17-08 through additional projections for shortfin mako (using only the base run from Stock Synthesis—run 3). Specifically, alternative TAC, minimum size limit, and live release measures were explored with two tools: Stock Synthesis and the Decision Support Tool (DST). The Committee noted that fixed TACs with size regulations (210 cm fork length for females and 180 cm fork length for males) accelerated stock recovery. However, these projections implicitly assumed that fish released below the size limit had 100% post-release survival. The Committee also explored the effect of live release regulations (through reduction in fishing mortality but considering a post-release mortality rate of 25%) contemplated in Rec. 17-08 and found that all projection scenarios resulted in population declines until 2035 regardless of the fixed level of fishing mortality used and that the biomass that supports MSY was only reached by 2070 for the fishing mortality equal zero scenario.

Projections with the DST revealed that if fishers are unable to avoid catching shortfin makos and those discarded have a substantial mortality rate, then it is necessary to greatly decrease the retained catch to allow the stock to rebuild. Size limits and other strategies to release live sharks must be accompanied by a reduction in retained catch. The Committee thus concluded that a live release approach may be a way to reduce F if discard mortality rates are low, but other management measures such as reduction of soak time, time-area closures, and safe handling and best practices for the release of live specimens may also be required to further reduce incidental mortality. The Committee also noted that a slot limit that protects some mature age groups may be appropriate, although selectivity on those ages is low.

The Committee noted that North Atlantic catches increased from 2,964 t in 2015 to 3,347 t in 2016 and then decreased to 3,116 t in 2017, and that they further decreased to 2,388 t in 2018. It is not clear if the decrease can be attributed to Rec. 17-08 or to continued decrease in stock size. Projections (**SHK-Table 3**) indicate that this current catch will not allow the stock to rebuild by 2070 and overfishing will continue. 2019 is the first full year during which Rec. 17-08 applies. The Committee will not be able to review 2019 shortfin mako catches until after 31 July 2020 (noting that it will provide the Committee with only one year of data).

The Committee had insufficient information to determine which ICCAT recommendations regarding possible conservation measures (Rec. 17-08) were implemented for which fleet, making it difficult to evaluate the effect of the possible conservation measures by fleet in the projections. Nevertheless, a general evaluation of the effect of the conservation measures was undertaken which showed that they are insufficient to rebuild the stock within the specified timeframe.

SHK-5.2 Blue shark

The Commission adopted Rec. 16-12, which in paragraph 2 establishes a catch limit for blue sharks in the North Atlantic (39,102 t as the average of two consecutive years). At present, the Committee is not in a position to assess the effect of this measure because the recommendation only came into effect in 2017. However, the Committee noted that the preliminary catches in 2016 and 2017 were 44,067 t and 39,675 t, respectively.

In 2013 Uruguay prohibited retention of porbeagle sharks and Canadian directed fisheries for porbeagle have also been closed since 2013. The other main porbeagle directed fishery in the North Atlantic (EU) ceased operations in 2010. For the North Atlantic stock, catches increased from 119 t in 2010 to 156 t in 2013 and have been decreasing thereafter; for the South Atlantic stock, catches increased slightly from 29 t in 2013 to 38 t in 2014 and decreased to less than 4 t since 2015 (**SHK-Figure 1**).

The General Fisheries Commission for the Mediterranean (GFCM) adopted ICCAT's thresher shark Recommendation (banning retention of bigeye threshers *Alopias superciliosus*) in 2010. In 2012, the GFCM adopted Recommendation GFCM/36/2012/3 prohibiting finning, beheading and skinning of specimens. Beheaded and skinned sharks cannot be marketed at first sale markets and it is prohibited to purchase, offer for sale or sell shark fins. Moreover, it prohibits the retention, transhipment, landing, display and sale of the 24 elasmobranch species listed under Annex II of the Barcelona Convention *Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean* including shortfin mako, porbeagle, smooth hammerhead (*Sphyrna zygaena*), scalloped hammerhead (*Sphyrna lewini*), and great hammerhead (*Sphyrna mokarran).* The European Union implemented this measure for relevant EU Member States in 2015.

Porbeagle, hammerheads, oceanic whitetip sharks *(Carcharhinus longimanus)*, and manta rays *(Mobula birostris, M. alfredi)* were listed under Appendix II of the Convention on International Trade in Endangered Species (CITES) in 2013. Threshers *(Alopias* spp.), silky sharks *(Carcharhinus falciformis)* and the remaining mobulids were added in 2016 (effective October 2017). CITES Appendix II carries a requirement that Parties issue export permits based on findings that take is legal and sustainable. Development of these "non-detriment findings" and related permitting processes is underway.

Parties to the Convention on Migratory Species (CMS) have listed 29 elasmobranch species under its Appendices. Appendix II, which signals a commitment to international cooperation toward conservation, includes makos, porbeagles, hammerheads, threshers, and silky sharks. Mobulid rays are listed on Appendix I, which mandates strict protection. CMS has developed a Memorandum of Understanding specific to sharks as well as a Conservation Action Plan which may aid in implementation of CMS listings for elasmobranchs.

SHK-6. Management recommendations

Precautionary management measures should be considered particularly for stocks where there is the greatest biological vulnerability and conservation concern, and for which there are very few data and/or great uncertainty in assessment results. Management measures should ideally be species-specific whenever possible.

Considering the need to improve stock assessments of pelagic shark species impacted by ICCAT fisheries and bearing in mind Rec. 12-05 as well as the various previous recommendations which made the submission of shark data mandatory, the Committee strongly urges the CPCs to provide the corresponding statistics, including discards (dead and alive), of all ICCAT fisheries, including recreational and artisanal fisheries, and to the extent possible non-ICCAT fisheries capturing these species. The Committee considers that a basic premise for correctly evaluating the status of any stock is to have a solid basis to estimate total removals.

The Committee reiterates that the CPCs provide estimates of shark catches in both ICCAT and non-ICCAT fisheries for species that are oceanic, pelagic, and highly migratory within the ICCAT Convention area. The magnitude of shark entanglements in FADs should be investigated. Methods for mitigating shark by-catch in fisheries also need to be investigated and applied.

SHK-6.1 Blue shark

Considering the uncertainty in stock status results for the South Atlantic stock, the Committee strongly recommends that the Commission considers a precautionary approach for this stock. If the Commission chose to use the same approach taken for the North Atlantic stock, the average catch of the final five years used in the assessment model (28,923 t for 2009-2013) could be used as an upper limit. For the North Atlantic stock, while all model formulations explored predicted that the stock was not overfished and that overfishing was not occurring, the level of uncertainty in the data inputs and model structural assumptions was high enough to prevent the Committee from reaching a consensus on a specific management recommendation.

SHK-6.2 Shortfin mako

The Committee conducted new projections using two Stock Synthesis model scenarios that incorporated important aspects of shortfin mako biology. This was a feature that was not possible with the production model projections developed in the 2017 assessment (Anon. 2017i) and, therefore, the Committee considers the new projections as a better representation of the stock dynamics. The stock synthesis projections indicated that: i) a zero TAC will allow the stock to be rebuilt and without overfishing (in the green quadrant of the Kobe plot) by 2045 with a 53% probability; ii) regardless of the TAC (including a TAC of 0 t), the stock will continue to decline until 2035 before any biomass increases can occur; iii) a TAC of 500 t, including dead discards has only a 52% probability of rebuilding the stock to the green quadrant in 2070; iv) to be in the green quadrant of the Kobe plot with at least 60% probability by 2070, the realized TAC has to be 300 t or less; v) lower TACs achieve rebuilding in shorter time frames; and vi) a TAC of 700 t would end overfishing immediately with a 57% probability, but this TAC would only have a 41% probability of rebuilding the stock by 2070.

The Committee agreed that the projections that addressed the exceptions in Rec. 17-08 indicated that any retention of shortfin makos will not permit the recovery of the stock by year 2070. A range of TAC options with a range of time frames and associated probabilities of rebuilding are included in **SHK-Table 3**. Given the vulnerable biological characteristics of this stock and the pessimistic projections, to accelerate the rate of recovery and to increase the probability of success the Committee recommends that the Commission adopt a non-retention policy without exception in the North Atlantic as it has already done with other shark species caught as bycatch in ICCAT fisheries.

Given that fishery development in the South predictably follows that in the North and that the biological characteristics of the stock are similar, there is a significant risk that this stock could follow a similar history to that of the North stock. If the stock declines it will, like the North stock, require a long time for rebuilding even after significant catch reductions. To avoid this situation and considering the uncertainty in the stock status, the Committee recommends that, at a minimum catches should not exceed the minimum catch in the last five years of the assessment (2011-2015; 2,001 t with catch scenario C1 [Task I catches]).

The Committee emphasized that reporting all sources of mortality is an essential element to decrease the uncertainty in stock assessment results, and particularly the report of estimated dead discards for all fisheries. Although the reporting of dead discards is already part of the ICCAT data reporting obligations (Rec. 17-08), the requirement has been ignored by many CPCs. The reporting of dead discards and live releases is of the utmost importance.

The Committee indicated that additional measures can potentially further reduce incidental mortality, including safe handling and best practices for the release of live specimens (since post release survival can reach 77%). These and other measures are documented in papers published on the WCPFC's Bycatch Management Information System website. Gear restrictions/modification and time area closures also have the potential to reduce mortality. However, gear restriction/modification would require dedicated field work (e.g. the deployment of hook timers to measure the time that sharks are on the line), while the level of catch and effort data currently submitted to the Secretariat makes it difficult to evaluate time/area closures.

The Committee emphasized that the Kobe II Strategy Matrix (K2SM) does not capture all the uncertainties associated with the fishery and the biology of the species. In addition, the length of the projection period (50 years) requested by the Commission implies that estimates at the end of the projection period are highly uncertain. Therefore, the Committee advised that the results of the K2SM should be interpreted with caution. In particular, if the decrease in mature females is related not only to the catch of immature females, but to other, unknown causes, the management measures above may not lead to the recovery of the stock.

The Committee emphasizes that there will be a need for CPCs to strengthen their monitoring and data collection efforts by species to monitor the future status of the stocks, including but not limited to total estimated dead discards and the estimation of CPUEs using observer data.

SHK-6.3 Porbeagle

The Committee recommends that the Commission work with countries catching porbeagle and relevant RFMOs to ensure recovery of North Atlantic porbeagle stocks (e.g. ICES, NAFO). In particular, porbeagle fishing mortality should be kept at levels in line with scientific advice and with catches not exceeding the current level. New targeted porbeagle fisheries should be prevented, porbeagles retrieved alive should be released following best handling practices to increase survivorship, and all catches should be reported. Management measures and data collection should be harmonized as much as possible among all relevant RFMOs dealing with these stocks, and ICCAT should facilitate appropriate communication.

NORTH ATLANTIC BLUE SHARK SUMMARY

Current Yield (2018)		33,853 t[1]
Yield (2013)		36,748 t[2]
Relative Biomass	B_{2013}/B_{MSY}	1.35-3.45[3]
	B_{2013}/B_0	0.75-0.98[4]
Relative Fishing Mortality	F_{MSY}	0.19-0.20[4]
	F_{2013}/F_{MSY}	0.04-0.75[5]
Stock Status (2013)	Overfished	Not likely [6]
	Overfishing	Not likely [6]
Management Measures in Effect:		Rec. 16-12

[1] Task I catch.
[2] Estimated catch used in the 2015 assessments.
[3] Range obtained with the Bayesian Surplus Production (BSP) and SS3 models. Value from SS3 is SSF/SSF_{MSY}.
[4] Range obtained with the BSP model.
[5] Range obtained with the BSP and SS3 models.
[6] Although the models explored indicate the stock is not overfished and overfishing is not occurring, the Committee acknowledges that there still remains a high level of uncertainty.

SOUTH ATLANTIC BLUE SHARK SUMMARY

Current Yield (2018)		34,309t[1]
Yield (2013)		20,799 t[2]
Relative Biomass	B_{2013}/B_{MSY}	0.78-2.03[3]
	B_{2013}/B_0	0.39-1.00[3]
Relative Fishing Mortality	F_{MSY}	0.10-0.20[3]
	F_{2013}/F_{MSY}	0.01-1.19[3]
Stock Status (2013)	Overfished	Undetermined[4]
	Overfishing	Undetermined[4]

[1] Task I catch.
[2] Estimated catch used in the 2015 assessments.
[3] Range obtained with the Bayesian Surplus Production (BSP) and State-Space Bayesian Surplus Production (SS-BSP) models.
[4] Given the uncertainty in stock status, the Committee cannot make a determination but cautions that the stock may have been overfished and overfishing may have occurred in recent years.

NORTH ATLANTIC SHORTFIN MAKO SUMMARY

Current Yield (2018)		2,388 t[1]
Yield (2015)		3,227 t[2]
Relative Biomass	B_{2015}/B_{MSY}	0.57-0.95[3]
	B_{2015}/B_0	0.34-0.57[4]
Relative Fishing Mortality	F_{MSY}	0.015-0.056[5]
	F_{2015}/F_{MSY}	1.93-4.38[6]
Stock Status (2015)	Overfished	Yes
	Overfishing	Yes
Management Measures in Effect:		Rec. 17-08, Rec. 04-10, Rec. 07-06 Rec. 10-06, Rec. 14-06

1 Task I catch.
2 Task I catch used in the stock assessment.
3 Range obtained from 8 Bayesian production and 1 SS3 model runs. Value from SS3 is SSF/SSF_{MSY}. Low value is lowest value from 4 production model (JABBA) runs and high value is from the SS3 base run.
4 Range obtained from 8 Bayesian production and 1 SS3 model runs. Value from SS3 is SSF/SSF_0. Low value is lowest value from 4 production model (JABBA) runs and high value is highest value from 4 production model (BSP2JAGS) model runs.
5 Range obtained from 8 Bayesian production and 1 SS3 model runs. Value from SS3 is SSF_{MSY}. Low value is lowest value from 4 production model (JABBA and BSP2JAGS) runs and high value is from the SS3 base run.
6 Range obtained from 8 Bayesian production and 1 SS3 model runs. Values from the production models are H (harvest rates). Low value is lowest value from 4 production model (BSP2JAGS) runs and high value is from the SS3 base run and highest value from 4 production model (JABBA) runs.

SOUTH ATLANTIC SHORTFIN MAKO SUMMARY

Current Yield (2018)		3,158t[1]
Yield (2015)		2,686 t[2]
Relative Biomass	B_{2015}/B_{MSY}	0.65-1.75[3]
	B_{2015}/B_0	0.32-1.18[4]
Relative Fishing Mortality:	F_{MSY}	0.030-0.034[5]
	F_{2015}/F_{MSY}	0.86-3.67[6]
Stock status (2015)	Overfished	Possibly[7]
	Overfishing	Possibly[7]
Management Measures in Effect:		Rec. 04-10, Rec. 07-06, Rec. 10-06, Rec. 14-06

1 Task I catch.
2 Task I catch from the stock assessment.
3 Range obtained from 2 Bayesian production (BSP2JAGS) and 2 catch-only (CMSY) model runs. Low value is lowest value from the CMSY model runs and high value is highest value from the BSP2JAGS model runs.
4 Range obtained from 2 Bayesian production (BSP2JAGS) and 2 catch-only (CMSY) model runs. Low value is lowest value from the CMSY model runs and high value is highest value from the BSP2JAGS model runs.
5 Range obtained from 2 Bayesian production (BSP2JAGS) and 2 catch-only (CMSY) model runs. Low value is from the BSP2JAGS model runs and high value is from the CMSY model runs.
6 Range obtained from 2 Bayesian production (BSP2JAGS) and 2 catch-only (CMSY) model runs. Low value is lowest value from the BSP2JAGS model runs and high value is highest value from the CMSY model runs.
7 The Committee considers that results have a high degree of uncertainty.

NORTHWEST ATLANTIC PORBEAGLE SUMMARY

Yield (2008)		144.3 t[1]
Relative Biomass	B_{2008}/B_{MSY}	0.43-0.65[2]
Relative Fishing Mortality	F_{MSY}	0.025-0.075[3]
	F_{2008}/F_{MSY}	0.03-0.36[4]
Domestic Management Measures in Effect		TACs of 185 t and 11.3 t[5]
Stock Status (2008)	Overfished	Yes
	Overfishing	No
Management Measures in Effect:		Rec. 15-06

[1] Estimated catch allocated to the Northwest stock area. Not updated as area boundaries have not been formally defined.
[2] Range obtained from age-structured model (Canadian assessment; low) and BSP model (high). Value from Canadian assessment is in numbers; value from BSP in biomass. All values in parentheses are CVs.
[3] Range obtained from BSP model (low) and age-structured model (high).
[4] Range obtained from BSP model (low) and age-structured model (high).
[5] The TAC for the Canadian EEZ was 185 t (in 2008) (MSY catch is 250 t); the TAC for the USA is 11.3 t (dressed weight).

SOUTHWEST ATLANTIC PORBEAGLE SUMMARY

Yield (2008)		164.6 t[1]
Relative Biomass	B_{2008}/B_{MSY}	0.36-0.78[2]
Relative Fishing Mortality	F_{MSY}	0.025-0.033[3]
	F_{2008}/F_{MSY}	0.31-10.78[4]
Stock Status (2008)	Overfished	Yes
	Overfishing	Undetermined[5]
Management Measures in Effect:		Rec. 15-06 [6]

[1] Estimated catch allocated to the Southwest stock area. Not updated as area boundaries have not been formally defined.
[2] Range obtained from BSP (low and high) and CFASP models. Value from CFASP model (SSB/SSB_{MSY}) was 0.48 (0.20).
[3] Range obtained from BSP (low) and CFASP (high) models.
[4] Range obtained from BSP (low and high) and CFASP models. Value from CFASP model was 1.72 (0.51).
[5] Given the uncertainty in stock status, the Committee cannot make a determination but cautions that overfishing may have occurred in recent years.
[6] Retention of porbeagle sharks has been prohibited in Uruguay since 2013.

NORTHEAST ATLANTIC PORBEAGLE SUMMARY

Yield (2008)		287 t[1]
Relative Biomass	B_{2008}/B_{MSY}	0.09-1.93[2]
Relative Fishing Mortality	F_{MSY}	0.02-0.03[3]
	F_{2008}/F_{MSY}	0.04-3.45[4]
Stock Status (2008)	Overfished	Yes
	Overfishing	No
Management Measures in Effect		Rec. 15-06 [5]
		Maximum landing length of 210 cm FL[5]

[1] Estimated catch allocated to the Northeast stock area. Not updated as area boundaries have not been formally defined.
[2] Range obtained from BSP (high) and ASPM (low) models. Value from ASPM model is SSB/SSB_{MSY}. The value of 1.93 from the BSP corresponds to a biologically unrealistic scenario; all results from the other BSP scenarios ranged from 0.29 to 1.05.
[3] Range obtained from the BSP and ASPM models (low and high for both models).
[4] Range obtained from BSP (low) and ASPM (high) models. The value of 0.04 from the BSP corresponds to a biologically unrealistic scenario; all results from the BSP scenarios ranged from 0.70 to 1.26.
[5] In the European Union the TAC has been set at zero t since 2010.

BSH-Table 1. Estimated catches (t) of blue shark (*Prionace glauca*) by area, gear and flag.

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL				11301	11585	11651	39580	35624	37023	40664	35220	32765	37983	36306	43072	43889	50464	53903	58843	65195	73198	63245	57833	62961	62791	70214	68142	68220
	ATN			8592	8468	7396	29285	26764	26172	28174	21128	20066	23006	21741	22359	23218	26927	30725	35199	37180	38089	36782	37061	36579	39627	44068	39664	33853
	ATS			2704	3108	4252	10145	8797	10829	12444	14044	12682	14966	14440	20642	20493	23487	23097	23459	27799	35069	26421	20672	26148	22498	25417	28373	34309
	MED			6	8	2	150	63	22	45	47	17	11	125	72	178	50	81	185	216	40	42	100	235	665	729	105	58
Landings	ATN		Longline	7646	7548	6131	28678	26153	25382	27305	20699	19290	22881	21297	22167	23068	26811	30516	35032	36954	37783	36553	36878	36245	38777	42859	38493	32654
			Other surf.	373	300	560	428	419	682	732	324	708	70	380	126	104	63	80	63	59	100	109	74	205	726	1121	1033	1086
	ATS		Longline	2704	3108	4246	10135	8790	10801	12444	14043	12678	14960	14341	20638	20434	23417	22708	23453	27785	34532	25878	20387	24203	21736	24643	27662	33546
			Other surf.	0	0	0	6	4	27	0	1	4	6	99	3	59	10	375	6	14	534	411	152	1831	635	634	487	664
	MED		Longline	5	8	2	150	63	22	45	47	17	11	43	72	83	48	81	18	50	40	41	68	190	664	728	92	54
			Other surf.	1	0	0	0	0	0	0	0	0	0	81	0	95	2	1	167	165	0	0	32	45	1	2	13	4
Discards	ATN		Longline	572	621	602	180	170	104	137	105	68	55	63	66	45	53	129	102	167	205	119	109	128	124	88	138	112
			Other surf.	0	0	103	0	22	4	0	0	0	0	1	0	0	0	1	1	1	2	1	0	0	0	0	0	0
	ATS		Longline	0	0	7	5	4	1	0	0	0	0	0	0	0	60	14	0	0	4	132	132	114	122	139	218	99
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	7	0
	MED		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings	ATN	CP	Barbados	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	6	7	4
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	461	1039	903	1216	392	4	6	201	317
			Brazil	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Canada	1260	1494	528	831	612	547	624	581	836	346	965	1134	977	843	0	0	0	0	1	0	0	0	0	0	0
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			China PR	0	0	0	0	0	0	0	185	104	148	0	0	0	367	109	88	53	109	98	327	0	1	27	2	6
			EU.Denmark	1	2	3	1	1	0	2	1	13	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	0	0	0	24497	22504	21811	24112	17362	15666	15975	17314	15006	15464	17038	20788	24465	26094	27988	28666	28562	29041	30078	29019	27316	21685
			EU.France	350	266	278	213	163	399	395	207	221	57	106	120	99	167	119	84	122	115	31	216	132	259	352	124	94
			EU.Ireland	0	0	0	0	0	66	31	66	11	2	0	0	0	0	0	0	0	1	3	2	1	0	0	0	**0**
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0**
			EU.Portugal	4669	4722	4843	2630	2440	2227	2081	2110	2265	5643	2025	4027	4338	5283	6167	6252	8261	6509	3768	3694	3060	3859	7819	5664	5195
			EU.United Kingdom	0	12	0	0	1	0	12	9	6	4	6	5	3	6	6	96	8	10	8	10	10	12	17	11	6
			FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0**
			Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Japan	1203	1145	618	489	340	357	273	350	386	558	1035	1729	1434	1921	2531	2007	1763	1227	2437	1808	3287	4011	4217	4444	4111
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	537	299	327	113	0	10	103	92
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
			Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	873	1623	1475	1644
			Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	0	**0**
			Mexico	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**0**
			Panama	0	0	0	0	0	9	0	0	0	0	0	0	254	892	613	1575	0	0	0	289	153	0	262	0	437
			Senegal	0	0	0	0	0	0	0	0	456	0	0	0	0	43	134	255	56	0	5	12	17	13	3	4	1
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	119	0	**0**
			Trinidad and Tobago	0	0	0	0	0	0	0	0	6	3	2	1	1	0	2	8	9	11	11	8	10	4	2	2	0
			U.S.A.	31	24	284	214	256	217	291	40	0	1	7	2	2	1	9	5	11	71	60	36	44	32	31	24	19
			UK.Bermuda	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Venezuela	18	16	6	27	7	47	43	47	29	40	10	28	12	19	8	73	75	117	98	52	113	129	116	105	
		NCC	Chinese Taipei	487	167	132	203	246	384	165	59	0	171	206	240	588	292	110	73	99	148	94	113	77	220	259	42	122
			Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	181	281	0	0	0	0	**0**
	ATS	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	**0**
			Belize	0	0	0	0	0	0	0	0	0	0	37	259	0	236	109	0	273	243	483	234	171	105	167	200	222
			Brazil	0	0	743	1103	0	179	1683	2173	1971	2166	1667	2523	2591	2258	1986	1274	1500	1980	1607	2013	2551	2420	1334	2177	3011
			China PR	0	0	0	0	0	0	0	565	316	452	0	0	0	585	40	109	41	131	84	64	48	20	30	283	127
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	16	9	8	247
			EU.España	0	0	0	5272	5574	7173	6951	7743	5368	6626	7366	6410	8724	8942	9615	13099	13953	16978	14348	10473	11447	10133	10107	11486	13515

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Portugal	0	847	867	1336	876	1110	2134	2562	2324	1841	1863	3184	2751	4493	4866	5358	6338	7642	2424	1646	1622	2420	5609	6663	8015
			EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	239	0	0	14	0	0	0	0	0	0	0	0	**0**
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Ghana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1583	396	436	479	416
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	6	0	0
			Japan	1388	437	425	506	510	536	221	182	343	331	209	236	525	896	1789	981	1161	1483	3060	2255	3232	2277	2127	3112	3495
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	222	125	112	61	10	71	252	87	192
			Namibia	0	0	0	0	0	0	0	0	2213	2316	1906	6616	3536	3419	1829	207	2352	2957	1439	1147	2471	2137	2775	1357	3290
			Panama	0	0	0	0	0	168	22	0	0	0	0	0	0	0	521	0	0	0	0	0	0	0	0	0	**0**
			Russian Federation	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			S. Tomé e Príncipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	143	147	152	156	206	183	0	
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	203	51	60	0	18	15	11	**0**
			South Africa	0	0	0	0	23	21	0	83	63	232	128	154	90	82	126	119	125	318	158	179	524	402	356	418	403
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	**0**
			U.S.A.	0	0	0	0	0	0	0	4	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Uruguay	84	57	259	180	248	118	81	66	85	480	462	376	232	337	359	942	208	725	433	130	0	0	0	0	**0**
		NCC	Chinese Taipei	1232	1767	1952	1737	1559	1496	1353	665	0	521	800	866	1805	2177	1843	1356	1625	2138	1941	2125	2128	1731	1853	1852	1276
		NCO	Benin	0	0	0	6	4	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED	CP	Algerie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7
			EU.Cyprus	0	0	0	0	0	0	9	0	0	3	6	5	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	0	0	0	146	59	20	31	6	3	3	4	8	61	3	2	7	48	38	39	37	53	65	58	40	19
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	5	15	0	2	2
			EU.Italy	0	0	0	0	0	0	0	0	0	0	113	1	95	46	75	175	165	0	0	57	173	0	18	59	17
			EU.Malta	1	1	1	2	2	2	1	1	1	0	0	0	0	1	1	2	1	1	2	2	4	5	3	4	2
			EU.Portugal	0	0	0	0	2	0	5	41	14	3	0	56	22	0	0	0	2	0	0	0	0	0	0	0	**0**
			Japan	5	7	1	1	0	0	0	0	0	1	1	2	0	0	2	0	0	0	0	0	0	0	0	0	**0**
			Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	580	650	0	10
Discards	ATN	CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	16	32	71
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	1	29	
			Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			U.S.A.	572	618	704	180	192	100	137	106	68	55	65	66	45	54	130	103	167	206	106	99	122	82	43	42	11
			UK.Bermuda	0	3	1	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	10	6	19	27	34	31
	ATS	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	60	14	0	0	0	0	0	0	0	0	0	
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
			EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	1	0
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	2
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
			South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
			U.S.A.	0	0	7	5	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	132	132	112	122	139	201	97
	MED	CP	EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

SMA-Table 1. Estimated catches (t) of shortfin mako (*Isurus oxyrinchu* s) by area, gear and flag.

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL				5841	8406	7701	5727	5861	4469	5179	4792	5531	7225	6528	6970	6620	6946	5682	6605	7254	6979	7338	5778	6126	5739	6111	5902	5547
	ATN			3659	5306	5306	3534	3845	2858	2587	2677	3426	3987	4000	3695	3574	4158	3800	4541	4767	3718	4431	3595	2852	2964	3347	3116	2388
	ATS			2182	3100	2395	2187	2008	1606	2588	2107	2103	3235	2526	3259	3036	2786	1881	2063	2486	3258	2905	2183	3274	2774	2765	2786	3158
	MED			0	0	0	6	8	5	4	7	2	2	2	17	10	2	1	1	2	2	2	0	0	0	0	0	1
Landings	ATN		Longline	3306	3828	5053	3351	3670	2756	2267	2446	3155	3970	3572	3387	3302	3976	3622	4344	4587	3496	4145	3312	2576	2638	3118	2713	1990
			Other surf.	331	1448	252	183	175	99	320	231	271	17	429	308	273	175	169	177	178	213	267	278	264	316	221	397	369
	ATS		Longline	2161	3085	2379	2163	1996	1596	2565	2090	2088	3204	2450	3245	2992	2745	1799	2057	2485	3196	2842	2149	3241	2760	2748	2620	3149
			Other surf.	21	15	16	25	12	10	22	18	15	31	76	14	43	30	82	7	1	62	55	34	31	12	13	162	7
	MED		Longline	0	0	0	6	8	5	4	7	2	2	2	17	10	2	1	1	2	2	2	0	0	0	0	0	
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Discards	ATN		Longline	21	29	1	0	0	0	0	0	0	0	0	0	0	7	9	20	2	9	19	5	12	10	8	4	28
			Other surf.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1
	ATS		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	8	0	2	2	3	3	2
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
	MED		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings	ATN	CP	Barbados	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	3	**0**
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	28	69	114	99	1	1	1	9	12
			Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Canada	0	111	67	110	69	70	78	69	78	73	80	91	71	72	43	53	41	37	29	35	55	85	82	109	53
			China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	81	16	19	29	18	24	11	5	2	4	2	**0**
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	2164	2209	3294	2416	2223	2051	1561	1684	2047	2068	2088	1751	1918	1814	1895	2216	2091	1667	2308	1509	1481	1362	1574	1784	1165
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	2	0	0	0	1	1	2	1	0
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Portugal	649	657	691	354	307	327	318	378	415	1249	473	1109	951	1540	1033	1169	1432	1045	1023	820	219	222	264	276	272
			EU.United Kingdom	0	0	0	0	0	2	3	2	1	1	1	0	0	0	1	15	0	0	0	0	0	0	0	0	**0**
			FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	4	0	0	4	0	0	0	0	**0**
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Japan	214	592	790	258	892	120	138	105	438	267	572	0	0	82	131	98	116	53	56	33	69	45	74	89	20
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	27	15	8	2	1	3	5
			Maroc	0	0	0	0	0	0	0	0	0	147	169	215	220	151	283	476	636	420	406	667	624	947	1050	450	594
			Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	**0**
			Mexico	0	10	0	0	0	0	10	16	0	10	6	9	5	8	6	7	8	8	8	4	4	4	3	5	2
			Panama	0	0	0	0	0	1	0	0	0	0	0	0	0	49	33	39	0	0	0	19	7	0	0	0	**0**
			Philippines	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	8	17	21	0	0	2	0	2	2	2	68	68
			St. Vincent and Grenadines	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	**0**
			Trinidad and Tobago	0	0	0	0	0	1	0	1	2	3	1	2	1	1	1	1	1	0	2	1	1	1	1	2	2
			U.S.A.	574	1658	400	345	296	198	414	350	372	106	477	422	353	319	296	314	335	331	365	355	345	255	262	299	165
			UK.Bermuda	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Venezuela	7	7	17	9	8	6	9	24	21	28	64	27	14	19	8	41	27	20	33	9	13	7	7	9	
		NCC	Chinese Taipei	29	32	45	42	47	75	56	47	53	37	70	68	40	6	23	11	14	13	14	8	4	13	7	1	**0**
		NCO	Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	
	ATS	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	**0**
			Belize	0	0	0	0	0	0	0	0	0	0	0	38	0	17	2	0	32	59	78	88	1	15	14	34	15

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Brazil	95	119	83	190	233	27	219	409	226	283	238	426	210	145	203	99	128	192	196	276	268	173	124	275	399
		China PR	45	23	27	19	74	126	305	22	208	260	68	45	70	77	6	24	32	29	8	9	9	5	3	1	**0**
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Côte d'Ivoire	20	13	15	23	10	10	9	15	15	30	15	14	16	25	0	5	7	0	20	34	19	11	13	161	4
		EU.España	552	1084	1482	1356	984	861	1090	1235	811	1158	703	584	664	654	628	922	1192	1535	1207	1083	1077	862	882	1049	1044
		EU.Portugal	0	92	94	165	116	119	388	140	56	625	13	242	493	375	321	502	336	409	176	132	127	158	393	503	300
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	11	0	0	0	0	0	0	0	0	**0**
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Japan	1369	1617	514	244	267	151	264	56	133	118	398	0	0	72	115	108	103	132	291	114	182	109	77	96	93
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	13	7	7	4	4	18	8	9
		Namibia	0	0	0	0	0	1	0	0	459	375	509	1415	1243	1002	295	23	307	377	586	9	950	661	799	194	980
		Panama	0	0	0	0	0	24	1	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	**0**
		Philippines	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
		Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	34	23	0	11	6	39	4
		South Africa	24	49	37	31	171	67	116	70	12	116	101	111	86	224	137	146	152	218	108	250	476	613	339	305	244
		UK.Sta Helena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Uruguay	12	17	26	20	23	21	35	40	38	188	249	146	68	36	41	106	23	76	36	1	0	0	0	0	**0**
		Vanuatu	0	0	0	0	0	0	0	0	0	0	52	12	13	1	0	0	0	0	0	0	0	0	0	0	**0**
	NCC	Chinese Taipei	65	87	117	139	130	198	162	120	146	83	180	226	166	147	124	117	144	203	150	157	158	152	92	85	64
MED	CP	EU.Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	**0**
		EU.España	0	0	0	6	7	5	3	2	2	2	2	2	4	1	0	0	1	2	2	0	0	0	0	0	**0**
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		EU.Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		EU.Portugal	0	0	0	0	1	0	1	5	0	0	0	15	5	0	0	0	0	0	0	0	0	0	0	0	**0**
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Discards	ATN	CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
		Mexico	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		U.S.A.	21	28	1	0	0	0	0	0	0	0	0	0	0	7	10	20	2	9	18	5	11	8	6	4	1
		UK.Bermuda	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	3
ATS	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	2	2	3	3	2
MED	CP	EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

POR-Table 1. Estimated catches (t) of porbeagle (*Lamna nasus*) by area, gear and flag.

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL				3049	2343	1952	2055	1779	1649	1769	1203	1075	887	954	740	642	671	613	485	136	90	149	185	66	59	22	30	17
	ATN			2770	2173	1640	1877	1516	1471	1555	1081	892	690	842	605	519	522	527	421	119	68	111	156	28	56	20	29	12
	ATS			279	170	311	178	262	178	214	121	182	196	109	133	122	149	85	62	16	21	37	29	38	4	1	0	4
	MED			0	0	1	0	1	0	1	1	0	0	3	2	1	0	2	1	1	0	1	0	0	0	1	1	0
Landings	ATN		Longline	1826	1485	1262	1459	1158	1063	1018	607	352	292	528	288	271	392	356	203	85	38	79	115	8	8	4	2	1
			Other surf.	943	687	378	417	357	408	537	474	541	398	315	316	248	130	170	219	31	29	32	39	12	12	11	15	7
	ATS		Longline	277	170	310	174	260	172	213	121	182	196	109	133	122	149	85	62	16	21	37	29	13	4	1	0	4
			Other surf.	1	0	0	4	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	
	MED		Longline	0	0	1	0	1	0	1	1	0	0	2	2	0	0	2	1	0	0	1	0	0	0	0	0	0
			Other surf.	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0
Discards	ATN		Longline	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	2	8	34	3	9	2
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2
	ATS		Longline	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings	ATN	CP	Barbados	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Canada	1575	1353	1051	1334	1070	965	902	499	237	142	232	202	192	93	124	62	83	30	33	19	9	4	2	2	1
			EU.Denmark	93	86	72	69	85	107	73	76	42	21	20	4	3	2	1	0	0	0	2	0	0	0	0	0	0
			EU.España	52	19	41	25	25	18	13	24	54	27	11	14	34	8	41	77	0	0	0	0	0	0	0	0	**0**
			EU.France	820	565	267	315	219	240	410	361	461	303	413	276	194	354	311	228	0	2	4	0	0	3	0	1	0
			EU.Germany	0	0	0	0	2	0	17	1	3	5	7	5	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Ireland	0	0	0	0	0	8	2	6	3	11	18	3	4	8	7	3	0	0	0	0	0	0	0	0	**0**
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Portugal	1	1	1	1	1	0	7	4	10	101	50	14	6	0	3	17	7	0	0	0	0	0	0	0	0
			EU.Sweden	2	2	1	1	1	1	1	1	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	
			EU.United Kingdom	0	0	0	0	1	6	8	12	10	25	24	24	11	26	15	11	0	0	0	0	0	0	0	0	**0**
			FR.St Pierre et Miquelon	0	7	40	13	20	0	13	2	1	2	4	0	0	0	1	0	0	0	0	0	0	0	0	0	**0**
			Iceland	4	6	5	3	4	2	2	3	2	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0	**0**
			Japan	29	15	15	13	19	41	47	52	21	7	20	27	18	17	10	13	13	14	49	98	0	0	2	0	**0**
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	**0**
			Norway	24	26	28	17	27	32	22	11	14	19	24	8	27	10	12	10	12	11	17	9	5	4	6	6	3
			U.S.A.	106	35	78	56	13	3	1	1	1	0	1	0	0	0	1	1	1	11	4	27	6	8	4	8	3
			Venezuela	4	1	7	2	8	9	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	10	12	27	18	13	27	19	18	22	12	8	7	5	3	0	0	0	0	0	0	0	0	0	0	**0**
		NCO	Cuba	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
			Faroe Islands	48	44	8	9	7	10	13	8	10	14	5	19	21	0	0	0	0	0	0	0	0	0	0	0	
	ATS	CP	Brazil	32	49	33	36	38	58	60	67	74	49	37	52	32	23	0	0	0	2	0	0	0	0	0	0	**0**
			China PR	1	0	0	0	0	13	36	4	0	5	4	2	2	6	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	35	43	28	27	2	14	7	14	2	9	4	0	3	5	4	13	0	0	0	0	0	0	0	0	**0**
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Poland	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Portugal	0	0	0	1	0	0	0	1	1	1	4	2	1	2	0	0	0	0	0	0	0	0	0	0	**0**
			Ghana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	**0**

				1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Japan	14	6	9	14	1	2	7	4	3	2	11	3	3	9	41	34	8	7	25	15	13	4	1	0	**0**
			Korea Rep.	2	1	6	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	14	0	0	0	0	4
			Panama	24	4	21	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Philippines	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	
			Uruguay	0	3	0	5	13	2	4	0	8	34	8	28	34	3	40	14	6	12	12	0	0	0	0	0	**0**
			Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	146	57	168	65	170	73	84	29	93	95	39	43	47	99	0	0	2	0	0	1	0	0	0	0	**0**
		NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Benin	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Chile	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Falklands	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	22	8	46	23	37	11	15	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED	CP	EU.Italy	0	0	0	0	0	0	0	0	0	0	2	1	1	0	2	0	0	0	0	0	0	0	1	1	0
			EU.Malta	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	**0**
Discards	ATN	CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	2	3
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			U.S.A.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	2	7	34	1	9	1
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATS	CP	Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Uruguay	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SHK-Table 2. Vulnerability ranks for 20 stocks of pelagic sharks calculated with three methods: Euclidean distance (v1), multiplicative (v2), and arithmetic mean (v3). A lower rank indicates higher risk. Stocks listed in decreasing risk order according to the sum of the three indices. Red highlight indicates risks scores 1-5; yellow, 6-10; blue, 11-15; and green, 16-20. Productivity values ranked from lowest to highest.

BTH=bigeye thresher; LMA=longfin mako; SMA=shortfin mako; POR=porbeagle; CCS=night shark; FAL SA=silky shark South Atlantic; CCP=sandbar shark; OCS=oceanic whitetip; FAL NA=silky shark North Atlantic; ALV=thresher shark; BSH NA=blue shark North Atlantic; DUS=dusky shark; SPK=great hammerhead; BSH SA=blue shark South Atlantic; TIG=tiger shark; PLS SA=pelagic stingray South Atlantic; SPL NA=scalloped hammerhead North Atlantic; SPZ=smooth hammerhead; SPL SA=scalloped hammerhead South Atlantic; PLS NA=pelagic stingray North Atlantic.

Stock	v_1	v_2	v_3
BTH	3	1	1
LMA	5	3	2
SMA	1	8	2
POR	2	7	4
CCS	11	4	5
FAL SA	12	5	6
CCP	15	2	6
OCS	4	13	8
FAL NA	8	11	8
ALV	9	14	11
BSH NA	6	19	10
DUS	17	6	12
SPK	14	10	13
BSH SA	7	20	14
TIG	10	16	15
PLS SA	18	9	16
SPL NA	16	12	16
SPZ	13	17	18
SPL SA	19	15	19
PLS NA	20	18	20

SHK-Table 3. Stock Synthesis model runs 1 and 3 combined Markov Chain Monte Carlo (MCMC, long chain) Kobe II risk matrix for North Atlantic shortfin mako projection results: Probability that the fishing mortality (F) will be below the fishing mortality rate at MSY ($F < F_{MSY}$; top panel), probability that the spawning stock fecundity (SSF) will exceed the level that will produce MSY ($SSF > SSF_{MSY}$; middle panel), and the probability of both $F < F_{MSY}$ and $SSF > SSF_{MSY}$ (bottom panel).

Probability that $F<F_{MSY}$

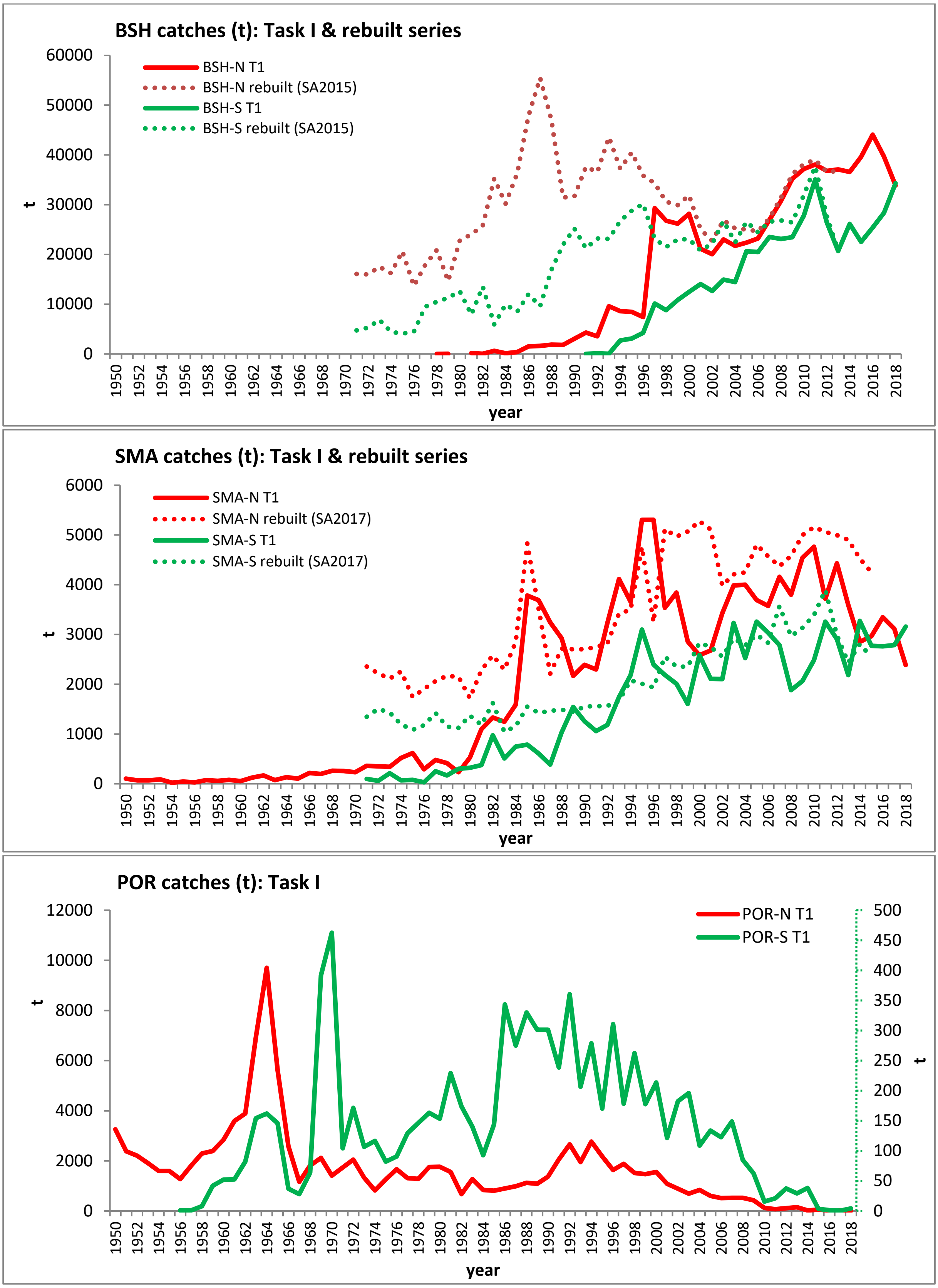
TAC (t)	2019	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
0	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100
200	100	100	100	100	100	100	100	100	100	100	100	100
300	100	100	100	100	100	100	100	100	100	100	100	100
400	100	100	100	100	100	100	100	100	100	100	100	100
500	96	99	100	100	100	100	100	100	100	100	100	100
600	81	89	99	99	98	96	95	97	97	97	96	95
700	57	69	93	92	88	82	80	83	84	85	82	82
800*	32	45	76	77	70	63	62	64	67	67	65	63
900	15	24	57	58	51	46	44	47	51	49	49	48
1000	5	11	37	38	31	27	26	28	30	31	30	30
1100	2	4	19	21	17	13	11	13	14	14	14	13

Probability that $SSF>SSF_{MSY}$

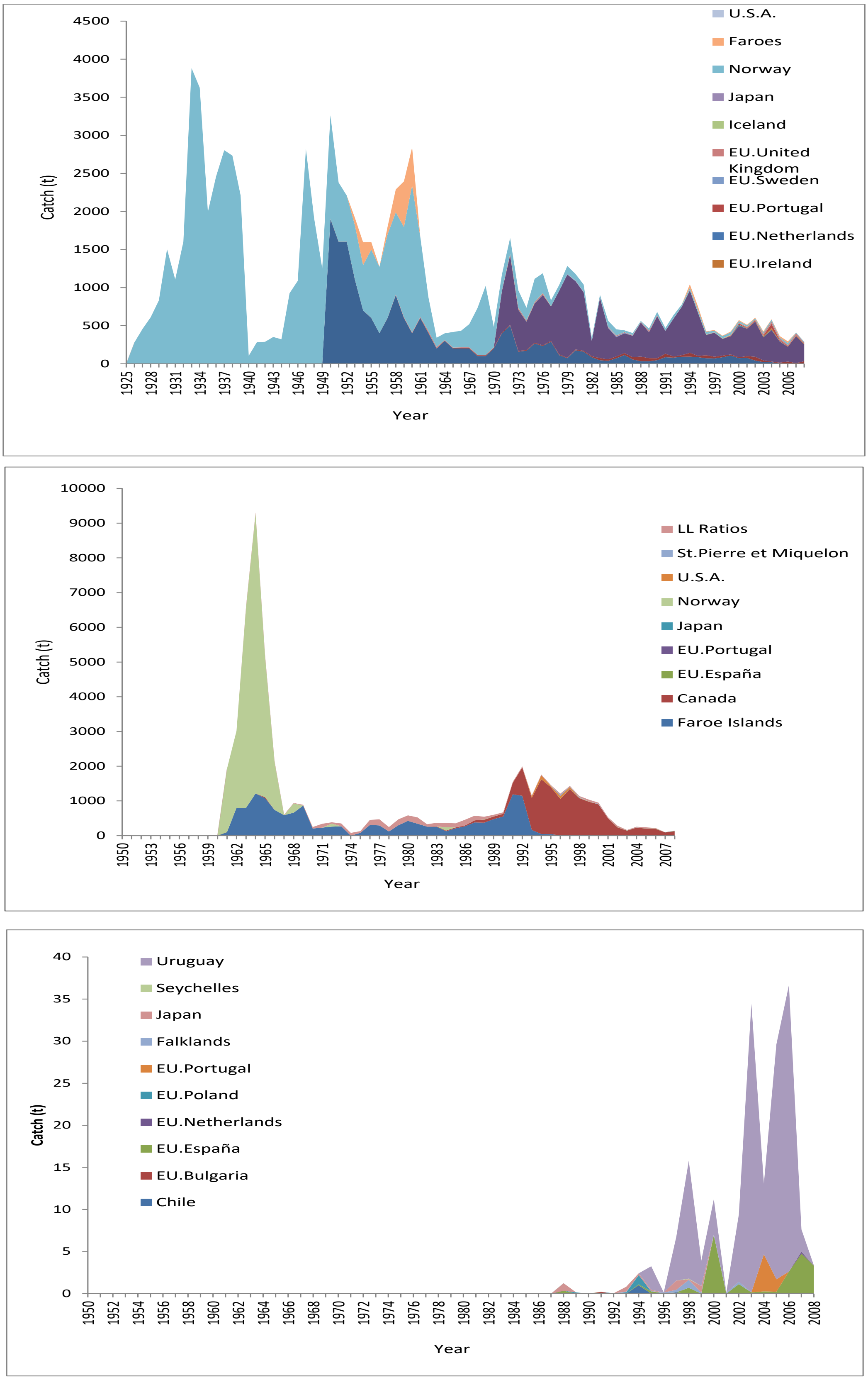
TAC (t)	2019	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
0	46	42	24	14	11	33	53	60	63	67	72	81
100	46	42	24	13	10	29	49	56	59	61	66	73
200	46	42	24	13	9	26	47	54	55	57	61	66
300	46	42	24	12	9	22	42	50	52	53	56	60
400	46	42	24	12	8	19	39	47	49	50	52	55
500*	46	42	24	12	7	17	34	42	45	47	49	52
600	46	42	24	12	7	14	28	37	40	41	43	47
700	46	42	24	11	6	11	23	31	34	35	37	41
800	46	42	23	11	6	10	19	26	27	28	30	32
900	46	42	23	11	5	8	16	20	21	21	23	24
1000	46	42	23	11	5	7	12	16	16	15	15	17
1100	46	42	23	10	5	6	10	12	12	11	10	10

Probability of being in the green zone ($F<F_{MSY}$ and $SSF>SSF_{MSY}$)

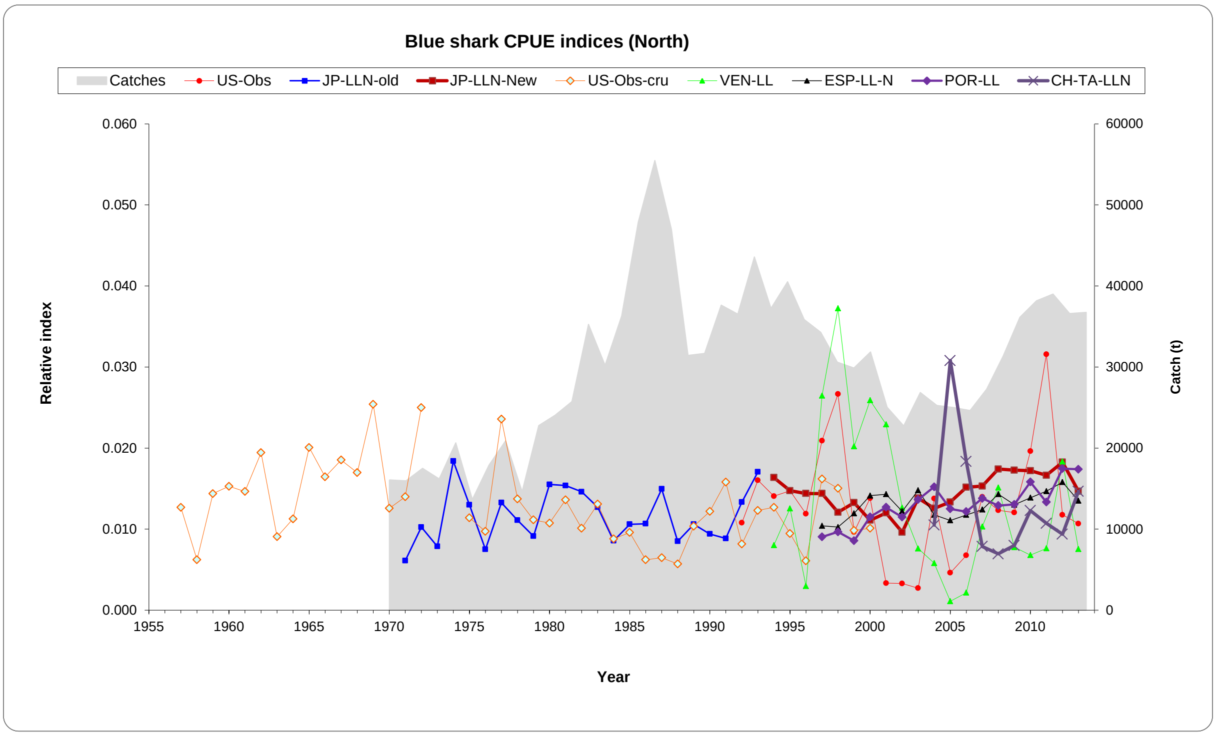
TAC (t)	2019	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
0	46	42	24	14	11	33	53	60	63	67	72	81
100	46	42	24	13	10	29	49	56	59	61	66	73
200	46	42	24	13	9	26	47	54	55	57	61	66
300	46	42	24	12	9	22	42	50	52	53	56	60
400	46	42	24	12	8	19	39	47	49	50	52	55
500*	46	42	24	12	7	17	34	42	45	47	49	52
600	45	42	24	12	7	14	28	37	40	41	43	47
700	41	41	24	11	6	11	23	31	34	35	37	41
800	27	34	23	11	6	10	19	26	27	28	30	32
900	14	21	23	11	5	8	15	20	21	21	23	24
1000	5	10	20	10	5	7	12	15	15	14	14	16
1100	2	4	14	9	4	5	7	9	9	8	8	8

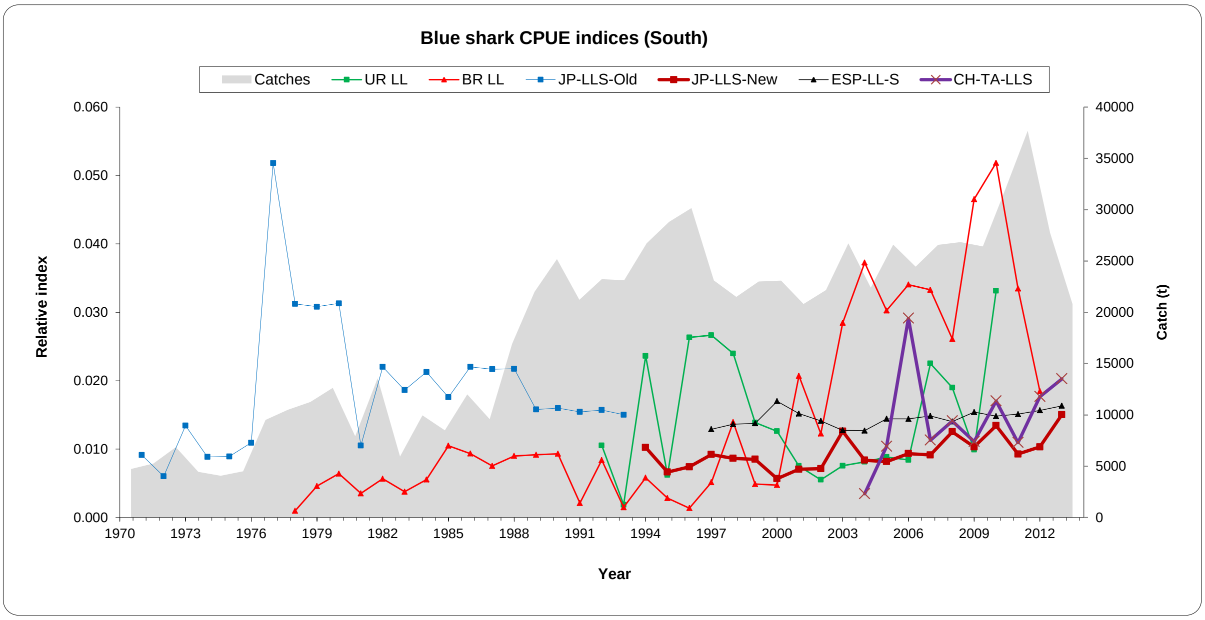


SHK-Figure 1. Blue shark (BSH, top panel) and shortfin mako (SMA, middle panel) catches reported to ICCAT (Task I) and estimated by the Committee, and Task I porbeagle (POR bottom panel, POR-S catch series is preliminary).

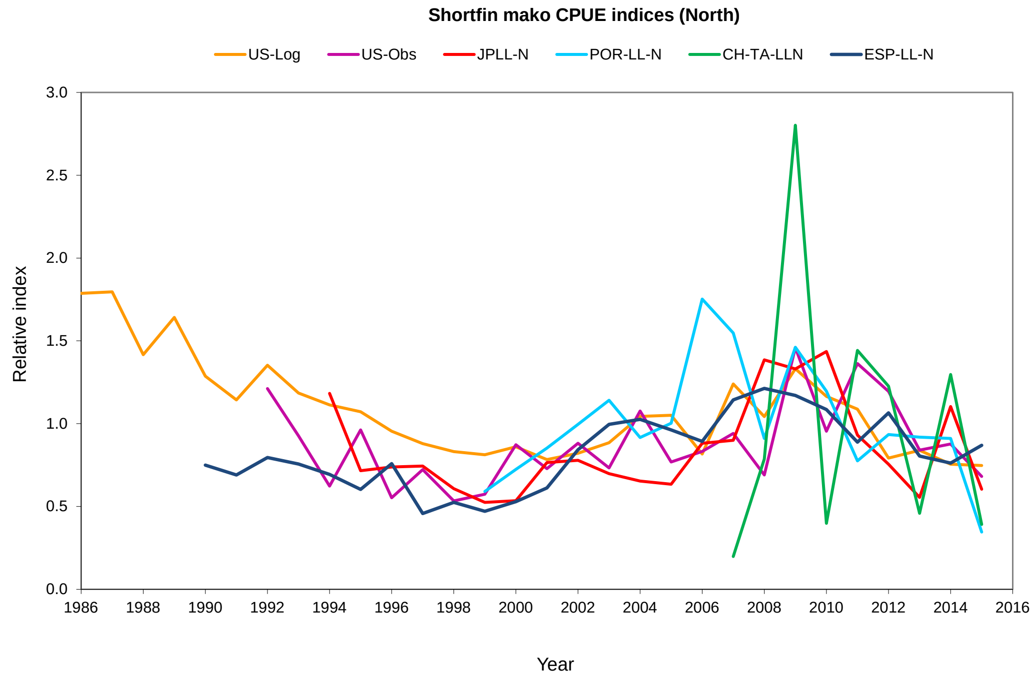


SHK Figure 2. Catch by flag of porbeagle sharks from the northeast Atlantic (top), northwest Atlantic (middle), and southwest Atlantic (bottom) used in the 2009 stock assessment. While these catches are considered the best available, NE catches are believed to underestimate the pelagic longline catches for this species, those from the NW include non-reporting fleets, which in this case represent a small proportion of the total, and those from the SW are Task I data also believed to significantly underestimate actual catches by all fleets.

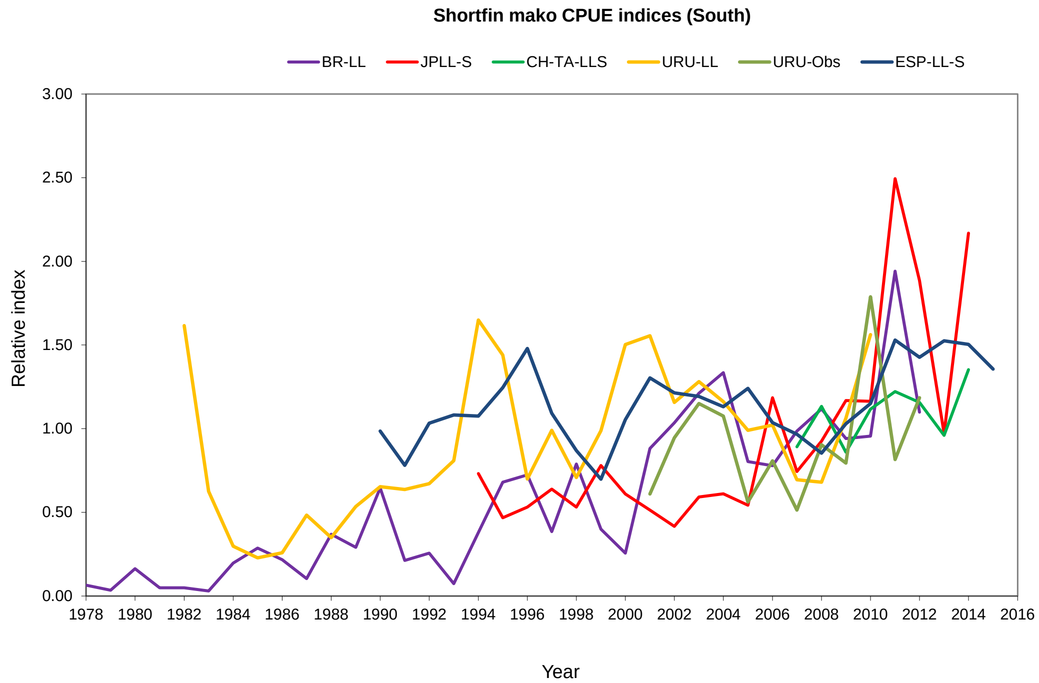




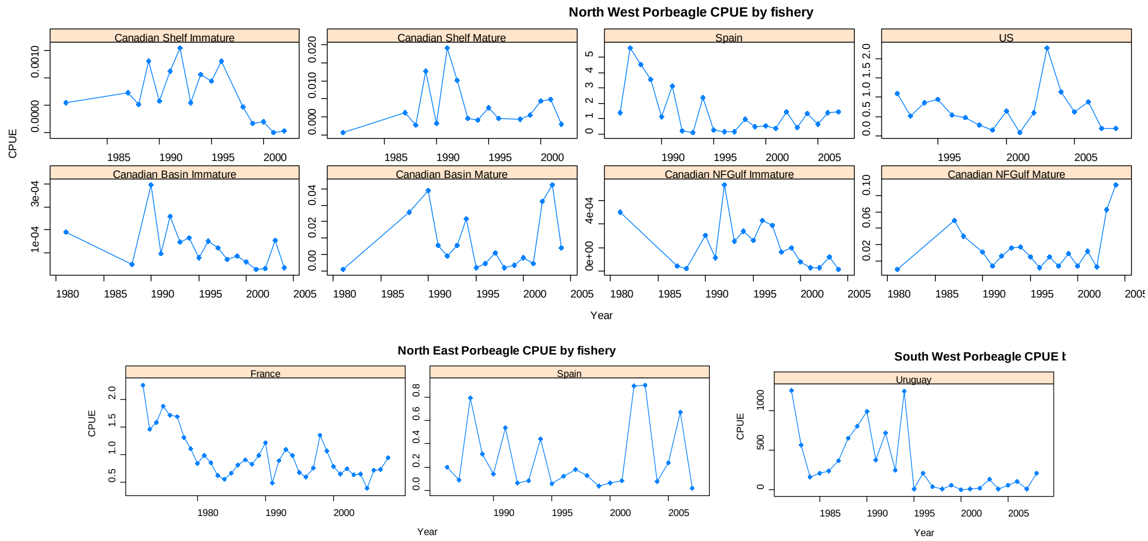
SHK-Figure 3. CPUE series used in the 2015 assessments of North and South Atlantic blue shark (BSH) stocks. Total catches (in t) used in the assessments are also shown.



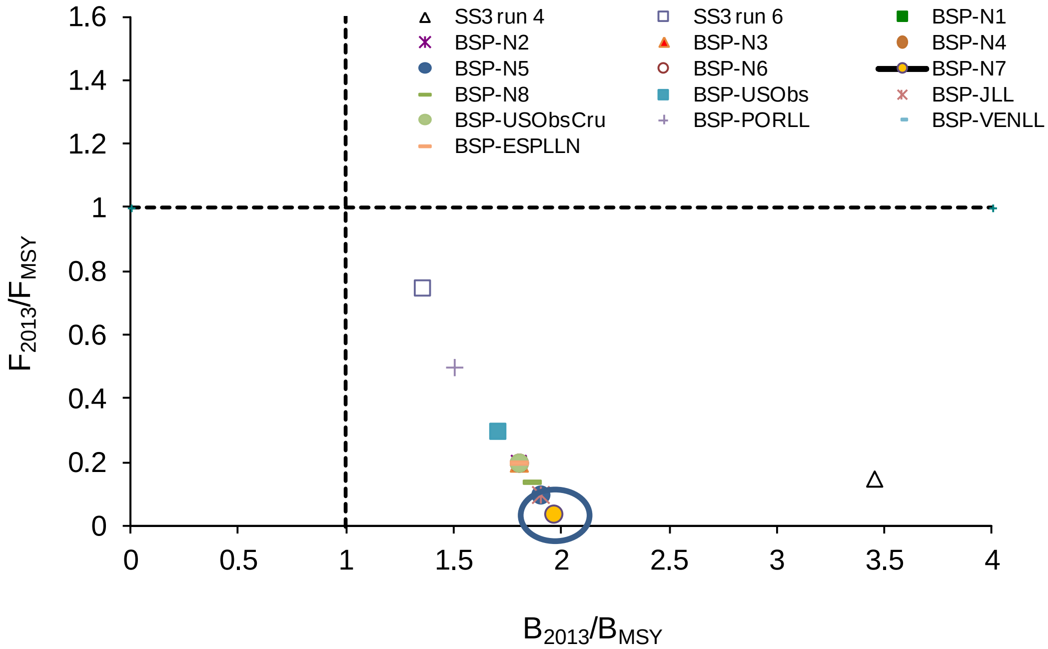
SHK-Figure 4. Indices of abundance for North Atlantic shortfin mako shark used in the 2017 stock assessment.



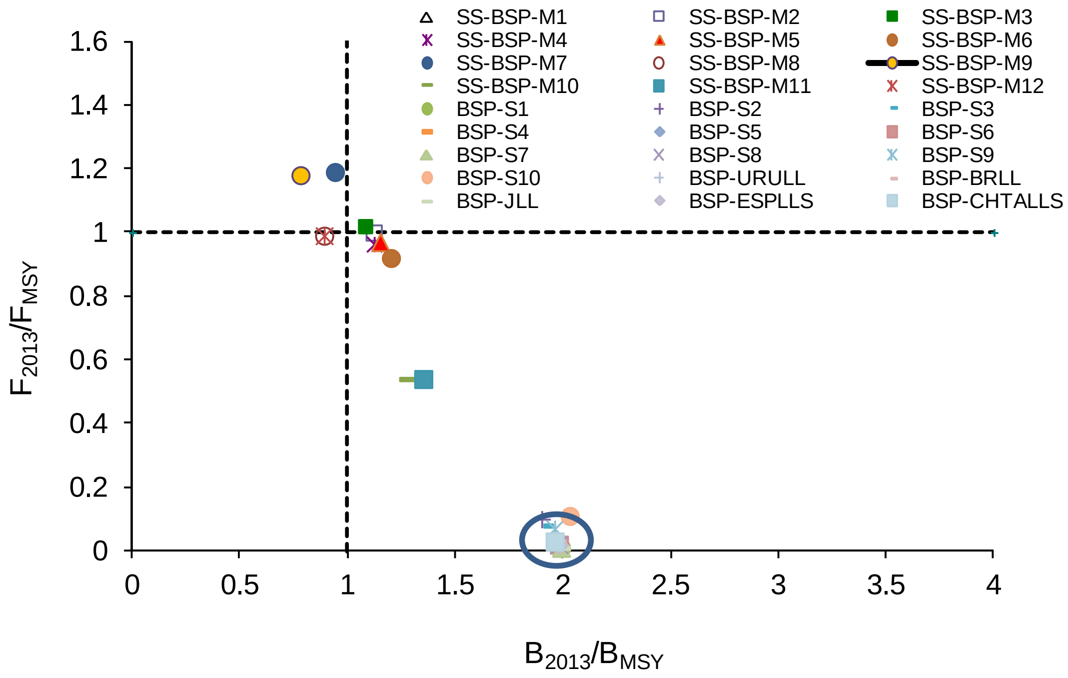
SHK-Figure 5. Indices of abundance for South Atlantic shortfin mako shark used in the 2017 stock assessment.



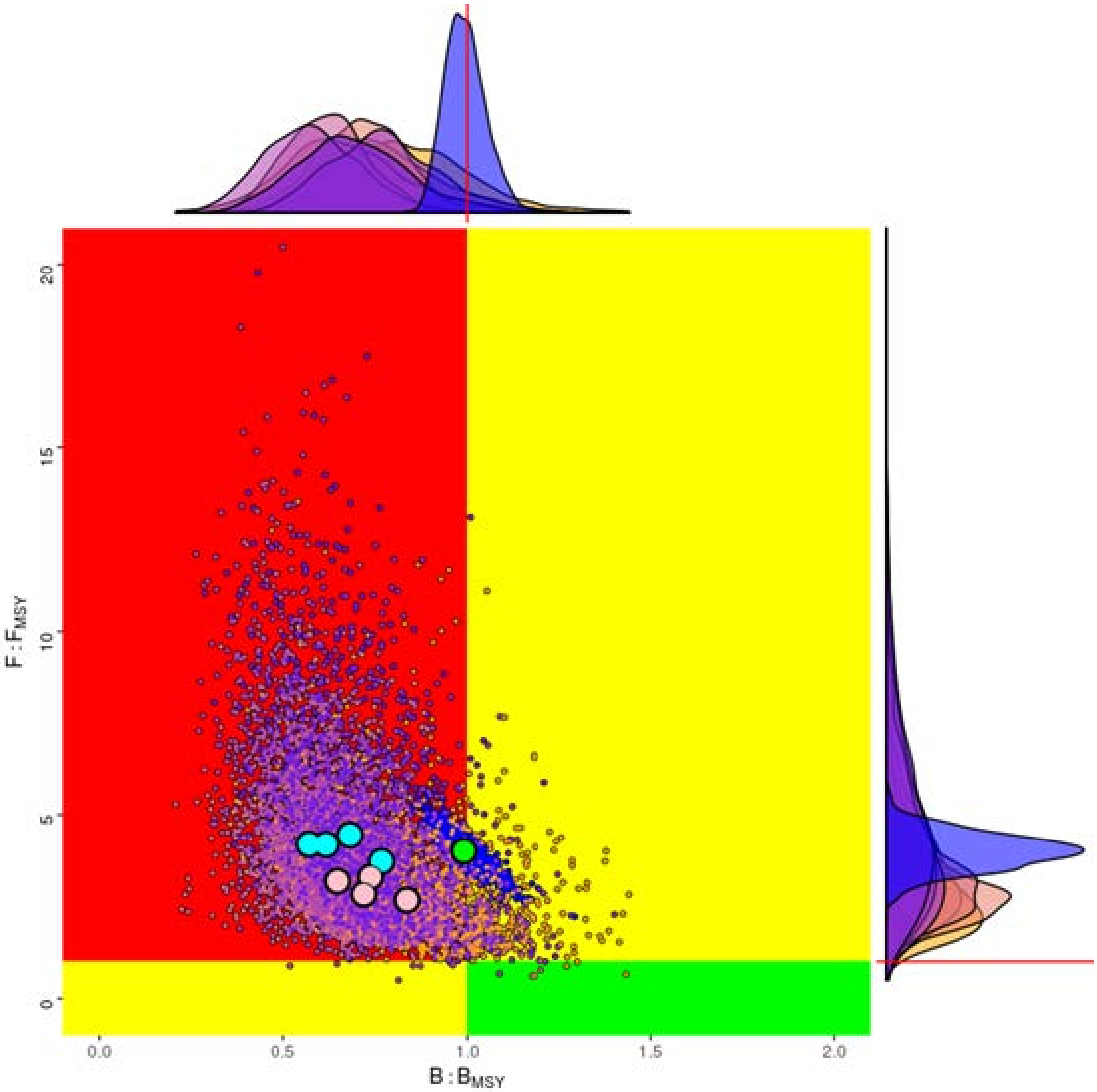
SHK-Figure 6. CPUE series for the porbeagle used in the last (2009) assessment NW stock (upper figures), NE stock (lower left figures) and SW stock (lower right figure).



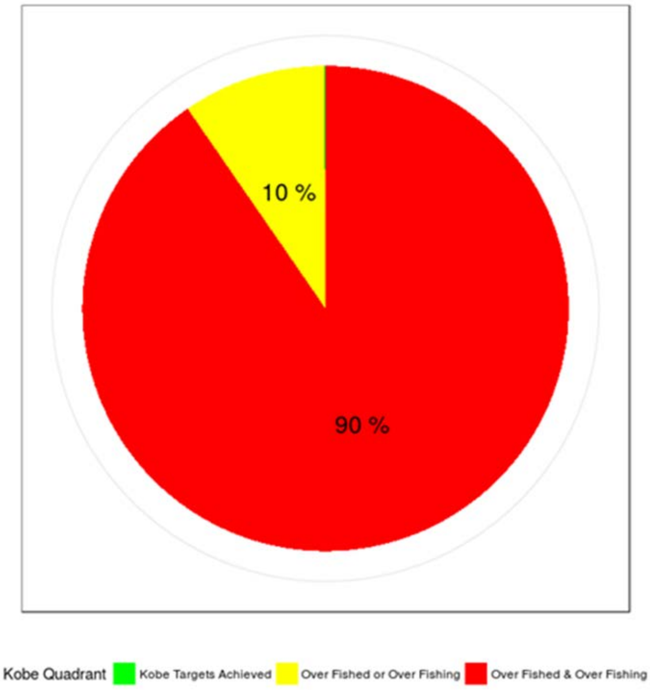
SHK-Figure 7. Phase plots summarizing scenario outputs for the current (for 2013) stock status of North Atlantic blue shark (BSH). BSP=Bayesian surplus production model; SS3=Stock synthesis model. The circle denotes common status for several BSP runs. Note that the x-axis values for SS3 are SSF_{2013}/SSF_{MSY}.



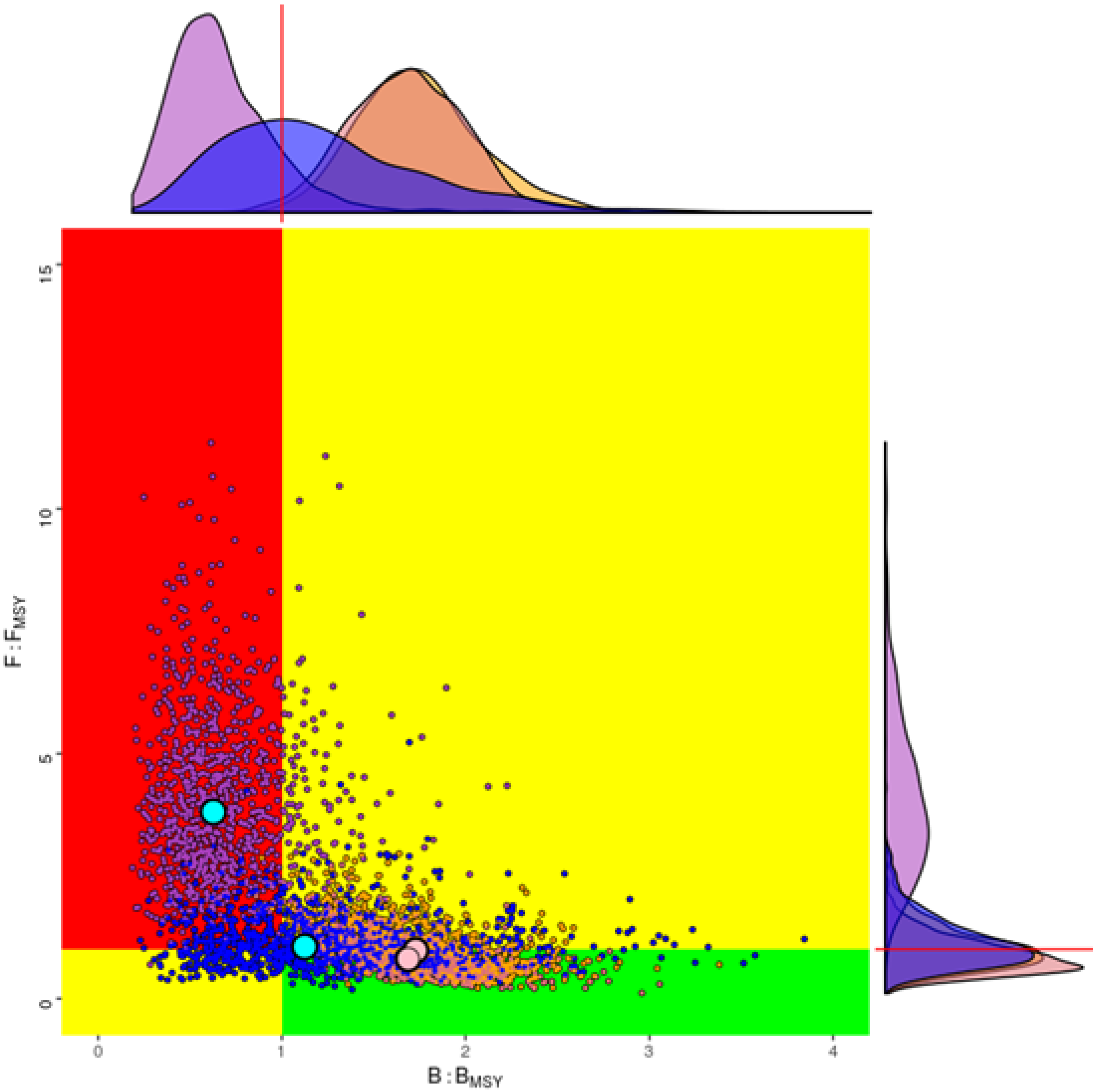
SHK-Figure 8. Phase plots summarizing scenario outputs for the current (for 2013) stock status of South Atlantic blue shark (BSH). BSP=Bayesian surplus production model; SS-BSP=State-space Bayesian surplus production model. The circle denotes common status for several BSP runs.



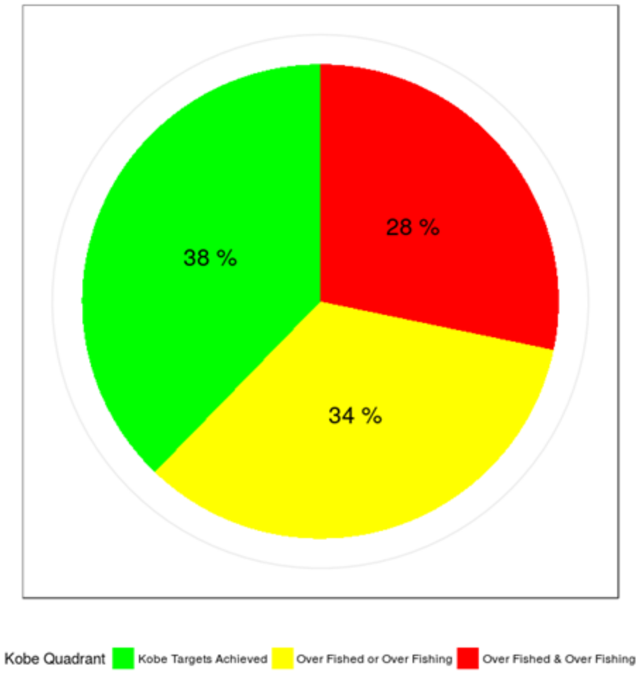
SHK-Figure 9. Stock status (2015) of North Atlantic shortfin makos based on Bayesian production models (4 BSP2JAGS and 4 JABBA runs) and 1 length-based, age-structured model (SS3). The clouds of points are the bootstrap estimates for all model runs showing uncertainty around the median point estimate for each of nine model formulations (BSP2JAGS: solid pink circles; JABBA: solid cyan circles; SS3: solid green circle). The marginal density plots shown are the frequency distributions of the bootstrap estimates for each model with respect to relative biomass (top) and relative fishing mortality (right). The red lines are the benchmark levels (ratios equal to 1).



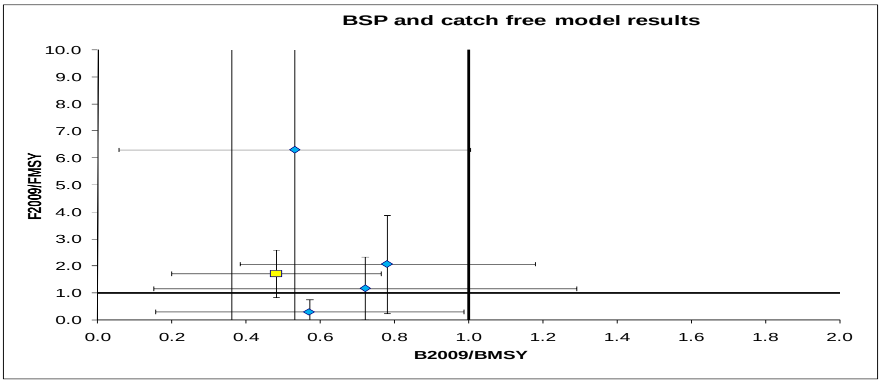
SHK-Figure 10. Kobe pie chart summarizing stock status (for 2015) for North Atlantic shortfin makos based on Bayesian production models (4 BSP2JAGS and 4 JABBA runs) and 1 length-based age-structured model (SS3). Probability of being in the green quadrant is less than 0.5%.



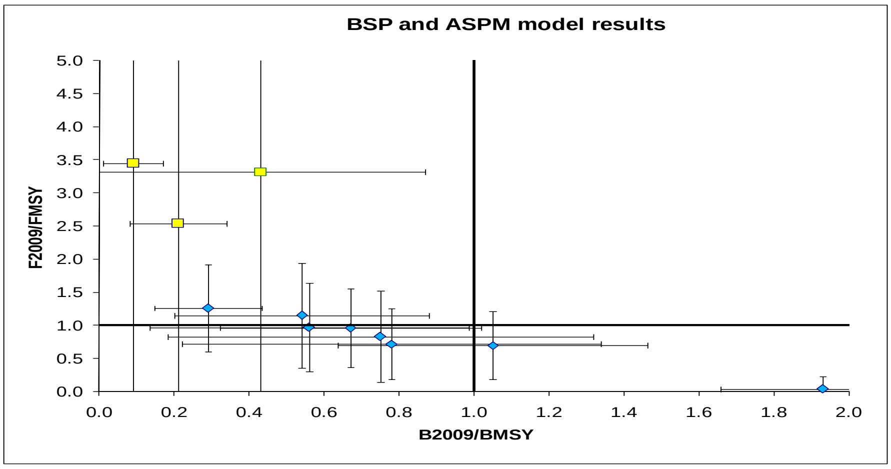
SHK-Figure 11. Stock status (2015) of South Atlantic shortfin makos based on a Bayesian production model (BSP2JAGS) and a catch-only model (CMSY). The clouds of points are the bootstrap estimates for all models combined showing uncertainty around the median point estimate for each of four model formulations (BSP2JAGS: solid pink circles; CMSY: solid cyan circles). The marginal density plots shown are the frequency distributions of the bootstrap estimates for each model with respect to relative biomass (top) and relative fishing mortality (right). The red lines are the benchmark levels (ratios equal to 1).



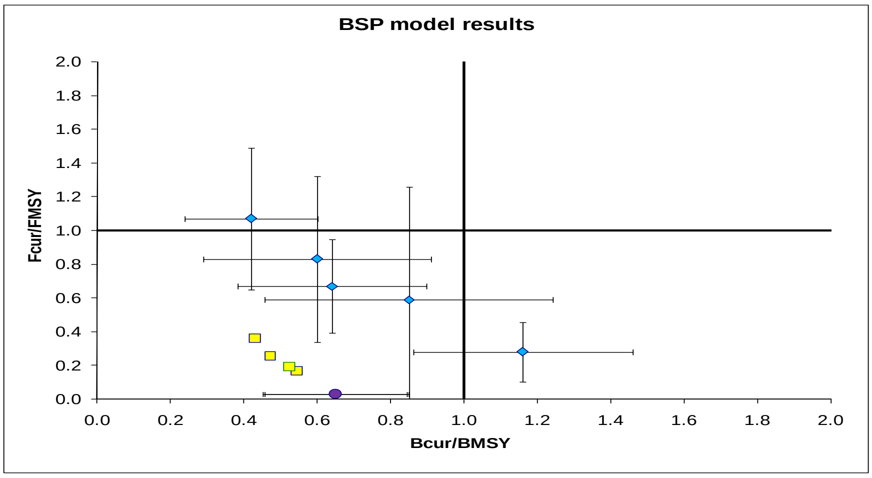
SHK-Figure 12. Kobe pie chart summarizing stock status (for 2015) for South Atlantic shortfin makos based on a Bayesian production model (2 BSP2JAGS runs) and a catch-only model (2 CMSY runs).



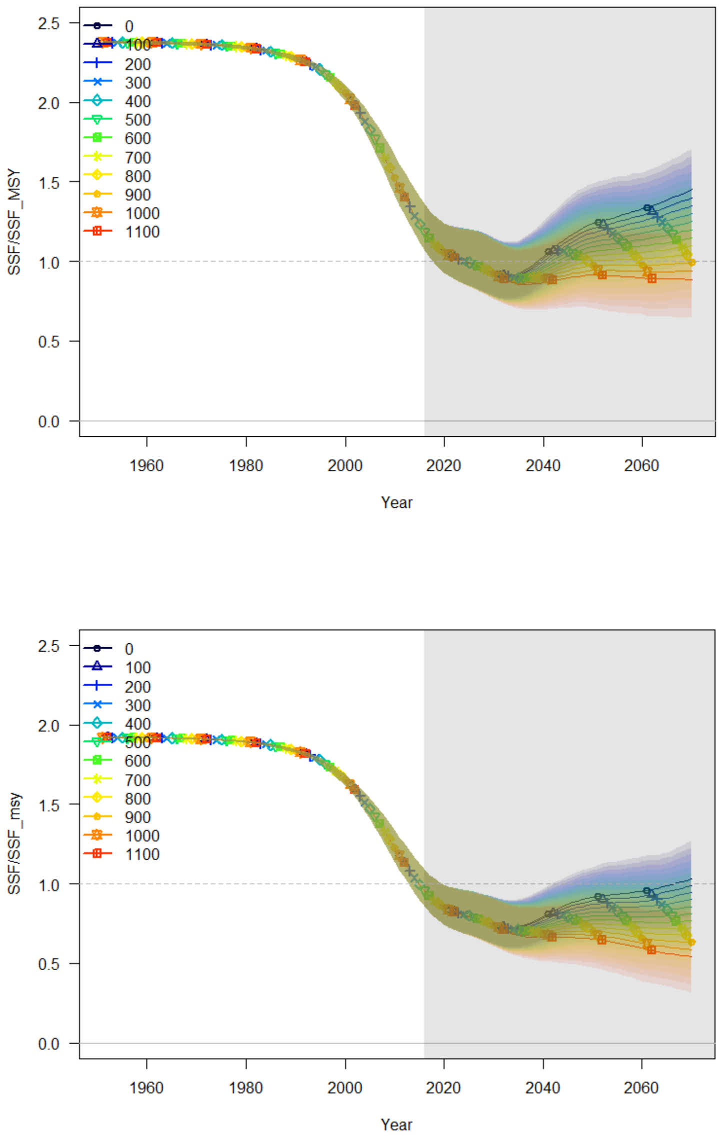
SHK-Figure 13. Phase plot for the southwest Atlantic porbeagle, showing status in 2009 from both the BSP model runs (diamonds) and the catch free age structured production model (square) results. Error bars are plus and minus one standard deviation.



SHK-Figure 14. Phase plot showing current status (for 2009) of northeast Atlantic porbeagle for the BSP model (diamonds) and the ASPM model (squares). Error bars are plus and minus one standard deviation.



SHK-Figure 15. Phase plot showing the northwest Atlantic porbeagle expected value of B/B_{MSY} and F/F_{MSY} in the current year, which is either 2005 (diamonds) or 2009 (circle), as well as approximate values from Campana *et al.* 2010 (squares). B/B_{MSY} was approximated from Campana *et al.* 2010 as N2009/N1961 times 2. Error bars are plus and minus one standard deviation.



SHK-Figure 16. Constant catch projections (0 – 1100 t) from Stock Synthesis model run 1 (top panel) and run 3 (bottom panel) for the North Atlantic shortfin mako (Anon. 2019g). Solid lines are medians and shaded areas are 95% credible intervals.

10. Report of Research Programmes

10.1 Atlantic-wide Research Programme for Bluefin Tuna (ICCAT GBYP)

The activities of the GBYP officially started in March 2010. Phase 8 started on 21 February 2018 with initial duration of 12 months, but later it was extended for 6 months (until 21 September 2019) in order to better address current research needs and make optimal use of available funds. Phase 9 started on 1 January 2019 with an initial duration of 12 months.

The most relevant research activities carried out during this reporting period (October 2018-October 2019) have been:

a) Data recovery **–** In the last part of Phase 8, 261 detailed electronic tags data sets (41 from satellite tags deployed off Canada and off Ireland in 2016-17 and 220 from satellite tags deployed in the western Atlantic between 2002 and 2011) were recovered and integrated into the GBYP e-tags database. These data contribute to enhancing knowledge on bluefin tuna spatial patterns and will be used within the MSE process.

b) Aerial survey on bluefin tuna spawning aggregations **–** In 2018 and 2019 sixth and seventh aerial surveys were carried out in 4 spawning areas in the Mediterranean, following the same methodology as in previous surveys. In order to improve the reliability of the results, first attempt of calibration of professional spotters estimations was performed, along with a feasibility study of acoustic survey to validate aerial observations. In addition, a re-analysis of the whole aerial surveys data set is being performed to remove any potential bias in the results and, consequently, provide a more accurate aerial survey index time series. Development of further strategies to improve reliability of estimates is in process. GBYP aerial survey index is being used in MSE.

c) Tagging **-** Conventional tagging continued as a complementary activity only. Although the tag reporting has slightly improved, the recovery rate remains low. The deployment of electronic tags conducted since 2011 have further enhanced the knowledge on bluefin tuna behaviour and helped address several previous hypotheses. These data have been used within the framework of MSE development. In 2018 and 2019 a total of 42 and 37 electronic tags have been deployed, respectively, in different areas in the North Atlantic. The methodology of tag implanting has been improved, which has resulted in remarkably higher tag retention rates. An international workshop on tagging techniques was organized, including practical tagging sessions, to produce a new improved GBYP e-tagging protocol.

d) Biological studies **-** Biological sampling was focused on collecting tissue samples and otoliths for the purpose of better determining the population structure and mixing and improving the accuracy of the age length key, used for the stock assessment and MSE. The results from otolith microchemistry continue to show important interannual variations in mixing proportion of West and East stock individuals in the East Atlantic. The results of genetic and integrated analyses show that BFT present more complex population dynamics than previously thought. These analyses also suggest that individuals captured in the Slope Sea could constitute a genetically intermediate population between E-BFT and W-BFT. The ongoing study will focus on combining genetic and microchemical analyses on the same sample and will continue analysing the individuals from the mixing zones, and especially from the Slope Sea. In order to improve the current knowledge on bluefin tuna reproductive and growth parameters, two dedicated workshops involving recognized experts in each field, were organized. Improved protocols for otolith preparation and reading have been elaborated as a result of the latter. Currently, a set of 2000 BFT otoliths is being analysed following such improved methodologies. Further efforts in ageing include calibration of otolith age estimates provided so far and creation of a bluefin otoliths reference collection. With the aim of improving the coherence within the bluefin growth rates derived from the eBCD, in 2019 GBYP initiated a new study on growth in farms, which is currently being carried out in five farming facilities.

e) Modelling – The work on MSE development continued, aiming at ensuring that the OM scenarios agreed by the CMG can be run; that third parties can use the OM to evaluate candidate MPs (CMPs) with their own specifications; and providing a set of agreed summary statistics that can be used by decision makers to identify the MP, including data and knowledge requirements, that robustly meets the management objectives. In addition, GBYP has continued providing financial support to various experts for their attendance to MSE Technical Group meetings.

The report was adopted and is attached as **Appendix 6**.

Discussion

The GBYP Coordinator presented to the Committee a brief summary of the GBYP programme, focusing on the main results of the activities carried out from the last SCRS plenary meeting within each line of activity (data recovery, biological studies, aerial survey, tagging and modelling). He especially emphasized the recent efforts directed to provide the growth rates of bluefin in farms, in line with the Commission request. He noted that due to nature of farming practice and logistical constraints, it will not be possible to provide the results within the initially required timeframe (2020), nor determine individual growth rates in all case studies. Finally, a draft proposal outlining the tasks to be carried out within the next GBYP Phase 10 was presented for consideration by the Committee, including a specific petition for maintaining, and if possible increasing, the current budgetary support.

The Committee acknowledged the important contribution of GBYP in filling knowledge gaps on bluefin tuna in support of stock assessment and MSE development.

The Committee requested that all GBYP meetings and workshops be announced well in advance through ICCAT circulars, and that all relevant corresponding information be made available on the GBYP webpage.

The Committee briefly discussed the growth in farms study, noting that alternative non-invasive methods for tracking the growth of individual fish in farms may be available, such as a technique combining acoustic and image analysis systems methods. The Coordinator informed that a pilot study to explore the usefulness of the method could be launched next year and, in the case of a positive outcome, further consideration would be given to use of this technology in other farms.

The Committee also noted that there should be joint coordination between the project leaders of the ongoing growth in farms study developed by the GBYP and those being carried out by CPCs (e.g. Morocco). The Committee also reiterated that other species groups should take advantage of the experiences and methodological improvements achieved by GBYP.

It was agreed that special efforts should be made by all donors to continue economic support for all GBYP activities.

10.2 Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP)

AOTTP has made substantial progress since the last SCRS Plenary report in 2018. ICCAT AOTTP evaluated and awarded seven contracts during this period (and 43 since the project began) with a total value of €10,911,434. Overall at least 1,657 days at sea have been spent on 393 tagging cruises throughout the Atlantic. Tagging targets (120,000) should be met, within budget, by the end of the last quarter of 2019. Currently *ca* 113,000 fish (94% of the target) have been tagged (first release, R-1) with conventional tags in the EEZs of more than 20 different countries in addition to many fish tagged in the high seas. A total of 524 electronic tags (pop-ups and internals) have been deployed and are already providing new scientific information on tuna migrations. Scientists and technicians, including women, from developing countries have tagged over two-thirds of all the fish. Formal tag-recovery and awareness raising infrastructures are now in place in 13 countries, with less formal arrangements in another 5 locations, including Japan and China (P.R.). Around 15,000 tags have been recovered (overall recovery rate is 13%) for which rewards (t-shirts, caps, lottery entry, cash, and mobile phone top-ups) have been paid. Tag-seeding experiments are ongoing within an extensive network of observers throughout the Atlantic, and reporting rates for the most important purse-seine fleets are: 80.7%; 83%; and 71.7% for BET, SKJ, and YFT, respectively. So far *ca* 20,000 have been double-tagged, allowing tag-shedding rates to be estimated, and 8,659 chemically tagged which is improving our ability to age recaptured fish. ICCAT AOTTP partners from Brazil and Senegal have created a pan-Atlantic Otolith Reference Set to standardise age-determination of tropical tunas and routine ageing has begun. Otolith ring deposition rate validation and training work is ongoing with contractors from Australia, Côte d'Ivoire, Brazil and Senegal. All AOTTP data continue to be uploaded rapidly into relational databases using smartphone applications and messaging applications, which are also used very effectively to maintain communication between AOTTP and the many field operatives around the Atlantic Ocean. Training in all aspects of tagging at sea, tag-recovery, and data transmission methodologies continued this year building on the foundations already made. ICCAT AOTTP organised two otolith-reading capacity-building workshops during the current reporting period, which were very successful. Two contracts for data analysis have been awarded: one to investigate mortality and movement/migration; and the other on growth. The YFT stock was assessed in Côte d'Ivoire in July 2019 (Anon. 2019k). The tagging data were formatted for inclusion in the integrated assessment model, Stock Synthesis, and provided estimates of selectivity for the Brazilian handline fleet. AOTTP and partners have also provided the stock assessors with daily YFT ages from the Reference Collection and annual ages of large individuals caught off South Africa. Growth trajectories from tagging data and otolith ages were used to guide the estimation of growth in Stock Synthesis model. Preliminary analyses of chemically marked fish contributed to the decision to raise the assumed maximum age of yellowfin tuna from 11 to 18 years. This is important for the stock assessment as the assumed lifespan of a fish impacts estimates of mortality and productivity. In late 2018, the AOTTP Coordination discovered a serious issue with the tag-recapture data sent by a member of a Contractor working in northern Brazil. The problem was detected quickly thanks to the AOTTP's quality control procedures and strong cooperation with the Contractor coordination team. It negatively affected AOTTP ICCAT investment, but compensation was offered by the Contractor and accepted by ICCAT. All the data affected were immediately removed from the AOTTP database and will not prejudice future scientific analyses. In addition, extra tagging of 2,765 tuna was done at no cost.

The report was adopted and is attached as **Appendix 7**.

Discussion

The Committee expressed their appreciation for the programme's contributions as well as the support from the Secretariat and the contributing parties. They were particularly pleased with the AOTTP's contribution to the 2019 YFT stock assessment.

The Committee discussed the importance of tag seeding for scaling the recovery rates appropriately and estimating mortality rates accurately and asked how reporting rates from the AOTTP compare to reporting rates in other large-scale tuna tagging programmes. The Coordinator responded that rates were similar to those observed in the IOTC tagging program, at least with respect to purse seiners, where the tag seeding took place. He reassured the Committee that awareness raising activities are still ongoing and target not only major ports but also smaller points of entry for fish captured in the artisanal fishery to maximize probabilities of reporting. Regarding that point, the Committee also highlighted the importance of continuing tag seeding activities beyond the lifetime of the AOTTP because, as awareness raising efforts and the number of tag recoveries subside reporting rates are also likely to decrease. In that case, it is unlikely that reporting rates calculated in the first 5 years of the programme will be an accurate reflection of reporting rates going forward in time.

The Committee was encouraged by the preliminary analyses provided by AOTTP and collaborators regarding mixing rates (i.e. high viscosity) and growth (i.e. relatively slower growth rates in YFT at the youngest ages observed in the tag-recapture data) and highlighted the importance that these results will have on the stock assessment and the success and effectiveness of management approaches like moratoria and other time area closures. Given the human and monetary investments that have already been put into this programme and the high scientific value of any tags recovered further into the future, the Committee stressed the importance that recovery activities (including tag seeding and ageing) continue beyond November 2020.

The Committee noted the lack of tagging in the Angola region and asked if any additional tagging will be done in that area. The AOTTP Coordinator responded that attempts to tag in that region have been thwarted by low fish concentrations and high risks of piracy and that it is unlikely that AOTTP will be able to conduct tagging in that region. He suggested that the historical ICCAT tagging data may be a useful source of information to complement analyses of AOTTP data.

10.3 Small Tunas Research Programme (SMTYP)

In 2018 and 2019, SMTYP continued the collecting biological samples aiming growth, maturity and stock structure studies on small tunas species (little tunny, LTA, *Euthynnus alletteratus*; Atlantic bonito, BON, *Sarda sarda*; and wahoo, WAH, *Acanthocybium solandri*). In that regard, a single contract was issued to a consortium of 12 institutions (11 CPCs) by the ICCAT Secretariat in 2018 that ended on 31 March 2019. In July 2019 a new contract was signed with the same consortium. The objective of this second contract is to continue the collection of biological samples for estimating the growth parameters, assessing the maturity (size/age at the first maturity, spawning season) and stock structure (mainly genetic analysis) of three prioritized species in the Atlantic and the Mediterranean Sea. Secondarily, this study aims at analyzing the samples collected, namely as regards the biological parameters mentioned above, in particular, the final analysis of stock structure for the little tunny and preliminary results for the remaining species two species.

Preliminary results of the research conducted in the previous year were presented during the annual intersessional meeting of the Small Tunas Species Group. In addition, the Group identified the priorities that should be taken into account in terms of the species and areas to be sampled, and revised the biological data to be collected under the SMTYP biological collection contract. These priorities are presented in the small tunas workplan for 2019 (**Appendix 13**), which also contains details on other relevant research activities that has been developed throughout 2019-2020 including: updating the biological meta-database, estimation length-weight relationships representative the stocks/regional level; and, further investigating and applying Data Limited methods to be used to provide management advice.

The report was adopted and is attached as **Appendix 8**.

10.4 Shark Research and Data Collection Programme (SRDCP)

After completing the collaborative work on updating the age and growth dynamics of the North Atlantic stock of shortfin mako, which were used in the 2017 shortfin mako stock assessment (Anon. 2017i), the Group continued focusing on the age and growth of the South Atlantic stock. SRDCP work is ongoing as the growth curves estimated using data from the 332 specimens available are still too uncertain to recommend their use and samples received from Japan and Namibia will be included to improve sample size and model fit. In parallel, a study aimed at improving the knowledge of porbeagle reproductive biology continued and found a biennial cycle for the western North Atlantic stock. The population genetics study to estimate stock structure and phylogeography of shortfin mako continued through the use of next generation sequencing (NGS) to clarify stock delimitation, particularly between the southwest and southeast Atlantic stocks. A post-release mortality study of shortfin mako caught on pelagic longline fisheries continued with the deployment of new Survivorship Popup Satellite Archival Transmitting Tags (sPATs). A total of 43 tags (14 sPATs and 29 miniPATs) have been deployed to date for this project in the northwest, northeast, tropical northeast and equatorial region, and southwest Atlantic. Data available from 35 of the 43 tagged specimens revealed a 22.9% rate of post-release mortality. Of the 43 tags deployed, 41 data sets were also available for the satellite telemetry study to gather and provide information on stock boundaries, movement patterns and habitat use by the shortfin mako shark. A total of 1,656 tracking days have been recorded to date with results showing that shortfin makos moved in multiple directions and travelled considerable distances. In addition, porbeagle electronic tagging continued by teams from EU-France, EU-Portugal and Norway in the North Atlantic to better understand the movement patterns, stock boundary, and habitat use of this species in the Atlantic. A total of 10 miniPATs have been deployed to date on silky, oceanic whitetip and hammerheads sharks, which were deemed by the Group to be priority species. Finally, in 2019 an additional 17 tags were acquired and will be deployed on these priority species.

The report was adopted and is attached as **Appendix 9**.

10.5 Enhanced Programme for Billfish Research (EPBR)

The EPBR continued its activities in 2019. The Secretariat coordinates the transfer of funds information and data. The overall programme Coordinator and Coordinator for the eastern Atlantic Ocean during 2018-2019 was Dr Fambaye Ngom Sow (Senegal). Dr John Hoolihan (USA), previous coordinator for the western Atlantic Ocean was replaced by Ms. Karina Ramírez López (Mexico) in 2019. The original plan (1986) for EPBR included the following objectives: (1) to provide more detailed catch and effort statistics, particularly for size frequency data; (2) to initiate the ICCAT tagging programme for billfish; and (3) to assist in collecting data for age and growth studies. These objectives have been expanded to evaluate adult billfish habitat use, study billfish spawning patterns and billfish population genetics, as these are essential aspects to improve billfish assessments. The original plan was revised by the Group, to overcome the data gap issues, in particular artisanal fisheries of developing CPCs, taking into account the findings of these regional reviews. The previously available specific funding for EPBR has now been combined with the general research fund (ICCAT Science Envelope). Project funding is now being allotted on a more competitive basis with other Species Groups. The US Data Fund have been supporting the EPBR activities.

In 2018 funding from the ICCAT Science Envelope was awarded to a Consortium led by *Institut Fondamental d'Afrique noire Cheikh Anta DIOP* (*Université Cheikh Anta Diop de Dakar,* Senegal) to support the collection of hard parts (otoliths, spines or vertebra) and associated information for marlins and sailfish caught off West Africa or from other ICCAT Convention areas, either from directed or by-catch billfish fisheries. This contract was extended until May 2019. In July 2019 a new contract was awarded to *Centre de Recherches Océanographiques de Dakar /Thiaroye* (ISRA/CRODT, Senegal) to continue the activities of the previous contract for a 12 months period. Now, it also engages EU research teams (from Portugal and Spain), which will significantly enhance the collection of samples onboard industrial vessels operating in the same area and support the analysis of data on length and age for estimating the growth parameters of the main billfish species that occur in the eastern Atlantic (*Makaira nigricans*, BUM; *Tetrapturus albidus*, WHM; and *Istiophorus albicans*, SAI).

The genetic sampling study to compare mixing and distribution of white marlin and roundscale spearfish is ongoing, and in 2019 sample kits were distributed among SCRS scientists responsible for local sampling programmes. In 2019 four sample kits have been returned as of 25 September 2019.

Following the SCRS request, in September 2019, a contract is being negotiated with the *Dirección General Adjunta de Investigación Pesquera en el Atlántico, Centro Regional de Investigación Acuícola y Pesquera en Veracruz* (Mexico) to develop a *Reproductive biology study on Atlantic blue marlin in the Gulf of Mexico*.

The report was adopted and is attached as **Appendix 10**.

10.6 Other research activities

1. Other research programs

Research Programs are used by ICCAT as a mechanism to help focus, coordinate and complement national research activities. The programs usually center on improving biological knowledge and fishery data for a particular species, and usually last a few years.

Currently there are ongoing research programs for several species groups in ICCAT, namely bluefin tuna, tropical tunas, sharks, marlins and small tunas. Besides those, in the past years, there has been significant scientific work carried out for other species groups, such as albacore and swordfish, even though these two latter groups do not yet have established research programs.

As such, the Committee agreed that during next year (2020) both the albacore and swordfish species groups should develop research programs, that in each case should include the Atlantic and Mediterranean stocks. Such proposals should include descriptions of the various research activities that the groups are proposing, and timeframes for such work to be carried out. Updates of the work carried out should be provided regularly to the SCRS.

2. Dissemination of data-data requests

ICCAT has established Rules and Procedures for the Protection, Access to, and Dissemination of Data Compiled by the Secretariat. Recently there have been a number for requests to access data collected by entities contracted under ICCAT research and data collection programmes for which the rules and guidelines are unclear. The Secretariat has proposed an addendum to the rules that clarify these requests and the procedures required for access to these requests for review and adoption by the SCRS. The changes are identified in **Appendix 11**.

The Committee felt that there was insufficient time to review this important proposal and requested it to be reviewed by the species working group meeting in 2020.

3. Submission of scientific paper/presentations at meetings

Papers providing a summary of research results are an important aspect of the SCRS. Unfortunately, in recent years insufficient time has been available during the species group meetings to accommodate all the prepared papers. This is especially true for stocks which must undertake an assessment. To overcome this problem it is proposed that the SCRS reserve Friday to host all research papers and presentations. The length of time required would depend upon the number of papers submitted. If more that 30-35 papers are proposed there is the possibility of concurrent sessions. Although some species group sessions would be shorter, there is a time saving in the reduction of papers to be presented. The exception would be that those papers directly related to the stock assessment would be presented during the species group meeting. A convener would be appointed to coordinate the papers and presentations. For intersessional meetings the practice of presenting scientific papers would continue within the meeting.

Deadlines for both the intersessional and species/working group for the submission of abstracts for papers and presentations would be 2 months where funding for participation is requested. Rapporteurs would respond within 1 week, when possible, to ensure adequate time is available to process funding requests. The actual paper/presentation deadline would remain at 1 week before the meeting for the presentation of the full paper/presentation. Documents/presentations submitted after the deadlines can be accepted at the Chair's discretion.

Chairs will be responsible for approval/rejection of documents/presentations submissions. If funding is dependent on presenting a paper the Chair will provide reasons for rejection or a different time for the presentation. During intersessional meetings that involve stock assessments or specific objectives, priority will be given to assessment documents, followed by the analyst's work, then presentations not directly related to the assessment.

The Committee agreed with the general idea of a scientific "Science Friday" but should take into consideration logistics of implementing such process.

The Committee agreed with the above approach which infers that the current deadlines for SCRS documents (SCRS/year/xxx) extend to SCRS presentations (SCRS/P/year/xxx) submissions.

10.7 Other activities

There is continuing concern regarding the increasing number of SCRS activities being held annually. This is presenting challenges (financial and technical) for both the CPCs and the Secretariat to provide representatives and support. For CPCs there is the added burden of providing individuals and travel funds to attend the meetings and for the Secretariat additional technical support for the meetings. A number of suggestions have been proposed to help alleviate these challenges. In the case of the number of meetings it has been suggested that the meetings could be prioritized, maybe the length of the meetings be shortened or, in some cases, consideration could be given to holding meetings at 2-year intervals. For the Secretariat and the increased workload, some efficiencies would be gained by having effective deadlines for data submission and increasing in-house expertise. Often species summary data for reports and stock assessment inputs provided by the Secretariat must be re-run several times due to the late submission of pertinent data. In addition, there is insufficient capacity to support the demands of new areas of scientific focus at the Secretariat. MSE represents a major activity of several species groups and requires significant input to support these initiatives in both time and resources. These concerns need to be reviewed and solutions found.

The Committee acknowledged these concerns and recognized the need to explore options or approaches that would alleviate these issues.

The Committee agreed that SCRS presentations, as in the cases of the SCRS papers, shall be provided at least one week before the start of the meetings.

10.8 Composition of Program Steering Committees

Within ICCAT there are a number of active special research and data collection programs for mandated species (e.g., Enhance Program for Billfish Research (EPBR), Shark Research and Data Collection Programme (SRDCP) and Small Tunas Year Programme (SMTYP)), but only two, the GBYP and the ATTOP, have Steering Committees and there are differences in the structure and membership.

Guidelines should be established to determine if a research program is required to have a formal steering committee, and if so, the structure, meeting intervals and membership needs to be established for consistency among programs. Currently the GBYP Steering Committee is composed of the ICCAT Executive Secretary, SCRS Chair, Species Group coordinator and rapporteurs, and an independent member. In the case of AOTTP, the current Steering Committee is composed of the ICCAT Executive Secretary, SCRS Chair, Tropical Tunas Species Group coordinator and rapporteurs and a representative of the major funder.

Guidance is needed for consistency on the formal structure and membership of SCRS research and data collection programs Steering Committees (e.g. one to two external members, member or observer for funding agency, coordinator member). In addition, the responsibilities and tasks of the members shall also be defined, particularly as regards the external expert(s).

The Committee recommend that these issues be addressed this year to present an approach in 2020 to the SCRS.

11. Report of the Meeting of the Sub-committee on Statistics

The Secretariat presented to the SCRS the 2019 Sub-committee's report (Madrid, 23 and 24 September 2019) on behalf of Dr Guillermo Diaz, Convener of the Sub-committee on Statistics. The Sub-committee acknowledged the Secretariat's work and all the support it provides to this Sub-committee, and to the SCRS in general. In the report, the Convener referenced the Secretariat report on Statistics which has detailed explanations of the work done by Secretariat including current CPCs reporting status (using the SCRS Report Cards which used the filtering criteria to validate 2018 Task I Task II data submissions), improvements made in statistics (historical revisions and recoveries) and related data handling tools (databases, infrastructure, technologies, etc.), and progress made in various Secretariat ongoing projects (historical data recoveries, IOMS, etc.). The SCRS "scorecard on Task I/II data availability", proposed by the Secretariat and endorsed by the Sub-committee of Ecosystems and the Working Group on Stock Assessment Methods, was approved by the Sub-committee on Statistics.

Special emphasis was given once again to the failure of most CPCs to comply with the mandatory reporting of both dead and live discards in Task I, as required by the Commission, and the important need to improve this aspect in the short term.

The Convener also summarised the status of addressing the 2018 Sub-committee's recommendations, reiterating the need to continue advancing on those that have not been addressed, and the need for active participation of species group rapporteurs and CPC statistical correspondents in the Sub-committee. It was recalled that many decisions made by this Sub-committee usually affect the entire ICCAT community, such as the set of proposals aiming to improve and normalise the ICCAT coding system, as well as important changes made to statistical and tagging forms. These forms, revised every year, always contain important updates (e.g. since 2016, all the Task II information must be reported by month, Task I and Task II forms allow submissions of data from multiple years at once, etc.). For 2020, the Task I nominal catches form (ST02-T1NC) will have two additional columns that aim to report the raising factors used to obtain the live/round weight catches equivalent to both the landings and the discards.

The progress made on the ICCAT Online Managing System IOMS (Phase 1, planned for 12 months, started in May 2019) was highlighted and the Convener informed of the Commission's Online Reporting Technology Working Group workplan and the Commission support for its development in 2019. The Sub-committee encourages this development and support from the Commission and the CPCs.

Finally, the Sub-committee presented to the SCRS its 2019/2020 work plan (**Appendix 13**).

The Report was adopted and is attached as **Appendix 12**.

Discussion

The Committee congratulated the Convener of the Sub-committee on Statistics for the excellent work done. It also noted that future priority should be given to new and more robust approaches of EFFDIS estimations (a high priority task) and the separation of longline types in Task II, especially with regards to shallow vs deep setting longlines.

The Secretariat informed the Committee that the EFFDIS estimation work is intrinsically related to the longline gear types discrimination, and the need to recover missing or poor Task II catch-and-effort datasets reported.

12. Report of the Sub-committee on Ecosystems and By-catch

The meeting was held in Madrid, Spain, 8-12 April 2019. The ecosystem agenda included a review of the progress on developing new indicators for all ecological components of ICCAT's Ecological Based Fisheries Management framework (EBFM) (i.e. target species, by-catch, habitat and trophic relationships); an assessment of indicators to support the development of an Ecosystem report card and discussions on justification and an implementation plan. As regards the by-catch agenda, there was a review of the progress on scientific collaboration among researchers of ICCAT CPCs: on seabird interaction estimations and mitigation measures; and, the results obtained to date regarding knowledge of the impact of the ICCAT fisheries on marine turtles, among other topics.

Finally, the conveners of the Sub-committee presented to the SCRS its 2019/2020 workplan (**Appendix 13**).

With respect to ecosystems activities the Co-convener summarized: the creation of six potential ecoregions that could form the basis for ecosystem reporting; feedback from Species Groups on the Ecosystems Report Card; and progress on an EBFM plan presented to managers at the 2018 Meeting of the Standing Working Group to Enhance Dialogue Between Fisheries Scientists and Managers (SWGSM). With respect to the Ecosystems Report Card (**Appendix 14**), the Co-convener provided the Committee with some examples of summary output. He noted that if this Report Card is to be a regular part of the SCRS meeting that some additional decisions need to be made, notably: some work on developing thresholds for management responses; the frequency and spatial resolution of the Report Card; data management, and communication with species group chairs.

With respect to by-catch, the Co-convener gave a broad overview of much of the work done in 2018. Many studies addressed seabirds, sea turtles, alternative mitigation measures and the effects of these mitigation measures. For data kept by the Secretariat, the Committee agreed to keep the existing format for the ST09 form and try using it for a number of years to see if it meets the species group's needs. The Chair provided a summary of the Common Oceans tuna project on seabirds as well as other collaborative projects developed by ICCAT CPCs to examine fisheries impact on seabirds and the effects of measures to reduce this by-catch. The Sub-committee on Ecosystems also reported on other collaborative work to assess sea turtle by-catch in longline fisheries. The details of these projects, recommendations and workplan are summarized in the species group's documents.

The Report was adopted (Anon. 2019m).

Discussion

The Co-convener of By-catch noted that the Co-convener of Ecosystems was unable to be present. Ms. M.J. Juan Jordá would give the presentation on ecosystems on his behalf.

The Committee asked if the workplan item about modifying the ST09 form had in fact been completed. The answer was yes. The Committee discussed if preliminary methodologies present to estimate by-catch interactions and mitigation could be applied to other species under some circumstances. The Committee further raised that more details of the methods used to evaluate the impact of mitigation measures at the June 2019 workshop would need to be presented and reviewed by the Sub-Committee on Ecosystems before it could receive the approval of the Committee.

The Committee noted that FAO had met to discuss the implementation of the Ecosystem Approach to Fisheries Management (EAFM) and that a recommendation emerging from that meeting among other things, was that reviewing ecosystem indicators had some merit, the application of the EAFM is in progress in most tRMFOs, and that the various elements of the EAFM required more development. The final report from the FAO meeting on EAFM has not yet been approved or published by FAO.

The Committee discussed how best to get feedback from the Commission on Ecosystem Approaches to Fisheries Management. It was noted that the last time this subject was discussed at the meeting of the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers (SWGSM), it did not receive great interest and that different approaches would need to be employed in subsequent meetings in order to generate the desired feedback.

The use of indicators was further discussed, and it was noted by the Committee that it could be conceived as an early warning system. The Sub-committee's progress defining ecoregions was discussed. The Co-convener noted that the definition of such areas was difficult because it depended on the objectives and purpose for such regions i.e. such areas could be defined on the basis of oceanography and or species distribution but that the factors determining the appropriateness of such areas depended on the species or problem being considered. However, the Sub-committee recommended that ongoing work in two ecoregions, the Sargasso Sea and the eastern tropical Atlantic should be continued as case studies to assist further development of indicators to assess the state of ecosystems.

13. Considerations of implications of the Intersessional Meeting of Panel 2

The following is the report of the meeting of the SCRS Chair.

The Report of the Intersessional Meeting of Panel 2 contains details of the presentations and discussions that took place at the meeting that was held in Madrid, Spain, 4-7 March 2019. Part 2 of the meeting discussed issues related to bluefin tuna Management Strategy Evaluation (MSE), including the identification of initial operational management objectives.

The Chair summarized to the Plenary the discussions and decisions made during the Panel 2 meeting. What follows is a summary from the SCRS Chair on these discussions and decisions.

A general presentation describing the MSE process was provided. Panel 2 members were referred to the ICCAT bluefin tuna MSE quick reference (Appendix 7 of the Report of the Intersessional Meeting of Panel 2), which provides key definitions and describes the steps involved in the development of management procedures (MPs).

Another presentation summarized outcomes of the 2019 Intersessional Meeting of the Bluefin Tuna MSE Technical Group (7-9 February 2019) (Anon. 2019b) and the 2019 Intersessional Meeting of the ICCAT Bluefin Tuna Species Group (11-15 February 2019) (Anon. 2019a). At these meetings the SCRS identified issues with the input data, including issues related to electronic tagging data, microchemistry, and genetics, and scientists are working to address potential sources of bias. Coding errors were also noted and have been or are being addressed.

In summarizing the discussions on Initial Operational Management Objectives, relating to Status, Safety, Yield and Stability, the Chair recalled that additional specificity in the initial operational management objectives will help guide the SCRS as scientists continue to develop and refine the bluefin tuna MSE. Panel 2 agreed to provide guidance on initial operational management objectives, which will be tested and will, in turn, inform further development of management objectives.

There was general agreement that any values identified by Panel 2 will be applied on an interim basis for purposes of testing candidate management procedures (CMPs). These exploratory approaches can be refined by the Commission at a later date and once they receive the MSE outputs from the SCRS. Furthermore, it was suggested that Panel 2 does not to focus on a specific value but a range of values at this stage, as a range will provide more flexibility to identify a candidate MP that best meets the objectives. Panel 2 agreed to start gradually by identifying a range of figures for the initial operational management objectives.

The SCRS Chair noted its intent to include an option where catch is reduced to zero within the candidate MPs, to illustrate the bounds on the extent to which the Status and Safety management objectives can be achieved under the most extreme case of closing the fishery.

There was general agreement that the probability to be tested for being in the green zone of the Kobe plot should be 60% or greater and a consensus on 30 years as a useful timeframe over which to evaluate Status, given their dynamics. The SCRS Chair was requested to provide information on Status for specified intervals within the 30 years as determined to be appropriate in the Trial Specification Document.

It was recognized that the Bluefin Tuna Species Group and Bluefin Tuna MSE Technical Group have made substantial progress in developing OMs. At the same time, there was general agreement that the process should not be rushed to meet current deadlines and that the SCRS should revise its work plan as needed. The SCRS is now considering two options for providing 2021 TAC advice: (Option A) to continue with the MSE development process as outlined in the roadmap; (Option B) to begin planning for a 2020 stock assessment. Panel 2 took note of the revised plans of the SCRS. There was general agreement that Option A is preferred, but that the SCRS should take the necessary time to ensure that the technical issues are addressed in a thorough and satisfactory way.

A meeting of the BFT MSE Technical Group meeting took place in July 2019 to review the OM conditioning. If development of the MSE has not progressed to the satisfaction of the SCRS, then Option B is the likely path forward. In this case, the MSE process would be further delayed by at least one year as the SCRS focuses its attention on preparations for a bluefin tuna 2020 stock assessment, with MSE to be used as the basis for TAC advice in 2022 at earliest.

The report of the meeting was adopted.

14. Considerations of implications of the Meeting of the Joint t-RFMO FAD Working Group

The following is the report of the meeting of the SCRS Chair.

Hosted by the IATTC, the 2nd Joint t-RFMO FAD Technical Working Group met in San Diego, California, USA in May 2019, a wide range of issues were covered during the meeting. A set of recommendations were raised by the participants, highlighting mainly the importance of the review and adoption of common standards and protocols by the t-RFMOs regarding definitions, data collection, marking and tracking of FADs. In this regard, a glossary of FAD terms has been provided for the RFMOs to review and adopt as starting point for standard FAD data collection. In addition, the Joint Technical Group recommended priority of scientific research within t-RFMOs to support advice on specific management objectives, such us limits on FAD/buoy deployments, and or sets on FADs, prioritizing systematic monitoring and reporting procedures. The Group also calls for a five-year research plan with input from the tRFMOs scientific committees, for defining common research priorities and mechanism to exchange information, knowledge and experience among RFMOs, with emphasis in acoustics data analysis, impacts of FADs on juvenile tunas, and mitigation of negative impacts of FADs on marine ecosystems.

The recommendations also highlighted the importance of collaboration among scientist, industry and NGOs across tRFMOs to address main issues of FAD fishery sustainability worldwide. A Chair's detailed report of the meeting and recommendations are available on the ICCAT meetings webpage.

For the SCRS and in particular the Tropical Tunas Species Group, the main activities to be considered from this meeting are:

- To review a glossary of terms and definitions for FAD fisheries as recommended by the Joint tRFMOs FAD Technical Working Group.
- To participate in the five-year research plan for the t-RFMOs FAD TWG and define main research priorities for ICCAT FAD fisheries.
- To participate in a tRFMOs meeting to assess the effect of each RFMO's measures on FADs, indicating challenging and successful issues in particular.

The Chair's report of the meeting is available here.

Discussion

The workplan of the tropical tuna Working Group for 2020/2021 included all the activities described above.

15. Progress related to work developed on MSE

Rec. 15-07 and Rec. 17-04 engage ICCAT in a number of MSE processes for a subset of priority stocks. These processes are in different stages of development, have different structural challenges and have progressed with the support of different sources of funding. The roadmap for MSE, developed by the ICCAT Commission, reflects a desire to match the delivery of MSE products to the needs for advice on MSE. Trying to implement this roadmap has been very challenging, for both the SCRS and the Commission.

Progress on the MSE process has been hampered by the lack of experience in MSE in ICCAT, by technical challenges in the development of stock specific simulation frameworks and by the limited resources to participate in both the MSE process and in the current stock assessment and management process.

In 2018 the Commission decided that it would slowdown and not to have four MSE processes running in parallel and that it would be preferable to focus on one or two of the ongoing species. However, no clear guidance was given to which of the MSE processes should the SCRS give priority. Accordingly, during 2019 the ICCAT MSE process focused mostly on bluefin tuna and northern Atlantic swordfish, and at a low level on northern Atlantic albacore. Little work was conducted on the tropical tuna MSE. Nevertheless, some major accomplishments were made, which are detailed below.

15.1 Work conducted for bluefin tuna

Work on the bluefin MSE has advanced substantially since last year through the bluefin tuna intersessional meeting in February and the three meetings of the Bluefin Tuna MSE Technical Group partially funded by ICCAT GBYP in February, July and September 2019. The main objectives were to finalize a reference set of OMs with acceptable conditioning and to review the progress on the CMPs. The expert contracted by ICCAT GBYP under the supervision of the Bluefin Tuna MSE Technical Group has worked on the updates of the OMs continuously, following the recommendations made at these several meetings. The major updates to the OMs involved incorporating revised input data and adjusting the fleet structure closer to the assumptions of the bluefin Stock Synthesis assessment model settings; furthermore, a list of sensitivity runs requested by the Group were pursued. The expert has provided all updates of the OMs within the ABFT MSE R package (https://drive.google.com/drive/BFTMSE).

Although both the Bluefin Tuna Species Group and the MSE Technical Group have thoroughly reviewed the updated OMs and acknowledged that substantial progress has been made in improving the OMs, the MSE Technical Group still identified some remaining problems with the revised OMs that would require more time to address. Therefore, the Group has recommended the Bluefin Tuna Species Group to move to "Option B (to begin planning for a 2020 bluefin stock assessment)". Because of the delays encountered in the development of the OMs and the CMPs evaluations within the bluefin MSE process, the Bluefin Tuna Species Group has adjusted the bluefin MSE roadmap adopted by the SCRS in 2018 (**Appendix 15**).

Discussion

The Committee expressed their concerns on the complexity of current OMs, and strongly encouraged the BFT SG to allocate enough time to discuss simplification of OMs by taking into account the data availability for the highly complicated model. Multiple CPCs showed strong desire to move to simplification, and the

Committee was also reminded that the OMs need to be clearly understood by all CPCs in the MSE process. The BFT SG rapporteurs noted that such a simplification would likely cause further delay in the process. They acknowledged the desire of the Committee to request a time and feasibility estimate from the contractor for OMs with reduced dimensionality. Though simplification of OMs may require further delay of the MSE process due to the restructuring of the model, if the OM reference grid cannot be adopted by the BFT SG in April, delay will be inevitable. Regarding Candidate Management Procedures (CMPs), the Committee noted that model-based CMPs can be tested in addition to the index-based in the current OMs. The need to test F0.1 approach used for the management recommendations has been recognized, however it is only possible in future iterations of the MSE process, potentially five years after the adoption of MSE, due to the technical difficulties of producing an OM that could output size and age composition to evaluate an F0.1 reference point.

15.2 Work conducted for northern albacore

In 2017, the ICCAT Commission adopted an interim Harvest Control Rule (HCR) for North Atlantic albacore (Rec. 17-04), which represents the first HCR adopted in the history of ICCAT. This HCR imposes an F_{TARGET}=0.8*F_{MSY}, a $B_{THRESHOLD}$=B_{MSY}, a B_{LIM}=0.4B_{MSY} and an F_{MIN}=0.1F_{MSY} (see **ALB-Figure 12** of the northern albacore Executive Summary, item 9 of this report), with a maximum TAC of 50,000 t and a maximum TAC change of 20% when B_{CURR}>$B_{THRESHOLD}$. Recommendation 17-04 also requested that the SCRS pursue an independent peer review during 2018, to develop criteria for the identification of exceptional circumstances, to test several variants of the interim HCR with the aim to adopt a long-term Harvest Control Rule (HCR) in 2020, and to produce a single consolidated report about the albacore MSE process.

In 2018, the albacore MSE was active on several fronts: the peer review requested in Rec. 17-04 was conducted, the Albacore Species Group identified the list of indicators that could be used to judge whether exceptional circumstances had occurred, and several interim HCR variants were tested.

The main priority for 2019 was to address the recommendations by the peer reviewer and to produce a single consolidated report. In 2019, a contractor was hired for this purpose. The contractor presented the work to the Albacore Species Group.

Discussion

The Committee made some clarifications on the some of the mathematical notation used in the documents but otherwise there was no discussion.

15.3 Work conducted for northern swordfish

Work on North Atlantic swordfish MSE started in 2018. ICCAT awarded a contract for operating model and management procedure development to an expert team. The contractor presented to the Swordfish Species Group documents detailing the work to date which included proposals for candidate Operating and Observation Error Models that will be used in simulation trials to evaluate alternative management strategies. The Operating Model proposed could be conditioned on a variety of data sets and hypotheses. The Swordfish Species Group agreed to use the Base Case stock synthesis assessment from 2017 to set up the initial OM design based on a factorial design (i.e. grid) to develop scenarios that represent the main uncertainties identified by the Group.

For 2019, the ICCAT MSE roadmap requested the development and evaluation of alternative management procedures. However, the Swordfish Species Group/SCRS believed that this was not realistic and therefore proposed the finalization of the OMs as the main objective for 2019. In 2019, a contractor was hired to pursue this work.

The contractor presented two SCRS documents to the 2019 meeting of the Swordfish Species Group (Hordyk and Carruthers 2020a and 2020b). These outlined the framework for conducting the North Atlantic swordfish MSE and describing a case study using the base-case stock synthesis assessment from 2017 as the basis for demonstrating the technique for validating operating models. The current operating models are composed of an uncertainty grid of 288 assessments with alternative assumptions including a range of assumed values for natural mortality, variance in recruitment deviations, and steepness of the stock-recruitment relationship, and other assumptions such as degree of observation error in the indices of abundance. This grid was constructed and provided following the MSE workshops/courses organized by ICCAT in 2018, that resulted in a paper presented to the SCRS (Rosa *et al*., 2018a).

For 2020 the workplan is to continue the work with the contractor to finalize the OM conditioning with diagnostics and continue work on MPs.

Discussion

The Committee reviewed the document and requested some clarifications on how OM conditioning and diagnostics would be finalized in the next year. Text was added to the document during the meeting to address this point.

15.4 Work conducted for tropical tunas

The MSE for the Atlantic tropical tuna stocks work started in 2018 through an ICCAT contract awarded to a consortium of researchers. In 2019, the Tropical Tuna Species Group was provided the final report (Merino *et al*. 2020) for phase 1, and had some limited discussions on MSE during the yellowfin data preparatory and yellowfin stock assessment meetings. Phase 2, which was planned for 2019, was not carried out, following the indication from the Commission to revise the schedules for the different ICCAT species MSE process, lowering the priority of Tropical Tunas MSE. The Tropical Tuna Species Group expressed a concern that it is important to reactivate the MSE process, if MSE is going to be used to provide advice on tropical tunas in 2022. It was recommended that funds be secured to enable continuing the development and evaluation of MSE operating models and candidate management procedures.

Discussion

The Committee clarified that Stock Synthesis model for eastern skipjack will be newly developed to condition OMs for three species in the proposed Phase 2, while the Stock Synthesis models were applied in the stock assessments for bigeye tuna in 2018 and yellowfin tuna in 2019. It was also reiterated that the Committee needs further guidance from the Commission in management objectives, performance indicator etc., for tropical tunas.

15.5 Roadmap for the ICCAT MSE processes

The Chair presented an update to the roadmap for the ICCAT MSE processes, based on the Commission comments in 2018 and the workplans of the Bluefin Tuna, Albacore, Swordfish and Tropical Tunas Species Groups (**Appendix 16**).

Discussion

The discussions focused mostly on the activities on 2020. Therefore, planning beyond 2020 should be considered preliminary.

16. Report on the implementation of the Science Strategic Plan for 2015-2020 in 2019 and work plan for 2020, which includes the update of the stock assessment software catalogue

The current SCRS Strategic Plan expires in 2020. Plans are now underway to develop a new SCRS Strategic Plan for the next 5 years (2021-2025). The new plan will incorporate revisions of the outputs from the 2015-2020 plan, aspects of the mid-term review and the 2nd independent performance review. A small team comprised of CPC representatives, the Secretariat and the SCRS Chair, will be tasked to develop the 2021-2025 plan.

The roadmap for the Strategic Plan is to review all material between now and December, draft the strategic between January and June 2020 circulate the Draft Plan for review, including discussions at the SCRS Process and Protocol Meeting and finalize the plan at the 2020 SCRS meeting.

The Secretariat informed the Committee that an update of the ICCAT stock assessment software catalogue (ICCAT software catalogue) was done in 2019. The current ICCAT software catalogue in Github contains all links up to date and has been reorganized following the suggestions made by the WGSAM in 2018. The Secretariat suggested to add JABBA ("Just Another Bayesian Biomass Assessment", Winker *et al*., 2018) into ICCAT software catalogue in 2019.

Discussion

The SCRS Chair clarified that the doors are open to all the SCRS community to develop a draft 2021-2025 Strategic Plan. In addition, the Chair also informed the Committee that some SCRS experts were already identified and that this process will continue inviting all scientists who which to participate in the important SCRS task.

The Committee recommended to create a table of the stock assessment models used for the management recommendations by species with the year, and the version of the software for the assessment. It was further requested to add the list of software with its link to the current webpage for the ICCAT software catalogue (https://www.iccat.int/en/AssessCatalog.html), while maintaining the GitHub site.

17. Consideration of plans for future activities

17.1 Annual Work Plans

The Rapporteurs summarized the workplans for 2020 for the various species groups, the Working Group on Stock Assessment Methods, the Sub-committee on Statistics and the Sub-committee on Ecosystems and By-catch. These plans were adopted and are attached as **Appendix 13**.

17.2 Intersessional meetings proposed for 2020

Taking into account the assessments mandated by the Commission and the Committee's recommendations for research coordination, the proposed intersessional meetings for 2020 are shown in **Table 17.2**. The Committee noted that the schedule needs to maintain some flexibility in order to account for any changes that may result from the deliberations held by the Commission in November 2019 and the meetings scheduled by other RFMOs.

The Committee expressed its concern on the decision taken by the Commission to allocate in 2020 an equal amount of funding regarding MPF to both semesters, as most of the SCRS meetings are scheduled for the first semester. Moreover, the Committee reiterated the importance of ensuring wide participation of scientists in its meetings, and requested the Commission to allocate the necessary funds to allow delegates from developing CPCs to attend the SCRS meetings.

The EU expressed its willingness to host the following 2020 intersessional meetings: i) Mediterranean swordfish stock assessment (Crete, EU-Greece); ii) the porbeagle stock assessment (Azores, EU-Portugal); and, iii) North and South Atlantic albacore stock assessment (Tenerife, Canary Islands, EU-Spain). Canada express its willingness to host the July Bluefin una Technical MSE Group (Canada, St. Andrews, New Brunswick), though pending confirmation. Finally, the Secretariat informed that it will establish contact with Senegal to assess the possibility of hosting the Skipjack Data Preparatory Meeting in Dakar.

17.3 Date and place of the next meeting of the SCRS

The next meeting of the Standing Committee on Research and Statistics (SCRS) will be held in Madrid, Spain, from 28 September to 2 October 2020; the Species Groups will meet from 21-25 September 2020 at the ICCAT Secretariat (Madrid, Spain).

Table 17.2. Calendar of the Inter-sessional meetings for 2020.

	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN
January					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
February								1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
																											SCRS Proc. & Protoc.				BFT Tech MSE++						
March		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
																	SWO intersessional																				
April					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
																								BFT intersessional													
May							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
																								Ecosystems / WGSAM							Med-SWO assessment						
June			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30					
																	POR assessment (ICES)	AOTTP Symposium			SKJ data preparatory										ALB assessment						
July					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
					ALB assessment												BFT Tech MSE																				
August	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
September				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30				
																				BFT				SCRS Species Groups+							SCRS Plenary*						
October						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
						SCRS Plenary*																															
November		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30						
December				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			

(*) Meetings of ALB, BFT, BIL, SHK, SMT, SWO, TRO and SC-STATS — Free day in ICCAT

(+) SC STATS will be on 21 Sep 2020 — Meeting of technical nature — ++ No funding to be provided

18. General recommendations to the Commission

18.1 General recommendations to the Commission that have financial implications

SCRS Process and Protocol Meeting 2020

In order to further develop the SCRS Strategic Plan and additional issues, it is requested that funding be made available for the participation of SCRS officers and delegates from developing CPCs. This is considered a high priority meeting for the SCRS (~ €50,000).

Eastern and western Atlantic bluefin tuna

- Continued funding to support the essential work of GBYP including funding of the MSE development process, biological studies, including studies related to growth in farms and the full GBYP workplan.

- Two meetings devoted primarily to MSE-related work (February and July) and two BFT SG intersessional meetings (April 5-days) and 3 days prior to the September Bluefin Tuna Species Group meetings.

Albacore

- In 2020, stock assessments of two albacore stocks (North Atlantic and South Atlantic) are planned. During the last years, the Albacore Species Group experienced poor attendance from some CPCs directly involved in the fishery. This also affected the expertise of the Group to conduct different analyses. The stock assessments that are planned to be conducted in 2020 will require expertise on surplus production models (both Bayesian and non-Bayesian). Thus, the assistance of an external stock assessment expert, with expertise in surplus production models, is required to conduct the analyses.

- The Committee recommends continued funding of the albacore research program for North Atlantic albacore. Over a four-year period, the research will be focused on three main research areas: biology and ecology, monitoring of stock status, and management strategy evaluation. The requested funds to develop this research plan have been estimated at a cost of €842,000 for a 4-year work plan, with a cost of €70,000 for top priority tasks (reproductive biology and electronic tagging) to be executed in 2020. More details of the proposed research and economic plan are provided in the 2020 albacore workplan (**Appendix 13**).

- During the most recent series of scientific meetings of the Albacore Species Group, several countries with important albacore fisheries have not been represented at the meeting. This limited the ability of the Group to properly revise the basic fishery data and some standardized CPUEs that were submitted electronically. This continues to result in unquantified uncertainties which negatively affected successfully achieving the objectives of the meetings. To overcome this, the Group continues to recommend that CPCs make additional efforts to participate and be made aware of capacity building funds available for participation in and contribution to working group meetings.

Tropicals

- *Support the continuation of the AOTTP activities in 2020:* The current funding of some AOTTP activities will cease at the end of 2019, however, there is an urgent need to support some essential AOTTP activities in 2020 including, continuation of recovery efforts, tag seeding, and ageing of collected samples. Such activities will require funding of €50,000. Continuation of such activities are especially important to support the upcoming skipjack assessment.

- *Support the continuation of MSE for tropical tunas:* It is important to maintain the *momentum* of progress on MSE for tropical tunas and to capitalize on recent assessment of bigeye tuna in 2018, yellowfin tuna in 2019 and the proposed skipjack assessment in 2021. The Group recommends that phase two of the MSE project is completed in 2020 and phase three in 2021. This will require €125,000 of funding from the Commission in each 2020 and 2021. Work will follow the schedule proposed by phase one of the project. The tropical tuna MSE consortium includes experts on data limited methods. These experts will be engaged in the skipjack assessment of 2021, thus helping satisfy the need for expanded expertise on such methods as requested by the species group.

Billfishes

- *Enhanced Program for Billfish Research:* The Group recommends continuing funding for the EPBR research activities for future years, to further improve knowledge gaps for the species and areas prioritized:

    - Continue reproduction study of blue marlin in the Gulf of Mexico;
    - Continue the growth study of the three priority billfish species in the eastern Atlantic;
    - Organize a workshop on growth and ageing techniques for billfish with teams from eastern and western Atlantic teams.

- To fund two regional workshops in West Africa and Caribbean for CPC statistical correspondents on artisanal fisheries data collection. The objective is collecting detailed information describing their fishery(ies) and sampling programs, aiming to improve the collection and submission of billfish fisheries data in these regions (€50,000).

- To develop a feasibility study on the development of an app for mobile phone to collect and report fisheries data on artisanal fisheries in collaboration with local scientific institutions.

Sharks

- Provide funding for the SRDCP for Year 6 (€125,000) to complete work on South Atlantic shortfin mako age and growth, shortfin mako genetics, continue work on the reproductive biology of porbeagle and shortfin mako, and continue work on movement and habitat characterization of silky, oceanic whitetip, and hammerhead sharks through satellite tagging.

- The Committee continues to recommend designing and implementing a study to compare the effects of circle versus J hooks on retention rates, catch rates, and at haulback mortality of sharks. The experimental design should account for the influence of leader material types (wire vs nylon) and consider possible regional and fleet operational differences.

Small tunas

- *Continuing support to the SMTYP:* The Group recommends continuing with the ICCAT SMTYP research program activities in 2020 to further improve the biological information (growth, maturity and stock identification) for the species/areas prioritized. The requested budget is presented below:

Activity	*Amount (€)*
Reproductive biology processing and analysis	40,000
Age and growth processing and analysis	35,000
Genetics study for stock differentiation	20,000
Sampling collection and shipping	5,000
Total	**€100,000**

- *Workshop for ageing and reproduction*: The Group recommended that a workshop is planned for the 1st trimester of 2020 (tentatively in EU-Spain), with the main objectives to create ageing and reproduction reference sets and provide training to the teams involved in these studies. To accomplish the objectives of such workshop, there is the need to have already some processed samples of spines and gonads, in order to use those for the reference sets. Costs are estimated at €20,000, which would allow for participation by 1-2 external experts and 8-10 national scientists.

- *Regional workshop for small tunas data-limited MSE*: Data limited MSE approaches are potentially good tools for managing data-limited stocks. With such tools it is possible to generate simulated data that include uncertainties around biological and fisheries parameters, and then test options for management procedures that are robust to such uncertainties. Such approaches require inputs from biologists and fisheries experts. As such, the Group recommended a workshop be planned to advance with the data-limited MSE tools applied for small tunas. The regions to be prioritized should be the NE and/or SE Atlantic regions. Such workshop could be held immediately after (back-to-back) the 2021 intersessional meeting of the Small Tunas Species Group. Costs are estimated at €20,000 per workshop, which would allow for participation of 1-2 experts and 8-10 national scientists (regional level).

- *AOTTP funding for additional tagging of wahoo and little tunny*: The Group recommends that within the AOTTP program, financial support be provided for additional inexpensive tagging of wahoo in the Canary Islands and little tunny in the Gulf of Cadiz and Alboran Sea (Portugal and Spain). The Group estimates that the costs to conduct such work would be €20,000.

- *Revision of the ICCAT manual for small tunas species*: The Group recommends to extend the species description chapter(s) of the ICCAT Manual for other small tuna species including wahoo (*Acanthocybium solandri*), serra Spanish mackerel (*Scomberomorus brasiliensis*), West African Spanish mackerel (*Scomberomorus tritor*), dolphinfish (*Coryphaena hippurus*), BOP (Sinopsis unicolor) and CER (*Scomberomorus regalis*), and update all other species chapters which were last updated in 2006, except for *Thunnus atlanticus*, which was updated in 2013. The Group estimates that the costs to conduct such work would be €5,000.

North and South Atlantic swordfish

- *Biology and stock structure studies (this recommendation applies to both the North and South Atlantic and Mediterranean stocks):* An understanding of the species biology, including age, growth and reproductive parameters, as well as stock structure and mixing is crucial for the application of biologically realistic stock assessment models and, ultimately, for effective conservation and management. Given the current uncertainties that still exist, the Group recommends as high priority to continue biological studies on swordfish. An ICCAT project on swordfish biology, genetics and satellite tagging started in 2018 and the Group recommends that the project continue for at least the next two years and is provided with financial support. The costs for continuing such work would be €280,000 for 2020 (€210,000 for continuation of the biology project currently being developed by the Consortium, €20,000 for an age and reproduction inter-laboratory calibration workshop and €50,000 to continue the satellite tagging work). A detailed table is provided in the workplan with specific costs for each study.

- *MSE timetable and funding*: Delivering MSE results for northern swordfish according to the schedule agreed upon by the Commission will be very challenging and require time and resources. Funding to start this work was provided in 2018, and a contractor was hired to start the work. The Group recommended funding for continuing the swordfish MSE work at least over the next 2-year period. The Group expressed concern over the existing timeline for provision of the MSE to the Commission, and highly recommended that such timeline is extended. Funds requested for 2020 to continue this work are €90,000.

Mediterranean swordfish

- *Data recovery plan (adopted as a recommendation from the 2018 SCRS plenary)*: The Group noted that the catch and CPUEs time series currently in use in the stock assessment models started in 1985. Therefore, the early period of the fisheries, which accounted to increasing catches, is not being accounted in the model. As such, the Committee recommended conducting a recovery of historical data, so that the entire history of the fishery is taken into account in the stock assessment models. Particular effort should be dedicated to collecting available information from the major fisheries of the early years, especially EU-Italy fisheries. Such a project could be accomplished within one year and its cost is estimated to be up to €10,000.

Sub-committee on Ecosystems and By-catch

- The Sub-committee requested financial assistance to support the attendance of three to five CPC scientists at a collaborative workshop to evaluate the impact of ICCAT fisheries on sea turtles. This is in support of an ongoing process that will continue over the coming years (€10,000).

Sub-committee on Statistics

- The Sub-committee reiterates its support for the developing of the ICCAT Integrated Online Management System and the work of the Online Reporting Technical Working Group. As such, the Sub-committee recommends that the Commission fully supports this effort.

18.2 Other general recommendations

Eastern and western Atlantic bluefin tuna

- Noting the difficulties in conducting studies of individual growth in farms, due to potential risk of loss of fish, it would be necessary to find means to compensate farms for fish which die in the course of these studies. Possible solutions could be found in allowing some flexibility in the current RMA provisions.

- The Committee recommends that all CPCs, in coordination with GBYP, institute or maintain biological sampling programmes designed to collect an adequate number of tissue, otolith and other biological samples in a representative fashion from all fishing fleets.

- The Committee recommends that analysts from the BFT Species Group attend the Working Group on Stock Assessment Methods (WGSAM) workshop focused on incorporating habitat modeling and environmental considerations into indices and surveys and initiate the formation of a working network for analysts to facilitate the future sharing of knowledge and tools.

Albacore

- The Committee recognized the lack of standardized CPUE data from the eastern Mediterranean as a potential source of uncertainty when assessing Mediterranean albacore. The Group recommended the CPCs predominantly fishing in this area (EU-Greece, EU-Cyprus and Turkey) make a concerted effort to generate, and submit, standardized CPUE data. Likewise, the Committee supports the continuation of larval index data collection in the Balearic Sea and other spawning areas (e.g. central and eastern Mediterranean), and recommends further research into the use of larval indices to supplement fisheries dependent data in stock assessments.

- The Committee recommends conducting a review and collation of all the available data on age-length from the various studies that have estimated age from spines with the view to updating the estimate of the growth curve for Mediterranean albacore. It is also recommended that methods of accounting for selectivity in the year 1 cohort in the von Bertalanffy growth function (VBGF) be explored to ensure accurate parameter estimation.

North and South Atlantic swordfish

- *To the Secretariat on hosting biological database:* For the Secretariat and the biology SWO consortium to continue to work together to integrate the biological database in the new ICCAT Task 3.

- *To the CPCs on size data submissions*: Given that sometimes size data are reported at relatively low resolution (e.g., 5cm size classes) even when it is collected at higher resolution (e.g., 1cm), which may substantially impair the conversion of CAS to CAA, the Group recommends that size measurements are reported at the highest resolution available.

Mediterranean swordfish

- *Discards:* Recently adopted management measures may have increased discard levels, therefore the Committee noted that participating countries should improve their estimates of discards of juvenile swordfish, not only from the swordfish targeting fisheries but also from the albacore ones, and submit such information to the ICCAT Secretariat.

- *To the SCRS and the ICCAT Commission on allowing sampling on undersized swordfish:* Currently there are Minimum Sizes established for Atlantic swordfish (Recs. 17-02 and 17-03) and Mediterranean swordfish (Rec. 16-05). Those "minimum sizes" refer to either "taking and landing" or "catching and retaining on board", depending on each specific Recommendation or paragraph. In order to allow the collection of biological samples during commercial fishing operations on undersized swordfish (e.g., vertebrae, tissue, reproductive tracts, stomachs) the SCRS recommends that the Commission consider establishing a new ICCAT Recommendation allowing such procedures. The sampling on undersized swordfish would only be carried out if:

  1. Specimens are dead at the haulback;

  2. Samples are collected by a fishery observer; and

  3. The biological samples are taken in the framework of a research project notified, endorsed and carried out within the priorities of the Swordfish Species Group and the SCRS.

Tropicals

- The Group recommends continued work on the estimation of purse seine catches with the T3+ software, which includes a workshop to train ICCAT scientists in the use of this software in early 2020. The Group requests that the ICCAT Secretariat considers providing support to potential participants from developing country CPCs to such workshop, possibly through capacity building funds available at ICCAT.

Billfishes

- *Need for CPCs to report discards*: The Group noted that to date only 7 CPCs (out of 68 CPCs or fishing entities) have ever reported billfish discards and using such limited information the estimates of dead discards are around 2-3%. On the other hand, by using statistical analysis within the stock assessment models it was noted that unaccounted IUU catches, including dead discards may reach values of around 27% of the reported catches. Having the total catches, including dead and live discards, and estimates of post-release mortality is important for stock assessment purposes. As such, the Group emphasized the need for all CPCs to comply with the mandatory requirements to report discards (both dead and alive) for billfishes.

- *Develop estimates of billfish discard mortality*: The Group recommended that national scientists collaborate in a study of the effect of time, area and gear configuration variations for discards using observer data to improve discard estimates.

Sharks

- CPCs should report on how they implemented Rec. 17-08 (shortfin mako) in their respective fisheries in order for this Group to properly evaluate the effectiveness of these measures.

- CPCs should comply with the requirement to report discards (both dead and alive) of all sharks and especially for blue shark, shortfin mako, and porbeagle in Task I because data on these discards are generally not provided to the Secretariat. CPCs should also report on the estimation protocols for dead discards and live releases, and whether what is reported is totally observed or fleet-level estimates.

- Conduct an analysis of the feasibility of applying CKMR (close kin mark recapture) for shortfin mako.

Small tunas

- To consider requesting the Commission to develop a process which could support funding of research programs for periods longer than usual biannual budget period, since SMTYP, as well as other ICCAT research programs, require multiannual and multiregional initiatives that are difficult to handle based on annual budgets. The ICCAT Strategic Research Plan recognizes that such long-term commitment is essential for improving scientific advice.

- The application or update of data-limited assessment models and MSE for species considered of high priority, giving special attention to the input data availability and their quality.

Working Group on Stock Assessment Methods (WGSAM)

- The Group recognized that several of the species groups are in "data limited" situations, as well as the lack of stock assessment capacity. Thus, the Group recommends that a series of Data Limited Workshops be conducted to specifically address the needs of ICCAT. These workshops should have long-term benefits for the species group and cover the various aspects of conducting reliable stock assessment, such as data requirements, collection, model implementation, etc.

- The Group agreed that the swordfish Species Distribution Model was a useful tool and recommended that it should be continued through the WGSAM Work Plan. The Group recommended that funding be made available to continue this work by a cooperative effort between the WGSAM and an independent expert. The products of this work should support the ongoing development of the Longline Simulator which will significantly increase the utility of the simulator in providing the means to investigate CPUE standardization and develop best practices for it.

- In the response to the Commission's request for an MSE Independent Peer Review (IPR), the Group recommended that the SCRS creates a panel of one to three reviewers independent of ICCAT to be formed to review the entire process and effectiveness of the ICCAT MSE process to date. The products of this IPR would be a review of past and current practices, recommendations for improvements and a subsequent design of a generalized framework for the MSE process suited to the ICCAT process. To facilitate this review, it was recommended that appropriate representatives from the species group should be consulted to help facilitate the review.

Sub-committee on Ecosystems and By-catch

Pertaining to Ecosystems:

- The Sub-Committee recognizes the need for more time at the next ecosystem meeting in order to address issues related with the development of the ecosystem report card. Therefore, the Sub-committee recommends that more time be allotted to the discussion of this issue at the 2020 meeting.

- The Sub-committee recommends the development of two ecosystem-based risk assessment studies: one for the Atlantic Ocean tropical area and another for the Sargasso Sea area. These risk assessments would aim to identify the high-risk ecosystem impacts in the Convention area.

- The Sub-Committee recommends that the national scientists participating in the marine turtle workshop prepare a report documenting their progress to present it at the 2020 meeting of Sub-committee. In addition, and bearing in mind the need for input information for the Ecosystem Report Cards, the Sub-committee recommended that the following aspects be considered:

    - Creating species distribution maps
    - Review and determine the best methods to determine BPUEs and the number of fisheries interactions at the species level

Pertaining to By-catch

- Acknowledging the value of collaborations between industry and scientists in the development of new tools and gears to assist in release operations, the Sub-committee recommends that new mitigation approaches be further explored, e.g. sharks' release from the net. In addition, purse seine fleets should exclusively deploy non-entangling FADs. Further research and increased use of biodegradable FADs is encouraged, as stated in Rec. 16-01.

- In order to expand the knowledge on post-release survival rates, the Sub-committee recommends further experiments to estimate the mortality and track post-release movements of species of concern.

Sub-committee on Statistics

- The Sub-committee reminds CPCs that the submission of the ST02B sub-form (zero catch matrix) is mandatory (Res. 15-09).

- The Sub-committee recommends that species groups do not request data from the previous years for stock assessments conducted before 31 July. These requests greatly increase the Secretariat's workload and the data reported is usually incomplete and, therefore, they are not included in the analyses.

19. Responses to Commission's requests

19.1 Refine the MSE for W-BFT and continue testing the candidate management procedures. Rec. 17-06, paragraph 16

Background: Rec. 17-06, paragraph 16. In 2019, the SCRS shall refine the MSE and continue testing the candidate management procedures.

19.2 Continue its MSE work for E-BFT, testing candidate management procedures, including harvest control rules (HCRs). Rec. 18-02, paragraph 13

Background: Rec. 18-02, paragraph 13. The SCRS shall continue its MSE work, testing candidate management procedures, including harvest control rules (HCRs), which would support management objectives to be agreed by the Commission in 2019.

Due to joint nature of MSE process for eastern and western bluefin tuna stocks, this response applies to 19.1 and 19.2.

The primary focus of the Committee for the past year has been on the Management Strategy Evaluation (MSE). The Committee is of the opinion that the MSE process is likely the best means of developing management advice robust to the complexities of bluefin tuna including stock mixing, environmental variability and other uncertainties that affect current assessment advice. Due to the complexities involved in developing operating models, the Committee has concluded that it cannot yet recommend a final reference set of operating models. As operating models are required for testing candidate management procedures, the MSE process will not be completed in time for the 2020 Commission meeting to provide TAC advice for 2021. Accordingly, the Committee recommends a workplan that will extend the MSE process for another year with a goal of completing the MSE process in time for the 2021 Commission meeting to provide TAC advice for 2022-2024 as outlined in the revised roadmap (**Appendix 15**). However, the MSE process requires sequential progress, hence completion of this plan is dependent upon achieving each step in the revised roadmap. In parallel, the Committee recommends a simple update of the stock assessment models in 2020 to provide TAC advice for 2021. Further, the Committee does not perceive requiring specific input from the Commission representatives and stakeholders in the form of Panel 2 and the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers (SWGSM) for further input on the MSE until the end of 2020 when tangible results from the MSE are anticipated to be available.

19.3 Develop a new data collection initiative as part of the EPBR to overcome the data gap issues of those fisheries, in particular artisanal fisheries of developing CPCs. Rec. 18-04, paragraph 10

Background: *Rec. 18-04, paragraph 10. CPCs shall provide their estimates of live and dead discards, and all available data including observer data on landings and discards for blue marlin, white marlin/spearfish, annually by 31 July as part of their Task I and II data submission to support the stock assessment process. The SCRS shall review the data and determine the feasibility of estimating fishing mortalities by commercial fisheries (including longline and purse seine), recreational fisheries and artisanal fisheries.*

The Group did not have enough time for fully review the information regarding mortality of live discard for blue and white marlin/roundscale spearfish. Therefore, this item will be addressed in the workplan for 2020.

Background: *Rec. 18-04, paragraph 10 (continued). The SCRS shall also develop a new data collection initiative as part of the ICCAT Enhanced Program for Billfish Research (EPBR) to overcome the data gap issues of those fisheries, in particular artisanal fisheries of developing CPCs, and shall recommend the initiative to the Commission for its approval in 2019.*

Background

The SCRS and the Commission has recognized the importance and socio-economic benefits associated with artisanal fisheries in several of the ICCAT CPCs. However, the limited information on artisanal fisheries statistics, total catch, fishing effort and basic biological sampling of these fisheries has been also recognized. Following the recommendations of the SCRS, the Commission approved a research study with focus on the West African and Caribbean marine artisanal fisheries, aiming at identifying priorities, monitoring objectives and recommendations to improve knowledge, monitoring and statistics reporting of "artisanal fisheries", aiming to develop a strategic investment for artisanal fisheries of ICCAT species of interest.

The first study was completed in 2015 on an inventory of strategic investments relative to artisanal fisheries in the West African region (Kebe, 2015). The study summarized the projects, financial support and development of activities towards artisanal fisheries in Mauritania, Cabo Verde, Senegal, Republic of Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Nigeria, Gabon and São Tomé & Príncipe. The study concluded that substantial financial and development support has been provided by multiple agencies, through the years but without an interagency or national coordination or consultation which led to the duplication of efforts and the lack of a general comprehensive plan for the region in terms of allocation of resources and continuity of main projects. The study recommended a harmonization of strategic investments, and call for the expertise of regional organizations (e.g. COMHAFAT) and local scientific support. It highlighted the importance of data collection and monitoring systems in all the regions, with common standards for exchangeability and overall regional scientific support of fisheries resource management and policies.

The second study was completed in 2018 with a review of similar programs in the Caribbean and Central America region (Arocha, 2018). The study focused on countries with artisanal fisheries catching billfish and pelagic sharks, species for which the SCRS noted the lack of information which largely increased the uncertainty in the assessments of these stocks. Important artisanal fisheries were identified in Barbados Curaçao, Grenada, Suriname, Guyana, Trinidad and Tobago, Venezuela, Belize, Honduras, Guatemala, Nicaragua, Panama, Colombia and Dominican Republic. The study also noted the important catches of small tunas (wahoo, black fin tuna, mackerels) and dolphin fish, that are an important source of local food and interregional trade. The study noted that data collection and monitoring vary greatly among countries, with better reporting and coverage in general by those countries that are members of ICCAT. It did also highlight the efforts of the WECAFC to promote the data submission of ICCAT fisheries and sharing scientific recommendations for ICCAT species. There were several recommendations, specifically for each county, but overall the study suggests investment in personal training and harmonization of data reporting and formats, to make them useful for scientific purposes. It noted, that most of the countries in the Caribbean regions has infrastructure for the monitoring of artisanal fisheries, but due to limited resources or lack of trained personal data collection has been hindered in recent years.

Overall the EPBR had supported sampling and data collection for specific artisanal fisheries, and the success of this program has provided important information to the SCRS management advice. However, it also led up the need for a more comprehensive data collection and monitoring from all artisanal fisheries. These studies provided the general overview of the magnitude and importance of the artisanal fisheries, indicating that not only ICCAT, but multiple organizations and projects have dedicated substantial efforts and funds to artisanal fisheries in the Atlantic. However, the lack of coordination among organizations, a continued support, training of personal and common policies among countries are hampering these efforts. For ICCAT strategic investment is recommended to coordinate with other agencies and national government complementary projects and synergistic actions. It is suggested to use more academic organizations for the basic sampling and monitoring of artisanal fisheries, taking advantage of local expertise both in the West African region and the Caribbean.

Initiatives to overcome the data gap issues of those fisheries, in particular artisanal fisheries of developing CPCs

After reviewing the artisanal fisheries studies and general discussions, the Group recommended several initiatives to improve the collection of statistics of these fisheries. These include one on a general collaboration with another RFMO (WECAFC) and two proposals involving developing CPCs.

Western Central Atlantic Fishery Commission (WECAFC)

The Group is aware of recent exchanges of correspondence between ICCAT and WECAFC Secretariat, regarding the provision of a MoU to be presented at the upcoming Commission meeting. The MoU will emphasize in the collaboration between ICCAT and WECAFC, aiming the submission of fisheries statistics of WECAFC members to the ICCAT Secretariat including artisanal fisheries for billfish species. Recently, ICCAT was represented at a WECAFC Working Group on FOBs meeting held in April 2019. The meeting provided progress on the science in support of management of moored FOBs in the WECAFC area. It discussed some information relevant to billfish and particularly to blue marlin, which dominates billfish catches made on FOBs. Given that most species caught around FOBs are managed by ICCAT, efforts on data collection and analysis related to FOBs made by this WECAFC Working Group are of clear benefit to ICCAT. The Group highlighted the importance to continue to strengthen the coordination and collaboration of activities between ICCAT and WECAFC. It was informed that a proposal MoU will be presented to the Commission.

Other proposals aiming at improvement in data collection and reporting

The Group was informed that funds had been secured to allow continuing support of sampling billfish fishing activities and to improve the quality of data on billfish collected from artisanal fisheries in the eastern Atlantic.

The Group also noted that despite efforts that have been made since the 1980s, data collection gaps in mostly artisanal fisheries still remain. To fill the gaps noted in artisanal fisheries it is proposed to hold two regional workshops, one in West Africa and another in the Caribbean, to bring together the CPC statistical correspondents. The objective is to help improve the statistics of small-scale fisheries. In addition, the national statistical correspondents will be requested to provide with descriptive and detailed documents of their fishery and suggestions that they would have defined to improve the collection of fisheries statistics and reporting to ICCAT.

The Group also consider the recommendations from scientists familiar with the artisanal fisheries in West Africa and the Caribbean, and recommends to initiate trial studies with local scientific institutions to develop applications (electronic phone e-forms) and portable databases to easily record fishing effort, catches, catch composition, photo-id of species, for remote port sampling of artisanal fisheries, and evaluate if such App can be useful as a tool to record and report artisanal fisheries statistics for ICCAT species, in particular. Once the efficiency of this system is evaluated, in a second phase, it could be provided to national authorities for wider implementation.

19.4 Updated assessment of the state of the Mediterranean swordfish stock on the basis of the most recent data available. Rec. 16-05, paragraph 45

Background: *Rec. 16-05, paragraph 45. The SCRS shall provide in 2019 an updated assessment of the state of the stock on the basis of the most recent data available. It shall assess the effectiveness of this Recovery plan and provide advice on possible amendments of the various measures. SCRS shall advice the Commission on the appropriate characteristics of the fishing gear, the closure period for the sport and recreational fishery, as well as the minimum size to be implemented for Mediterranean swordfish.*

An updated assessment has been foreseen in 2020 and this may allow to evaluate the effectiveness of the recovery plan and identify deficiencies and amendments needed. Recent studies suggest that the adopted minimum size results in a high number of undersized dead discards. The Committee showed concern that such discards are not being fully reported and reiterated that all dead discards should be reported in Task I NC for all fisheries.

More detailed answers on those aspects will be provided after the 2020 assessment.

19.5 Review the effectiveness of the measures contained in Rec. 17-08 and provide the Commission with additional scientific advice on conservation and management measures for North Atlantic shortfin mako. Rec. 17-08, paragraph 10

Background: *Rec. 17-08, paragraph 10. In 2019, the SCRS shall review the effectiveness of the measures contained in this recommendation and provide the Commission with additional scientific advice on conservation and management measures for North Atlantic shortfin mako, which shall include:*

a) an evaluation of whether the measures contained in this recommendation have prevented the population from decreasing further, stopped overfishing and begun to rebuild the stock, and whether or not, the probability of ending overfishing and rebuilding that would be associated with annual catch limits at 100 t increments.

b) a Kobe II strategy matrix that reflects timeframe(s) for rebuilding of at least two mean generation times; and

In conducting such review and providing advice to the Commission, the SCRS shall take into account:

a) a spatial/temporal analysis of North Atlantic shortfin mako catches in order to identify areas with high interactions;

b) available information on growth and size at maturity by sex as well as any biologically important areas (e.g. pupping grounds); and

c) the effectiveness of the use of circle hooks as a mitigation measure to reduce mortality.

Although the exceptions contemplated in Rec. 17-08 were only partially implemented in 2018, continued fishing at the current catch (2,388 t in 2018) will not allow the stock to rebuild by 2070 and overfishing will continue. Given the vulnerable biological characteristics of this stock and the pessimistic projections, to accelerate the rate of recovery and to increase the probability of success the Committee recommends that the Commission adopt a non-retention policy without exception in the North Atlantic. Other management measures such as reduction of soak time, time-area closures, and safe handling and best practices for the release of live specimens may also be required to further reduce incidental mortality.

(parag. 10 a, b) Full implementation of the measure only happened in 2019 and it is not clear what fleets have implemented what components of the measure. Projections suggest that the stock will continue to decline until at least 2035 with zero catches. With zero catches, including bycatch, the stock would be rebuilt (stop being overfished) in 2050 with a 60% probability. Overfishing would be stopped with catches less than 700 t starting in 2020. To rebuild to the green quadrant with a 60% probability in two generations (by 2070) would require a TAC of 300 t or less.

(parag. 10 a) The resolution of data submitted to ICCAT does not allow the identification of areas of high interactions that would be practical for the implementation of closed areas. Higher resolution spatial catch and effort data would be necessary to identify areas that could be closed with a high probability of protecting mako shark and minimize negative impacts on the target species.

(parag.10 b) Available information on growth and size at maturity by sex was incorporated into the projections. Ongoing research confirms size at maturity estimates by sex that were used in the projections. Biologically important areas (e.g. pupping grounds) were not considered.

(parag. 10 c) There is ongoing research that is investigating the effectiveness of the use of circle hooks as a mitigation measure to reduce at-vessel mortality.

Rec. 17-08 If post-release survival is high, size limits and live releases would decrease fishing mortality and therefore accelerate rebuilding provided that total mortality from the catch and post-release mortality are within a range that would allow rebuilding.

19.6 Summary of the scientific data and information collected and reported pursuant to Rec. 16-14 and any relevant associated findings, Rec. 16-14, paragraph 12(c) and (d)

Background: *Rec. 16-14, paragraph 12(c). Provide with a summary of the scientific data and information collected and reported pursuant to Rec. 16-14 and any relevant associated findings.*

In 2018, the ICCAT Secretariat reviewed and compiled all National Observer Program data that had been stored at the Secretariat since 2016. It included records from national observer programs from fishing activities from 2012 to 2019. The information that was reported is not the same as that which was collected in the ICCAT database system. Whereas data entries before 2019 received visual inspections only, the Secretariat developed a JAVA software application in 2019 to validate form completeness and errors. As a result of this, data submissions could be verified before being compiled. In 2019 therefore, all data submissions with potential problems were fixed through re-submission in August-September 2019 so that all 2019 ST09 submissions could be uploaded into the ICCAT database system.

But, not all the pre-2019 submissions of National Observer Program data could be uploaded into the ICCAT database system. 58 of 107 ST09 form submissions could be uploaded. As part of the compilation process, data submissions were evaluated to determine if they could be entered into the database or not. The evaluation process excluded the uploading of form data submitted to the Secretariat where the data were rated as having no data or as being not useable. **Table 1 and 2** show the number of records by species and the number of operations what were observed, respectively, that were entered into the database.

Generally speaking, the rate of reporting of observer data using the ST-09 form has increased in the past 2 years. However, the number of CPCs that reported data on seabirds and sea turtles remains low. At the time, the Committee cannot determine if the low number of CPCs reporting sea turtles and seabird data is because most CPCs do not interact with this species, or because that data are not being collected/reported, or a combination of both.

Table 1. Summary of preliminary National Observer Program data records by species group.

Row Labels	2012	2013	2014	2015	2016	2017	2018	Grand Total
1-Tuna (major sp.)	49,322	141,655	65,492	24,100	25,854	8,658	4,175	319,256
2-Tuna (small)	1,488	1,429	4,527	1,623	12,100	4,310	4,868	30,345
3-Tuna (other)	3,722	1,884	1,265	491	2,116	560	455	10,493
4-Sharks (major)	8,145	9,732	13,051	3,187	4,649	2,134	939	41,837
5-Sharks (other)	251	194	2,113	724	5,564	2,495	3,248	14,589
Grand Total	**62,928**	**154,894**	**86,448**	**30,125**	**50,283**	**18,157**	**13,685**	**416,520**

* Number of records reported in 2017 and 2018 cannot be compared with reporting in years before 2017 because aggregation levels and submission format differ between the earlier (pre 2017) data.

Table 2. Preliminary summary of distinct fishing operations observed by year and gear.

Row Labels	2012	2013	2014	2015	2016	2017*	2018*	Grand Total
BB						4	5	9
GN						7	12	19
HL							29	29
HP							3	3
LL	2,214	6,368	3,374	1,285	213	400	467	14,321
OT						1		1
OTH							17	17
PS			266		1,323	3,339	6,694	11,622
RR						2		2
TN						8	13	21
TP						3		3
TR							2	2
TW						144	161	305
Grand Total	**2,214**	**6,368**	**3,640**	**1,285**	**1,536**	**3,908**	**7,348**	**26,299**

* Number of fishing operations reported in 2017 and 2018 cannot be compared with reporting in years before 2017 because the definition of a fishing operation changed.

Background: *Rec. 16-14, paragraph 12(d). Recommend on how to improve the effectiveness of scientific observer programmes, including possible revisions to Rec. 16-14 and/or with respect to implementation of these minimum standards and protocols by CPCs.*

In order for the Committee to further develop a response to the Commission, the Committee encourages the following actions:

- CPCs resubmit old data in new format including the 2018, 2019 submissions as well as old submissions that could not be imported. The Secretariat will advise CPCs on which submissions are required;
- The Secretariat will provide clear instructions on how aggregated fields should interpreted for sampling and mitigation measures;
- Encourage all CPCs to be compliant with data submission requirements to improve National Observer Program coverage and completeness.

The SCRS has already adopted and recommended the implementation of minimum standards (Ruiz *et al*. 2017) for the use of Electronic Monitoring System for purse seine vessels in the tropical tuna fishery.

19.7 The SCRS will provide an update on the progress of the work on Ecosystem Based Fisheries Management in 2018 and report back to the Commission with available findings in 2019, if possible. Res. 16-23, paragraph 2

Background: *Res. 16-23, paragraph 2. Provide an update on the progress of the work on Ecosystem Based Fisheries Management in 2018 and report back to the Commission with available findings in 2019, if possible.*

The Sub-committee provided a response in 2018, and there were no available findings in 2019.

19.8 Review of annual catch rates by fleet segment and gear. Rec. 18-02, paragraph 18

Background: *Rec. 18-02, paragraph 18. Each CPC shall adjust its fishing capacity to ensure that it is commensurate with its allocated quota by using relevant yearly catch rates by fleet segment and gear proposed by the SCRS and adopted by the Commission in 2009. Those parameters should be reviewed by SCRS no later than 2019 and each time that a stock assessment for eastern bluefin tuna is performed, including specific rates for gear type and fishing area.*

Given changes in the fishery and stock conditions, the Committee considers that the currently available 'best catch rates' may no longer be appropriate for fishing capacity calculations. The SCRS requests further guidance on what is the meaning of 'best catch rates' and requests an explicit definition. This is critical for the Committee to have such a definition so that they can conduct analyses to develop these rates. The Commission may wish to continue applying the current estimates until the SCRS provides updated figures as promptly as possible.

19.9 The SCRS shall review and update the growth table published in 2009, and the growth rates utilized for farming the fish referred to under paragraph 35 c, and present those results to the 2020 Annual meeting of the Commission. Rec. 18-02, paragraph 28

Background**:** *Rec. 18-02, paragraph 28. SCRS, on the basis of a standardized protocol to be established by the SCRS for the monitoring of recognizable individual fish, shall undertake trials to identify growth rates including in weight and size gains during the fattening period. Based on the result of the trials and other scientific information available, SCRS shall review and update the growth table published in 2009, and the growth rates utilized for farming the fish referred to under paragraph 35 c, and present those results to the 2020 Annual meeting of the Commission. In updating the growth table, the SCRS should invite independent scientists who have appropriate expertise to review the analysis. The SCRS shall also consider the difference among geographic area (including Atlantic and Mediterranean) in updating the table. Farm CPCs shall ensure that the scientists tasked by the SCRS for the trials can have access to and, as required by the protocol, assistance to carry out the trials. Farm CPCs shall endeavor to ensure that the growth rates derived from the eBCDs are coherent with the growth rates published by the SCRS. If significant discrepancies are found between the SCRS tables and growth rates observed, that information should be sent to SCRS for analysis.*

The SCRS and some CPCs conducted or have initiated a series of studies on growth in farms. Since there are differences in the conditions and the nature of farming practices, the GBYP has initiated five growth trials in which individual fish tagging is being carried out in only two farms. Logistical and methodological issues were identified, due to the mortality generated and the uncertainty related to different behaviour of tagged fish. Due to these difficulties the Committee suggest that other methods may need to be used, knowing that in separate analyses, caging stereoscopic-camera data is being used in conjunction with harvest sample data to determine growth in fattening cages without individual fish identification. The preliminary results from some of these analyses showed different growth rates from those of the SCRS table. The Committee cannot, however, prejudge the validity of these results because of their preliminary nature.

The Table below describes the proposed study designs and the timeline of each individual study. The first results will be presented in 2021 and the final results by 2023.

Location	Method	Dates	Pro/Con	Length intervals	Duration intervals in captivity	Comments
Southern Portugal/TUNIPEX farm	Tagging	July-December 2019	individual growth trajectories of adult fishes/stress induced mortality of tagged fishes.	110/240 cm	4-6 months	Stereocam measurements of tagged fishes will allow to evaluate SC system accuracy
Southern Portugal/TUNIPEX farm	Stereo-camera measurements at caging (minimumn 20% of caged fishes) and direct L/W measurements at harvesting of all the fishes farmed in 2016 and 2017.	July-December 2020	mean and maximum growth rates of caged population in a representative cage/no individual growth rates	110/240 cm	4-6 months	Determination of growth rates in fishes with an initial bad condition, which has in principle the higher potential growth rates
Western Mediterranean/Balfegó farm	Stereo-camera measurements at caging and direct L/W measurements at harvesting in selected cages.	June 2016-June2018	mean and maximum growth rates of caged population/no individual growth rates.	130/240 cm	4-18 months	L/W at harvesting available for 100%of caged fishes.
Western Mediterranean/Balfegó farm	Bi-monhtly stereo-camera measurements from caging to harvesting (minimum 20% of fishes in the cage) and direct L/W measurements at harvesting in one representative cage	June 2019-December 2020	mean and maximum growth rates of caged population&determination of seasonal growth rates/no individual growth rates.	100/340 cm	4-18 months	L/W at harvesting available for 100%of caged fishes
Adriatic sea/Pelagos farm	Tagging/oxytetraciclin injection	June 2019-December 2021	individual growth trajectories of adult fishes/stress induced mortality of tagged	75/130 cm	18-30 months	Otolith reading validation studies
Adriatic sea/Pelagos farm	Seasonal (3 months) stereo-camera measurements from caging to harvesting (minimum 20% of caged fishes)and direct L/W measurements at harvesting in two representative cages	June 2019-December 2022	mean and maximum growth rates of caged population in a representative cage/no individual growth rates	75/130 cm	18-30 months	L/W at harvesting available for 100% of caged fishes
Central Mediterranean/Aquabiotech	Bi-monhly stereo-camera measurements from caging to harvesting (minimum 20% of caged fishes) and direct L/W measurements at harvesting of all the fishes in one representative cage	June 2019-December 2020	mean and maximum growth rates of caged population&determination of seasonal growth rates/no individual growth rates.	96/264 cm	4-18 months	L/W at harvesting available for 100%of caged fishes
Eastern Mediterranean/Akua group farm	Bi-monhtly stereo-camera measurements from caging to harvesting (minimum 20% of caged fishes)and direct L/W measurements at harvesting of all fishes in one representative cage	June 2019-December 2021	mean and maximum growth rates of caged population&determination of seasonal growth rates/no individual growth rates.	120/230 cm	18/30 months	L/W at harvesting available for 100%of caged fishes
All areas where BFT farming takes place	Stereo-camera measurements at caging (minimum 20% of caged fishes) and direct L/W measurementsof all fishes at harvesting in all BFT farms	2014-2019	mean and maximum growth rates of caged population in all BFT farms/no individual growth rates	whole length range of purse seine catches	4-30 months	DB useful for stock assessment
Morocco Atlantic	Stereo-camera measurements at caging (minimum 20% of caged fishes).At harvesting both stereoscopic camera measurement and direct L/W measurementsof at least 10% fishes at harvesting in 12 BFT cages	May-September 2019/May-September 2020	mean and maximum growth rates of caged population in all Moroccan BFT farms/no individual growth rates.	140/300 cm	4 months	The preliminary results (no individual growth aproach) suggest that growth rates could be higher than those used by the SCRS. SCRS/2019/193
Malta	Stereo-camera measurements at caging (minimum 20% of caged fishes) and direct L/W measurements of at least 10% fishes at harvesting of 37 BFT cages.	June 2014-December 2018	mean and maximum growth rates of caged population in all BFT farms/no individual growth rates.Challenges to identify individual grwth rates	165/278cm at caging	3-5.5 months	Determination of growth rates in upper mode of population in the cages. SCRS/2019/183

19.10 Evaluate the efficacy of the area/time closure referred to in paragraph 13 for the reduction of catches of tropical tuna juveniles. Rec. 16-01, paragraph 15

Background: *Rec. 16-01, paragraph 15. Evaluate the efficacy of the area/time closure referred to in paragraph 13 for the reduction of catches of tropical tuna juveniles.*

The Group has provided prior responses to the Commission in regard to this. Some preliminary analyses conducted with AOTTP data have provided new insights on the movements of tuna in the Gulf of Guinea. Tagged tuna showed evidence of incomplete mixing throughout the distribution of the stock for at least a year post-release. This implies that tuna can remain in the same area where they are released for a few quarters, including the closure area. Analyses have also noted differences in the migration and residence time of large and small tunas. The Group has incorporated in their 2020 workplan activities that will help provide additional information to the Commission. The Group is using AOTTP data to review the prior analysis conducted in the effectiveness of the current area/time closure as part of a broader review of effectiveness of control measures (see tropical tuna workplan).

19.11 Provide performance indicators for skipjack, bigeye and yellowfin tuna, with the perspective to develop management strategy evaluations for tropical tunas. Rec. 16-01, paragraph 49(b)

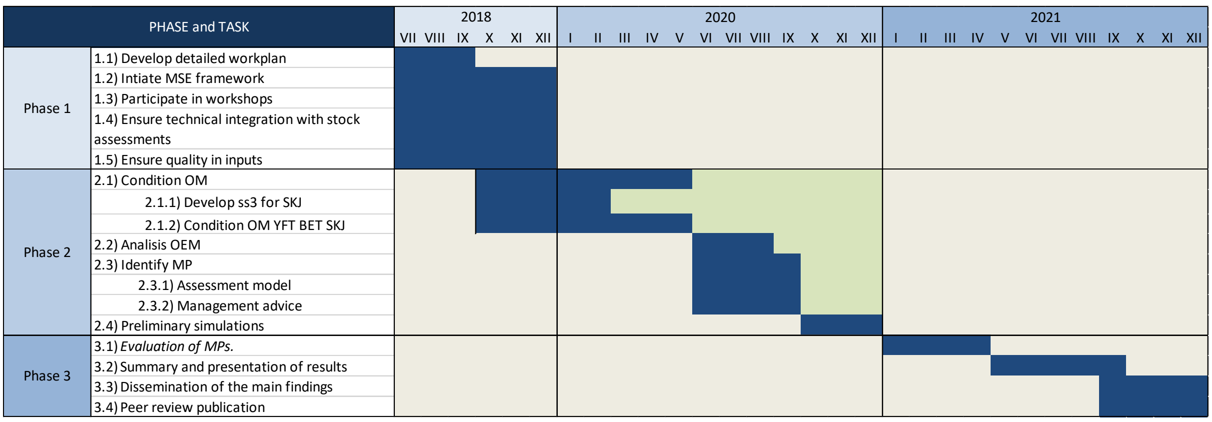
Background: *Rec. 16-01, paragraph 49(b). Provide performance indicators for skipjack, bigeye and yellowfin tuna, with the perspective to develop management strategy evaluations for tropical tunas.*

In the first phase of the project, the Group determined that the performance indicators used for albacore were considered adequate in the interim for tropical tunas. In order to continue and develop the MSE work for tropical tunas, costs, timelines, and workplan are outlined below.

Phase one of a research project in support of the MSE process on tropical tunas was completed in 2018 (Merino *et al.*, 2020) but no further funding was provided by the Commission to complete phases two and three. It is important to maintain the momentum of progress on MSE for tropical tunas and to capitalize on recent assessment of bigeye tuna in 2018, yellowfin tuna in 2019 and the proposed skipjack assessment in 2021. Information and knowledge gained on these assessments is essential to support the MSE process.

The Group recommends that phase two be completed in 2020 and phase three in 2021. This will require €125,000 funding from the Commission in each 2020 and 2021. Work to be completed in 2020 and 2021 will follow the schedule proposed by Phase 1 of the project. To progress the MSE work the SCRS will also need the support of the Commission in the development of operational management objectives for tropical tunas. If more specific input is provided for these objectives, it will be easier for the MSE Technical Group to develop and calculate relevant performance indicators within the MSE.

Funding of activities related to the Commission development of these objectives are not part of the €250,000 budget request. The FAO ABNJ tuna project may be able to provide some financial support to some of the MSE activities.



19.12 The SCRS shall evaluate the contribution of by-catches and discards to the overall catches in ICCAT tropical tuna fisheries, and advise the Commission on possible measures allowing to reduce discards and to mitigate onboard post-harvest losses and by-catch in ICCAT tropical tuna fisheries. Rec. 16-01, paragraph 53

Background: *Rec. 16-01, paragraph 53. The SCRS shall evaluate the contribution of by-catches and discards to the overall catches in ICCAT tropical tuna fisheries, on a fishery by fishery basis and advise the Commission on possible measures allowing to reduce discards and to mitigate onboard post-harvest losses and by-catch in ICCAT tropical tuna fisheries.*

The SCRS provided a response in the *Report for Biennial Period 2016-2017, Part II (2017), Vol. 2* describing the average by-catch and discards from the EU tropical tuna purse seine fishery, based on a report released that year. The response presented the estimated contribution of each taxonomic group to the total by-catch by fishing mode for the period 2010-2016 (in percentage and in tons/1,000 t of production).

Such response was limited as it contained data only for the EU tropical tuna purse seine fishery and was derived from a scientific study. The response did not contain data on the other gears, and other purse seine fleets harvesting tropical tunas.

In 2019 the ICCAT Secretariat described work carried out to review information received on National Observer Programs (form ST-09) and the ongoing efforts to store such information in a dedicated database. Reviews performed so far suggest there are several data cleaning and cross-checking tasks pending before these data can be used to estimate by-catch.

The Group intends to use the available ST-09 data for longline fleets targeting tropical tunas to estimate by-catch from these fleets in 2020. This will require collaboration between the Tropical Tunas Species Group, ICCAT Secretariat, Sub-committee on Statistics and Sub-committee on Ecosystems. Initial examination of the available data suggest estimates may only be possible for a subset of longline fleets. It will also be necessary to agree on: 1) a method to raise the available data to represent total by-catch and 2) the taxonomic level for reporting by-catch.

19.13 Review the available information on fishing capacity and provide advice on adapting the fishing capacity in all its components (number of FADs, number of fishing vessels and support vessels) to achieve the management objectives for tropical tuna species. Rec. 16-01, Annex 8

Background: Rec. 16-01, Annex 8. Review the available information on fishing capacity and provide advice on adapting the fishing capacity in all its components (number of FADs, number of fishing vessels and support vessels) to achieve the management objectives for tropical tuna species.

In the last few years, reported catches of YFT and BET have exceeded the current TACs established for these two stocks and catches of SKJ have exceeded the levels recommended by the SCRS. The SCRS has shown that such overages have led to fishing mortality rates that are in excess of the recommendations made by the SCRS for bigeye tuna.

Annex 8 of Rec. 2016-01 requested that the SCRS include in its workplan a review of "…the available information on fishing capacity and provide advice on adapting the fishing capacity in all its components (number of FADs, number of fishing vessels and support vessels) to achieve the management objectives for tropical tuna species." Appendix 5 to ANNEX 4.6 of *Report for Biennial Period 2018-2019, Part I (2018), Vol. 1* also mentioned that "The Commission has to find ways to make sure that catches do not exceed the TAC through a range of possible measures... Measures for the purpose of reducing mortality of juvenile BET and YFT through a range of possible measures … The measures … should be established on the basis of advice provided by the SCRS".

The SCRS reviewed a new analysis that evaluates the possible future benefits of using alternative management measures for tropical tunas based on moving from a system that involves primarily output-based controls to another that relies on input-based controls for its purse seine fishery. Specifically, the analysis proposes that the SCRS would calculate a sustainable catch limit and how such limit should be divided among major gears. The SCRS notes that it would require guidance from the Commission to complete this task.

The SCRS noted that any one type of effort control measure is unlikely to be able to perfectly control fishing mortality, thus the need to accompany the closures with other capacity measures that may control other components of effort such as supply vessel limitations, FAD limitations, etc. Such additional capacity measures would aim to limit possible increases in fishing power and catchability of the purse seine fleet. This new management based on effort would require continued SCRS monitoring of the fishing mortality exerted by the purse seine. Assuming such monitoring was effective, the allocations of purse seine fishing days could be periodically adjusted by the Commission, to ensure fishing mortality remained at sustainable levels, though alternative approaches might be necessary to achieve a desirable level of fishing mortality for all tropical tunas including bigeye, which is in the worst status among tropical tunas.

The SCRS agrees that there is value in further exploration of these and other possible management measures for tropical tunas and has incorporated into its workplan further work on this topic. In 2020, the SCRS proposes to:

1. Identify data needs to evaluate the effectiveness of these alternative measures
2. Develop a list of selected fishery indicators that will be used to evaluate the performance of these measures and
3. Review available methods to evaluate effects of alternative measures on stock status (fishing mortality and biomass).[1]

Finally, the SCRS recognises that since it is the responsibility of the Commission to decide which management measures are appropriate for tropical tunas, in particular allocation among fishing gears upon advice from the SCRS, and therefore the SCRS will follow the Commission guidance for evaluation of alternative management measures for the topical tunas that may be adopted. Accordingly, the Committee requests the advice of the Commission on the possible alternative management measures for the tropical tunas that the SCRS should evaluate.

19.14 Conduct another fishery impact assessment to evaluate the efficacy of these mitigation measures. Based on this fishery impact assessment, make appropriate recommendations, if necessary, to the Commission on any modifications. Rec. 11-09, paragraph 8

Background: Rec. 11-09, paragraph 8. In 2015, the SCRS shall conduct another fishery impact assessment to evaluate the efficacy of these mitigation measures. Based on this fishery impact assessment, the SCRS shall make appropriate recommendations, if necessary, to the Commission on any modifications.

The Sub-Committee recalled that the paucity of seabird bycatch data submitted to the ICCAT Secretariat following requirement for the implementation of mitigation measures still prevents the full assessment required by Rec. 11-09. Nevertheless, the Sub-committee acknowledged that progress has been made towards addressing this issue.

The FAO Common Oceans/ABNJ Tuna project has achieved a preliminary estimate of seabird by-catch mortality for pelagic longline fisheries in the Southern Hemisphere for 2016 by 5x5 grid squares south of 20 degrees south latitude. The analyses aggregated the data from 2012 to 2016 to compensate for a paucity of seabird bycatch information collected by observers, and annual trends of estimates would only reflect a change in fishing time and area of overlap with seabird distribution. This means it is not possible to obtain the anticipated outcome of providing pre-regulation and post-regulation total estimates of bycatch. In addition, the project recognized that although a set of mitigation measures referred to in Rec. 11-09 could substantially reduce seabird bycatch if implemented in an appropriate way, quantitative measurements on proper implementation of certain mitigation measures are currently missing.

Collaborative work is in its third year and ICCAT CPCs national scientists continue to analyse seabird bycatch based on detailed operational level observer data.

[1] The SCRS may be able to extend the work to complete evaluation of the effectiveness of some of the measures that the Commission may adopt in 2019 depending on the complexity of the measure and availability of data.

The Sub-committee agreed to continue its effort to deliver the response to the Commission, taking into account data paucity, expected progress in development of a seabird indicator in the Ecosystem Report Card (reported in Section 3 of the Report of the 2019 Sub-committee on Ecosystems Meeting (Anon. 2019m)), and all the historical works done including the CCSBT Scoping Paper presented at the 2016 Intersessional meeting of the Sub-committee on Ecosystems.

20. Other matters

20.1 Analysis of recommendations emanating from the Meeting of the Ad Hoc Working Group to Follow up on the Second Performance Review Panel and possible necessary actions

The Vice-chair provided an update on the actions carried out in 2019. However, due to limited time to properly analyse the document the Committee decided to defer this item to the SCRS Process and Protocol Meeting in 2020 (**Appendix 17**).

20.2 Collaboration with other International Organizations (ICES, CITES, GEF, etc.)

ISSF

ISSF participating companies continue to provide the Secretariat with detailed information on catches (by vessel trip, species and commercial size category) for all their purchases. These correspond to unloading of catches of tropical tunas (bigeye, yellowfin, skipjack) and albacore to canning plants around the world. This information has previously been used by the SCRS. In 2019 the Secretariat was informed by ISSF that the Secretariat of the Pacific Community (SPC, Science Provider to WCPFC) receives the same types of data files from ISSF participating companies as the ICCAT Secretariat does. SPC has developed code to semi-automatically input the data into their database. SPC has expressed willingness to process the ICCAT data, at no cost to ICCAT, and export them in a format that the Secretariat can use effectively. The Secretariat will soon contact SPC to see how to make this happen. ISSF also noted that it has amended its requirement for cannery data submissions to RFMOs, so that a single data reporting format must be used starting in 2020. This should solve the problem found with multiple submission formats.

International Council for the Exploration of the Sea (ICES)

Considering the fruitful experience ICCAT and ICES have had in recent years regarding scientific collaboration, in 2018 both organisations expressed their willingness to strengthen this cooperation and explore new initiatives and discussions which have commenced between the Secretariats. It has been agreed therefore that it is appropriate and desirable to improve collaboration between ICCAT SCRS-ICES, particularly in the areas of bycatch, sharks and stock assessment issues, through our Sub-committee on Ecosystems and Bycatch, the Shark Species Group, as well as the WGSAM. Specifically, it would be convenient to keep the participation of ICES scientific experts in ICCAT shark stock assessments, as well as in both (stock assessment) Methods Working Groups.

FAO Common Oceans/ABNJ Tuna Project

In 2015 the Commission, decided to continue with the cooperation between GEF Common Oceans ABNJ Tuna Project and ICCAT. To this end, since the 2018 SCRS plenary, the ICCAT Secretariat has participated in several ABNJ Common Oceans initiatives. These include participation in the following meetings that were funded or partially funded by the project:

- Joint t-RFMO FAD Working Group Meeting 8-10 May 2019, held in California, USA;
- Sixth Project Steering Committee (PSC) meeting of the Common Oceans ABNJ tuna project held in Rome, 8-10 July 2019.

A Joint t-RFMO meeting on bycatch, mainly focusing on sharks and in collaboration with other tRFMOs, is currently being organised by the ICCAT Secretariat with the support of the European Union with a contribution of the ABNJ. It will take place in Porto (Portugal) 16-18 December 2019.

In addition, ABNJ provided funding for one staff member to attend the Tuna Compliance Network and one staff member to attend the IATTC Compliance Committee Meeting.

Following the conclusion of the feasibility study on the development of an Online Reporting System funded by the Common Oceans ABNJ Tuna Project, the Secretariat, in line with the directives of the Online Reporting Working Group has now commenced work on the development of an Integrated Online Management System and two software developers have been hired to work on this project. Funds have come from CPCs voluntary financial contributions (USA, Canada, China) and a contribution from the Common Oceans/ABNJ Tuna Project.

General Fisheries Commission for the Mediterranean (GFCM)

In late 2018 and throughout 2019 contacts have been made between the ICCAT Secretariat and the GFCM Secretariat, aiming to enhance the collaboration between the two organizations, namely regarding the collection and reporting of tuna fisheries data to ICCAT. In that sense, a MoU between the two organizations has been circulated to ICCAT CPCs and a final text will be submitted for consideration of the Commission in 2019.

Collaboration with Western Central Atlantic Fishery Commission (WECAFC)

In 2019 contacts have been made between the ICCAT Secretariat and the WECAFC Secretariat, aiming to enhance the collaboration between the two organizations, namely regarding the collection and reporting of tuna fisheries data to ICCAT. In that sense, the Executive Secretary has been in contact with the WECAFC Secretariat to further discuss and table a draft text for a MoU between the two organizations to be submitted for consideration of the Commission in 2019.

South East Atlantic Fisheries Organisation (SEAFO)

In 2019 contacts have been made between the ICCAT Secretariat and the SEAFO Secretariat, aiming to enhance the collaboration between the two organizations, namely regarding the collection and reporting of bycatch of ICCAT species in SEAFO fisheries. In that sense, the Executive Secretary has been in contact with the SEAFO Secretariat to further discuss and table a draft text for a MoU between the two organizations to be submitted for consideration of the Commission in 2019.

Discussion

The Committee acknowledge the increasing collaborations undertaken by ICCAT and saw them as having great potential to improve ICCAT data and practices.

20.3 Update of the ICCAT glossary

The Chair informed the Committee that the Joint tRFMO FAD Technical Group, led by Dr Josu Santiago and held in San Diego, USA in May, has proposed a set of definitions related to:

- Definitions of terms related to buoys used in FAD fishing operations
- Definitions of terms related to FAD fishing operations

In addition, the Chair referred to the definitions and terms related to harvest strategies, management procedures and management strategy evaluation, which was reviewed by participants in the 2018 Joint tuna RFMO Management Strategy Evaluation Working Group, and adopted in early 2019 for the purposes of improving consistency and clarity of communication in tRFMO MSE processes. This glossary was developed to encourage a consistent use of terms associated with harvest strategies, management procedures and management strategy evaluation processes underway across the five tuna RFMOs. In addition, it was developed from a range of sources, including ISSF, Rademeyer *et al.* 2007, IOTC, PEW Charitable Trusts and a range of MSE practitioners with broad experience across tuna and other fisheries. The glossary is available for use by others with appropriate acknowledgement (*Glossary of terms for harvest strategies, management procedures and management strategy evaluation*).

Discussion

The Committee noted that the draft glossary prepared by the joint tRFMO FAD Working Group is available in the report of the meeting. It was noted that some of these terminologies had already been adopted by the SCRS in 2018 (item 19.3 of the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 2*).

The Committee adopted the MSE items for inclusion in the ICCAT glossary together with the FAD/FOB terms adopted by the SCRS in 2018.

20.4 Consideration of new publication guidelines: executive summaries, detailed reports and SCRS report

The Committee decided to defer this item to the SCRS Process and Protocol Meeting in 2020.

20.5 Peer review publication (SCRS documents)

The ICCAT SCRS has had a long-standing agreement with the Aquatic Living Resources journal (ALR) to annually publish several scientific papers from those presented at the SCRS Sub-committees and Species/Working Groups. In 2014 the journal changed its editorial focus towards an ecosystem approach to fisheries management, which limited the possibilities of publishing SCRS documents presented, but broaden its scope in terms of an ecosystem approach, potentially opening the way for a larger number of SCRS documents.

In 2016 the ALR expressed their continued willingness to publish a few more ICCAT papers (12-15) on an annual basis. However, the SCRS has failed to select a minimum number of papers for submission to ALR during the last three years (only 2 papers were selected in 2016, 0 in 2017 and 0 in 2018). To reverse this important aspect of scientific research, the Committee agreed in 2018 to have each Species Group Chair identify, in their workplans for 2020, a specific paper that will be put forward for publication in the primary literature. Species Group Chairs were requested to put 1-2 papers from their Species/Working Group that could be put forward from the 2019 meetings, however only a single suggestion was made.

Accordingly, the Committee decided to defer this item to the SCRS Process and Protocol Meeting in 2020.

20.6 Consideration of exemptions from reporting requirements SHK 7005 and BIL 5001

The Secretariat informed the Committee that it has received several requests for exemptions from requirements BIL 5001 and SHK 7005. Additionally, the Secretariat informed that both the Billfish and Sharks Species Groups agreed on some basic principles for granting the exemptions form reporting. These include the cases of CPCs that do not have active fleets and those cases of ICCAT tuna fisheries that do not overlap spatially with the species distribution. However, the species groups request the Commission to provide guidelines on how to assess the exemptions from reporting requirements for those situations not covered by the latter cases.

The Chair and Vice-chair present the following proposal of Guidelines to access the CPs requests for exemptions from reporting requirements BIL 5001 and SHK 7005.

Rec. 18-05, paragraph 3, states that *CPCs may be exempt from the submission of the check sheet when vessels flying their flag are not likely to catch any billfish species covered by the Recommendations covered by the check sheet, on the condition that the concerned CPCs obtained a confirmation by the Billfish Species Group through necessary data submitted by CPCs for this purpose*.

Rec. 18-06, paragraph 3, states that *CPCs may be exempt from the submission of the check sheet when vessels flying their flag are not likely to catch any sharks species covered by the abovementioned Recommendations in paragraph 1, on the condition that the concerned CPCs obtained a confirmation by the Shark Species Group through necessary data submitted by CPCs for this purpose*.

However, the Commission did not provide clear guidelines to the SCRS Billfish and Sharks Species Groups on how to proceed when assessing the requests for exemptions from reporting requirements SHK 7005 and BIL 5001. Accordingly, the SCRS proposed the following:

Guidelines to assess the CPs requests for exemptions from reporting requirements SHK 7005 and BIL 5001

CPCs requesting for exemptions from reporting requirements SHK 7005 and BIL 5001, shall present the following to the SCRS Shark/Billfish Species Groups:

1. For CPCs that do not have active fleets targeting tuna and tuna-like species in the ICCAT area of competence:

   i. Declaration/evidence that the CPC does not have active fleets on fisheries targeting tuna and tuna-like species in the ICCAT area of competence.

2. For CPCs that have active fleets on fisheries targeting tuna and tuna-like species in the ICCAT area of competence:

   i. List of species of ICCAT shark/billfish species recorded in the area of fishing activities of the CPC;

   ii. Evidence (e.g., report of scientific surveys or report of onboard observer programme) that clearly demonstrates the level of interactions of ICCAT sharks/billfish species with gears used in the CPCs fisheries targeting tuna and tuna-like species in the ICCAT area of competence:

      a) such surveys should cover all seasons with multiple trips to ensure that relatively rare events of catches of some rare by-catch species can be detected;

      b) such surveys should include a high degree of spatial coverage of fishing effort by gear type;

      c) such observer programmes shall have a high degree of spatial-temporal coverage in terms of annual effort by gear.

   iii. Present a plan of periodic review of the need for reporting shark/billfish species, including the calendar years when such periodic review should be undertaken.

Discussion

The Committee considered the above preliminary guidelines and agreed that these should be further developed and reviewed in 2020. Accordingly, the above guidelines were not adopted, and current reporting requirements shall continue.

21. Adoption of report and closure

The Chair thanked the SCRS for its hard work this year.

Dr Melvin thanked the Secretariat staff for their excellent work, as well as appreciating their professional attitude. Dr Melvin then expressed his appreciation towards the interpreters and to all participants.

The Report of the 2019 SCRS meeting was adopted and the 2019 meeting of the SCRS was adjourned.

Appendix 1

Opening address ICCAT Executive Secretary, Mr. Camille Jean Pierre Manel

SCRS Chair, SCRS Vice-Chair, welcome to office,
Ladies and gentlemen of the species groups,
Scientific delegates,
Partners,
Interpreters,
Colleagues,
Ladies and gentlemen,

Welcome. It is the second time that I have the honour and the privilege to be with you for this meeting of the ICCAT Standing Committee on Research and Statistics.

Once again, I have been able to appreciate, over the course of the year, and through the very heavy work schedule, the huge efforts that you make in providing advice to the Commission to support its decision-making. Moreover, the effects of the intensive workload, which has been constantly increasing, have been felt at the Secretariat.

Chair, through me, the Secretariat would like to sincerely thank the SCRS and express its full satisfaction for all the work done. I would also like to take this opportunity to appeal to the SCRS, as already noted last year, to find ways and means to ensure balance between SCRS requests and the human resources of the Secretariat; this would enable us to optimize our contribution. In this regard, there are some avenues that could potentially be explored such as reducing the number of meetings, submitting documents and data to the Secretariat by deadlines, and improving intersessional coordination within the different groups.

Ladies and gentlemen, despite the multiple constraints, there continue to be many expectations. However, I am convinced that any efforts made to address complex subjects such as management strategy evaluation, harvest control rules, ecosystem approach, improved data, among others, will enable us to respond appropriately to these expectations.

Chair, ladies and gentlemen, I would like, at this point, to congratulate and thank all the Secretariat staff for their expertise, dedication, availability and commitment to constantly improving their contribution to SCRS work.

I wish you every success in your work.

Thank you for your kind attention.

Appendix 2

Agenda

1. Opening of the meeting
2. Adoption of Agenda and arrangements for the meeting
3. Introduction of Contracting Party delegations
4. Introduction and admission of observers
5. Admission of scientific documents
6. Report of Secretariat activities in research and statistics
7. Review of national fisheries and research programmes
8. Reports of inter-sessional SCRS meetings
   - 8.1 Intersessional Meeting of the Bluefin Species Group
   - 8.2 Bluefin MSE Technical Group meetings
   - 8.3 Intersessional Meeting of the Swordfish Species Group
   - 8.4 Meeting of the ICCAT Working Group on Stock Assessment Methods
   - 8.5 Shortfin Mako Stock Assessment Update Meeting
   - 8.6 White Marlin Data Preparatory and Stock Assessment Meetings
   - 8.7 Yellowfin Data Preparatory and Stock Assessment Meetings
   - 8.8 Intersessional Meeting of the Small Tunas Species Group
9. Executive Summaries on species:

   YFT-Yellowfin, BET-Bigeye, SKJ-Skipjack, ALB-Albacore, BFT-Bluefin, BUM-Blue marlin, WHM-White marlin, SAI-Sailfish, SWO-Atl. Swordfish, SWO-Med. Swordfish, SMT-Small tunas, SHK-Sharks

10. Reports of Research Programmes
    - 10.1 Atlantic-Wide Research Programme for Bluefin Tuna (GBYP)
    - 10.2 Atlantic Ocean Tropical tuna Tagging Programme (AOTTP)
    - 10.3 Small Tunas Year Programme (SMTYP)
    - 10.4 Shark Research and Data Collection Programme (SRDCP)
    - 10.5 Enhanced Billfish Research Programme (EBRP)
    - 10.6 Other research activities
    - 10.7 Other activities
    - 10.8 Composition of Programmes Steering Committees
11. Report of the Sub-committee on Statistics
12. Report of the Sub-committee on Ecosystems and By-catch
13. Considerations of implications of the Intersessional Meeting of Panel 2
14. Considerations of implications of the Meeting of the Joint t-RFMO FAD Working Group
15. Progress related to work developed on MSE
    - 15.1 Work conducted for bluefin tuna
    - 15.2 Work conducted for northern albacore
    - 15.3 Work conducted for northern swordfish

15.4 Work conducted for tropical tunas

15.5 Roadmap for the ICCAT MSE processes

16. Report on the implementation of the Science Strategic Plan for 2015-2020 in 2019 and workplan for 2020, which includes the update of the stock assessment software catalogue

17. Consideration of plans for future activities

17.1 Annual workplans and research programmes

17.2 Intersessional meetings proposed for 2020

17.3 Date and place of the next meeting of the SCRS

18. General recommendations to the Commission

18.1 General recommendations to the Commission that have financial implications

18.2 Other general recommendations

19. Responses to Commission's requests

19.1 Refine the MSE for W-BFT and continue testing the candidate management procedures. Rec. 17-06, paragraph 16

19.2 Continue its MSE work for E-BFT, testing candidate management procedures, including harvest control rules (HCRs). Rec. 18-02, paragraph 13

19.3 Develop a new data collection initiative as part of the EPBR to overcome the data gap issues of those fisheries, in particular artisanal fisheries of developing CPCs. Rec. 18-04, paragraph 10

19.4 Updated assessment of the state of the Mediterranean swordfish stock on the basis of the most recent data available. Rec. 16-05, paragraph 45

19.5 Review the effectiveness of the measures contained in Rec. 17-08 and provide the Commission with additional scientific advice on conservation and management measures for North Atlantic shortfin mako. Rec. 17-08, paragraph 10

19.6 Provide with a summary of the scientific data and information collected and reported pursuant to Rec. 16-14 and any relevant associated findings. Recommend on how to improve the effectiveness of scientific observer programmes, including possible revisions to Rec. 16-14 and/or with respect to implementation of these minimum standards and protocols by CPCs. Rec. 16-14, paragraph 12 *c* and *d*

19.7 The SCRS will provide an update on the progress of the work on Ecosystem Based Fisheries Management in 2018 and report back to the Commission with available findings in 2019, if possible. Res. 16-23, paragraph 2

19.8 Review of annual catch rates by fleet segment and gear. Rec. 18-02, paragraph 18

19.9 The SCRS shall review and update the growth table published in 2009, and the growth rates utilized for farming the fish referred to under paragraph 35 c, and present those results to the 2020 Annual meeting of the Commission. Rec. 18-02, paragraph 28

19.10 Evaluate the efficacy of the area/time closure referred to in paragraph 13 for the reduction of catches of tropical tuna juveniles. Rec. 16-01, paragraph 15

19.11 Provide performance indicators for skipjack, bigeye and yellowfin tuna, with the perspective to develop management strategy evaluations for tropical tunas. Rec. 16-01, paragraph 49(b)

19.12 The SCRS shall evaluate the contribution of by-catches and discards to the overall catches in ICCAT tropical tuna fisheries, and advise the Commission on possible measures allowing to reduce discards and to mitigate onboard post-harvest losses and by-catch in ICCAT tropical tuna fisheries. Rec. 16-01, paragraph 53

19.13 Review the available information on fishing capacity and provide advice on adapting the fishing capacity in all its components (number of FADs, number of fishing vessels and support vessels) to achieve the management objectives for tropical tuna species. Rec. 16-01, Annex 8

19.14 Conduct another fishery impact assessment to evaluate the efficacy of these mitigation measures. Based on this fishery impact assessment, make appropriate recommendations, if necessary, to the Commission on any modifications. Rec. 11-09, paragraph 8

20. Other matters

20.1 Analysis of recommendations emanating from the Performance Review Panel and possible necessary actions

20.2 Collaboration with other International Organizations (ICES, CITES, GEF, etc.)

20.3 Update of the ICCAT glossary

20.4 Consideration of new publication guidelines: Executive summaries, SCRS report and Coll. Vol. Sci. Pap.

20.5 Peer review publication (SCRS documents)

20.6 Consideration of exemptions from reporting requirements SHK 7005 and BIL 5001

21. Adoption of report and closure

Appendix 3

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Appendix 4

List of 2019 SCRS Documents and Presentations

Reference	*Title*	*Authors*
SCRS/2019/001	Report of the intersessional meeting of the bluefin MSE Technical Group	Anonymous
SCRS/2019/002	Report of the intersessional meeting of the bluefin Species Group	Anonymous
SCRS/2019/003	Report of the swordfish Species Group intersessional meeting	Anonymous
SCRS/2019/004	Report of the white marlin stock assessment session	Anonymous
SCRS/2019/005	Report of the sub-committee on ecosystems intersessional meeting	Anonymous
SCRS/2019/006	Report of the working group on stock assessment methods	Anonymous
SCRS/2019/007	Report of the yellowfin tuna data preparatory session	Anonymous
SCRS/2019/008	Report of the shortfin mako stock assessment update meeting	Anonymous
SCRS/2019/009	Report of the white marlin stock assessment meeting	Anonymous
SCRS/2019/010	Report of the small tunas species group intersessional meeting	Anonymous
SCRS/2019/011	Report of the yellowfin tuna stock assessment session	Anonymous
SCRS/2019/012	Report of the second intersessional meeting of the bluefin MSE Technical Group	Anonymous
SCRS/2019/013	Report of the sub-committee on statistics meeting	Anonymous
SCRS/2019/014	Candidate management procedures for bluefin tuna	Hanke A.
SCRS/2019/015	Observation error model for tropical tuna fisheries in a management strategy evaluation framework	Urtizberea A., Merino G., García D., Korta M., Harford W., Die D., Walter J., Gaertner D., Santiago J., and Murua H.
SCRS/2019/016	Origin and age composition of Norwegian catch	Arrizabalaga H., Lastra P., Rodríguez-Ezpeleta N., Rodriguez-Marín E., Ruiz M., Ceballos E., Garibaldi F., and Nøttestad L.
SCRS/2019/017	Evaluation of an F0.1 management procedure using an alternative management strategy evaluation framework for Atlantic bluefin tuna	Morse M. R., Kerr L. A., and Cadrin S. X.
SCRS/2019/018	Application of "fixed proportion" candidate management procedures for North Atlantic bluefin tuna using operating model package version 4.2.15	Butterworth D. S., Miyagawa M., and Jacobs M. R. A.
SCRS/2019/019	Standardized catch rates for Mediterranean Swordfish (*Xiphias gladius*) from the Spanish longline fishery: 1988-2017	Saber S., Macías D., García S., Rioja P., Gómez-Vives M.J., and de Urbina J.O.
SCRS/2019/020	Preliminary development of a simple candidate management procedure using index of Japanese longline	Tsukahara Y., and Nakatsuka S.

SCRS/2019/021	Quantifying the impact on estimates of recruitment trends of previously unreported catches of age-0 bluefin tuna in the Mediterranean	Carruthers T., and Butterworth D. S.
SCRS/2019/022	A comparison of stock origin assignment methods	Hanke A. R., Busawon D., Puncher G., Hamilton L., Dettman D., and Pavey S.
SCRS/2019/023	Review and preliminary analysis of size samples of Mediterranean swordfish (*Xiphias gladius*)	Ortiz M., and Palma C.
SCRS/2019/024	Nouvelles données de distribution de fréquence de taille de l'espadon *Xiphias gladius* obtenues le long de la côte Algérienne	Kouadri Krim A., and Bouhadja A.
SCRS/2019/025	Length-weight relationship, monthly size distributions of length and weight for swordfish (*Xiphias gladius L.*) caught by longliners in the Tyrrhenian Sea	Pignalosa P., Pappalardo L., Gioacchini G., and Carnevali O.
SCRS/2019/026	Length-weight relationships and size distributions of Mediterranean swordfish (*Xiphias gladius L.*) caught by longliners in the Mediterranean Sea	Pignalosa P., Pappalardo L., Gioacchini G., and Carnevali O.
SCRS/2019/027	Females reproductive biology of Mediterranean swordfish (*Xiphias gladius L.*): New insights from a multidisciplinary study	Gioacchini G., Pappalardo L., Pignalosa P., and Carnevali O.
SCRS/2019/028	Report of the Third Intersessional Meeting of the Bluefin MSE Technical Group	Anonymous
SCRS/2019/029	At-sea tests of releasing sharks from the net of a tuna purse seiner in the Atlantic Ocean	Hutchinson, M., Justel-Rubio, A., and Restrepo, V.
SCRS/2019/030	An update of the Moroccan longline fishery targeting swordfish (*Xiphias gladius*) in the southern Atlantic coasts	Ikkiss A., Baibbat S.A., and Abid N.
SCRS/2019/031	Updated Swordfish (*Xiphias gladius*) fishery statistics collected from artisanal fishers in Côte d'Ivoire (1984 - 2012)	Bahaou L., Amandé M.J., Konan K.J., and Diaha N.C.
SCRS/2019/032	Final report of the ICCAT short-term contract: Modelling approaches: support to ICCAT North Atlantic swordfish MSE process	Kell L., and Levontin P.
SCRS/2019/033	Final report of the ICCAT short-term contract Modelling Approaches: Support to ICCAT Tropical Tunas MSE Process	Merino G., Urtizberea A., Garcia D., Santiago J., Murua H., Harford W., Walter Jr. III J., and Gaertner D.
SCRS/2019/034	Bayesian generalized linear models for standardization of white marlin (*Kajikia albida*) catch rates based on Brazilian sport fishing tournaments (1996-2017) in the southwestern Atlantic	Mourato B.L. Malavasi-Bruno E.; Dantas M. Hazin F., Pimenta E. and Amorim A. F.
SCRS/2019/035	Standardization of longline Catch-Per-Unit-Effort for white marlin (*Kajikia albida*) from Brazilian fleet (1978-2017)	Mourato B.L., Hazin F. and Amorim A.F.
SCRS/2019/036	Review and preliminary analyses of size samples of Atlantic white marlin (*Tetrapturus albidus*)	Ortiz M., and Palma C.
SCRS/2019/037	Japanese longline CPUE standardization (1976-2017) for Atlantic white marlin (*Kajikia albidus*) using zero-inflated generalized linear mixed model (GLMM)	Ijima H., and Honda H.

SCRS/2019/038	CPUE standardization for white marlin (*Kajikia albida*) caught in the Chinese Taipei distant-water longline fishery in the Atlantic	Su N.J., and Lu J.L.
SCRS/2019/039	White marlin (*Kajikia albida*) standardized indices of abundance from the U.S. recreational tournament fishery	Lauretta M.
SCRS/2019/040	Preliminary study and description of the Artisanal fishery of drifted gillnets of Côte d'Ivoire	Justin Konan K., Kouame Y.N., Diaha N.C. and Amande M.J.
SCRS/2019/041	Application of the DLM tool kit: small tunas case study	Mourato B., Pons M., Lucena-Frédou F., and Frédou T.
SCRS/2019/042	Progress in the standardization of direct ageing methodology of swordfish (*Xiphias gladius*) using anal fin rays	Quelle P., González F., Ruiz M., Gutiérrez O., Rodriguez-Marin E., and Mejuto J.
SCRS/2019/043	A potential indicator for non-retained sharks in support of an ICCAT ecosystem report card	Coelho R., Santos C., Rosa D., and Lino P.G.
SCRS/2019/044	Hook and bait type effects on surface pelagic longline catch rates: a meta-analysis for target, bycatch and vulnerable fauna interactions	Santos C.C., Rosa D., and Coelho R.
SCRS/2019/045	Global scores on Task I and Task II data availability by species and stock, for the major ICCAT managed species	Palma C., Mayor C., Taylor N.G., Schirripa M., and Diaz G.
SCRS/2019/046	Standardized yields of the white marlin (*Kajikia albida*) and the roundscale spearfish (*Tetrapturus georgii*) caught as by-catch of the Spanish surface longline fishery targeting swordfish (*Xiphias gladius*) in the Atlantic Ocean	Ramos-Cartelle A., Garcia-Cortes B., Fernandez-Costa J., and Mejuto J.
SCRS/2019/047	Update of scientific observations of white marlin (*Kajikia albida*) in the Spanish surface longline fishing fleet targeting swordfish in the Atlantic in the period 1993-2018	Garcia-Cortes B., Ramos-Cartelle A., Fernandez-Costa J., and Mejuto J.
SCRS/2019/048	Indicators of Orcinus orca Interactions with Pelagic Longline Gear and in the ICCAT Convention Area	Hanke A. and Domingo A.
SCRS/2019/049	Databases and Metadata for ICCAT National Observer Program Data Submissions 2015-2018: an Analysis of Coverage and Completeness	Taylor N.G., Mayor G., Gallego J.L., Palma C., and Ortiz, M.
SCRS/2019/050	Analytical possibilities and analytical limitations: assessing the suitability of 2015-2017 and 2018 ST09 forms to address ICCAT Commission Recommendations	Taylor N.G., Palma, C. and Ortiz M.
SCRS/2019/051	In support of the ICCAT Ecosystem report card: three ecosystem indicators to monitor the ecological impacts of purse seine fisheries in the tropical Atlantic ecoregion	Juan-Jorda M.J., Andonegi E., Murua H., Ruiz J., Lourdes R.M., Sabarros P., Abascal F., and Bach P.
SCRS/2019/052	Does ICCAT need ecosystem plans? A pilot ecosystem plan for the Atlantic Tropical Ecoregion	Juan-Jordá M.J., Murua H., Andonegi E., Baez Barrionuevo J.C., Abascal F., Coelho R., Todorovic S., Apostolaki P., Lynam C., Perez A.
SCRS/2019/053	Review of Studies on Catch Rates of Commercial and Bycatch Species by Hook Type Using in Pelagic Tuna Longline Fisheries	Okamoto K., Ochi D., Oshima K., and Minami H.

SCRS/2019/054	Machine Learning Approach to Estimate Species Composition of Unidentified Sea Turtles That Were Recorded on the Japanese Longline Observer Program	Okamoto K., Kanaiwa M., and Ochi D.
SCRS/2019/055	Toward Ecosystem-based Fisheries Management in the Sargasso Sea	Kell L., Luckhurst B.E., and Leach A.
SCRS/2019/056	At-sea Distribution and Fisheries Bycatch Risk of Juvenile Grey-headed Albatrosses from South Georgia (Islas Georgias del Sur)	Frankish C.K., Clay T., Small A., and Phillips C.
SCRS/2019/057	Progress on the Code of Good Practices on the tropical tuna purse seine fishery in the Atlantic Ocean	Grande M., Ruiz J., Murua H., Krug I., Arregi I., Goñi N., Murua J., Zudaire I., and Santiago J
SCRS/2019/058	Etat des lieux sur la situation des tortues marines en Algérie	Benounnas K., and Tifoura A.
SCRS/2019/059	Analytical approach for diagnostic of parameters estimation in management strategy evaluation	Mikhaylov A.
SCRS/2019/060	Comparison of yellowfin tuna CPUE and length composition between the Chinese Taipei and Japanese longline fisheries in the Atlantic Ocean	Matsumoto T., Satoh K., Kitakado T., Wang S., Su N., and Yeh Y.
SCRS/2019/061	Impact of a stock synthesis version update on the outputs of assessment for shortfin mako in the North Atlantic Ocean	Kai M., and Courtney D.
SCRS/2019/062	Proposal of use of the hindcasting approach for evaluating prediction skill of the stock assessment models	Kitakado T., Satoh K., Matsumoto T., and Yokoi H.
SCRS/2019/063	Exploration of length-based and catch-based data limited methods for small tunas	Pons M., Lucena-Frédou F., Frédou T., and Mourato B.
SCRS/2019/064	Review and preliminary analyses of size samples of Atlantic yellowfin tuna (*Thunnus albacares*)	Ortiz M., and Palma C.
SCRS/2019/065	AOTTP yellowfin tuna Tag-recapture data by numbers - an update	Beare D., Ailloud L., Garcia J., and Seynabou N.
SCRS/2019/066	Accounting for fishing days without set in the CPUE standardisation of yellowfin tuna in free schools for the EU purse seine fleet operating in the eastern Atlantic Ocean during the 1991-2018 period	Guéry L., Deslias C., Kaplan D., Marsac F., Abascal F., Pascual P., and Gaertner D.
SCRS/2019/067	Assessing the effectiveness of the current moratorium on dFADs using conventional tagging data from the AOTTP	Deledda-Tramoni G., and Gaertner D.
SCRS/2019/068	First estimate of tag-shedding for yellowfin tuna in the Atlantic Ocean from AOTTP data	Gaertner D. , Goni N. , Amande J., Pascual Alayon P., N'Gom F., Addi E., Conceicao I., da Silva G. B., Alves Bezerra N., Ferreira Muniz R., Niella Y., Wright S., Beare D., and Ailloud L.
SCRS/2019/069	First estimates of the reporting rate for recaptures of yellowfin, bigeye and skipjack tunas from tag-seeding experiments conducted during the AOTTP program	Akia S., Amande M., and Gaertner D.
SCRS/2019/070	Assessing the randomness of unreported recapture data for the Atlantic Ocean tropical tuna purse seine fishery	Norelli A. P.

SCRS/2019/071	Preliminary Results on AOTTP Validation Of Otolith Increment Deposition Rates In Yellowfin Tuna in the Atlantic	Ailloud L., Beare D., Farley J.H., and Krusic-Golub K.
SCRS/2019/072	Japanese longline CPUE for yellowfin tuna (*Thunnus albacares*) in the Atlantic Ocean standardized using GLM up to 2018	Yokoi H., Matsumoto T., and Satoh K.
SCRS/2019/073	Propose of stock assessment model specification of yellowfin tuna in the Atlantic Ocean	Yokoi H., and Satoh K.
SCRS/2019/074	Review of St. Helena yellowfin tuna (*Thunnus albacares*) tagging data	Wright S., Riley A., Stamford T., Beard A., Clingham E., Henry L., Thomas W., Caswell D., Madigan D., Schallert R., Castelton M., Righton D., Block B., and Collins M.
SCRS/2019/075	A novel index of abundance of juvenile yellowfin tuna in the Atlantic Ocean derived from echosounder buoys	Santiago J., Uranga J., Quincoces I., Orue B., Grande M., Murua H., Merino G., and Boyra G.
SCRS/2019/076	Estadística de las pesquerías españolas atuneras, en el Océano Atlántico tropical, período 1990 a 2018	Pascual-Alayón P., Rojo V., Amatcha H., Sow F.N, Ramos M.L., and Abascal F.J.
SCRS/2019/077	Statistics of the European and associated purse seine and baitboat fleets, in the Atlantic Ocean (1991-2018)	Pascual-Alayón P., Floch L., Gom F.N., Dewals P., Irié D, Amatcha A.H., and Amandè M-J.
SCRS/2019/078	Standardized catch rate in number and weight of yellowfin tuna (*Thunnus albacares*) from the United States pelagic longline fishery 1987-2018	Rios A.
SCRS/2019/079	Catch rate standardization for yellowfin tuna caught by the Bazilian pelagic longline fleet (1978-2016)	Sant´Ana R., Travassos P., and Hazin F.
SCRS/2019/080	Integrated modeling of growth for Atlantic yellowfin tuna	Walter J., Lang E., Falterman B., Pacicco A., Schirripa M., Brown C., Shuford R., Cass-Calay S., Sharma R., and Allman R.
SCRS/2019/081	Collaborative study of yellowfin tuna CPUE from multiple Atlantic Ocean longline fleets in 2019	Hoyle S.D., Lauretta M., Lee M.K., Matsumoto T., Sant'Ana R., and Yokoi H.
SCRS/2019/082	Example of a stock synthesis projection approach at alternative fixed Total Allowable Catch (TAC) limits implemented for three previously completed north Atlantic shortfin mako Stock Synthesis model runs	Courtney D., and Rice J.
SCRS/2019/083	Shortfin mako (*Isurus oxyrinchus*) fishery in the South of the Moroccan Atlantic waters	Baibbat S.A., Serghini M., Abid N., Ikkiss A., Joundoul S., and Houssa R.
SCRS/2019/084	Standardized catch per unit effort (CPUE) of shortfin mako (*Isurus oxyrinchus*) for the Moroccan longline fishery	Serghini M., Moustahfid H., Habiba H., Aziza L., Abid N., and Baibat S.
SCRS/2019/085	A comparison of the 2008, 2012 and 2017 assessments of the north Atlantic shortfin mako shark	Maguire J.-J., and Cortés E.
SCRS/2019/086	A SPiCT assessment of the North Atlantic shortfin mako shark	Maguire J.-J., and Berg C.W.

SCRS/2019/087	Preliminary estimates of population dynamics parameters of porbeagle shark in the western North Atlantic Ocean	Cortés E.
SCRS/2019/088	Examples of diagnostic methods implemented for previously completed North Atlantic Shortfin Mako Stock Synthesis model runs	Courtney D., Carvalho F., Winker H., and Kell L.
SCRS/2019/089	The effect of size regulations to protect immature North Atlantic shortfin mako	Kai M., Semba Y., Courtney D., and Rice J.
SCRS/2019/090	Updates on the habitat use and migrations patterns for shortfin mako in the Atlantic using satellite telemetry	Santos C.C., Domingo A., Carlson J., Natanson L., Travassos P., Macías D., Cortés E., Miller P., Hazin F., Mas F., Ortiz de Urbina J., and Coelho R.
SCRS/2019/091	Assessing the effects of hook, bait and leader type as potential mitigation measures to reduce bycatch and mortality rates of shortfin mako: a meta-analysis with comparisons for target, by-catch, and vulnerable fauna interactions	Rosa D., Santos C.C., and Coelho R.
SCRS/2019/092	Updated projections for the Bayesian Production model (BSP2JAGS) from the 2017 shortfin mako shark assessment	Babcock E.A., Cortes E., and O'Farrell H.
SCRS/2019/093	A rapid approach to approximate Kobe posteriors from Stock Synthesis assessment models with applications to north Atlantic shortfin mako	Winker H., Kell L., Fu D., Sharma R., Courtney D., Carvalho F., Schirripa M., and Walter J.
SCRS/2019/094	An overview of Namibian pelagic longline fishery for shortfin mako (*Isurus oxyrinchus*) in the southeast Atlantic Ocean	Jagger C.E., Kimoto A., and Frans E.
SCRS/2019/095	Summary of intersessional work completed with stock synthesis projections to evaluate a subset of the 2017 conservation measures recommended by ICCAT, related to tac and size limits, to reduce mortality for north Atlantic shortfin mako	Courtney D., Kai M., Semba Y., and Rice J.
SCRS/2019/096	Updates on post-release mortality of shortfin mako in the Atlantic using satellite telemetry	Miller P., Santos C.C., Carlson J., Natanson L., Cortes E., Mas F., Hazin F., Travassos P., Macias D., Ortiz de Urbina J., Coelho R., and Domingo A.
SCRS/2019/097	CPUE and hooking mortality of shortfin mako (*Isurus oxyrinchus*) caught by longliners in the southwestern Atlantic	Mas F., Forselledo R., Jimenez S, Miller P., and Domingo A.
SCRS/2019/098	Age-structured biomass dynamics of north Atlantic shortfin mako with implications for the interpretation of surplus production models	Winker H., Carvalho F., and Kerwath S.
SCRS/2019/099	Final report for the ICCAT short-term contract: swordfish biological samples collection for growth, reproduction and genetics studies	Gillespie K., and Hanke A.
SCRS/2019/100	Datos estadísticos de la pesquería de túnidos de las Islas Canarias durante el periodo 1975 a 2018	Delgado R.

SCRS/2019/101	Summary of intersessional work completed with the decision support tool to evaluate 2017 conservation measures recommended by ICCAT to reduce mortality for north Atlantic shortfin mako	Vaughan N., Babcock E. A., and Courtney D.
SCRS/2019/102	Stock synthesis projections at alternative fixed fishing mortality rates to evaluate the effect of live release for North Atlantic shortfin mako	Courtney D., Kai M., and Rice J.
SCRS/2019/103	Unifying parameterizations between age-structured and surplus production models: an application to Atlantic white marlin (*kajika albida*) with simulation testing	Winker H., Mourata B., and Chang Y.
SCRS/2019/104	Developing of Bayesian state-space surplus production model JABBA for assessing Atlantic white marlin (*Kajikia albida*) stock	Mourato B., Winker H., Carvalho F., Kimoto A. and Ortiz M.
SCRS/2019/105	Report for the Short-term contract FOR ICCAT SMTYP for the biological samples collection for growth, maturity and genetics studies	Viñas et al.
SCRS/2019/106	Survival and sex ratio of white marlin (*Kajikia albida*) caught in the Chinese Taipei longline fishery in the Atlantic Ocean	Su N.J., and Lu J.L.
SCRS/2019/107	Using effort control measures to implement catch capacity limits in ICCAT PS fisheries: an update	Sharma R., and Herrera M.
SCRS/2019/108	Estimation des paramètres de croissance de la thonine commune *Euthynnus alletteratus* (Rafinesque, 1810) capturée sur les côtes algériennes	Labidi-Neghli N., Neghli L., Ouadah S., and Nouar A.
SCRS/2019/109	Indices d'exploitation de la thonine commune *Euthynnus alletteratus* (Rafinesque, 1810) des côtes algériennes	Labidi-Neghli N., Neghli L., and Nouar A.
SCRS/2019/110	Current status of the white marlin (*Kajikia albida*) stock in the Atlantic Ocean 2019: predecisional stock assessement model	Schirripa M.
SCRS/2019/111	Macroscopic and microscopic maturity stages. living working document for small tuna species	Saber S., Lino P.G., Ciércoles C., Gómez-Vives M.J., Lechuga R., Godoy D., Ortiz de Urbina J., Coelho R., and Macías D.
SCRS/2019/112	Small tunas in the Atlantic Ocean: synthesis of knowledge	Lucena-Frédou F., Pons M., Frédou T., Soares A., and Mourato B.
SCRS/2019/113	Two species within little tunny (*Euthynnus alletteratus*) fishery	Ollé J., Vilà L., and Viñas J.
SCRS/2019/114	The wahoo *Acanthocybium solandri* (Cuvier, 1832) fishery in el Hierro island (Canary Islands, Spain) and biology in the East Atlantic Ocean	Pascual-Alayón P.J., Casañas-Machin I., Báez-Barrionuevo J.C., Ramos M.L., and Abascal F.J.
SCRS/2019/115	Stock assessment for Atlantic yellowfin using a biomass production model	Merino G., Murua H., Urtizberea A., Santiago J., Andonegi E., and Winker H.
SCRS/2019/116	Life history parameters for frigate tuna *Auxis thazard* in the northeast Atlantic	Petukhova N. G.
SCRS/2019/117	A length-based assessment for Atlantic bonito (*Sarda sarda*) exploited in the Moroccan Atlantic coast	Baibbat S.A., Pons M., Chattou E.M.A., Abid N., Bensbai J., and Houssa R.
SCRS/2019/118	Analise des captures des thonidés mineurs dans les eaux Tunisiennes	Hajjej G., Missaoui H., and Jarboui O.

SCRS/2019/119	Evolution de la stratégie de reproduction chez *Auxis rochei* (Risso, 1810) dans le Golfe de Guinée	Diaha N.C., Amandé M.J., Konan K.J., Bahou L., and Edoukou A.
SCRS/2019/120	Regional abundance indices of yellowfin tuna (*Thunnus albacares*) inferred from data based on the Chinese Taipei distant-water longline fishery in the Atlantic Ocean	Sung YF., Lin WR., Su NJ., and Lu YS.
SCRS/2019/121	Stock synthesis model for Atlantic yellowfin tuna	Walter J., Urtizberea A., Hiroki Y., Satoh K., Ortiz M., Kimoto K, and Matsumoto T.
SCRS/2019/122	Standardization of yellowfin tuna CPUE in the Atlantic Ocean by the Japanese longline fishery which includes cluster analysis	Matsumoto T., Yokoi H., and Hoyle S.
SCRS/2019/123	Standarized cath rates for yellowfin tuna (*Thunnus albacares*) from the Venezuelan pelagic longline fishery in the Caribbean Sea and adjacent waters of the western central Atlantic for the period of 1991-2018	Narvaez M., Alarcon J., Evaristo E., Gutierrez X., and Arocha F.
SCRS/2019/124	Estimation of Ghana Tasks I and II purse seine and baitboat catch 2012-2018: data input 2019 yellowfin stock assessment	Ortiz M., Palma C., Ayivi S., and Bannerman P.
SCRS/2019/125	Atlantic yellowfin tuna stock assessment: an implementation of Bayesian state-space surplus production model using JABBA	Sant'Ana R., Mourato B., Kimoto A., Walter J., and Winker H.
SCRS/2019/126	Engagement of U.S. stakeholders in management strategy evaluation of Atlantic bluefin tuna fisheries	Cadrin S.X., Kerr L.A., Weston A., and Golet W.
SCRS/2019/127	Performance of a F0.1 management procedure using alternative operating models	Weston A.E., Kerr L.A., Cadrin S.X., and Morse M.R.
SCRS/2019/128	Japanese longline catches of bluefin tuna in the Atlantic Ocean, 1950-1970	Schalit D.
SCRS/2019/129	Development of constant harvest rate and index-based candidate management procedures for Atlantic bluefin tuna using the ABT_MSE R package (ver 5.2.3)	Lauretta M., and Walter J.
SCRS/2019/130	Application of "Fixed Proportion" candidate management procedures for North Atlantic bluefin tuna using Operating Model package version 5.2.3	Butterworth D. S., Jacobs M. R. A., Rademeyer R. A., and Miyagawa M.
SCRS/2019/131	Master indices for initializing spatial, seasonal, multi-fleet, multi-stock models: alternative indices and sensitivities	Carruthers T.
SCRS/2019/132	Report of the ICCAT GBYP international workshop on Atlantic bluefin tuna growth	Rodríguez-Marín E., Quelle P., Addis P., Alemany F., Bellodi A., Busawon D., Carnevali O., Cort J.L., Di Natale A., Farley J., Garibaldi F., Karakulak S., Krusic-Golub K., Luque P.L., and Ruiz M.
SCRS/2019/133	Summary of input data (catch, size and indices) used in the Atlantic bluefin tuna Operating Models (version 5.2.3)	Kimoto A., Carruthers T., Walter J.F., Mayor C., Hanke A., Abid N., Arrizabalaga H., Rodríguez-Marín E., Palma C., and Ortiz M.
SCRS/2019/134	Spanish albacore (*Thunnus alalunga*) surface fishery in the Northeastern Atlantic, summary description in 2018	Ortiz de Zárate V., Quelle P., and Ruiz M.

SCRS/2019/135	Effects of ICCAT Rec [16-05] size regulation on the discards of the Spanish longline fishery targeting swordfish (*Xiphias gladius* Rafinesque, 1815) in the western Mediterranean	García S., Macías D., Saber S., Gómez M., RiojaP., and Ortiz de Urbina J.
SCRS/2019/136	2019 Update of Canadian fishery dependent indicators of relative bluefin tuna abundance	Hanke A.R.
SCRS/2019/137	Update to the fishery independent index of abundance for Gulf of Saint Lawrence Atlantic bluefin tuna	Minch T.
SCRS/2019/139	Performance of circle hooks in swordfish targeting longline fisheries in the Mediterranean	Tserpes G., Peristeraki P., Lazarakis G., and Skarvelis K.
SCRS/2019/140	Standardized catch rates of swordfish caught by the Greek surface longline fleet in the eastern Mediterranean	Tserpes G., and Peristeraki P.
SCRS/2019/141	Preliminary assessment of the Mediterranean swordfish stock by means of Bayesian surplus production models	Kolesidis D.A., and Tserpes G.
SCRS/2019/142	Length-weight relationships and a new length conversion factor for Atlantic bluefin tuna (*Thunnus thynnus* L.) caught in the Mediterranean Sea	Pignalosa P., Pappalardo L., Gioacchini G., and Carnevali O.
SCRS/2019/143	Length-weight relationships and a new conversion factor for Mediterranean swordfish (*Xiphias gladius L.*) caught by longliners in the Mediterranean Sea	Pignalosa P., Pappalardo L., Gioacchini G., and Carnevali O.
SCRS/2019/144	Evaluation of Atlantic bluefin tuna otolith ageing protocols	Busawon D.S., Addis P., Allman R., Bellodi A., Garibaldi F., Ishihara T., Karakulak S., Lastra-Luque P., Quelle P., and Rodriguez-Marin E.
SCRS/2019/145	Projections to create Kobe 2 strategy matrix using the multivariate log-normal approximation for Atlantic yellowfin tuna	Walter J., and Winker H.
SCRS/2019/146	Management strategy evaluation framework for North Atlantic swordfish	Hordyk A., and Carruthers T.
SCRS/2019/147	Techniques for validation of operating models	Hordyk A., and Carruthers T.
SCRS/2019/148	Methodology for the monitoring of fob and buoy use by French tropical tuna purse seiners in the Atlantic Ocean	Maufroy A., and Goujon M.
SCRS/2019/149	Aggregation processes of tuna under drifting fish aggregating devices (DFADs) assessed through fisher's echosounder buoy in the Atlantic Ocean	Baidai Y., Dagorn L., Amande M., Gaertner D., and Capello M.
SCRS/2019/150	Mapping tuna occurrence under drifting fish aggregating devices from fisher's echosounder buoys in Atlantic Ocean	Baidai Y., Dagorn L., Amande M., Gaertner D., and Capello M.
SCRS/2019/151	Update U.S. time series of shortfin mako shark commercial landings for 1981-2016	Diaz G.A., and Cortés E.
SCRS/2019/152	Revision of the U.S. commercial landings of king mackerel 2009-2017	Diaz G.A.
SCRS/2019/153	The Italian annotated bibliography on bluefin tuna (*Thunnus thynnus*, Linnaeus, 1758)	Di Natale A., Addis P., Garibaldi F., Piccinetti C., and Tinti F.

SCRS/2019/154	Atlantic bluefin tuna fisheries: temporal changes in the exploitation pattern, feasibility of sampling, factors that can influence our ability to understand spawning structure and dynamics	Di Natale A., Macias D., and Cort J.L.
SCRS/2019/155	Why there is still the bluefin tuna aerial spotting ban?	Di Natale A.
SCRS/2019/156	The Italian annotated bibliography on albacore (*Thunnus alalunga*, Bonnaterre, 1788)	Garibaldi F., Addis P., Di Natale A., Piccinetti C., and Tinti F.
SCRS/2019/157	The Italian annotated bibliography on swordfish (*Xiphias gladius*, Linnaeus, 1758)	Addis P., Di Natale A., Garibaldi F., Piccinetti C., and Tinti F.
SCRS/2019/159	The Italian annotated bibliography on Mediterranean spearfish (*Tetrapturus belone*, Rafinesque, 1810) and other billfish species	Tinti F., Addis P., Di Natale A., Garibaldi F., and Piccinetti C.
SCRS/2019/160	First estimates of the reporting rate for recaptures of yellowfin, bigeye and skipjack tunas from tag-seeding experiments conducted during the AOTTP program	Akia S., Amande M. and Gaertner D.
SCRS/2019/161	Update of the French aerial survey index of abundance for 2018	Rouyer T., Brisset B., and Fromentin J.-M.
SCRS/2019/162	Statistics of the French purse seine fishing fleet targeting tropical tunas in the Atlantic Ocean (1991-2018)	Floch L., Hervé A., Yala D., Guillou A., Depetris M., Duparc A., Lebranchu J., Kaplan D., and Bach P.
SCRS/2019/163	CPUE standardization of yellowfin tuna caught by Korean tuna longline fishery in the Atlantic Ocean, 1979-2018	Lee M.K., Kim d.N., Lee S.I., and Hoyle S.D.
SCRS/2019/164	Using effort control measures to implement catch capacity limits in ICCAT purse seine fisheries: an update	Sharma R., and Herrera M.
SCRS/2019/165	A case for fishery closures to manage purse seine fisheries for tropical tunas in the context of tuna Regional Fisheries Management Organisations	Herrera M.
SCRS/2019/166	Introducing a process to assess the contribution of purse seine fisheries to incidental catches of endangered, threatened and protected species in the area of competence of ICCAT	García-Horcajuelo A., Báez J.C., Herrera M., Justel A., Moniz I., Murua H., and Ruiz J.
SCRS/2019/167	Addressing recommendations of the peer review and amendments to the North Atlantic albacore MSE	Merino G., Santiago J., Andonegi E., Urtizberea A., and Arrizabalaga H.
SCRS/2019/168	The challenge to assign maturity stages: development of a histology-validated macroscopic criteria based on the GSI	Marisaldi L., Basili D., Candelma M., Sesani V., Pignalosa P., Gioacchini G., and Carnevali O.
SCRS/2019/169	Standardized catch rates of skipjack (*Katsuwonus pelamis Linnaeus*, 1758) from the Mediterranean Spanish recreational fishery (2006-2018)	Saber S., Macías D., Gómez-Vives M.J., and de Urbina J.O.
SCRS/2019/170	North Atlantic albacore Management Strategy Evaluation	Merino G., Kell L.T., Arrizabalaga H., and Santiago J.
SCRS/2019/171	Bluefin CPUE time series and catch at age of the Balfegó purse-seine fleet in the Balearic waters from 2003 to 2018	Gordoa A.

SCRS/2019/172	Tuna Ocean Restocking (TOR) Pilot study - Sea-based hatching and release of Atlantic bluefin tuna larvae – theory and practice	Bridges C.R., Nousdili D., Kranz-Finger S., Borutta F., Schulz S., Na'amnieh S., Vassallo-Agius R., Psaila M., and Ellul S.
SCRS/2019/173	Progress report of genetic stock structure of shortfin mako (*Isurus oxyrinchus*) in the Atlantic Ocean	Nohara K., Takeshima H., Noda S., Coelho R., Santos M.N., Cortés E., Domingo A., de Urbina J.O., and Semba Y.
SCRS/2019/174	Determining an appropriate mixing period for fish tagged in the AOTTP	Ailloud L.E.
SCRS/2019/175	Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP) in 2019: an update of progress towards targets	Ailloud L., Garcia J., Kebe S., Pastor R., and Beare D.
SCRS/2019/176	Does origin of catch affect the length-weight relationships and sex ratios of Atlantic bluefin tuna (*Thunnus thynnus*)?	Caria A., Bouilla N., and Deguara S.
SCRS/2019/177	Standardized joint CPUE index for bluefin tuna (*Thunnus thynnus*) caught by Moroccan and Portuguese traps for the period 2008-2018	Lino P.G., Abid N., Malouli M.I., and Coelho R.
SCRS/2019/178	Detecting the presence-absence of North Atlantic albacore tuna in automated analysis of medium-range sonars on fishing vessels	Uranga J., Arrizabalaga H., Hernandez M.C., Onandia I., Boyra G., and Santiago J.
SCRS/2019/179	From fishermen's to scientific tools: progress on the recovery and standardized processing of echosounder buoys data	Grande M., Capello M., Baidai Y., Uranga J., Boyra G., Quincoces I., Orue B., Ruiz J., Zudaire I., Murua H., Depetris M., Floch L., and Santiago J.
SCRS/2019/180	Report of the ICCAT GBYP workshop on Atlantic bluefin tuna reproductive biology	Anonymous
SCRS/2019/181	Preliminary results of the BIOFAD project: testing designs and identify options to mitigate impacts of drifting fish aggregating devices on the ecosystem	Zudaire I., TolottiM., Murua J., Capello M., Andrés M., Cabezas O., Krug I., Grande M., Arregui I., Uranga J., Goñi N., Sabarros P., Ferarios J.M., Ruiz J., Baidai Y., Ramos M.L., Báez J.C., Abascal F., Moreno G., Santiago J., Dagorn L., Arrizabalaga H., and Murua H.
SCRS/2019/182	Evolution de la pêcherie palangrière artisanale de l'espadon *Xiphias gladius* en Algérie	Krim A.K., and Bouhadja A.
SCRS/2019/183	Preliminary analysis of stereocamera and harvast data for the determination of growth in farmed Atlantic bluefin tuna (*Thunnus thynnus*) in Malta	Deguara, Camilleri T., and Gatt M.
SCRS/2019/184	Migration patterns of yellowfin, skipjack and bigeye tunas in the tropical Atlantic, based on recent tagging and recapture data	Arregui I., Goñi N., and Chifflet M.
SCRS/2019/185	Acoustic-based fishery-independent abundance index of juvenile bluefin tunas in the Bay of Biscay: results from the first five surveys	Goñi N., Uranga J., Arregui I., Onandia I., Martinez U., Boyra G., Melvin G.D., and Arrizabalaga H.
SCRS/2019/186	Review of the Croatian purse seine bluefin tuna fisheries - catch rates and specificities in the recent years (2015-2019)	Grubišić L., Katavić I., Maleš J., Vujević A., Petrina I.
SCRS/2019/187	Update of the United States longline index for bluefin tuna from the Gulf of Mexico	Walter J.F.

SCRS/2019/188	Evaluation of post-release mortality for porbeagle and shortfin mako sharks from the Canadian pelagic longline fishery	Bowlby H., Joyce W., Benoit H., and Sulikowski J.
SCRS/2019/189	Assess the species composition of major tropical tunas in catches of the purse seine fishery: a new modelling approach for the tropical tuna treatment processing	Duparc A., Aragno V., Depetris M., Floch L., Cauquil P., Lebranchu J., Daniel G., and Bach P.
SCRS/2019/190	Local market of the tropical purse seine fishery: update and perspective for its assessment in Abidjan	Duparc A., Amandé J., Lesage M., Cauquil P., Gaertner D., Pascual P., and Bach P.
SCRS/2019/191	Report of the 2019 ICCAT workshop on swordfish biology studies for growth, reproduction and genetics	Gillespie K., Coelho K., Farley J., Garibaldi F., Gioacchini G., Pappalardo L., Poisson F., Quelle P., Rosa D., and Saber S.
SCRS/2019/193	Preliminary results on the growth rate of bluefin tuna fattened in the Moroccan Atlantic waters during 2019	Abid N., Tamssouri N., Benziane M., Taleb S.A., and Faraj A.
SCRS/2019/194	Update of the Atlantic Canadian index of bluefin tuna relative abundance	Hanke A.R.
SCRS/2019/195	The standardized bluefin CPUE of Japanese longline fishery in the Atlantic up to 2019 fishing year	Tsukahara Y., and Nakatsuka S.
SCRS/2019/196	Illustration of a suggested simple approach for recommending Atlantic bluefin TACs for the 2021 season	Butterworth D.S., and Rademeyer R.A.
SCRS/2019/197	ICCAT Atlantic-Wide Research Programme for Bluefin tuna (GBYP) Activity report for Phase 8 and the first part of Phase 9 (2018-2019)	Alemany F., Tensek S., Pagá García A.
SCRS/2019/198	Notes on the design and implementation by GBYP of the broad study on bluefin growth in farms requested by the ICCAT Commission (Rec. 18-02, Paragraph 28)	Alemany F., Ortiz M., Palma C., Tensek S., Pagá García A., and Santos M.N.
SCRS/2019/199	Implementation of the GBYP Aerial surveys calibration and validation exercise	Vázquez Bonales J.A., Alemany F., Cañadas A., Tensek S, Pagá García A.
SCRS/2019/200	Revised time series of U.S. recreational landings 2014-2017	Cass-Calay S., and Diaz G.
SCRS/2019/201	Is the southern Bay of Biscay a spawning ground for *Thunnus thynnus* and *Sarda sarda*?	Rodriguez J.M., Johnstone C., and Lozano-Peral D.
SCRS/2019/202	External Review of Atlantic yellowfin tuna assessment in 2019	Methot R.
SCRS/2019/203	Raft methods for predicting indices of stock abundance of Atlantic bluefin tuna from assessment projections	Lauretta M. et al.
SCRS/2019/204	Bluefin tuna Working Group rules for the provision of indices in support of science advisory processes	Anonymous

SCRS/P/2019/001	Preliminary evaluation of a CMP for Atlantic bluefin using MSE	Merino G., Arrizabalaga H., Rouyer T., and Gordoa A.
SCRS/P/2019/002	Population structure and mixing: new information and analyses	Arrizabalaga H., Rodriguez-Ezpeleta N., Fraile I., Brophy D., Diaz-Arce N., Tsukahara Y., Richardson D., Varela J. L., Nøttestad L., Rodriguez-Marín E., Medina A., Hanke A., Abid N., and Lino P.

SCRS/P/2019/003	Constant exploitation rate candidate management procedures for Atlantic bluefin tuna	Walter J., and Lauretta M.
SCRS/P/2019/004	New information on the reproductive biology of swordfish in the Strait of Gibraltar	Abid N., Laglaoui A., Arakrak A. and Bakkali M.
SCRS/P/2019/005	Effects of Mediterranean swordfish size regulations on discards of Spanish longline fishery	García-Barcelona S., Ortiz de Urbina J.M., and Macías D.
SCRS/P/2019/006	Progress towards a swordfish species distribution model based on habitat: a work in progress	Schirripa M. J., Forrestal, F., and Goodyear, C. P.
SCRS/P/2019/007	Update on biological sampling of Atlantic and Mediterranean swordfish	Gillespie K., and Hanke A.
SCRS/P/2019/008	Swordfish depth and temperature utilization and summary of Cooperative Tagging Center data	Orbesen E.
SCRS/P/2019/009	Initial Surplus Production Model Priors For Atlantic White Marlin (*Kajikia albida*) With Limited Biological Information	Winker H., Mourato B., Sow F.N., and Ortiz M.
SCRS/P/2019/010	Modelling abundance indices of white marlin species and stock assessment	Ba K., and Ngom F.
SCRS/P/2019/011	White marlin (*Kajikia albida*) + spearfish (*Tetrapturus spp.*) standardized index of annual relative abundance U.S.A. pelagic longline observer program 1993-2017	Lauretta M.
SCRS/P/2019/012	Initial results for white marlin (*Kajikia albida*) stock assessment using the Catch-Resilience method CMSY	Mourato B., Winker H., Fambaye N.S, and Ortiz M.
SCRS/P/2019/013	Collection of biological samples for the study of growth of billfish in the eastern Atlantic	Diouf K., Diop K., Ba A., Ndiour Y., Sow F., Konan J.K. and Conceicao I.D.
SCRS/P/2019/014	Selecting ecosystem indicators for fisheries targeting highly migratory species. An EU project to advance the operationalization of the EAF in ICCAT. What have we learned?	Juan-Jorda, M.J., Murua, H., Apostolaki, P., Lynam, C., Perez Rodriguez, A., Baez Barrionuevo, Abascal, F., Coelho, R.
SCRS/P/2019/015	EFFDIS: A modelling approach to estimate overall Atlantic fishing effort by time area strata	Beare D.
SCRS/P/2019/016	Challenges to choose and adopt indicators for sea turtles on ICCAT Convention area	Giffoni, B., and Sales, G.
SCRS/P/2019/017	Progress towards a swordfish species distribution model based on habitat: a work in progress	Schirripa, M.J., Forrestal F., Goodyear C.P., and Abascal F.
SCRS/P/2019/018	List of fish species (excluding tuna) accessory caught by purse seine fleet in Tunisian waters	Hajjej, G., Missaoui, H., Jarboui, O.
SCRS/P/2019/019	Summary of North albacore MSE	Arrizabalaga H.
SCRS/P/2019/020	The Multivariate Normal (MVN) approach to capture uncertainty about the stock status within a two-dimensional Kobe-framework	Winker H.
SCRS/P/2019/021	Assessing the impact of fisheries on the sea turtle population in Liberia	Daniels R.
SCRS/P/2019/022	CMSY is not Catch-MSY: ICCAT assessment applications	Winker H., and Mourato B.

SCRS/P/2019/023	LBB: Length-Based Bayesian estimator	Winker H.
SCRS/P/2019/024	Effect of climate variability on catches of yellowfin tuna (T*hunnus albacares*) in the southwestern Atlantic Ocean	Forselledo R., Ortega L., Jiménez S., and Domingo A.
SCRS/P/2019/025	Age validation, growth, and mortality of yellowfin tuna (*Thunnus albacares*) from the U.S Gulf of Mexico and Atlantic	Pacicco A., Allman R., Andrews A., Lang E., Falterman B., Golet W., and Murie D.
SCRS/P/2019/026	Preliminary estimates of tag shedding and mortality from the AOTTP mark recapture data	Ailloud L., and Beare D.
SCRS/P/2019/027	A histological assessment of yellowfin tuna ovaries sampled in the U.S Gulf of Mexico and Atlantic from 2010-2017	Pacicco A., Allman R., and Murie D.
SCRS/P/2019/028	Preliminary results of abundance indices by size category of yellowfin tuna of Japanese longline fishery in the Atlantic Ocean	Satoh K., Kitakado T., and Matsumoto T.
SCRS/P/2019/029	Spatio-seasonal trajectory of tuna vessels in the West African area: case of Mauritania	Braham C.B., and Bamba D.A.
SCRS/P/2019/030	Descriptive statistics of the French purse seiner fleet targeting tropical tunas in the Atlantic Ocean (1991-2018)	Depetris M., Duparc A., Lebranchu J., and Floc'h L.
SCRS/P/2019/031	Regional boundaries for Atlantic yellowfin tuna CPUE	Hoyle S.
SCRS/P/2019/032	Overview of the yellowfin information by Korean tuna longline fishery in the Atlantic Ocean	Lee M.K.
SCRS/P/2019/033	Analysis of sexual maturity yellowfin tuna *Thunnus albacares* in the Gulf of Mexico	López R.K., and Wakida-Kusunoki A.T.
SCRS/P/2019/034	The pelagic longline fisheries from Vigo (Spain)	Biton-Porsmoguer S.
SCRS/P/2019/035	MVLN: A rapid approach for projections, too? Applications to North Atlantic shortfin mako	Winker H.
SCRS/P/2019/036	AOTTP: Preliminary observations on little tunny	AOTTP coordination
SCRS/P/2019/037	Age estimates of yellowfin tuna caught near Ascension Island	Downes K., Pacicco A., and Ailloud L.
SCRS/P/2019/038	Preliminary evaluation of a CMP for Atlantic bluefin using MSE (ver 5.2.3)	Merino G., Arrizabalaga H., Andonegi E., Rouyer T., and Gordoa A.
SCRS/P/2019/039	Catch, effort, size and weight of yellowfin tuna (*Thunnus albacares*) from the Venezuelan purse seine and baitboat fleets operating in the Caribbean Sea and the western central Atlantic	Narváez M., Alarcón J., Evaristo, E., Marcano J., and Arocha F.
SCRS/P/2019/040	Catch, size and sex distribution of dolphinfish (*Coryphaena hippurus*) and wahoo (*Acanthocybium solandri*) caught by longliners in the southwestern Atlantic Ocean	Forselledo R., Mas F., and Domingo A.
SCRS/P/2019/041	Population genetics of Atlantic bonito	Viñas J.
SCRS/P/2019/042	Age and growth of Small Tunas *Auxis rochei*, *Sarda sarda* and *Euthynnus alletteratus* from Portugal	Muñoz-Lechuga R., Coelho R., and Lino P.G.
SCRS/P/2019/043	Diagnostics for stock synthesis model SS3	Yokoi H., Satoh K., Walter J., and Matumoto T.

SCRS/P/2019/044	Performance of two empirical management procedures tested on ABT MSE version 5.2.3	Hanke A.R., and Atkinson T.
SCRS/P/2019/045	Report of activities April - July 2019 for Atlantic bluefin OMs	Carruthers T.
SCRS/P/2019/046	Designing and testing a multi-stock spatial management procedure for Atlantic bluefin tuna	Carruthers T.
SCRS/P/2019/047	Additional results of BFT OMs for v5.3.1	Carruthers T.
SCRS/P/2019/048	Model based CMPs using multi-model inference	Cox S.P., Johnson S.D.N., and Rossi S.P.
SCRS/P/2019/049	OM report for OM_1 and three CVs for the precision of the GOM Larval survey (v5.3.2)	Carruthers T.
SCRS/P/2019/050	Analysis of movement patterns of tropical tuna (SKJ, BET and YFT) between the Cote d'Ivoire and adjacent EEZ and the high sea	Akia S., Amandé J.M., and Gaertner D.
SCRS/P/2019/051	2019 Tagging campaign on a French purse seiner	Rouyer T., Bonhommeau S., Giordano N., Giordano F., Wendling B., Ellul S., Ellul G., Psaila M.A., Deguara S., Bernard S., and Kerzerho V.
SCRS/P/2019/052	Updated Standardized catch rates of albacore (*Thunnus alalonga,* Bonnaterre, 1788) for the Spanish surface longline fishery in the western Mediterranean (2009-2017)	García-Barcelona S., Saber S., Macías D., Gómez-Vives M.J., Rioja P., and de Urbina J.O.
SCRS/P/2019/053	Updated standardized catch rates of albacore (*Thunnus alalonga,* Bonnaterre, 1788) for the Spanish recreational fishery in the western Mediterranean (2005-2018)	Saber S., Macías D., García-Barcelona S., Meléndez M.J., Gómez-Vives M.J., Rioja P., Godoy D., Puerto M.A., and de Urbina J.O.
SCRS/P/2019/054	Update on the AOTTP ageing work and training workshops	Ailloud L., Diouf K., Beare D., Silva G., Sadia S., Ahissi V., Diaha C., Sow F., Ndiour Y., Sutrovic A., and Krusic-Golub K.
SCRS/P/2019/055	Updating the Balearic larval indices of bluefin tuna, advances in the integration of environmental variability and pelagic habitats in the calculation of abundance indices	Alvarez-Berastegui D., Martín M., Ingram W., Balbín R., and Reglero P.
SCRS/P/2019/056	Predicting bluefin tuna larval survival scenarios in the Western Mediterranean Sea, combining oceanographic models and rearing experiments	Reglero P., Balbín R., Abascal F.J., Medina A., Alvarez-Berastegui D., Rasmuson L., Mourre B., Saber S., Ortega A., Blanco E., Martin M., de la Gándara F., Alemany F.J., Ingram G.W., and Hidalgo M.
SCRS/P/2019/057	North Atlantic albacore pop-up tagging in the Canary Islands	Onandia I., Arregi I., Ortiz de Zarate V., Delgado de MolinaR., Santiago J., and Arrizabalaga H.
SCRS/P/2019/058	Variability in growth rate of yellowfin tuna (*Thunnus albacares*) from St Helena	Gutiérrez D.D., Wright S., and Grant A.
SCRS/P/2019/059	The ecology of yellowfin tuna around St Helena: an example of a resident population?	Wright S., Laptikovsky V., Griffiths C., Naulaerts J., Block B., Clingham E., Beare D., Bendall V., Righton D., Stamford T., Thomas W., Schallert R., Chapple T., Madigan D., Hobbs R., Henry L., Ailloud L., Garcia J., and Collins M.
SCRS/P/2019/060	Preliminary results of a Bayesian method for estimating vascularized rings in spines	Waterhouse L., and Hoenig J.M.

SCRS/P/2019/061	Summary of data inputs for age-growth study for skipjack, yellowfin, and bigeye tuna from AOTTP	Waterhouse L., and Hoenig J.M.
SCRS/P/2019/062	Progress on Operating Model Conditioning since St Andrews	Butterworth D., and Carruthers T.
SCRS/P/2019/063	Fisheries and biological data submitted during 2019: data deficiencies and recovery plans	Palma C., Mayor C., and Gallego J.
SCRS/P/2019/064	ICCAT coding system and ICCAT-DB development status	Palma C., and Mayor C.
SCRS/P/2019/065	Secretariat yearly based estimations (CATDIS, EFFDIS, CAS/CAA)	Palma C., Nathan T., and Beare D.
SCRS/P/2019/066	IOMS (Integrated Online Management System)	Mayor C., Maestre M., Sanz J., and Palma C.
SCRS/P/2019/067	Progress toward West Atlantic bluefin tuna close-Kin mark-recapture	Lauretta M., Walter J., Grewe P., Bravington M., Baylis S., Gosselin T., McDowell J., Hanke A., Busawon D., Davies C., and Porch C.
SCRS/P/2019/068	Albacore sampling gonads in Canary Islands	Ortiz de Zárate V., and Delgado de Molina R.
SCRS/P/2019/069	National Observer Program Database Importing, Form Modifications, Next Steps	Taylor, N., Palma, C., and Mayor, C.
SCRS/P/2019/070	Updated indices of Atlantic bluefin tuna abundance from U.S.A. fisheries in the West Atlantic	Lauretta M.
SCRS/P/2019/071	Draft methods for predicting indices of abundance of Atlantic bluefin tuna from VPA	Lauretta M., and Walter J.
SCRS/P/2019/072	Short-term contract for bluefin tuna growth in farms study	Lino P.G., Muñoz-Lechuga R., Nunes M., Poço A., Morikawa H., and Coelho R.
SCRS/P/2019/073	The blue shark project in southern Brazil	Cardoso L.G.
SCRS/P/2019/074	Short-term contract for ICCAT to continue the collection of biological samples for the study of growth of billfish in the Eastern Atlantic	Anonymous
SCRS/P/2019/075	Atlantic mako sharks: outline design for Close-Kin Mark-Recapture	Bravington M.
SCRS/P/2019/076	Tagging adult bluefin tuna in Skagerrak	Sundelöf A., Hellström G., Casini M., Cardinale M., Onandia I., Aerestrup K., Birney-Gauvin K., and MacKenzie B.
SCRS/P/2019/077	Synchronised acoustic and optical measurements of bluefin tuna: from cage monitoring and catch control, in the way to sonar biomass estimates	Espinosa V., Puig-Pons V., Pérez-Arjona I., Muñoz-Benavent P., Llorens S., Ordóñez P., Andreu-García G., Valiente-González J.M., Atienza-Vanacloig V., Ortega A., and de la Gándara F.

Appendix 5

Detailed specifications for 2020 BFT stock assessment advice

The Committee outlines the specifications for a strict update of the stock assessments conducted in 2017 for the provision of 2021 TAC advice. A strict update is to follow as closely as possible to the exact specifications of the 2017 advice models. In 2017, only VPA for BFT-East was used for the advice, and Stock Synthesis and VPA were for BFT-West equally weighted using the same biological assumptions (old/young spawning fraction at age).

Stock Assessment Model Specifications

The same model parameter settings (F-ratio) and variance scaling will be used for VPA and the same model structure will be used for Stock Synthesis. The BFT Species Group will also do standard diagnostic of models and if problems arise they will be dealt with appropriately. This gives the modelers the ability to handle problems/issues that can arise when things are changed. For continuity a model with data up to 2015 (mimic 2017 end date) and then up-to 2018 (new time).

Index specifications

Indices to be used for the update to advice for BFT to be conducted in 2020 are listed below, as well as a description of the indices that were updated at the BFT Species Group meeting in September 2019 which were used in the 2017 western and eastern BFT assessments. For the updated assessment to be conducted in 2020 the indices below should be used and, with only two exceptions, they are all available as of the 2019 BFT Species Group meeting.

- Several of indices will be slight revisions, some will be strict updates (as defined in Anon. 2019n).

- The same indices will be used in 2020 (in name) as those used in 2017 assessment:

BFT-West Assessment

- Accepted *revisions* to indices will be adding new years of data and new methods/data as presented at 2019 BFT Species Group meeting, and briefly described below:

  - SWNS/GSL CANRR: removed data first 7-yr of SWNS

  - US RR 66-114cm, 115-144cm, +177cm: updated data in time-series, standardization model also changed and now includes month and state improving temporal and spatial scale

- *Strict update* to indices, just years of data added:

  - JPNLL west: strict update to 2018 fishing year (up to 2019 fishing year was presented at SCRS but this final year will be removed for the 2020 stock assessment), split in 2009/2010

  - US GOM PLL: strict update to 2018

  - US GOM Larval: strict update to 2018

  - CAN Acoustic survey: strict update to 2018, however BFT SG discussed the large shift in 2018 and the treatment of this index in 2020. The decisions were made as follows:

    - The 2018 data-point will remain in the series

    - Canada will data-check the raw data and provide updated, correct value, by 15 January 2020 (previous time-series was done by another analyst)

- A 2019 data-point will also be ready by July 2020

    - Assessment will be run with and without 2018 value to see impact of this point

    - A new method for standardizing the index (Gillespie *et al*. 2019) will not be used at this time to maintain a strict continuity of the the survey index based on its original statistical design.

BFT-East Assessment

- Accepted *revisions* to indices will be adding new years of data and new methods/data as presented at 2019 BFT SG meeting, and briefly described below:

    - W-Med Larval survey: Revision recommended as presented at the BFT SG meeting in 2019

        - Data up to 2016 presented at 2019 BFT SG meeting, BFT SG will accept inclusion of 2017 without needing to review it, if provided by *15 January 2020*

        - New method:

            - Allows better fitting of presence and absence

            - Improved modeling of variance structure

    - MOR+POR traps: now uses daily catch per trap as it was considered a better reflection of relative abundance of the stock

- *Strict update* to indices, just years of data added:

    - JPNLL Northeast: strict update to 2018 fishing year (up to 2019 fishing year was presented at SCRS but this final year will be removed for the 2020 stock assessment), split in 2009/2010.

    - French Aerial strict update to 2018, split in 2008/2009

Catch at size data, size composition and age data

The BFT Species Group requests the Secretariat to process the catch-at-size data through 2017+2018 as soon as possible. The Secretariat has indicated these data will likely be available by *15 March 2020*.

- This would allow the analysts to begin working with the data and address data errors/issues, as this is an iterative process

- The BFT Species Group requests the same method for calculating the catch-at-size data be used as in 2017.

- For stock synthesis the age data (raw otolith and spine ages) will be required by *15 March 2020*

- Stock Synthesis size composition and fleet structure will be the same as in 2017

BFT-West Stock Synthesis:	*BFT-West VPA,* *same as Stock Synthesis except:*
US RR <145, 1980-1992	No US RR +177
US RR 195+, 1983-1992	No CAN combined indices
US RR 66-114, 1993-2018	No US GOM LL, 1987-1991
US RR 115-144, 1993-2018	
US RR +177, 1993-2018*	
CAN RR Combined CPUE, 1984-2018*	
JPN LL West, 1976-2009	
JPN LL West, 2010-2018	
JPN GOM LL, 1974-1981	
US GOM LL, 1992-2018	
US GOM larval survey, 1977-2018	
CAN acoustic survey, 1994-2018 (2018 value to be checked)*	
BFT- East VPA	
SPN BB, 1952-2006	French Aerial survey, 2000-2003
SPN-FRA BB, 2007-2014	French Aerial survey, 2009-2018
JPN LL East+Med, 1975-2009	West Med larval survey, 2001-2016 (2017 value to be provided by 15 March 2020)
JPN LL NE, 1990-2009	
JPN LL NE, 2010-2018	
SPN+MOR traps, 1981-2011	
MOR+POR traps, 2012-2018	

* Catchability linked to AMO.

Appendix 6

Report of the ICCAT Atlantic-wide research programme for bluefin tuna (ICCAT GBYP)

(Activity report for the last part of Phase 8 and the first part of Phase 9 (2018-2019))

1. Introduction

The ICCAT Atlantic-wide Research Programme for Bluefin Tuna (GBYP) was officially adopted by the SCRS and the ICCAT Commission in 2008, and it started officially at the end of 2009, with the objectives of improving a) basic data collection, including fishery independent data; b) understanding of key biological and ecological processes and c) assessment models and provision of scientific advice on stock status. It was initially envisaged as a 6 year programme, but in 2014 the Commission, acknowledging the importance of the programme for bluefin tuna management, endorsed the GBYP Steering Committee (2015) and the SCRS recommendations (Report of Special Research Programmes – GBYP contained in the *Report for Biennial Period 2014-15, Part I (2014) - Vol. 2*) for extending the GBYP activities up to 2021. Consequently, the donors have maintained their budgetary support (EU 80%, other donors 20%) since then, allowing for the continuity of the programme. The general information about GBYP activities and its results, as well as on budgetary and other administrative issues of the GBYP programme, from the very beginning of the programme until today, are available on the GBYP webpage. All the relevant documents related to the programme development, including final reports of every activity and derived scientific papers, Annual Reports to the SCRS and European Union, GBYP workshops or Steering Committee meetings reports, are also readily available on the GBYP webpage.

The eighth phase of the GBYP officially started on 21 February 2018 following the signature of the Grant Agreement for the co-financing of the GBYP Phase 8 (SI2.777629) by the European Commission and should have ended on 20 February 2019. However, in order to better address new research needs, and make optimal use of Phase 8 funds, the GBYP Phase 8 Grant Agreement was amended, extending Phase 8 until 20 September 2019. The activities carried out during the first six months of Phase 8 and their preliminary results were presented to the SCRS and the Commission in 2018 (Alemany *et al*., 2018) and approved. The ninth phase of the GBYP officially started, following an EU request, on 1 January 2019, after the signature of the Grant Agreement for co-financing of Phase 9 (SI2.777629) by the European Commission with a planned duration of one year. This implies that, for the first time, two GBYP phases have been developed in parallel, making a bit more complex the GBYP programme management, but this has not caused any major problem since each phase has a different and well defined workplan and budget, and every cost can be assigned unequivocally to the activities detailed in the respective Grant Agreements.

In general, in spite of some technical problems affecting a couple of specific activities within field surveys, all the activities planned within both phases have been or are being implemented successfully. The activities in both phases have continued to be structured considering the same main lines of research established since the beginning of the programme, i.e. data recovery, biological studies, tagging, aerial surveys and modelling, but this does not mean that the workplans of these last two phases mimic those of the previous ones. Thus, in line with the new strategic approach resulting from the global internal review of project performance carried out at the beginning of GBYP Phase 8 and presented to and approved by the SCRS at the 2018 SCRS meeting, new actions aiming mainly at improving and standardising the methodologies applied for generating data which are crucial for proper stock assessment have been developed during the extension of Phase 8 and the first months of Phase 9. Specifically, in order to reach the widest consensus among SCRS specialists on some controversial issues, three workshops involving representatives from most research teams working on the respective topics have been organized within this reporting period, one on BFT reproductive biology, another on BFT ageing and the last one on electronic tagging methodologies. In addition, several new actions focused on increasing the reliability of aerial survey indices, such as calibration exercises among spotters, feasibility studies for the application of acoustic techniques to the validation of aerial surveys and future development of new fishery independent indices, development of optimized sighting strategies and protocols and reanalysis of the whole aerial survey indices time series to correct some detected bias, have been implemented. It is also worth pointing out the broad study on BFT growth in farms that have been designed and implementation started during this last year by the GBYP in five different areas in order to address ICCAT Rec. 18-02, paragraph 28.

Both these new scientific activities and those initiated in previous phases carried out throughout the GBYP Phase 8 and those launched during the first part of Phase 9, as well their final or preliminary results and the related coordination activities, are described and summarised in this report. Moreover, it also includes a proposal of activities to be carried out within Phase 10, for consideration and eventual support of the SCRS.

2. Coordination activities and general issues of GBYP programme management

The GBYP Steering Committee in Phases 8 and 9 has been composed of the SCRS Chair, the Western Bluefin Tuna Rapporteur, the Eastern Bluefin Tuna Rapporteur, the ICCAT Executive Secretary and one external expert, who was contracted for this purpose at the beginning of Phase 8, and such contract has been renewed in Phase 9. Within this reporting period, the GBYP Coordination Team has been composed of the GBYP Coordinator, the Assistant Coordinator and the Database Specialist. The ICCAT Secretariat has provided technical and administrative support for all GBYP activities on a daily basis.

Three GBYP Steering Committee meetings have been held during the last year. The first (24 September 2018) was a short meeting centred on the review of Phase 8 ongoing tasks. The second (17-19 December 2018) was more extensive, focusing on the elaboration of the amendment proposal for the Phase 8 Grant Agreement, to adapt it to the latest recommendations from the SCRS and Commission, and to the refinement of the workplan for the planned activities in Phase 9. The last one, dedicated to the review of the results from the last Phase 8 activities and the Phase 9 ongoing activities, as well to the elaboration of an amendment proposal for the last part of Phase 9 and of the first draft of the Phase 10 workplan, was held on 23-24 September 2019.

The GBYP Steering Committee members have been constantly informed by the GBYP Coordination Team about the status of the activities through detailed reports provided on a monthly basis, and they are regularly consulted by e-mail on many issues.

The GBYP Coordination Team, with the advice of the GBYP Steering Committee and the direct help of ICCAT Secretariat staff, managed in Phase 8 a total of 5 calls for tenders and 10 official invitations that were released, and which resulted in a total of 21 contracts being awarded to various entities. In Phase 9, an additional 5 calls for tenders have been launched, and a total of 19 contracts have now been signed.

Moreover, within this reporting period, the GBYP Coordination Team has organized three international workshops, and funded and managed the participation of several members of the MSE Technical Groups in the four MSE related workshops held over the last year.

In addition, to improve the communication and coordination with different stakeholders, to seek potential synergies and to get first-hand information on logistic capabilities of private and public organisms relevant for future GBYP research activities, the GBYP Coordinator has participated in four international workshops and held, accompanied in most cases by ICCAT Secretariat staff and/or GBYP Steering Committee members, eight bilateral meetings. The most relevant activities and their results will be described in following chapters.

Other routine project management activities have been the actions related to GBYP Research Mortality Allowance (RMA), the Tag Awareness and Rewards Programme, and updating of the GBYP webpage. Details about the use of RMA and numbers of tags recovered, as well information about the Rewards Programme, are available in Alemany *et al*. 2019a.

2.1 Financial aspects

In Phase 8 the GBYP budget has had the following funders (in order of contribution already received or committed): European Union (Grant Agreement) €1,400,000.00, Kingdom of Morocco (donation according to quota) €66,898.53, Japan (donation according to quota) €59,139.54, Tunisia (donation according to quota) €54,883.78, Libya (donation according to quota) €46,942.83, Turkey (donation according to quota) €36,692.99, United States (donation) €32,220.77, Norway (donation) €19,195.00, Canada (donation) €18,976.53, ICCAT Secretariat €10,000.00, Egypt (donation according to quota) € 4,696.91, Korea (donation according to quota) €4,151.96, Chinese Taipei (donation) €3,000.00, Iceland (donation according to quota) €2,179.78, China (P.R.) (donation according to quota) €2,050.03. Thus, the total budget has been €1,750,000.00.

In Phase 9 the total budget has been the same, €1,750,000.00, thanks to the contributions from the following donors: European Union (Grant Agreement) €1,400,000.00, United States of America (donation) €165,330.24, Japan (donation according to quota) €56,060.18, Tunisia (donation according to quota) €52,886.96, Turkey (donation according to quota) €41,428.12, Libya (donation according to quota) €34,294.50, ICCAT Secretariat €10,000.00.

Further amounts were residuals of previous GBYP Phases and they were used to better balance the EU contribution and to compensate costs that were not covered by EU funding in various Phases. Additional eventual residuals from the amounts provided in Phase 9 will be used for the following Phases of GBYP. It should be noted that contributions for the current and previous GBYP Phases are still pending from some ICCAT CPCs.

The approved budget for Phase 8 and Phase 9 is summarised in the **Table 1**.

3. Summary of Phase 8 and Phase 9 GBYP activities and results by main line of research

3.1 Data recovery

The general objective of GBYP data recovery activities is to fill the many gaps existing in several data series currently present in the ICCAT databases, concerning both recent and historical catch or catch by size data, which causes a large amount of substitutions in the assessment process, increasing uncertainties. Such activities can include also the recovery of old or recent raw data on BFT ecology or biological parameters.

Three data recovery activities have been carried out during the last year, all of them within the GBYP Phase 8: a) recovery of old data on BFT catches in several Italian traps data, b) recovery of data on tuna catches from ICES reports and c) obtaining electronic tags datasets.

a) Ancient traps data recovery

The GBYP was informed that there might be a possibility of recovering some original data on bluefin tuna catches in Italian traps, directly from the owners' registers, and which have not been included in the ICCAT database so far. The recovered set of data consists specifically of daily and or annual catches from five Italian traps, covering different periods between the end of 19th century and the first half of 20 century and, in one case, between 1755 and 1900.

b) Recent catch data from ICES reports

Another potential set of data identified were the data on bluefin tuna catches contained in reports of ICES Bluefin Tuna Species Group, from the 1960s and the 1970s. It was recommended to recover these data at the Data Preparatory Meeting in 2017, because, apparently, they had never been reported to ICCAT. Copies of the reports were found in the ICCAT library, as part of Dr Rodriguez-Roda's personal library, and the GBYP database specialist has taken care in converting the data into electronic format compatible with the ICCAT database. The data set gathered contains information on a large number of bluefin tuna landings by different entities in the Atlantic and Mediterranean, from 1962 to 1978, including details on flag, geographical location, fishing gear and biological data (length and/or weight), by year, month or even week. More details are provided in Pagá García *et al*. 2018.

c) Recovery of electronic tags data

Two electronic tags data sets from different research institutions have been obtained within this period and included in the GBYP electronic tags database through ad hoc contracts. The first, generated by Dr Barbara Block's team and belonging to Stanford University, referred to 41 electronic tags deployed in 2016-2017 off Canada and in 2017 off Ireland, with a mean duration on fish of 190 days and including the raw data on light, temperature and depth, and the processed geolocations. The data have already been provided to the modelling expert, to be used for operating model and MSE purposes. The second data set was provided by Dr Molly Lutcavage (University of Massachusetts). This dataset, referring to 220 electronic tags deployed in the Western Atlantic from 2002 to 2009, had already been provided to the SCRS in aggregated form (number of days each tag spent in a certain MSE statistical area), but this new contract enabled acquiring of detailed processed data (track) and detailed raw sensor data.

3.2 Aerial Survey on Bluefin Tuna Spawning Aggregations

The GBYP Aerial Survey on Bluefin Spawning Aggregations was initially identified by the Commission as one of the three main research objectives of the programme, in order to provide fishery-independent trends on the minimum SSB. However, due to different reasons, this activity has not been developed regularly and has not followed homogenous methodologies and sampling strategies throughout the successive GBYP Phases (see previous GBYP annual reports and GBYP aerial surveys final reports). Fortunately, in 2015, 2017 and 2018 (the surveys were cancelled in 2016), GBYP aerial surveys were developed following the same standardized methodology. However, in spite of that, no clear patterns in weight and/or abundance among years and areas have been discerned yet, except maybe in the case of the Balearic Sea area. Moreover, the Coefficient of Variation of the indices remains very high, above the commonly accepted levels. Thus, an in depth internal review of the available reports from the whole time series has been carried out within Phase 8, detecting some potential sources of bias, and concluding that there was still room for further methodological improvements. Thus, in addition to the regular aerial surveys, during the last part of Phase 8 and the ongoing Phase 9, several activities aiming at improving the accuracy of the currently available aerial survey indices time series and optimizing as much as possible the sampling strategy and sighting methodology in the next surveys, have been implemented. Specifically, these actions have consisted in:

a) elaboration of improved aerial survey strategies and sighting protocols
b) design and implementation of an aerial survey professional spotters calibration exercise
c) feasibility study to explore the use of acoustic techniques to validate aerial survey observations
d) re-analysis of the whole aerial survey indices time series

The final reports of all these activities will be available through the GBYP web page, and the results of the calibration exercise have been also presented in Vázquez Bonales *et al*. 2019.

Regarding the regular aerial surveys, in Phase 8 it was carried out on the same four preferential spawning areas already defined in the previous Phases, using the same design and methodology as in 2017. There were a total of 87 sightings of bluefin tuna, from which 79 could be used for fitting the detection function and 67 that were used later for determining the abundance. The results indicate that there was a real increase of bluefin tuna in area A in respect to the previous five years, continuing the increasing trend already observed in 2017, whereas areas C and E were rather similar to previous years. In contrast, in Area G an important decrease was observed of 80% in total weight and 68.5% in abundance compared to the mean for 2010-2017. Detailed results were presented in Vázquez Bonales *et al*. 2018.

The aerial surveys in Phase 9 were carried out also on the same 4 preferential spawning areas already defined in the previous Phases, from 28 May to 29 June 2019, using the same design and methodology as in 2017, except for the change in the delimitation of Area A introduced for getting a better match between spawners distribution and surveyed area, as well as for optimizing observation time and hence reducing costs. In general, the surveys were successful, although there were some minor problems due to unfavorable weather conditions and also an unexpected restriction of the air space applied by Malta, which for the first time did not give permission to carry out the scientific aerial survey within the 25 nautical miles of the fishing protection area. In spite of the fact that the new protocols were not yet available, during the training course special attention was paid to prevent potential sources of bias, introducing some of the improvements that will be introduced in the new protocols, such as making clear distinctions between juveniles and adult schools, correct use of declinometers and maximum time to dedicate to the recording of non-target species. For the first time the data analysis for the calculation of the aerial survey index, which is still ongoing, has been carried out filtering out the sightings of juvenile fish. However, to allow a more complete comparative analysis between the currently available time series and that resulting from the ongoing re-analysis, such analysis has been also carried out including all the sightings. Final results will be available shortly through the GBYP webpage, and also reported to the next relevant BFT SCRS meetings.

3.3 Tagging activity

This line of research has faced two important problems from the very beginning of the GBYP tagging program in Phase 2, which have prevented or limited the full achievement of the main objectives, it is the estimation of the natural mortality rates (M) of bluefin tuna populations by age or age-groups and the evaluation of habitat utilization and large-scale movement patterns (spatio-temporal,), including estimates of mixing rates between stock units by area and time strata, of both juveniles and spawners.

One is the very low recovery rate of conventional tags, which impeded the use of these data to estimate reliable mortality rates. Due to this, the GBYP SC decided to cancel the conventional tagging programme in Phase 4 and focus on electronic tagging instead, maintaining only complementary conventional tagging activities by providing tags and tagging equipment to different institutions or organizations, as well as maintaining the awareness and reward campaigns and the database, integrating all the results from recovered tags. The second major problem has been the relatively short time that most of the electronic pop up tags have remained on fish. The premature releases are attributable to different factors, such as, technological problems of the tags, fishing activities, death of the fish after tagging and, in general, probably the use of equipment and tagging methodologies which are not fully adequate for bluefin tuna.

These potential problems have been addressed in Phases 8 and 9 by improving the equipment, using a new model of MiniPat satellite tag designed to minimize "pin broke" problems, and reinforced tethers, similar to those currently used by the Stanford University BFT tagging team. Moreover, an ad hoc workshop focused on e-tagging methodologies, including practical tagging sessions in the field, was held in July 2019, which was attended by 25 experts representing all the teams that have been involved in GBYP electronic tagging activities in the past. The final report of the workshop, including a new GBYP tagging protocol agreed among the participants and an in depth analysis of the performance of different e-tags deployment methods, based on a database which is currently being elaborated from detailed data provided by the participants, will soon be available on the GBYP web page and the main results reported to the next relevant SCRS meetings.

Regarding electronic tags deployment, in both Phase 8 and 9 the main specific objective of GBYP tagging programme was, considering the current needs of the MSE modelling process, to improve the estimations of the degree of mixing of western and eastern bluefin tuna stocks in the different statistical areas and throughout the year. To this end, the Steering Committee decided to concentrate tagging activities in the North Sea and/or Celtic Sea and in Southern Portugal area. Thus, in Phase 8 one contract was awarded to TUNIPEX for deploying 30 satellite tags in Portuguese traps, a second contract was awarded to the Marine Institute of Ireland for deploying 10 satellite tags in the Celtic area and, finally, a Memorandum of Understanding was signed between ICCAT GBYP and the Institute of Marine Research of Norway, for deploying 20 tags in the Norwegian Sea.

In order to get precise information on the performance of different tagging methods the tagging operations in Southern Portugal traps were carried out using two methods, underwater tagging by experienced divers directly underwater using a long pole (10 fish) and onboard a vessel by IPMA scientific staff (20 fish). Preliminary results show that all the tags deployed by scuba divers popped off shortly after tagging, and that most of those deployed on board also popped off soon after, but some tags remained for longer times, suggesting that underwater tagging on free swimming fishes is not a good method for deploying e-tags on BFT, and that on board tagging does not guarantee by itself tagging success. Within the tagging campaigns in the Celtic Seas 24 tags were deployed (10 provided by GBYP and 14 by the Marine Institute). In this case, all fish were captured using angling methods and tagged on board a vessel equipped with transom doors, and the miniPATs were attached using titanium darts and tethers similar to those used by Stanford University within the Tag a Giant program, as well as retention loops. The results have been very good, since most of these tags have remained on the fish for long times, even some of them are still on the fish and probably will pop off when programmed, after one complete year cycle, which had only happened twice in the GBYP tagging programme, suggesting that the use of adequate equipment is also a key factor for the success of e-tagging operations. Because of bad weather only 2 bluefin tuna were tagged in Norway, and the remaining 18 tags were returned to the GBYP.

The GBYP e-tagging surveys in Phase 9 have been developed taking into account the results from phase 8 and the conclusions of the aforementioned workshop. Therefore, all the tags have been equipped with reinforced tethers and titanium darts manufactured by Dr Barbara Block's team and tagged on board using retention loops. Ten tags were deployed on fishes from TUNIPEX trap in Southern Portugal, during the practical sessions within the workshop, and another 30 tags have been successfully deployed by the Marine Institute from Ireland (15) and the Technical University of Denmark (DTU) (15), in the Celtic Sea and Skagerrak, respectively.

It is worth mentioning that besides these activities carried out under formal GBYP contracts or agreements, GBYP has supported e-tagging activities carried out independently by other institutions (SLU, CEFAS, Exeter University, WWF), by allowing the use of GBYP RMA in case of BFT casualties during tagging operations and the use of GBYP Argos system account for data transmission, with the condition that relevant information obtained from these tags will be shared with GBYP.

Other activity within this line of study in Phase 8 was the development of a new Shiny application for visualization of multiple tracks on the interactive map, including filtering and grouping according to several criteria. More details on this activity were presented in the scientific paper Tensek, 2018. In addition, a preliminary analysis of bluefin tuna depth and temperature preferences revealed by electronic tags was also carried out (Tensek *et al*., 2018).

As regards conventional tagging, the GBYP programme has been maintained as a complementary activity, providing logistical support to several institutions. In Phase 8, a total of 945 tags were deployed on 904 bluefin tuna individuals. Detailed information about these deployments is available in Alemany *et al*. 2019b.

The GBYP tag awareness and reward policy has also been maintained as in previous phases. As a result, the impressive improvement in the recovery rates detected from the beginning of the GBYP programme (from 0.88 tags per year to an average of 88.21 tags per year) has been maintained. Thus, in the years 2018 and 2019 (up to 1 September) a total of 76 and 50 tags were recovered respectively. These are slightly fewer than in previous years, but this can probably be attributed to the fact that, on recommendation of the Steering Committee, from 2014 onwards the GBYP massive conventional tagging programme was cancelled, and hence the number of deployed conventional tags has decreased. It should be stressed that, in the last couple of years, for the first time in ICCAT bluefin tuna tagging activities, the number of tags recovered and reported from the Mediterranean Sea is higher than any other area. Considering that reported tags from the Mediterranean were almost nil before the GBYP, this is the clear evidence that GBYP tag awareness campaign is producing positive effects.

As for the study of conventional tags shedding rate, tags were recovered from 254 double tagged fish (up to 1 September 2019). According to the results it seems that both types of tags (single barb and double barb) are more or less equally resistant, with slightly better resilience for double barb.

3.4 Biological studies

The GBYP biological sampling and analysis programme covering the main bluefin fisheries and including a series of studies based on the analysis of the available samples, as ageing studies and microchemical and genetics analyses to investigate mixing and population structure, aiming at guaranteeing the availability of key information for BFT stock assessment, has been maintained throughout this reporting period. Bluefin tuna biological samples are stored in the GBYP Tissue Bank, which is maintained by AZTI. The information on available samples can be obtained through an interactive web application, specially designed for that purpose at https://aztigps.shinyapps.io/bluefin/. Moreover, given that in spite of the huge research efforts dedicated to determine some crucial biological parameters, such as those related with reproductive biology and growth, some controversies remain, making it difficult to decide on the set of biological parameters that must be used for stock assessment. The GBYP has organized two ad hoc workshops on these issues, aiming at improving and standardizing the methodologies used for determining such parameters and to reach wider consensus about the values that should be considered for stock assessment. In addition, as a result of ICCAT Rec. 18-02, paragraph 28, the GBYP has designed and started to implement a broad study on BFT growth in farms.

3.4.1 Biological sampling and analysis

As done in previous GBYP phases, both in Phase 8 and Phase 9, calls for tenders have been issued for maintenance and management of the ICCAT GBYP Tissue Bank, collecting tissue samples and otoliths and performing analyses - both microchemistry analyses of otoliths and genetic analyses of tissue samples. Two contracts were awarded for carrying out the biological studies in Phase 8, one with the Consortium led by AZTI for both sampling and biological analysis, including microchemical and genetic ones, and the other contract was signed with the University of Bologna – BiGeA - for sampling in Italian waters, whereas in Phase 9 only one proposal was awarded, which was submitted by the Consortium led by AZTI.

This sampling and analyses have aimed primarily at contributing to knowledge on population structure and mixing, aiming to provide accurate information and clear alternative hypotheses to the MSE process. In this line, in Phase 9 one of the most important uncertainties to resolve is related to the understanding of the implications of the new spawning grounds in the Atlantic Ocean (Slope Sea, Bay of Biscay).

In addition, to ensure the availability of biological samples from adult bluefin tuna representative of the whole population, enough to elaborate reliable ALK or carry out in the future "close kin" studies, calls for tenders to carry out sampling of adults in BFT farms have been launched both in Phase 8 and 9. The awarded companies have been the same in both years, AquaBioTech, from Malta, for providing samples from the Southern Tyrrhenian Sea and the Central/Southern Mediterranean Sea, and Taxon, from Spain, for providing samples from specimens fished in the Balearic Sea. Further biological samples have been provided to the GBYP tissue bank from ROP and tagging teams.

It must be pointed out that the GBYP sampling has been done independently from other routine sampling activities for fisheries and fishery resources monitoring (e.g. the Data Collection Framework), according to the GBYP Biological sampling protocol and following the GBYP sampling strata. However, looking for synergies and to prevent any duplication of efforts between the GBYP and EU DFC sampling, and hence to optimize available resources, in Phase 9, a close collaboration with the EU Regional Coordination Group on Large Pelagics has started, including as a first step the sharing of detailed information about the respective sampling schemes.

In relation to ageing analysis, the Australian company Fish Ageing Services, has been awarded with a contract to prepare (Phase 8) and proceed with the reading (Phase 9) of a set of 2000 otoliths from the GBYP tissue bank.

The main specific activities carried out over the last year in relation to biological sampling and analysis of biological samples are detailed in Alemany *et al*. 2019a. The most relevant results are summarized below:

a) Biological sampling

In Phase 8 the Consortium headed by AZTI obtained young of the year and large fish from potential mixing areas in the Atlantic, whereas UNIBO provided juvenile and adult samples from Italian waters. The sampling in farms completed the sampling of adults in the Western and Central Mediterranean. Including the samples from ROP and tagging operations, a total of samples from 2706 individuals (1826 pairs of otoliths, 495 spines and 2694 muscle/fin samples for genetics) were submitted to AZTI to be included in the GBYP tissue bank. In Phase 9 the sampling activity is following the same general scheme as in Phase 8, focusing on sampling in mixing areas. A task to gather biological material (BFT larvae from the Balearics) that can be used in future close-kin analyses has also been included. As regards sampling large individuals for constructing the age length key, which was one of the priorities identified by the Bluefin Species Group, it was decided to focus the effort of the Consortium on collecting hard parts from the individuals from the Atlantic Ocean, while the sampling of individuals in the Mediterranean will be carried out mainly through the contracts for sampling adults in the farms. It should be mentioned that these sampling tasks in the future should be mostly achieved through national sampling programs, such as the EU Data Collection Framework.

b) Biological analyses

In Phase 8, new carbon and oxygen stable isotope analyses that were carried out on 256 otoliths of Atlantic bluefin tuna captured in the Central North Atlantic, indicated that these samples were dominated by eastern origin individuals. The comparative analysis with previous Phases suggests that important interannual variations in the mixing proportions can be observed in this area, which warrants year to year monitoring.

Previous genetic analyses supported the presence of two populations of Atlantic bluefin tuna, but a new study suggested the presence of a third spawning ground within the Slope Sea and controversy existed about the origin of the larvae and young of the year found in this area. The presence of a new spawning ground called for the development of a new traceability panel taking a potential "third stock" into account. Therefore, in Phase 8, population genetic analyses were performed based on about 10,000 SNPs and 400 reference samples from the Gulf of Mexico, the Slope Sea and the Mediterranean, and have determined genetic origin of over 1,000 individuals from feeding aggregates based on 96 SNPs that discriminate between the Gulf of Mexico and the Mediterranean Sea. These analyses confirmed the genetic differentiation of the Gulf of Mexico and Mediterranean Sea; yet, they also showed that Mediterranean-like individuals are found in the Gulf of Mexico and that the Slope Sea constitutes a genetically intermediate population. This demonstrates that Atlantic bluefin tuna presents more complex population dynamics than previously thought and calls for additional analyses to determine how genetic differentiation between the two components is maintained and how the "intermediary" population in the Slope Sea is originated. Concerning the origin of the feeding aggregates, the analyses confirmed that samples collected at eastern locations are mostly of Mediterranean origin, and also suggested a larger proportion of Mediterranean origin fish in western locations. A specific objective was to conduct age and genetic analyses on the Norwegian bluefin tuna. Thus, a total of 446 individuals were genetically analysed, showing that they are predominantly from Mediterranean origin.

In relation to genetic analysis, it is worth pointing out that given the success of the close kin study on western bluefin tuna and some new methodological improvements in this field, the GBYP Steering Committee reviewed the new information available on this topic at the meeting held in December 2018. The main conclusion was that it would be recommendable to re-evaluate in-depth the possibility of resuming the studies in the eastern part as well. Thus, in Phase 8 some preparatory work has been initiated, such as the intensive sampling of adults and larvae in the Mediterranean Sea, which would allow such studies to be carried out in the near future.

Integrated genetic/microchemical analysis analyses were also carried out to assign bluefin from potential mixing zones in the Atlantic (N=306). The classification accuracy of the integrated model (97.3%) exceeded that reported in this or previous studies using stable isotopes or genetics.

In Phase 9, both genetic and microchemical analyses are being carrying out on the same sample in order to improve the mixing proportions accuracy. Also, a specific study on YOY in the Mediterranean will continue in order to discriminate their nursery areas, by means of analysis of trace elements and stable isotopes. It is also planned to perform the genetic analysis (RAD-seq) of more than 500 bluefin tuna individuals captured in the Slope Sea, including larvae, in order to determine the contribution of the Mediterranean and Gulf of Mexico population to the Slope Sea population. In addition, high resolution stable isotope analysis will be performed in order to identify resident and migratory contingents within the Mediterranean population.

Regarding ageing related activities, to ensure that the ALKs provided by the GBYP were elaborated following the best standard methodologies approved by the SCRS, they were postponed until the calibration exercise carried out by SCRS experts in 2018 would be concluded. Finally, the results of the aforementioned international calibration exercise were presented at 2018 SCRS BFT Species Group meeting, as in Rodriguez-Marín *et al*. 2018a. This exercise also provided an improved protocol for BFT otoliths interpretation (Rodriguez-Marín *et al*., 2018b). Nevertheless, the SCRS BFT ageing specialists group involved in this calibration exercise recognized that age estimations for younger ages still remain uncertain and recommended to hold an ad hoc workshop, whose results are summarized in the next point. Finally, two contracts were signed with Fish Ageing Services (FAS), the first under Phase 8 to prepare the selected set of 2000 otoliths and the second one under Phase 9 to proceed with the interpretation of these otoliths, following in both cases the protocols agreed within the aforementioned workshop. In addition, in Phase 9 it is envisaged to realize a calibration of the 2000 otolith age estimates provided by Fish Ageing Services (FAS) in Phase 7 and create an otolith reference collection. As a result of all these activities, GBYP will provide for the next BFT stock assessment a new ALK based on the reading of 4000 otoliths from the eastern stock sampled along the last years.

3.4.2 Workshops on biological parameters

In order to address some controversies about key biological parameters and aiming to build up wide consensus among specialists in each field on the most reliable methodologies and set of parameters to be used in BFT stock assessments, the GBYP has organized and funded two workshops on BFT biological issues, one on reproductive biology and another on ageing methodologies based on otolith analysis. The first was held in November 2018, involving 7 experts who gave presentations and discussed various topics, including discrepancies in eastern/western reproductive parameters, reproductive physiology, reproduction in captivity, larval ecology, spawning habitat modelling, life history, effects of fisheries practices on sampling and implications for MSE and assessment. The report of this workshop is included in Anon. 2019o. In order to elaborate a reference document for guiding the discussions during the workshop, two independent experts, Dr Jessica Farley (CSIRO, Australia) and Dr Seiji Ohshimo (Seikai National Fisheries Research

Institute, Japan) were contracted in Phase 8. Such report was presented in the 2018 SCRS meeting (Farley and Oshimo, 2018). The BFT ageing workshop was held in February 2019 with the participation of 14 SCRS experts in Atlantic BFT growth and representatives of the Australian company FAS. The results of the workshop, which can be considered highly satisfactory since new improved protocols both for otoliths mounting and interpretation were agreed among participants, who in addition agreed to carry out further calibration exercises and elaborate a reference otolith collection, are presented in Rodriguez-Marín *et al*. 2019.

3.4.3 Study on BFT growth in farms

During the 21st Special Meeting of the Commission, the SCRS was asked to provide an update on the potential growth rates of bluefin tuna in farming/fattening facilities, with the aim of improving coherence within the growth rates derived from eBCD, as stipulated in paragraph 28 of Rec. 18-02. Consequently, GBYP was committed to carry out a broad study on this topic, involving ad hoc experiments in selected farms along the eastern Atlantic and Mediterranean. Such broad study was planned within Phase 8, including several preparatory tasks as elaboration and distribution of a detailed questionnaire submitted to all the operative BFT farms and meetings with farm owners, local authorities and scientists in the five areas where the study will be developed. The implementation of the study has started in Phase 9, including tagging experiments to determine individual growth trajectories, intensive monitoring of representative cages, including the record of relevant environmental variables and food provided to caged fishes and seasonal measurements of their growth by means of stereo-cameras measurements, as well the elaboration and analysis of a database including data on initial length distributions from stereo-cameras and data on final sizes and weight at the end of farming period obtained during harvesting operations. A detailed report describing all the actions carried out up to now in relation to this study were presented in Alemany *et al*. 2019a.

3.5 Modelling approaches

The modelling programme addresses the GBYP general objective 3, which is to "Improve assessment models and provision of scientific advice on stock status through improved modelling of key biological processes (including growth and stock-recruitment), further developing stock assessment models including mixing between various areas, and developing and use of biologically realistic operating models for more rigorous management option testing". The modelling activities already started in the Phase 2, and very soon became evident that this line of study had greater importance than perceived at the time when the GBYP was conceived and that the amount of effort for this activity should be much larger than initially considered. In addition, the MSE process being embarked upon by ICCAT has been an important initiative which represents a significant investment of time and resources by the Commission, CPCs and the scientists involved. Thus, GBYP has been supporting from the very beginning this strategic initiative.

In Phases 8 and 9 the contract for modelling approaches was again awarded to Dr Tom Carruthers (Blue Matter Science, Canada), who initiated the work on MSE and modelling in 2014. The main objectives for Phase 8 were ensuring the OM scenarios agreed by the ICCAT GBYP Core Modelling Group (CMG) and MSE Group can be run, that third parties can use the operating model to evaluate candidate management procedures of their own specifications and to provide a set of agreed summary statistics that can be used by decision makers to identify the management procedures, including data and knowledge requirements, which robustly meet the management objectives. Details about specific activities carried out by the expert in Phases 8 and 9 were presented in Alemany *et al*. 2019a.

The outputs from GBYP MSE modelling activities in Phase 8, as mixture model interpretation of stock of origin data and an updated summary of conditioned operating models were presented within BFT SCRS Species Group session in Carruthers and Butterworth 2018a and 2018b. At the end of Phase 8, the MSE framework has been completed, although not all components downstream of the Management Procedures and the Management Objectives have been finalized yet.

In Phase 9 the contracted expert is continuing his work on bluefin tuna MSE development, aiming to ensure that the OM scenarios agreed by the CMG in 2016 and revised in 2017, 2018 and 2019 by the Technical MSE Group (formerly CMG) and the MSE BFT Group, can be run; that third parties can use the OM to evaluate candidate MPs (CMPs) with their own specifications; and providing a set of agreed summary statistics that can be used by decision makers to identify the MP, including data and knowledge requirements, that robustly meets the management objectives.

In order to support the important and complex MSE development by an effective coordinating body with the requisite technical expertise and appreciation of needs of the SCRS and Commission, in 2014 the GBYP Core Modelling and MSE Group was created, holding 6 meetings until 2017, funded by the GBYP. During the BFT MSE intersessional meeting held in April 2018, the Bluefin Tuna Core Modelling Group presented its work and obtained feedback from the SCRS focusing on adjustments to the bluefin tuna operating models. The MSE trial specification document was updated and several initial candidate management procedures were proposed and tested on a preliminary basis. The Group shared the experiences with the coding package and discussed its possible amendments and associated trials. Several other topics were discussed, and the further CMP refinement schedule was drafted, as well as priority actions identified including closer consideration of stock mixing, B_{MSY} calculations, future recruitment scenarios, abundance indices, and definition of key uncertainties. During the meeting, it was also decided to dissolve the MSE CMG and create the BFT MSE Technical Group, which, unlike the CMG, would be open to all interested ICCAT scientists, without restriction on participation. The GBYP has continued to provide its support to this new group, and in general to the whole BFT MSE process, by financing the attendance of some members of the MSE Technical Group (those that belonged to the previous CMG) not only to the successive MSE Technical Group meetings, such as those held in July 2019 (St. Andrews, Canada) and September 2019 (Madrid, Spain), but also to other MSE related meetings. Specifically, the GBYP facilitated the attendance of Dr Doug Butterworth at the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers held in May 2018, in Madeira (EU-Portugal) and at the September 2019 SCRS Species Group meeting. The progress in BFT MSE development is summarized in item 15.1 of this report.

4. Outline of GBYP Phase 10 proposal

a) Data recovery: Recovery of data sets relevant for improving BFT management
b) Fishery independent indices: Development of new series of aerial surveys, feasibility study for the application of acoustic surveys to the development and validation of fishery independent indices; development and application of habitat models to standardize fishery independent or dependent indices
c) Tagging: Support to conventional tagging and tag awareness activities; development of electronic tagging campaigns, prioritizing areas according to MSE needs
d) Biological studies: Maintenance of GBYP tissue bank, development of biological sampling and analysis program aiming to ensure availability of samples and generation of basic data to cover research needs derived from SCRS recommendations, implementation of "BFT growth in farms study; implementation, within ICCAT DBs system framework, of relational databases integrating data from GBYP (biological analysis, tagging, data from stereocamera systems and harvesting operations); workshop on close-kin methodologies; support to the coordination and standardization of larval surveys; support to activities aiming at calibrating and improving ageing activities
e) Modelling: Continuous GBYP support to the development of the ICCAT BFT MSE process (funding developers and BFT MSE technical group workshops)

Total envisaged budget €1,750,000.

Table 1. Approved budget of GBYP Phase 8 and 9.

Item	Phase 8	Phase 9
Coordination	€312,500.00	€285,000.00
Data Recovery	€58,000.00	€20,000.00
Aerial Survey	€494,500.00	€512,000.00
Biological Studies	€583,000.00	€585,000.00
Tagging	€159,000.00	€208,000.00
Modelling	€143,000.00	€140,000.00
Total	**€1,750,000.00**	**€1,750,000.00**

Appendix 7

Report of the ICCAT Atlantic Ocean tropical tuna tagging programme (AOTTP)
(Evidence based approach for sustainable management of tuna resources in the Atlantic)

1. AOTTP Results and activities

1.1 Background

The overall objective of the Atlantic Ocean Tropical Tuna tagging Programme (AOTTP) is to contribute to the food security and economic growth of the Atlantic developing coastal States by ensuring sustainable management of tropical tuna resources in the Atlantic Ocean. The specific objective of this programme is to provide evidence based scientific advice to developing coastal States, and other Contracting Parties, to support the adoption of effective Conservation and Management Measures (CMMs) in the framework of the International Commission for the Conservation of Atlantic Tunas (ICCAT). This will be achieved through improving the estimation, derived from tag-recapture data, of key parameters for stock assessment analyses, i.e. growth, natural mortality, movements and stock structure, etc.

1.2 Budget

The total budget for the programme is 15 million euros over five years of which the European Union contributes 90% and the rest is made up from voluntary contributions from the ICCAT CPCs. During this period 7 contracts have been negotiated and signed (**Table 1**).

2. Tag-recapture and associated data from the three main tropical tuna and on neritic tuna species in the Atlantic are stored in a database at the ICCAT Secretariat

2.1 Tagging of tropical tunas

Tagging began in June 2016 around the Azores. Since then ICCAT-AOTTP has tagged tuna over large areas of the tropical Atlantic. Tagging has recently finished in the EEZ of Côte d'Ivoire, and is still ongoing off northern Brazil, around the island of St. Helena (BOT), and in the seas of the Caribbean/USA using sport fishers.

In late 2018, the AOTTP Coordination discovered a serious issue with the tag-recapture data sent by a contractor working in northern Brazil. The problem was detected quickly thanks to the quality control procedures instigated by AOTTP and strong cooperation by the contractor coordination team. It obviously negatively affected AOTTP-ICCAT investment, but compensation (extra tagging of 2,765 tuna at no cost) was offered by the relevant contractor and accepted by ICCAT. The main donor of AOTTP (the European Union) was informed of this issue and it was confirmed that no more administrative actions were required regarding the contractor. All the data affected were immediately removed from the AOTTP database and will not prejudice future scientific analyses.

A total of 113,045 tropical tuna across species have now been tagged and released with conventional tags (e.g. **Figure 1**), and 15,127 of those have been recovered. AOTTP has now achieved 94% of its overall tagging targets (**Table 2**). Similarly, AOTTP and colleagues have deployed 29 Desert Star, 101 Wildlife Computers and 7 Microwave Telemetry electronic pop-up tags, while 29 ArcGeo 9 (Lotek), and 357, Lat2810 (Lotek) internal/archival tags (**Figure 2 & Table 3**) have been deployed. Over 20 different boats have so far been used by ICCAT-AOTTP to tag fish in the Atlantic on 393 tagging trips overall (**Table 4**).

2.2 Awareness campaigns and recovery schemes

Awareness raising and recovery schemes are ongoing in the following thirteen locations: (1) Azores Islands (Portugal), (2) Madeira (Portugal); (3) Canary Islands (Spain); (4) Mauritania; (5) Senegal; (6) Cabo Verde; (7) United States; (8) Côte d'Ivoire; (9) São Tomé and Príncipe; (10) South Africa; (11) Brazil; (12) Ghana; (13) St Helena (UK); and (14) Uruguay, see **Figure 3**. Awareness raising has also started with sport and recreational fishers in the USA.

2.3 Recovery of tags and transmission of data to ICCAT Secretariat

The number of valid tag recoveries is now (September 2019) 15,127 (see **Figures 4 & 5**) translating to an overall recovery rate (**Table 2**) of 13.4% which is more than the rate originally predicted (10%). Of special importance is the fact that the recovery rates for BET and YFT are both each above 19% (**Table 2**). 1,925 BET, 3,493 SKJ, and 2,914 YFT have been tagged chemically (**Table 5**) and recovery rates of the chemically tagged BET and YFT are 17.8% and 14.8% respectively (**Table 5**). All data are sent to ICCAT in a standard format via the *AOTTP Tag Recovery Group* (35 Members), a system that facilitates rapid data correction and helps avoid coding mistakes. Tag seeding experiments to estimate the reporting rates are ongoing and 847 fish have so far been tagged with false tags throughout the tropical Atlantic (**Table 6**).

Improvements were made to the tag recovery data in 2018. The data entry program now requires input on the quality of: the fish length reported (measurement vs. estimate); the date and location provide (exact vs. approximate); and the physical state of the fish when measurements were taken (fresh, frozen or thawed). In addition, new codes were added to the ICCAT database structure such as the 'boat-associated bait fishing technique' used by some of our contractors. In addition, teams are instructed to collect logbook information for tags recovered on purse-seine vessels so that a more precise estimate of the date of capture can be calculated in cases where that date is not known exactly. All of these changes are improving the quality of the data stored by ICCAT-AOTTP; ultimately improving the analyses that will use the data.

3. Key parameters supporting stock assessments are estimated on the basis of data collected through the programme and integrated in stock assessments

ICCAT-AOTTP now has a rich dataset which is being used to estimate growth rates, mortality (including gear selectivity), and migration rates in tropical tunas. Statistics and observations (e.g. number of releases, numbers of recoveries) were presented at the SCRS Species Group Meetings in September 2017, 2018, and 2019 (Beare *et al.*, 2017; Guemes *et al.*, 2017; Goñi *et al.*, 2017; Onandia *et al.*, 2017; Arregui *et al.*, 2019; Gaertner *et al.*, 2019a, b); and again at the SCRS Plenaries in October 2017 (Appendix 8 to the *Report for Biennial Period 2016-2017, Part I (2017), Vol. 2*), and 2018 (Appendix 5 to the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 2*). Preliminary observations on LTA have now been presented at the 2017 Small Tunas Intersessional Meeting by the ICCAT Secretariat in Miami in April 2017 and at the Small Tunas Intersessional Meeting in June 2019 by Dr Fambaye Ngom in Olhão, Portugal.

AOTTP tag-recapture data contributed to the BET Stock Assessment in 2018 (Arregui *et al.*, 2019; Gaertner *et al.*, 2019b,c).

At the April 2019 YFT Data Preparatory meeting detailed analyses based on AOTTP data were presented concerning: tag shedding rates (Gaertner *et al.*, 2019a); the impact of the FAD moratorium (Deledda-Tramoni and Gaertner 2019); tag reporting rates (Akia *et al.*, 2020); and progress on the otolith growth rate validation work (Ailloud *et al.*, 2019).

Prior to the 2019 YFT Stock Assessment, by the SCRS, the AOTTP formatted the tagging data for inclusion in the integrated assessment model, Stock Synthesis. Tag-shedding (Gaertner *et al.*, 2019a, b) and tag reporting rate (Akia *et al.*, 2020) were estimated from the AOTTP double-tagging work (**Table 7**) and tag-seeding experiments, respectively. The stock assessors were also provided with daily YFT ages from the AOTTP reference collection together with annual ages of large individuals caught off South Africa. Growth trajectories from tagging data and otolith ages were used to guide the estimation of growth within the Stock Synthesis model. Preliminary analyses of chemically marked fish from the AOTTP contributed to the important decision to raise the assumed maximum age of YFT from 11 to 18 years.

3.1 Reading of hard parts

The AOTTP is targeting 10,000 fish for 'chemical tags', i.e. they are injected with oxytetracycline (OTC) so their otoliths (or other hard parts) can be 'read' and aged more easily (**Table 5**).

Thus far the ICCAT-AOTTP has purchased and taken biological samples from 888 fish representing all size classes, 4 species, and both sexes (**Table 8**). Other biological information like bodyweight, state of sexual maturity, and stomach contents has also been collected to complement eventual analyses.

The ICCAT-AOTTP is working with scientists in Senegal, Côte d'Ivoire, Brazil and Australia to analyse AOTTP chemically marked otoliths. Results are improving age reading protocols and assessing the relative use of daily versus annual increment counts for future age estimation. Preliminary results were presented at the 2019 YFT Data Preparatory meeting (Ailloud *et al.,* 2019) and at the 2019 Species Group Meeting. These results indicated that daily micro-increment counts lead to underestimates of age for fish any larger than 55cm FL, and that annual ageing might be more accurate (alternate opaque versus translucid increments). The AOTTP efforts to analyse hard parts will continue until the end of the project.

Two laboratory technicians were hired by ICCAT-AOTTP partners in January 2019: one at the CRO in Abidjan; and one at the CRODT in Dakar. These new hires attended a workshop in March 2019 where they learned advanced techniques in otolith preparation, growth ring interpretation, and calculation of bias and precision in age readings. They also underwent an additional week of training in August 2019, which focused on the preparation and interpretation of otoliths for annual ageing (as opposed to daily ageing), and on the use of the fluorescent microscope to validate the deposition rates of otolith rings in chemically marked fish.

3.2 Information from stakeholders

This activity relates to the organisation of the symposium planned for the final months of the AOTTP. The ICCAT Executive Secretary travelled to Dakar, Senegal, with the AOTTP Coordinator and Administrative and Financial Officer to formally inform the relevant Senegalese Authorities of the planning of the final symposium in their country (**Figure 6**).

Additional activities this year include:

- AOTTP Coordination (Dr Beare) described AOTTP experiences with pop-up tags at the European Users Conference on Argos Wildlife held in Toulouse, France, 21-22 November 2018.
- AOTTP Coordination (Dr Beare) visited St Helena in January 2019 to meet key personnel, support tagging activities there and raise awareness among the fishing community.
- AOTTP (Dr Ailloud) attended a workshop organised by IATTC in La Jolla, California in January 2019. The IATTC is initiating an extensive tagging program of tropical tuna in the eastern Pacific Ocean. Representatives from SPC, IOTC, NRIFSF, PFRP and AZTI were present providing AOTTP an opportunity to reach other scientists involved in tuna tagging campaigns.
- AOTTP Coordination (Dr Beare) traveled to Grenada (Caribbean) in March 2019 to support tagging activities in the area organised by the University of Maine.
- Dr Ailloud was asked (and supported by ICCAT-AOTTP) by ICES to review the Benchmark Assessment of Atlantic Mackerel in March 2019.
- AOTTP Coordination (Drs Ailloud and Beare) attended the Annual European Tuna Conference (http://www.europeantunaconference.com/) in Brussels on 6 May 2019.
- AOTTP (Drs Ailloud and Beare) attended the 70th Tuna Conference (https://www.tunaconference.org/) in California, USA between 21 and 23 May 2019 and gave talks during the Tagging Data session.

4. Scientists from developing country Contracting Parties of ICCAT are trained in tagging, data collection, and tagging data/stock assessment analysis

4.1 Training in tagging techniques and data collection

The numbers of fish tagged by scientists from all countries is summarised in **Table 9**. It shows that over two-thirds (66%), have been tagged by scientists/technicians from developing countries. During AZTI's Phase 2 tagging activities off West Africa and the Canary Islands, the following nine other organisations were involved: CIPA; CRO-CI; CRODT; DP-STP; DGPA-G; FSSD; IEO; IMROP; and INDP. AZTI also provided training in tagging to the AOTTP Database Specialist (Mr. Jesus Garcia) to provide some practical experience of life at sea, and also to the following seven individuals from developing countries:

- Ahmed Diagne (IMROP, Mauritania)
- Mario Nbunde (CIPA, Guinea-Bissau)
- Jeremias Intchama (CIPA Guinea-Bissau)
- Jean-Bernard Mougoussi (DGPA-G Gabon)
- Djimera Lassana (IMROP, Mauritania)
- Davy Angueko (DGPA-G, Gabon)
- Loïs Allela (DGPA-G Gabon)

4.2 Training in data analysis

The ICCAT-AOTTP has a large and important dataset including: (i) mark-recapture data from spaghetti/conventional tags; (ii) tag-seeding data; (iii) data from electronic tags; and (iv) biological samples such as otoliths and spines. Partners for the data analysis and capacity building work (merging of activities A2.2 and A3.3) were contracted during the current reporting period after a competitive process: one (CISEF) for mortality and movement/migration work; and one (VIMS/Shedd Aquarium) focusing on the growth of tropical tuna (from hard parts, length frequencies and tag-recapture data). The mortality and movement work started in April 2019 and the growth analyses in June 2019. All the results will be presented at the final symposium in June 2020 and written-up for peer-reviewed publication. Note that the Terms of Reference for the scientific aspects of the work were discussed and approved at the SCRS Species Groups Meeting in autumn 2018.

The AOTTP held two age reading workshops during this reporting period. Both took place in Dakar, the first in late October 2018 and the second in March 2019. Between them the workshops ensured that the otoliths and other hard parts collected by the AOTTP of chemically and non-chemically tagged fish are properly read, validated and calibrated.

Note: Access to the ICCAT-AOTTP conventional tag data (checked and validated to the extent possible) are now publicly available at six monthly intervals – organized by species - from the ICCAT website (https://www.iccat.int/en/accesingdb.html). Data (less well checked) are distributed at monthly intervals to partners more specifically involved in the project (e.g. participants at capacity building workshops, SCRS meeting participants, and other contractors), e.g. AOTTP Data (https://docs.google.com/document/d/1YfIgbpB9jXgyzLzjd3jc9WSBEPFP1ucj7F2mQP4ueIo/edit#heading=h.gjdgxs). Electronic tag data are available on request to the AOTTP Coordination. Furthermore, note that the original Activities A2.2 and A3.3 were merged to integrate the formal scientific research activities with the training and capacity building.

5. Beneficiaries

The AOTTP is working directly with State Authorities in Spain (Canary Islands), Portugal (Azores, Madeira), Côte d'Ivoire, Mauritania, Senegal, Brazil, USA, Ghana, Uruguay, São Tomé and Príncipe, Cabo Verde, UK (CEFAS, British Overseas Territories of St Helena and Ascension Island) and South Africa.

The AOTTP is exchanging biological samples with a range of organisations, mutually benefiting all parties. Members of CEFAS and UCT have sent whole otoliths from very large BET and YFT to the AOTTP for ageing, and the AOTTP will share the resulting data and return the prepared slides when done. In addition, the AOTTP has sent CEFAS 30 YFT otolith samples from very young fish/short term recaptures caught in the Gulf of Guinea to be analysed for isotopic signatures and natal origin. Results will improve our understanding of stock structure of YFT in the Atlantic.

ICCAT CPCs have also contributed funds to the AOTTP including the USA, Canada, and Chinese Taipei. IRD staff contribute their time without cost to analyse AOTTP data.

The AOTTP maintains good working relationships with all its contractors: communication with tagging teams and TROs around the world being done using a range of modern media, including WhatsApp, Telegram and e-mail.

During this reporting period the ICCAT-AOTTP worked with a consortium, led by AZTI (Spain), to tag tuna in the Azores, the Canary Islands, and West Africa. This consortium involved CRO-CI, CRODT, FSSD, IEO, IMAR, and MFRD/FSSD. More recently, and in other areas of the Atlantic we are working, or have worked, with: the FADURPE Consortium (Brazil), CEFAS (UK), LPRC (USA), University of Maine (USA), NOAA (USA), Directorate of Fisheries (São Tomé and Príncipe), and CapMarine (South Africa) to tag fish at sea. In awareness-raising and tag-recovery activities the AOTTP is also working directly, and successfully, with many of the same organizations (e.g. CRO-CI, CRODT, MFRD/FSSD, IEO, and IMAR) but also with CapMarine and INDP (Cabo Verde). AOTTP has also signed a Memorandum of Understanding for reward reimbursements with the Saint Helena Government (BOT).

AOTTP partners at the University of Maine and NOAA (https://atuna.com/pages/noaa-seeking-volunteers-in-tagging-tuna) are working *voluntarily* with a large range of USA sport fishing associations and organisations including: the South Shore Marlin and Tuna Club (https://m.facebook.com/southshoremarlintuna/), Sail World (https://www.sail-world.com/news/214479/Help-wanted-Tropical-Tuna-Tagging-Program), Virginia Saltwater Fishing (https://www.virginia-saltwater-fishing.com/2019/02/09/atlantic-ocean-tropical-tuna-tagging-program-aottp/), the Billfish Foundation (https://billfish.org/featured/tropical-tuna-taggers-needed/), the Fort Walton Beach Sailfish Club, the Billfish Rundown (https://www.caymanbillfishrundown.com), Grenada Fishing Charters (https://exilecharters.com), The Anderson Cabot Center for Ocean Life (https://www.andersoncabotcenterforoceanlife.org/blog/help-wanted-atlantic-ocean-tropical-tuna-tagging-program/), and ROFFS (https://mailchi.mp/roffs/roffs-news-reel-14th-edition-may-08-2019?e=02d8638eec). These relationships are beginning to become productive and many fish have now been tagged and recovered by volunteers in the NW Atlantic.

AOTTP has worked with ARGOS-CLS (http://www.argos-system.org/) who run the satellites that collect the data from the pop-up electronic tags and the AOTTP Coordinator was invited to present AOTTP at the European Users Conference on ARGOS Wildlife (http://www.argos-system.org/eucaw/eucaw-speakers/) in late 2018.

The AOTTP has so far worked with the skippers and crews of more than 25 commercial fishing vessels and feedback with respect to the relationships between the scientific and technical teams and the fishing crews has been routinely positive, according to both verbal and cruise reports from our contractors. The fishers are usually extremely engaged, enthusiastic about the tagging work, and delighted to help in all possible ways.

The AOTTP has an agreement with IATTC to pay rewards on its behalf and collect metadata from tags where possible. The TROs in Abidjan work closely with personnel from IRD and IEO to gain access to logbook data, essential for ascertaining where and when a tagged tuna was actually caught.

The AOTTP Steering Committee is also regularly consulted on AOTTP progress and plans, and members have been involved in evaluating contracts. Members of the ICCAT SCRS are also enthusiastic about the AOTTP and are looking forward to undertaking research with the data.

The 'Final Beneficiaries' of the Action are: (i) Fishing communities and operators depending on the exploitation of tuna resources; and (ii) Consumers (of tuna).

The Action has already had an impact on the 'Final Beneficiaries'. AOTTP TROs have now recovered over 15,000 tags. Both recovery rates and reporting rates are good compared with similar oceanic tagging campaigns. These statistics indicate strong 'buy-in' to the project from fishers, dockers, stevedores and the tuna canning industry. More than 100 scientists and technicians from developing countries have benefited directly from the employment AOTTP is generating, and less directly from the training and capacity building activities they have received. Thousands of euros of cash rewards, substantial lottery prizes, and t-shirts have also been distributed to many diverse fishery stakeholders.

The AOTTP also works extensively with the Observer Programs in the target countries.

In Abidjan, Dakar, and Tema the TROs must liaise daily with the Port Authorities to gain access to harbors and fishing vessels. They have also done awareness-raising activities at the tuna canning factories building relationships with their staff.

In January 2019, AOTTP attended a meeting organised by IATTC to discuss implementation of largescale tuna tagging programs. IATTC benefitted from hearing about the AOTTP experience as the AOTTP provided expert advice and guidance on what works well and what mistakes to avoid.

In September 2018, the AOTTP met with the Vice-president of ISSF (Jefferson Murúa), an NGO self-described as serving as a "global bridge among industry, environmental stakeholders, scientists, and RFMOs and their members." ISSF provided AOTTP advice on how to reach the industry community and expressed interest in sponsoring the participation of early career scientists at the AOTTP final symposium. The AOTTP also provided ISSF with a some maps and data summarising the AOTTP project for regular presentation at the ISSF Skippers Workshops (https://iss-foundation.org/2018-a-record-breaking-year-for-issf-skippers-workshops/) which reached 700 participants in 2018.

The AOTTP is working productively with the Blue Belt (https://www.gov.uk/government/publications/the-blue-belt-programme) in the BOTs of Ascension and St Helena. The Blue Belt programme has tagged fish in both these locations. When Blue Belt tags are found by AOTTP TROs the rewards are paid and (release and recovery) data shared.

In March 2019 the AOTTP was approached by Cadiz University who offered to tag SKJ for free in the Gulf of Cadiz using sport and recreational fishers. Similarly, Instituto Nacional de Pesca y Acuacultura in Mexico is running tag-seeding experiments for AOTTP in the Gulf of Mexico.

Dr Barbara Block (https://en.wikipedia.org/wiki/Barbara_Block) from Monterey Aquarium in the USA visited AOTTP partners in St Helena and joined them in some tagging activities, particularly in relation to pop-up tagging. The team there was grateful for the input and advice.

6. Visibility

The EU logo and funding statement are always clearly visible on all AOTTP communication materials including websites, flyers, pamphlets, posters, reports, newsletters, t-shirts, and caps. The materials can be seen at harbours, at fishing beaches, and on-board fishing and recreational vessels throughout AOTTP target countries.

The AOTTP, together with the ICCAT Secretariat, has developed a website packed with regularly updated information about the project.

The AOTTP Coordination publishes quarterly newsletters (https://www.iccat.int/AOTTP/en/aottp-documents.html) about the project which, in addition to being available on the website, are also sent by email to all our partners working on the project.

The AOTTP final symposium will provide visibility and has been announced at various platforms, including: the European Tuna Conference, the IATTC meeting, the Tuna Conference and ICCAT SCRS meetings. A webpage is in development and will be distributed widely to increase visibility.

The AOTTP has been formally presented at many different fora around the Atlantic Coastal States, including:

- ICCAT Tropical Tunas Species Group (Dr Doug Beare, Dr Lisa Ailloud, Madrid, September 2018)
- ICCAT SCRS Plenary (Dr Doug Beare, Madrid, September 2018)
- ICCAT Commission meeting (Dr David Die, Dubrovnik, November 2018)
- European User Conference on Argos Wildlife - AOTTP summary presentation (Dr Doug Beare, Toulouse, 22 November 2019)
- IATTC tuna tagging program - four presentations on AOTTP (Dr Lisa Ailloud, San Diego, January 2019)
- Public presentation of AOTTP (Dr Doug Beare, Dr Serena Wright, St Helena, January 2019)
- ICCAT YFT Data Preparatory Meeting - AOTTP summary presentation (Dr Doug Beare, Madrid, April 2019)
- ICCAT YFT Data Preparatory Meeting - tag shedding and mortality estimation (Dr Lisa Ailloud, Madrid, April 2019)

- Poster setup at the European Tuna Conference (Dr Doug Beare, Dr Lisa Ailloud, Brussels, May 2019)
- The Tuna Conference – AOTTP summary presentation (Dr Doug Beare, California, May 2019)
- ICCAT Small Tunas Species Group Intersessional Meeting (Dr Fambaye Ngom, Portugal, June 2019)

AOTTP has already been published widely on the internet, e.g.:
- Safari News (https://www.safari.com/news/featured/tropical-tuna-populations-in-the-atlantic-ocean/)
- ARGOS-CLS (http://www.argos-system.org/tagging-tropical-tuna-atlantic/)
- Sail World (https://www.sail-world.com/news/214479/Help-wanted-Tropical-Tuna-Tagging-Program)
- NOAA (https://atuna.com/pages/noaa-seeking-volunteers-in-tagging-tuna)
- Saving Seafood (https://www.savingseafood.org/science/noaa-seeking-volunteers-in-tagging-tuna/)
- Skiboat (https://issuu.com/sheenacarnie/docs/sb_sept_2018/37)
- St Helena (http://www.sainthelena.gov.sh/new-tuna-tagging-programme-gets-underway/)
- Terramar Project (https://theterramarproject.org/2019/03/04/help-protect-tuna-in-the-atlantic-ocean-tropical-tuna-tagging-program-with-anderson-cabot-center-for-ocean-life/)

7. Updated Action Plan

No cost five month extension of the AOTTP. In early 2019, the EU agreed to allow a budget amendment and extend the duration of the AOTTP Project (at no extra cost) so that it formally now finishes on 30 November 2020 giving the project a full 60 months duration.

Tagging of tropical tunas (2019-2020). The AOTTP has now tagged *ca* 113,045 tropical tuna across the Atlantic Ocean, and the overall objective of 120,000 fish tagged should be achieved. In the USA and Caribbean tagging activity (target = 5000) has been very slow and will continue into 2020. Subsequent to the budget amendment, €150,000 was made available to fund additional tagging work at sea north of Brazil between 5 and 10 N. This work was targeted to fill in specific gaps deemed important by the Steering Committee.

Awareness campaigns and recovery schemes (2019-2020) will continue as normal until each relevant contract expires, but the most important (numbers of tag-recoveries) TRO/Focal Point contracts will be extended, if funds allow, corresponding to the duration of the extension (5 months). Reward payments will continue to be refunded, for a further 5 months, and t-shirts/caps will be distributed.

Tag recovery and transmission to ICCAT Secretariat (2019-2020). The TROs and Focal Points around the Atlantic coast will also continue to send in data to the AOTTP Coordination as normal from the most important TRO offices for a further 5 months.

Reading of hard parts (2019-2020). Ultimately age-data for all three tropical tuna species will be available for incorporation into the stock assessment process by the end of the project. The AOTTP Coordination is focusing on the priority species for each assessment (e.g. YFT in 2019 and SKJ in 2020). These data will be continually updated as chemically tagged fish with progressively longer times at liberty are caught.

Tagging data analyses and training in data analysis (2019-2020). The work will be planned to fit around all the stock assessments scheduled for tropical tunas during 2019 and 2020 and will also be tightly integrated with the AOTTP final symposium.

Information of stakeholders (2019-2020). The AOTTP final symposium will be held in Dakar, Senegal, 16-18 June 2020. Between now and the end of the project the following activities will be undertaken in support of 'Information for stakeholders':

- The AOTTP (Dr Ailloud) attended the YFT Stock Assessment in Abidjan in July 2019.
- Drs Ailloud and Beare will attend and present the AOTTP at both the SCRS Species Groups and Plenary meetings in Madrid in September and October 2019 and 2020.

- The AOTTP Coordination will attend the FAO International Symposium on Fisheries Sustainability in Italy in November 2019.
- The AOTTP Coordination will attend the ICCAT Commission meeting in Spain in November 2019.
- Drs Ailloud and Beare will attend both the SKJ data preparatory and stock assessment meetings in 2020 (probably both in Madrid).
- The AOTTP Coordination will travel to TRO offices to resolve outstanding data issues in late 2019 or early 2020.
- The AOTTP team will attend the AOTTP final symposium in Dakar in June 2020. Note that the AOTTP will also support travel to the Symposium of 5 representatives from the ICCAT Secretariat and the AOTTP Steering Committee.
- Possible attendance at the next FAO Committee on Fisheries (COFI) meeting in Rome July 2020.
- The AOTTP is preparing a proposal for a Theme Session on Large-scale Oceanic Tagging Projects for the 2020 ICES Annual Science Conference in Copenhagen. In the case that we are successful the session will be chaired by the AOTTP Coordination and partners and be another opportunity to disseminate the project. ICES ASC 2020 (https://www.ices.dk/news-and-events/news-archive/news/Pages/ASC2020.aspx)

Table 1. Contracts awarded by ICCAT-AOTTP since August 2018.

Date	*Supplier*	*Objective*	*Value*
29/01/2019	IFAN-UNIVERSITE CHEIKH ANTA DIOP	Provision of training in Otolith reading	€ 6,200
03/01/2019	FISH AGEING SERVICES PTY LTD	Otolith age readings and growth validation	€ 26,516
13/03/2019	BDO AUDITORES S.L.P.	Expenditure verification of year 4	€ 11,064
27/03/2019	CISEF CONSORCIUM_AZTI	Tagging data analysis and training: mortality & movement	€ 268,882
01/05/2019	INVESTIGACION PANIFICACION Y DESARROLLO S.A.	Awareness and recovery activities in the Canaries	€ 24,600
11/06/2019	VIMS/SHEDD CONSORTIUM	Tagging data analysis and training: tropical tuna growth	€ 122,070

Table 2. Tag releases by species and release stage code.

	Numbers released	*Numbers recovered*	*Percentage recovered*
BET	21953	4308	19.6
LTA	7676	566	7.4
SKJ	46198	3129	6.8
WAH	269	3	1.1
YFT	36949	7121	19.3
Totals	**113045**	**15127**	**13.4**

Table 3. Electronic tag releases by species.

Tag maker	*BET*	*SKJ*	*YFT*
Desert Star	22	0	7
LOTEK ARCGEO9	27	0	2
LOTEK LAT2810	121	9	227
Microwave Telemetry	5	0	2
Wildlife Computers	30	0	71
Total	**205**	**9**	**309**

Table 4. Tagging campaigns by location.

Location	*Number*
Azores	16
Brazil/Uruguay	50
Canary Islands	17
Gulf of Guinea	207
Saint Helena	76
Senegal	11
South Africa	7
USA	9

Table 5. Chemically tagged totals by species.

	BET	*SKJ*	*YFT*
Releases	1925	3493	2914
Recoveries	342	188	430
% recovered	17.8	5.4	14.8

Table 6. Reporting rates (%) from tag-seeding experiments by species.

Species code	*Baitboat*	*Purse seine*
BET	94.7	80.7
LTA	100	100
SKJ	89.7	83
YFT	77.9	71.7

Table 7. Double tagging by species.

	BET	*LTA*	*SKJ*	*WAH*	*YFT*	*Total*
Double tagged	4302	1478	8678	22	5497	19977
Single tagged	17651	6198	37520	247	31452	93068
% Double tagged	24	24	23	9	17	21

Table 8. Biological samples collected**.**

	Female	*Male*	*Unknown*
BET	126	146	30
LTA	1	1	0
SKJ	70	103	3
YFT	158	228	22
Total	**355**	**478**	**55**

Table 9. Numbers of fish tagged by tagger nationality.

Nationality	*Total*
Brazil	30398
Cape Verde	1258
Cote D'Ivoire	16431
EU Spain	21575
EU France	21
EU Portugal	6475
EU United Kingdom	338
Ghana	9083
S. Tome e Principe	6548
Senegal	10579
South Africa	195
U.S.A.	102
St Helena	3250
Uruguay	15
Total	**106268**

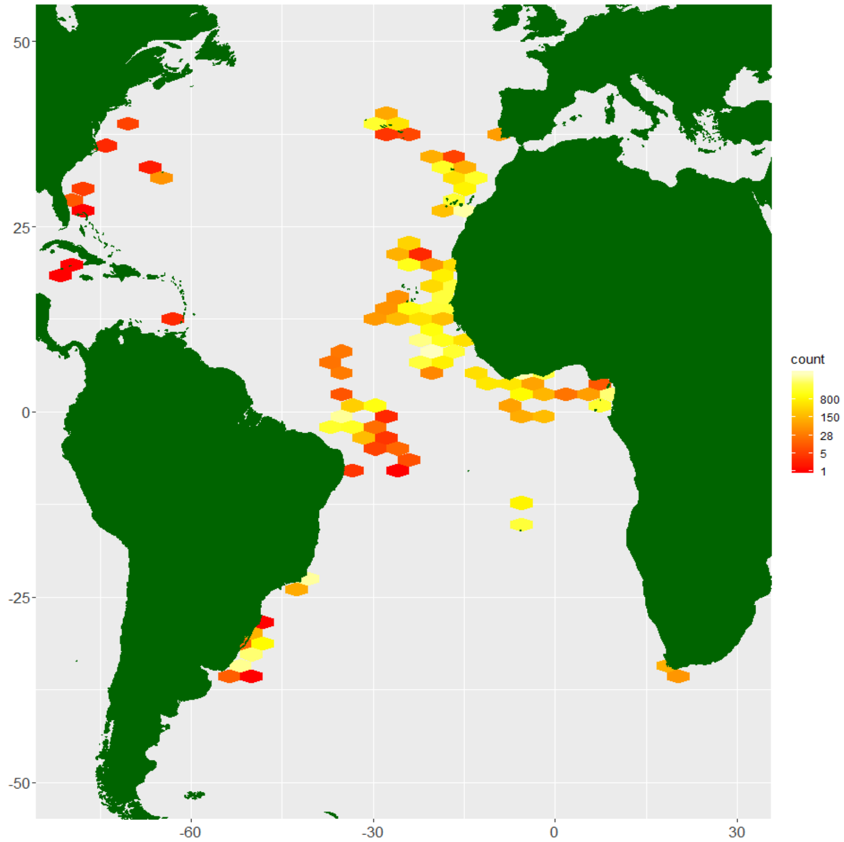


Figure 1. Spatial distribution of tropical tuna tagged and released [First release (R-1) conventional tags only] by ICCAT-AOTTP between July 2016 and September 2019.

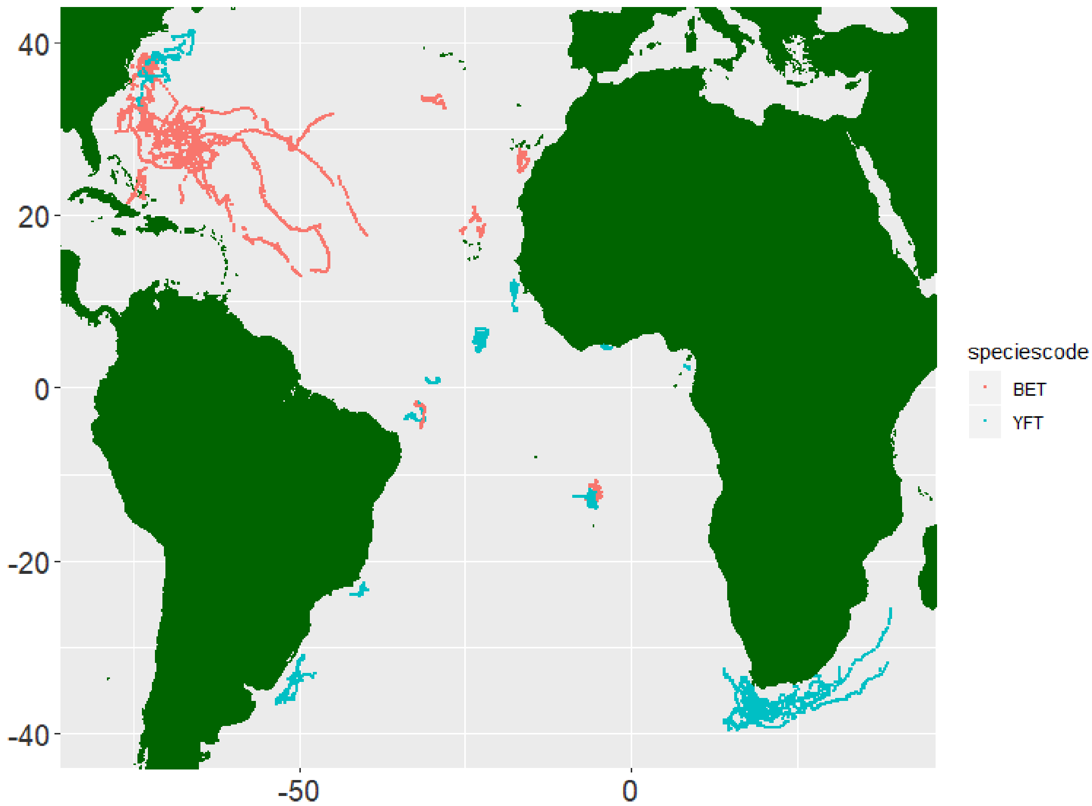


Figure 2. Migrations of BET and YFT tuna from pop-up tags.

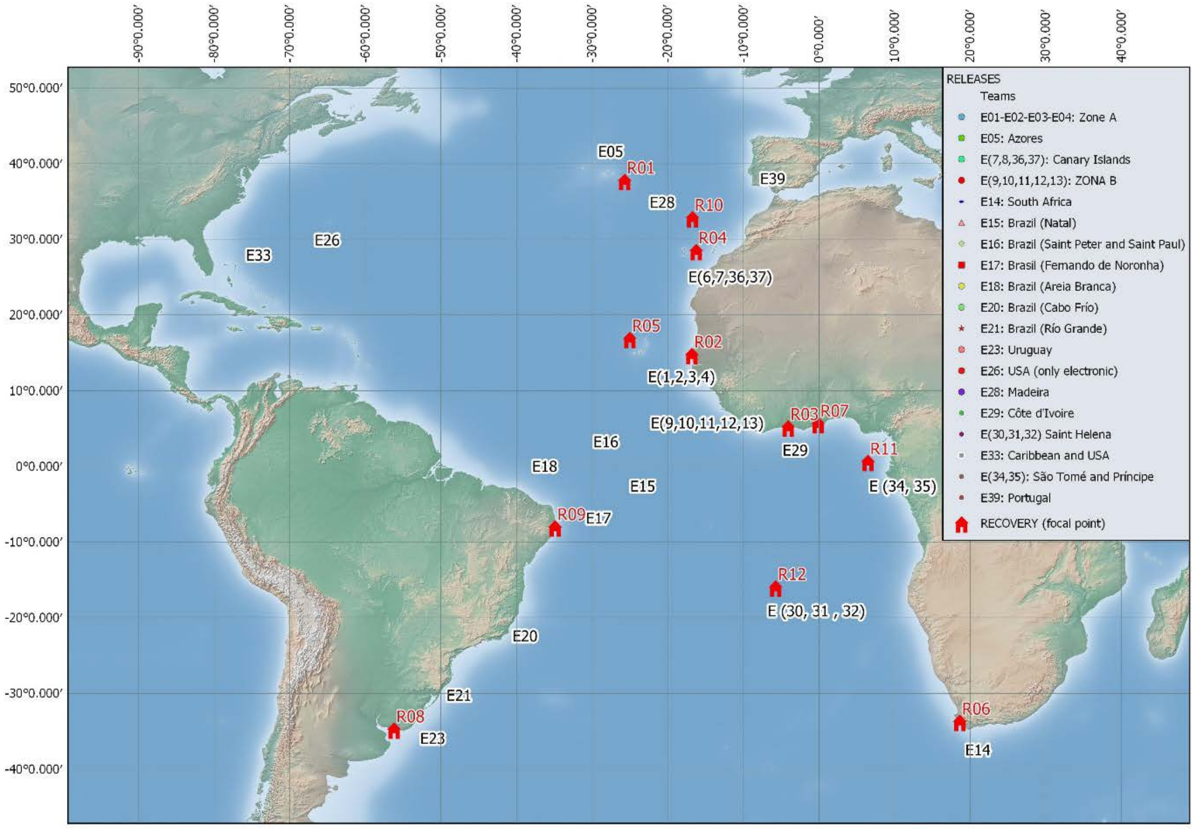


Figure 3. ICCAT-AOTTP tag teams (E) and recovery teams (R) around the Atlantic Ocean.

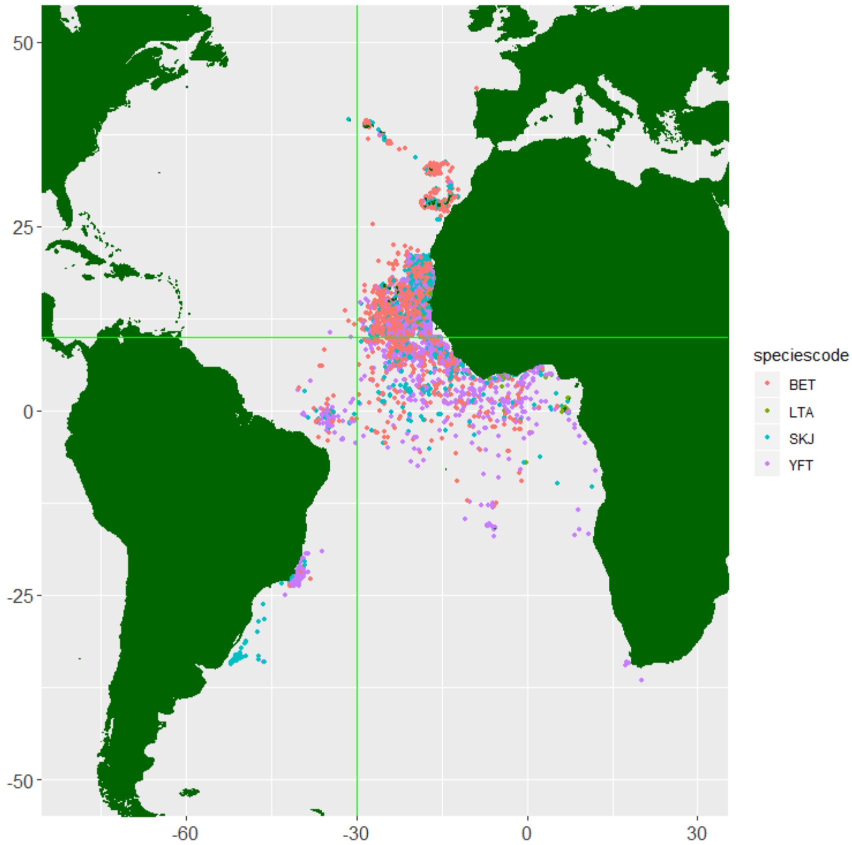


Figure 4. Conventional tag recoveries June 2016 to June 2019 by species.

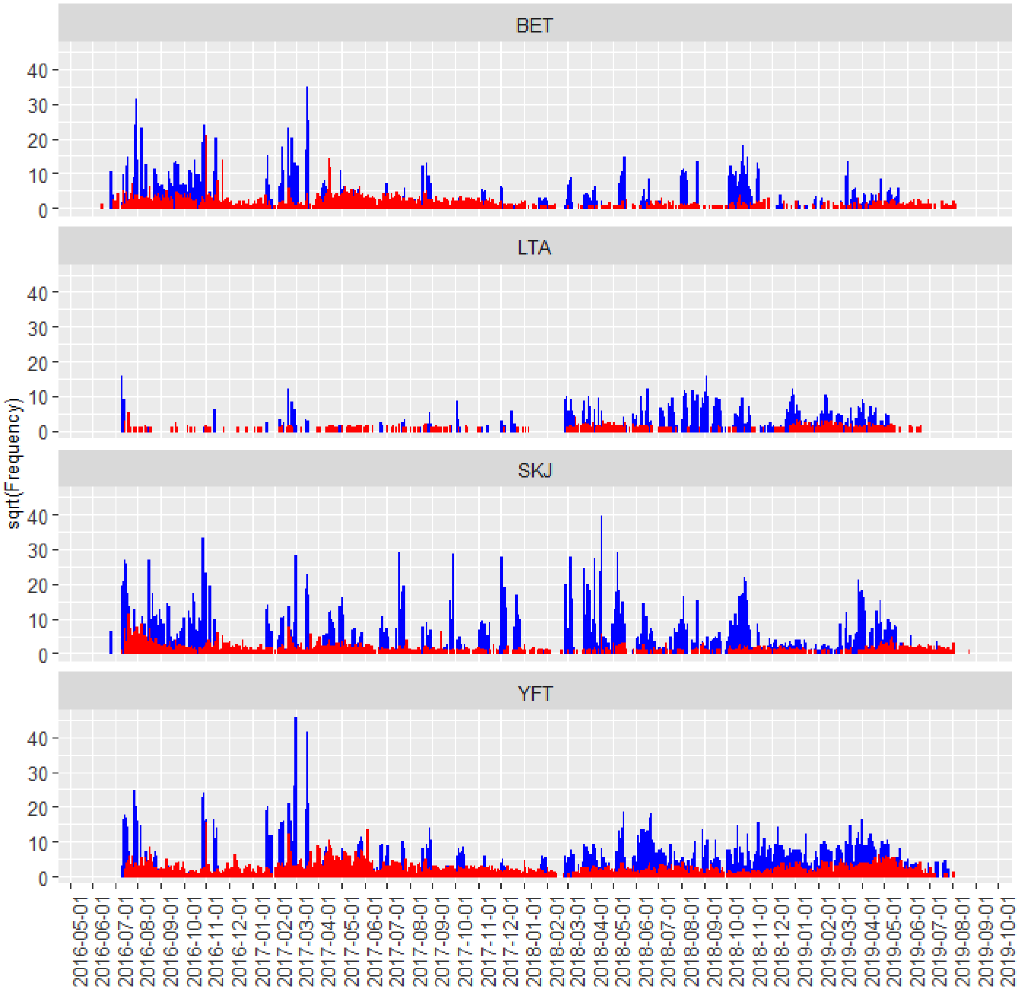


Figure 5. Total ICCAT-AOTTP tag-releases (green) and recoveries (red) over time by species. The numbers have been square-root transformed so they can be seen on the same axes.

Figure 6. ICCAT Executive Secretary and the AOTTP Coordination visit to the Fisheries Ministry in Dakar, Senegal.

Appendix 8

Report of the ICCAT Small Tunas Year Research Programme (ICCAT/SMTYP)

Programme objectives

The status of small tuna stocks in the ICCAT Convention area is generally unknown. Nevertheless, these species have a high socio-economic relevance for a considerable number of local communities at the regional level, which depend on landings of these species for their livelihoods.

Fisheries statistics and biological data, which can provide a basis for assessing these resources and thus providing the Commission with appropriate scientific advice for their sustainable exploitation, are generally incomplete and not updated for these species.

The ICCAT Year Research Programme for Small Tunas (SMTYP) was adopted by the SCRS in 2011 and approved by ICCAT during its 2012 Annual meeting in Agadir (Morocco). The main objectives of the programme are recovery of historical series of Task I and Task II data, collecting the available biological data, and conducting biological studies, mainly on growth, maturity and stock structure for the main species of small tunas.

This programme has a wide geographical sampling coverage:

- Mediterranean and Black Sea: bullet tuna, Atlantic bonito, little tunny and plain bonito;
- West Africa: Atlantic bonito, little tunny, tuna, West African Spanish mackerel, frigate tuna, wahoo;
- Caribbean Sea and south-west Atlantic: blackfin tuna, wahoo, king mackerel and serra Spanish mackerel and dolphinfish.

2019 activities

The ICCAT Secretariat launched in April 2018 a Call for tenders with the aim of implementing the main activities scheduled within SMTYP in 2018. The main objective of this Call was to collect biological samples for estimating the growth parameters, assessing the maturity (size/age at the first maturity, spawning season) and stock structure (mainly genetic analysis) of three prioritized species (LTA, BON and WAH) in the Atlantic and the Mediterranean Sea, from geographical areas that the Small Tunas Species Group identified as of high priority. As a result, the Secretariat selected one proposal of a consortium of a number of institutions, including 11 CPCs to carry out the tasks aforementioned (**Table 1**) and issued a short-term contract, which was extended until 31 March 2019.

Table 1. The detailed expenditures within SMTYP during 2018 and 2019.

Total Budget		*Activity*			
		Sampling, Reproduction and Age and growth studies		*Genetics analysis*	
2018	**2019**	**2018**	**2019**	**2018**	**2019**
€50,000.00	€60,000.00	€25,000.00	€30,000.00	€25,000.00	€30,000.00

Tables 2 and **3** provide a summary of the number of samples collected within the SMTYP within the *Short-term contract for ICCAT SMTYP for the biological samples collection for growth, maturity and genetics studies*.

Table 2. Details on the number of samples to be provided according to the Call of tenders and the number of samples actually provided (in bold).

		BON		LTA		WAH		Totals	
MU-SA region code *CPC EEZ*	*Institution*	*To be provided*	***Provided***	*To be provided*	***Provided***	*To be provided*	***Provided***	*To be provided*	***Provided***
MD; BIL95									
Tunisie	National Institute of Marine Science and Technology	113	**112**	97	**97**			210	**209**
Algerie	Centre National de Recherche du Développement de la Pêche et de l'Aquaculture, CNRDPA	109	**60**	80	**35**			189	**95**
EU-Spain	Instituto Español de Oceanografía	107	**108**	98*	**88**			370*	**196 (367)***
AT-NE; BIL94									
EU-Portugal	Instituto Português do Mar e da Atmosfera	98	**66**	56	**80**			154	**146**
EU-Spain	Instituto Español de Oceanografía					165	**161**	370*	**161 (367)***
Morocco	Laboratoire des Pêches (Dakhla)	116	**80**	72				188	**80**
Mauritania**	Laboratoire Evaluation des Ressources Vivantes Aquatiques	123	**114**	96		196		415	**114 (158)****
Liberia	National Fisheries and Aquaculture Authority			73	**5**			73	**5**
Senegal	Centre De Recherches Oceanographiques de Dakar	118	**119**	109	**50**			227	**169**
AT-SE; BIL97									
EU-Spain	Instituto Español de Oceanografía			98*	**23**			370*	**23**
Côte d'Ivoire	Centre of Oceanology Research	81	**83**	92	**81**	122	**90**	295	**254**
Gabon	Direction General des Pêches et de l'Aqualculture	52		67	**69**		**21**	119	**90**
S. Tomé e Príncipe	Direcção das Pescas	87	**35**	77	**50**	163	**35**	327	**120**
AT-SW; BIL96									
Brazil	Universidade Federal Rural do Semiárido					171	**30**	171	**30**
TOTAL		1004	**777**	917	**578**	817	**336**	2738	**1692**

*EU-Spain total is distributed in three regions (BIL95, BIL94 and BIL97) with a total of samples to be provided of 370 and total of samples provided 380.
**Mauritania included 44 frigate tuna (total of samples provided 158).

Table 3. Samples collected by the involved CPCs by species and type. N/A refers to the number of samples provided but information still missing. --, samples not provided.

	MU-SA region code	Stock structure	Growth		Reproduction
	CPC EEZ	Muscle	Spine	otoliths	Gonads
BON	**MD; BIL95**				
	Tunisie	112		112 (Head)	112
	Algerie	N/A	N/A	N/A	N/A
	EU-Spain	108	108	108	103
	AT-NE; BIL94				
	EU-Portugal	66	66 (Spines and Heads)		66
	Morocco	80		80 (Head)	40
	Mauritania	114	114	--	114
	Senegal	119	119	119	42
	AT-SE; BIL97				
	Côte d'Ivoire	83	52	49	73
	Gabon	--	--	--	--
	S. Tomé e Príncipe	35	35	--	35
LTA	**MD; BIL95**				
	Tunisie	97	97	--	97
	Algerie	N/A	N/A	N/A	N/A
	EU-Spain	88	88	80	88
	AT-NE; BIL94				
	EU-Portugal	80	80	80 (Head)	80
	Morocco	--	--	--	--
	Mauritania	--	--	--	--
	Liberia	N/A	N/A	N/A	N/A
	Senegal	50	50	50	30
	AT-SE; BIL97				
	EU-Spain	23	--	--	23
	Côte d'Ivoire	81	81	56	81
	Gabon	69	N/A	N/A	N/A
	S. Tomé e Príncipe	50	50	50	50
WAH	**AT-NE; BIL94**				
	EU-Spain	161	161	122 (Head)	49
	Mauritania	--	--	--	--
	AT-SE; BIL97				
	Côte d'Ivoire	90	90	90 (otolith head)	65
	Gabon	21			
	S. Tomé e Príncipe	35	35	--	35
	AT-SW; BIL96				
	Brazil	30	--	--	--

Activities planned for 2019-2020

During the period 2019-2020, the Group plans to continue collecting biological samples for priority species to further improve growth and maturity parameter estimates and also genetic analysis (see details on sample collection in **Table 4**). As a second priority, the Group aims at analysing the samples collected, regarding the biological parameters and providing the preliminary analysis of stock structure of one of the species.

Nevertheless, these objectives could not be achieved with the single financial support of ICCAT, and were only possible through additional external funds that were made available by one Contracting Party. **Tables 2 and 3** give detailed information on research activities to be conducted by species and research line and the corresponding estimated costs for 2019. In **Table 5** are identifies responsible for coordinating the analysis and Institutions where samples will be stored.

Table 4. The detailed information on the research activities to be carried out by species for between July 2019 and March 2020 under the ICCAT SMTYP.

Species	Research line	Area	CPCs involved	No. samples
Little Tunny (LTA)	Aging and growth	NE Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Morocco	250
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	150
		Med	Tunisia, EU-Spain	200
	Reproduction	NE Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Maroc	250
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	150
		Med	Tunisia, EU-Spain	200
	Stocks structure/ delimitation	NE Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Morocco	250
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	150
		Med	Tunisia, EU-Spain	200
Atlantic Bonito (BON)	Aging and growth	NE Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Morocco	250
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	150
		Med	Tunisia, EU-Spain	200
	Reproduction	NE Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Morocco	250
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	150
		Med	Tunisia, EU-Spain	200
	Stocks structure/ delimitation	NE Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Morocco	250
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	150
		Med	Tunisia, EU-Spain	200
Wahoo (WAH)	Aging and growth	NE Atlantic	EU-Spain	250
		SW Atlantic	Brazil	100
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	50
	Reproduction	NE Atlantic	EU-Spain	250
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	50
	Stocks structure/ delimitation	NE Atlantic	EU-Spain	50
		SW Atlantic	Brazil	100
		SE Atlantic	Côte d'Ivoire, Gabon, EU-Spain	50

Table 5. Scientist responsible for coordinating the analysis and Institutions where samples will be stored.

Analysis	Institution	Country	Coordinator
Growth	Instituto Português do Mar e da Atmosfera	EU-Portugal	P. Lino
Reproduction	Instituto Español de Oceanografía- Málaga	EU-Spain	D. Macias, S. Saber and J.M. Ortíz
Stock structure	University of Girona	EU-Spain	J. Viñas

2018 and 2019 Expenditures

The total expenditures within SMTYP during 2018 and 2019 amounted to €50,000 and €60,000, respectively. The detailed costs per activity are summarized above in **Table 1.**

Budget for 2020 and expected expenditures

To implement the main activities planned in the framework of SMTYP in 2020, a total budget of €100,000 is needed from ICCAT or other financial resources. The details of costs related to activities to be carried out in 2020 are shown in the **Table 6.**

Table 6. Required budget for the research activities to be carried out during 2020 under the ICCAT SMTYP.

Activity	Amount (€)
Reproductive biology study	€40,000
Age and growth study	€35,000
Genetics study for stock differentiation	€20,000
Sampling collection and shipping	€5,000
Total	**€100,000**

Appendix 9

Report of the ICCAT Shark Research and Data Collection Programme (ICCAT/SRDCP)

Background and programme objectives

During the 2014 Commission meeting it was decided that an overall budget of €135,000 would be allocated to the Shark Research and Data Collection Programme (SRDCP). During the 2015 Blue Shark Data Preparatory Meeting, (Anon. 2016a) the Shark Species Group (SSG) reviewed the proposal for implementation of the SRDCP that had been prepared in 2014 and identified national scientists who would be in charge of preparing proposals for receiving funds to carry out each of the research topics listed in the original proposal. For the first three years the programme focused on biological and other aspects of the shortfin mako and contemplated extensive collaborative work among national scientists with the aim of contributing information to the 2017 shortfin mako stock assessment. Activities under the SRDCP continued throughout 2018 and 2019, and extended to include other shark species.

2019 Activities

During the 2015 Blue Shark Stock Assessment Meeting (Anon. 2016b) and shortly thereafter, four project proposals covering different aspects of the life history, stock structure, and fisheries of the shortfin mako were presented: a pan-Atlantic age and growth study; a population genetics study to estimate the stock structure and phylogeography of Atlantic shortfin mako; a post-release mortality study focusing on pelagic longline fisheries; and a satellite tagging study for determining movements and habitat use. The following are the cumulative SRDCP activities conducted up to 2019.

Age and growth of shortfin mako in the Atlantic Ocean

The project leader for this study is Dr Rui Coelho, national scientist from EU-Portugal, with participation of scientists from EU-Portugal, United States and Uruguay. There still remained uncertainties about the age and growth parameters of shortfin mako and this project aimed to update the available estimates by ageing specimens from multiple areas in the Atlantic. To that end, an inventory of existing vertebral samples available at each national laboratory was compiled, and additional sampling was carried out. All samples were processed and digital images were uploaded to an ICCAT online repository. Following a two-day age and growth workshop organized by NOAA-NEFSC (Narragansett Laboratory) with the participation of the involved scientists in June 2016 in which an initial reference set for ageing samples was established, one biologist from each participating institution read and estimated the ages from all the samples, based on the agreed ages from the reference set, and growth models were developed based on those readings. For the North Atlantic, data from 375 specimens ranging in size from 57 to 366 cm fork length (FL) for females and 52 to 279 cm FL for males were analyzed. Growth models were fitted using the von Bertalanffy growth equation re-parameterized to calculate L_0, instead of t_0, and a modification of this equation fixing the known size at birth. Growth models were compared using information theoretical criteria and the von Bertalanffy growth equation with fixed L_0 (size at birth = 63 cm FL) adequately described model growth, with resulting growth parameters of L_{INF} = 241.8 cm FL, k = 0.136 year^{-1} for males and L_{INF} = 350.3 cm FL, k = 0.064 year^{1} for females. The results of this study (Rosa *et al.* 2017) were used in the 2017 Shortfin Mako Stock Assessment session (Anon. 2017i). In 2018, results for the South Atlantic stock based on data from 332 specimens, ranging in size from 90 to 330 cm FL for females and 81 to 250 cm FL for males, were analyzed (Rosa *et al.* 2018b). The von Bertalanffy growth equation with fixed L_0 (size at birth = 63 cm FL) with resulting growth parameters of L_{INF} = 218.5 cm FL, k = 0.170 year^{-1} for males and Linf = 263.1 cm FL, k = 0.112 year^{-1} for females, seemed to underestimate asymptotic size for this species, while overestimating k. Given the poorly estimated parameters, the Group did not yet recommend the use of the growth curves for the South Atlantic stock. It was noted that more samples are still required to develop more credible growth curves, particularly specimens from the southeast region. In that regard, scientists from Japan indicated that they have collected some samples (n=33) from that area and the scientist from Namibia also expressed its willingness to provide vertebral samples from the region to contribute to the age and growth study. Additional samples from Brazil will also be made available. It was also discussed the exploration of alternative growth models and a meta-analysis to incorporate variability in the growth curves to be used in future stock assessments.

Genetic analysis of shortfin mako in the Atlantic Ocean

Dr Yasuko Semba, national scientist from Japan took over as project leader for this study from Dr Kotaro Yokawa. The main goal of this study was to investigate the genetic stock structure of the Atlantic shortfin mako using mitochondrial and microsatellite DNA of specimens collected across the entire Atlantic Ocean. The mitochondrial analyses conducted under this project indicated the differentiation of populations in the northern, southwestern, and southcentral and south-eastern areas, which supports current stock structure hypotheses of Atlantic shortfin makos, and also suggested the possibility of multiple stocks within the South Atlantic; however, no significant genetic structuring was found based on the microsatellite analyses. Additional analyses to investigate the fine-scale genetic structure, especially in the North Atlantic, were conducted in 2017 based on tissues collected from the entire Atlantic through collaboration with CPC members of the Species Group. Tissues from a total of 54 individuals were collected from the Caribbean Sea, Mediterranean, tropical Atlantic Ocean and Uruguay and were processed. Results of the new analyses confirmed previous findings and were reported more in detail at the Species Group meeting in September 2017 and in Nohara *et al.* 2017. In 2018, a new approach using mitochondrial-genome sequencing was proposed to investigate the genetic population structure of shortfin mako. The Group welcomed this proposal that could help elucidate the stock delimitation of this species in the Atlantic, particularly the differences between the southwest and southeast Atlantic related to the high heterogeneity and low genetic diversity from the Uruguayan samples. The complete mitochondrial genome (mitogenome) sequencing was conducted using next generation sequencing (NGS) technology. Whole mitogenome sequencing with the Long PCR technique (Miya *et al*., 2003) was planned initially, and two Long PCR primer sets (set1; S-LA16S-H lso and L12321Leu, set2; S-LA16S-L lso and H12293Leu; located in tRNALeu and 16S rRNA gene of the mitochondrial DNA region) were designed for shortfin mako based on the nucleotide sequence deposited in the DNA data base (Accession No. KF361861). Although several conditions about long PCR reaction were tested, the amplification of Long PCR was not successful for many specimens. The main reason for this problem was suggested to be the condition of the template DNA (i.e., the fragmentation of total genomic DNA). Because of the variable preservation level of tissue samples, protocols to obtain mitogenomes from low quality and/or quantity DNA extracts will have to be developed. As an alternative for mitogenome sequencing with the long PCR method, the method proposed by Tilak *et al.* 2015 is being tested. In addition, the Uruguay samples showed different results compared to the past two studies (Taguchi *et al.,* 2016; Nohara *et al.,* 2017) and the study must be revisited. Samples from an additional 35 specimens collected in 2018 were provided by Uruguay and were analyzed as part of the project in 2019. At the 2019 Species Group meeting, (Anon. 2019g) a document was presented in which the previous definition of population was re-evaluated in the analysis of the portion of mitochondrial DNA and the annual fluctuation in genetic population structure was analyzed based on the re-defined data sets with additional data by Corrigan *et al*. 2018. As a result, a substantial genetic differentiation between the northern and southern regions in the Atlantic Ocean was observed in this species. An annual fluctuation of genetic composition was also found in the waters around equatorial area and the waters off Cape Town (South Africa). Furthermore, the whole mitochondrial genome analysis based on the Next Generation Sequencing (NGS) approach has been started to confirm the mitochondrial (maternal) genetic population structure of this species.

Post-release mortality of shortfin mako in the Atlantic Ocean

The project leader for this study is Dr Andrés Domingo, National scientist from Uruguay. The main purpose of this project is to quantify the post-release mortality of Atlantic shortfin makos on pelagic longlines, which was non-existent when the project started, to potentially contribute to their assessment and management. To that end, Survivorship Popup Satellite Archival Transmitting Tags (sPATs) were acquired and distributed to the participating laboratories for deployment in three main areas of the Atlantic: the northwest Atlantic, the tropical northeast Atlantic and equatorial region, and the southwest Atlantic. A total of 14 sPATs have been deployed thus far by scientific observers from IPMA (EU-Portugal), DINARA (Uruguay), NOAA (USA), Brazil and EU-Spain, and additional information from 29 miniPATs was also available to estimate post-release mortality. Of the 35 specimens with available information, eight died (22.9%), whereas the remaining 27 survived (77.1%), at least the first 30 days after tagging. The updated results from this project were reported and published in Miller *et al.* 2019. Tag deployment has continued throughout 2019 and in March two more shortfin makos were tagged with miniPATs.

Movements, stock boundaries and habitat use of shortfin mako in the Atlantic Ocean

The project leader for this study is Dr Rui Coelho, national scientist from EU-Portugal. The main purpose of this study is to use satellite telemetry to gather and provide information on stock boundaries, movement patterns and habitat use of shortfin mako in the Atlantic Ocean, to potentially contribute to their assessment and management. All phase 1 (2015-2016) and Phase 2 (2016-2017) tags have been deployed (36 tags: 22 miniPATs and 14 sPATs). Regarding Phase 3 (2017-2018), 5 of the 20 miniPATs acquired have been deployed on shortfin mako and 3 tags were deployed on silky shark. Eight of these tags are planned to be deployed in the Indian Ocean in order to assess inter-ocean movements of shortfin mako. Four of the 20 tags acquired during Phase 4 (2018-2019) were deployed on shortfin mako and 6 on other vulnerable species (oceanic whitetip, silky shark, porbeagle and scalloped hammerhead). In all, a total of 43 tags (29 miniPATs and 14 sPATs) were deployed by observers on EU-Portugal, Uruguay, Brazil, EU-Spain and US vessels in the temperate NE and NW, Equatorial and SW Atlantic. Data from 41 of the 43 tags/specimens are available for a total of 1,656 tracking days recorded. Twenty additional tags from other projects involving the same partners were also deployed in these same areas, covering both hemispheres and both sides of the Atlantic. The preliminary movement analysis shows that specimens tagged in the temperate northeast moved to southern areas, while specimens tagged in the tropical northeast region close to the Cabo Verde Archipelago moved easterly to the African continent shelf. One specimen was tagged in equatorial waters and moved south to Namibia. The specimens tagged in the southwest Atlantic off Uruguay stayed in the same general area, and the specimens tagged in the temperate Northwest Atlantic showed some general southward movements. Shortfin makos spent most of their time above the thermocline (0-90 m), between 18 and 22°C. The updated results from this project were reported and published in Santos *et al.* 2019. The main plan for the next phase of the project is to continue tag deployment (17 additional tags were acquired) during the rest of 2019 in several regions of the Atlantic. On that premise, in March 2019 two more shortfin makos were tagged by the EU-Spain fleet around the Canary Islands.

Reproduction of shortfin mako and porbeagle in the Atlantic Ocean

The point of contact for this study is Dr Enric Cortés. A two-day, hands-on training session on determination of reproductive maturity of porbeagle sharks was held at the Narragansett Rhode Island, NOAA Fisheries NEFSC Laboratory on 14-15 July 2017, led by Dr Lisa Natanson. During this training, scientists from the participating laboratories (NOAA SEFSC and NEFSC) worked together to collect reproductive organ samples to aid in determining reproductive habits and maturity for the species. The training was aimed at establishing standardized dissecting and sampling practices among researchers for more consistent collection of life history data. Sampling has taken place at several shark tournaments between New York and Maine, USA. In 2017, five male and 16 female shortfin makos and 8 female porbeagle were dissected. .Although previous research based on specimens collected from the western North Atlantic Ocean indicated that this lamnid shark has an annual reproductive cycle, the results of a recent evaluation of reproductive tracts from a geographically segregated group of porbeagles within the western North Atlantic Ocean indicate the presence of females in a resting stage of maturity. The observation of a resting stage has implications not only for the reproductive cycle (biennial versus annual), but also in the lifetime productivity of the species. This finding indicates that this shark follows the typical lamnid resting period between pregnancies, a period that would decrease the lifetime output of young sharks (Natanson *et al.* 2019). Presence of a resting population of female porbeagles (*Lamna nasus*), indicating a biennial reproductive cycle, in the western North Atlantic Ocean.

Movements, stock boundaries and habitat use of porbeagle in the Atlantic Ocean

A total of 16 miniPATs acquired for this project were distributed to scientists from EU-France, EU-Portugal, and Norway, to be deployed in the North Atlantic, and Uruguay to be deployed in the South Atlantic. Relevant to this activity and that related to shortfin mako, the Group was informed of other ongoing national programmes that can contribute data, such as Canada's, which is currently deploying 30 sPATs on shortfin mako and 30 sPATs on porbeagle during 2018-2019; and 12 new sPATs for porbeagle from a US/NOAA project that will be deployed in EU-Portugal, Uruguay, and United States vessels.

Movements, stock boundaries and habitat use of silky, oceanic whitetip and hammerhead sharks in the Atlantic Ocean

The Group also decided that of 17 satellite tags that were acquired in 2019 for the SRDCP, 9 should be deployed on oceanic whitetip and hammerhead sharks and 8 on silky sharks. A total of 4 silky sharks have been tagged with miniPATs thus far by USA scientists (in collaboration with the Cape Eleuthera Institute, and Florida State University) in the U.S. Gulf of Mexico, Caribbean Sea, and Atlantic Ocean and 11 await deployment. These are considered priority shark species and are currently prohibited to be retained in ICCAT fisheries (a review of satellite tags previously deployed on these species in the Atlantic revealed that only three silky sharks had been tagged off Cuba, and oceanic whitetip sharks were tagged only in the NW Atlantic, but almost nowhere else in the Atlantic). Also, these species were ranked with high vulnerability in the ICCAT shark ERAs (Cortés *et al*., 2010 and Cortés *et al.* 2015).

2020 Plan and Activities

Age and growth of shortfin mako in the Atlantic Ocean

In view of the need for additional vertebrae to develop reliable growth curves for the South Atlantic stock, the Group will endeavour to analyze samples collected by Japan, Namibia and Brazil in the southeast Atlantic and conduct final analyses.

Genetic analysis of shortfin mako in the Atlantic Ocean

National scientists from Japan will continue work on the genetic population structure of shortfin makos using next generation sequencing techniques and provide updated results. The Group will also investigate the possibility of acquiring samples from the southeast Pacific (e.g., from Chile) to determine if there is any relationship with the southwest Atlantic.

Post-release mortality of shortfin mako in the Atlantic Ocean/movements, stock boundaries and habitat use of shortfin mako in the Atlantic Ocean

The Group will continue deployment of the remaining tags acquired since late 2018, including 4 tags to be deployed by scientists from South Africa and 4 tags by scientists from EU-France, with the final analyses of these projects expected during late 2020.

Reproductive biology of shortfin mako and porbeagle in the Atlantic Ocean

There are still large data gaps in the biological knowledge of porbeagle, and as such it is important to continue the ongoing work on the reproductive biology of this species so that the results can be available for the next stock assessment. Since few samples can be collected each year and continued collection is important for updating reproductive parameters, we propose to opportunistically continue sampling reproductive organs of porbeagle (and shortfin mako) in the western North Atlantic in 2020. We also plan to conduct a workshop in early 2020 for reviewing and standardizing methods of analysis of reproductive data for these and other pelagic shark species and to review the results obtained for shortfin mako and porbeagle in early 2020. In particular, a spatial analysis will be conducted to help identify critical locations for shortfin mako in different reproductive conditions and updated maturity ogives will be developed and compared to those derived using existing historical samples.

Additionally, even though the main ICCAT shark species are blue shark, shortfin mako and porbeagle, the Group is also responsible for providing scientific advice on other pelagic, oceanic and highly migratory shark species that are caught in association with ICCAT fisheries. Most of these other species are data-limited, and as such it is a priority to start biological projects and data collection for these species in order to provide better advice in the future.

Movements and habitat use of porbeagle in the Atlantic Ocean

The project leaders for this study are Dr Andrés Domingo and Dr Rui Coelho, national scientists from Uruguay and EU-Portugal. The main purpose of this study is to use satellite telemetry to gather and provide information on stock boundaries, movement patterns and habitat use of porbeagle in the Atlantic Ocean, to potentially contribute to their assessment and management. In 2020 we plan to finish deployment of the 11 miniPATs acquired in late 2018, which have not yet have been deployed. The deployments are planned by scientists from EU-Portugal, EU-France and Norway in the North Atlantic, and Uruguay in the South Atlantic.

Movements, stock boundaries and habitat use of silky, oceanic whitetip and hammerhead sharks in the Atlantic Ocean

The project leaders for this study are also Dr Andrés Domingo and Dr Rui Coelho, National scientists from Uruguay and EU-Portugal. As stated above, the Group decided that the 17 satellite tags acquired in late 2018 and 2019 for the SRDCP should be deployed on silky oceanic whitetip and hammerhead sharks, with priority given to silky sharks as this was ranked as the most vulnerable species in the 2010 ERA (Cortés *et al*., 2010). In 2020 we propose to acquire 13-14 additional tags to be deployed on silky, oceanic whitetip and hammerhead sharks to continue the project.

2019 budget and expenditures

This section presents a summary of the contributions for the SRDCP during 2019. The Shark Species Group developed a budget of €115,000 for Year 5 of the programme (**Table 1**). These funds were approved and allocated as follows: €15,000 for the shortfin mako genetic analysis, €30,000 for the reproductive study; €70,000 for purchasing 16 satellite tags (including satellite time and fish costs) to be deployed on silky, oceanic whitetip and hammerheads sharks.

2020 budget and requested contributions

The proposed budget for Year 6 of the SRDCP (2020) amounts to a total of €125,000 (**Table 2**). Funds are being requested for research on shortfin mako, porbeagle, and silky sharks, oceanic whitetip, and hammerheads, distributed as follows:

- Shortfin mako genetics (NGS - next generation sequencing, with additional samples from Uruguay): €25,000;

- Shortfin mako South Atlantic age and growth study, including additional sample analysis and finalizing analytical results €10,000;

- Reproductive study of porbeagle, including continuation of sample collection and organizing a workshop to standardize sampling and analytical methodologies and analyze results: €35,000;

- Silky, oceanic whitetip and hammerhead sharks: €55,000 to study movement and habitat characterization studies for other priority ICCAT species (includes costs for purchasing 13-14 satellite tags, satellite use and fish);

Table 1. 2019 SRDCP budget.

Project	*Participating CPCs*	*Project leader*	*Approved Budget (€) 2018*
SHORTFIN MAKO			
Stock boundaries (Genetics)	EU, Japan, Uruguay, US, etc.	Y. Semba	15,000
Movements and habitat use (PSATs)	EU, Uruguay, US, etc.	R. Coelho/ A. Domingo	35,000
PORBEAGLE			
Reproduction	EU, Canada, Japan, US, Uruguay	E. Cortés	30,000
SILKY, OCEANIC WHITTIP & HAMMERHEAD			
Movements and habitat use (PSATs)	EU, Uruguay, US, etc.	R. Coelho/ A. Domingo	35,000
		Total	**115,000**

Table 2. Proposed budget for 2020 SRDCP.

Project	*Participating CPCs*	*Project leader*	*Budget requested (€) 2019*
SHORTFIN MAKO			
Stock boundaries (Genetics)	EU, Japan, Uruguay, US, etc.	Y. Semba	25,000
Age and growth (southern Atlantic)	EU, Brazil, Uruguay, Namibia, Japan	R. Coelho	10,000
PORBEAGLE			
Reproduction	EU, Canada, Japan, Uruguay, US,	E. Cortés	35,000
SILKY, OCEANIC WHITETIP & HAMMERHEAD			
Movements and habitat use (PSATs)	EU, Canada, Uruguay, US, Brazil	A. Domingo/ R. Coelho	55,000
		Total	**125,000**

Appendix 10

Report of the ICCAT Enhanced Programme for Billfish Research (ICCAT/EPBR)

(Expenditures/Contributions 2019 and Programme Plan for 2020)

Summary and Programme objectives

The ICCAT Enhanced Programme for Billfish Research (EPBR) continued its activities in 2018. The Secretariat coordinates the transfer of funds and distribution of tags, information, and data. The overall programme coordinator and western Atlantic coordinator during 2019 was Dr Fambaye Ngom Sow. Dr John Hoolihan (USA), previous coordinator for the western Atlantic Ocean was replaced by Ms. Karina Ramírez López (Mexico) in 2019, Dr Fambaye Ngom Sow was the 2019 coordinator for the eastern Atlantic.

The original plan (1986) for EPBR included the following objectives: (1) to provide more detailed catch and effort statistics, particularly for size frequency data; (2) to initiate the ICCAT tagging programme for billfish; and (3) to assist in collecting data for age and growth studies. During past Billfish Species Group meetings, the Billfish Species Group requested that the objectives of EPBR expand to evaluate adult billfish habitat use, study billfish spawning patterns and billfish population genetics. The Billfish Species Group believes that these studies are essential to improve billfish assessments. Efforts to meet these goals during 2018-2019 are highlighted below.

The specific funding for EPBR previously available has now been combined with the general research fund (ICCAT Science Envelope). Project funding will now be allotted on a competitive basis with other species working groups.

2019 activities

In 2018 funding from the ICCAT Science Envelope was awarded to a Consortium led by Institut Fondamental d'Afrique noire Cheikh Anta DIOP (Université Cheikh Anta Diop de Dakar, Senegal) to support the collection of hard parts (otoliths, spines or vertebra) and associated information for marlins and sailfish caught off West Africa or from other ICCAT Convention areas, either from directed or by-catch billfish fisheries. This contract was extended until May 2019. In July 2019 a new contract was awarded to Centre de Recherches Océanographiques de Dakar/Thiaroye (ISRA/CRODT, Senegal) to continue the activities of the previous contract for a 12 months period. Now, it also engages EU research teams (from Portugal and Spain), which will significantly enhance the collection of samples onboard industrial vessels operating in the same area and support the analysis of data on length and age for estimating the growth parameters of the main billfish species that occur in the eastern Atlantic (*Makaira nigricans*, BUM; *Tetrapturus albidus*, WHM; and *Istiophorus albicans*, SAI).

Following the SCRS request, in August 2019 through the ICCAT Science Envelope, a contract was awarded to the Dirección General Adjunta de Investigación Pesquera en el Atlántico, Centro Regional de Investigación Acuícola y Pesquera en Veracruz (Mexico) to develop a Reproductive biology study on Atlantic blue marlin in the Gulf of Mexico.

Scientists from Nova Southeastern University continued their involvement with genetic studies of white marlin and spearfishes. Genetic samples are being provided on a voluntary collection basis by participants from various ICCAT CPCs. Genetic sampling kits continued to be distributed in 2019 to a number of fleets to help identify the percentage of white marlin, longbill spearfish and roundscale spearfish in the mixture of landings that represent these three species. In 2019, 4 sample kits have been returned as of 25 September 2019.

Funds have been made available for sampling of artisanal and small scale fisheries in the eastern Atlantic (Côte d'Ivoire, São Tomé and Senegal). These funds were allocated to support the estimation of catch and effort statistics of fleets contributing the largest parts of the catch and/or those having traditionally provided the higher quality data in the past, to ensure the preservation of an uninterrupted time series of catch and relative abundance indices. As of 9 September 2019, request of such funds have been made to the Secretariat.

2020 plan and activities

The highest priorities for 2020 are to support the objectives established by the billfish work plan and those of the EPBR, with specific emphasis on the collection of biological samples for growth and reproductive studies, and enhance the collection of fisheries data in developing countries:

– support the collection of billfish biological samples off West Africa;

– support the blue marlin biological and photographic sampling in Gulf of Mexico;

– fund a workshop on growth and aging techniques involving researchers from both East and western Atlantic;

– support the monitoring of billfish catches from West African artisanal fishing fleets (i.e. Côte d'Ivoire, Ghana, São Tomé e Príncipe and Senegal);

– fund two regional workshops in West Africa and Caribbean for CPC statistical correspondents on artisanal fisheries data collection;

– fund the development of an App for mobile phones for the collection and report of fisheries data from artisanal fisheries in collaboration with local scientific institutions.

All these activities depend on successful coordination, sufficient financial resources and adequate in-kind support. Details of EPBR funded activities for 2020 are provided below.

Shore-based sampling

Sampling of artisanal and small scale fisheries to support the estimation of catch and effort statistics will be focused on fleets contributing the largest parts of the catch and/or those having traditionally provided the higher quality data in the past, to ensure the preservation of an uninterrupted time series of catch and relative abundance indices. In the eastern Atlantic, monitoring and sample collection will be supported for the artisanal fisheries of Côte d'Ivoire, Ghana, São Tomé e Príncipe and Senegal.

Biological studies

The collection of biological samples for genetic study to differentiate white marlin and spearfish, will continue in 2020.

Continue efforts to finalize the collection of biological samples for reproduction, age and growth studies for marlins and sailfish caught off West Africa, either from directed or by-catch billfish fisheries of both artisanal and industrial fleets. In 2020 increasing effort will be made for processing and analyze the available samples. Such activities require the continuation of financial support.

Coordination

Training and sample collection

Programme coordinators need to travel to locations not directly accessible to promote EPBR activities and ICCAT data requirements regarding billfish. This includes travel to West African countries, as well as the Caribbean and South America by the general coordinator and the coordinator from the West. Coordinated activities between EPBR, JCAP and ICCAT data funds will continue to be required.

Programme management

The EPBR budget is now part of the ICCAT Science Envelope and management is assumed by the programme coordinators, with the support of the Secretariat. Reporting to the SCRS is a responsibility of the coordinators. Countries that are allocated budget lines for programme activities need to contact the respective programme coordinators for approval of expenditures before the work is carried out. Invoices and brief reports on activities conducted need to be sent to the programme coordinators and ICCAT to obtain reimbursement. Funding requests need to follow ICCAT protocol for the use of funds (see Addendum 2 to Appendix 7 of *Report for Biennial Period 2010-2011, Part II (2011), Vol. 2*).

2019 Budget and expenditures

This section presents a summary of the EPBR budget for 2019, which amounted to €74,000 (**Table 1**). These funds were approved and allocated as follows: €50,000 for studies related to three billfish species (BUM, WHM and SAI) on: age and growth and genetics studies, sample collection and shipping; €15,000 for a marlin reproduction biology study including the collection of and photographic samples; and, €9,000 for shore-based sampling in the eastern Atlantic.

Table 1. 2019 EPBR budget.

Activity	*Requested (€)*	*Committed (€)*
Monitoring and collection statistics for the artisanal fisheries in eastern Atlantic	20,000	9,000
Age and growth study	20,000	50,000
Sampling collection and shipping	15,000	
Gulf of Mexico blue marlin reproduction biology and photographic samples	15,000	15,000
Total	**70,000**	**74,000**

As of 25 September 2019, no reimbursement regarding shore-based sampling in the eastern Atlantic has been made requested.

2020 budget and requested contributions

The proposed 2020 budget, totalling €152,000 is detailed in **Table 2.** To achieve all its objectives in 2020 the programme will continue to require contributions from other sources, such as those so generously provided lately by the US and Chinese Taipei.

Table 2. 2020 EPBR budget.

Activity	*Request (€)*
Monitoring and collection statistics for the artisanal fisheries in eastern Atlantic	12,000
Two regional workshops involving statistical correspondents	50,000
Development of an App for mobile phones	25,000
Age and growth study	60,000
Workshop on ageing	
Sampling collection and shipping	
Gulf of Mexico blue marlin biological and photographic samples	5,000
Total	**152,000**

Development of improved age and growth curves and estimates of maximum longevity of billfishes has been recommended by the Group. **Table 2** continues to include research funding allocations to conduct biological sampling for age and growth of sailfish, blue and white marlins in the eastern Atlantic, as currently no age and growth information is available for the eastern stock of sailfish, nor for the two marlin species caught in that region. Additionally, it includes now funds for a workshop on growth and aging techniques involving researchers from both East and western Atlantic.

The consequence of the programme failing to obtain the requested budget will be to stop or reduce programme activities for 2020 including: (1) collection and processing of genetic samples, collection and processing of gonad samples and hard structures (spines and otoliths), (2) size sampling and collection of statistics of catches from fleets in the eastern Atlantic, (3) enhancing regional sampling programmes. All these activities are critical to continue the improvement of the information available to the SCRS for billfish stock assessments.

Conclusion

The EPBR is an important mechanism towards completing the goal of having the highest quality information to assess billfish stocks. The EPBR has been credited for major improvements in the data supporting the last ICCAT billfish assessments and the SCRS advice to the Commission. The EPBR is the only programme that focuses exclusively on billfish. Therefore, programme continuation is paramount to facilitate the collection of biological and fishery information on billfish species. The EPBR will continue to require support from ICCAT and other sources to operate and address the needs of the Commission.

Appendix 11

PROPOSAL FOR AMENDMENT OF THE RULES AND PROCEDURES FOR THE PROTECTION, ACCESS TO, AND DISSEMINATION OF DATA COMPILED BY ICCAT

This is an addendum to Annex 6 of the ICCAT Report for biennial period, 2010-2011, Part I (2010) – Vol. 1, "Rules and Procedures for the Protection, Access to, and Dissemination of Data Compiled by ICCAT". This amendment aims to clarify the rules and procedures that apply to data collected by entities contracted under ICCAT research and data collection programmes. As ICCAT and the SCRS continue to promote Scientific Research of ICCAT species though the participation of CPCs, national scientist and Academic and Research Centres, it is important that rules and procedures be defined to ensure that data collected under these research programs are properly evaluated and effectively used for scientific advice.

ANNEX 6

RULES AND PROCEDURES FOR THE PROTECTION, ACCESS TO, AND DISSEMINATION OF DATA COMPILED BY ICCAT

1. Basic principles relating to the dissemination of data by the ICCAT

1. Data and information held by the ICCAT Commission or Secretariat, and by service providers or contractors acting on their behalf, shall only be released in accordance with these Rules and Procedures; which reflect the policies of confidentiality and security determined by the Commission.

2. Data may be disseminated if the CPC (Contracting Party or Cooperating non-Contracting Party, Entity or Fishing Entity) providing the data to the ICCAT authorizes its release.

3. Persons duly authorized by the Executive Secretary within the ICCAT Secretariat and service providers, who have read and signed the Commission's confidentiality protocol, shall have access to the data necessary to perform their ICCAT duties.

4. Officers of the Commission and its subsidiary bodies shall have access to the data necessary to perform their ICCAT duties.

5. CPCs shall have access to data to serve the purposes of the Convention, including data:
   a) covering vessels flying their flag in the ICCAT Convention area.
   b) covering any vessels fishing in waters under their jurisdiction.
   c) covering vessels applying to fish in their national waters, unloading in their ports or transshipping fish within waters under their jurisdiction.
   d) for the purpose of compliance and enforcement activities on the high seas, consistent with the Convention and the conservation and management measures and other relevant decisions adopted by the Commission, subject to the rules and procedures for access and dissemination of such data that the Commission will adopt under paragraph 23.
   e) for the purpose of scientific and other research, if the CPC that originally provided that data authorizes the Commission to release them. In cases where a CPC elects to provide an ongoing authorization for the release of such data, the CPC may at any time cancel this authorization by notifying the Secretariat that it has revised its earlier decision.

6. To the greatest extent practical, the ICCAT Commission, Secretariat and their service providers, should disseminate data in a timely manner.

2. Risk classification and definition of confidentiality

7. Data covered by these Rules and Procedures will be classified in accordance with the risk classification methodology included in **Table 1**, which reflects *inter alia* the damage that would be done to the operations or creditability of the Commission as a consequence of the unauthorized disclosure or modification of such information.

8. Data covered by these Rules and Procedures were determined to be either public domain or non-public domain data in accordance with the definition of confidentiality established in **Table 1**.

8 (bis) Clarification for data arising from ICCAT Research and Data Collection Programmes

Associated conventional tagging data: examples; Tag shedding and Tag seeding data are classified as no risk and thus fall under the public domain data category. Associated conventional tagging data includes species, seeding and recovery dates and positions, gear type, flag, and fish information where available. Associated conventional tagging data in this context does not include information identifying the fishing vessel that reported the tag, for example, which would otherwise alter its security classification.

Biological data are classified as medium risk and thus fall under the non-public domain data category. This should include biological samples and initial results from the analyses of such samples; for ageing, genetic, maturity and reproductive studies, stock identification samples such as microconstituents, parasites, stomach content, muscle or any other biological tissue used for scientific analyses.

Fisheries independent indices including aerial surveys, larval sampling, acoustic sonar data, video recording, and sampling from scientific based observer programs are classified as medium risk and thus fall under the non-public domain data category.

All other data types follow the definitions and classification rules outlined in **Table 1 and 2.**

3. Dissemination of public domain data

9. Data in the public domain shall not reveal the individual activities of any vessel, company or person and shall not contain private information. Catch and effort data in the public domain shall be aggregated by flag, gear, month and 1º x 1º grid (for surface fisheries) or 5ºx5º grid (for longline fisheries).

10. Annual catch estimates and aggregated catch and effort data that can be used to identify the activities of any vessel, company or person are not in the public domain.

11. Except for data as described in Paragraphs 9 and 10, the types of data listed in **Appendix 1 to ANNEX 6** have been designated to be public domain data.

12. Public Domain data shall be available to any persons for (a) downloading from the Commission's website and/or (b) release by the Commission on request.

13. The website should contain a statement describing the conditions associated with the viewing or downloading of public domain data (for example, that the source of the data must be acknowledged), and should require the person requesting the data to "Accept" these conditions before viewing or downloading can begin.

13 (bis) Public domain data collected by entities contracted by ICCAT research and data collection programmes (e.g. conventional tagging) shall be quality controlled and uploaded to the ICCAT website by the Secretariat, on an annual basis. Immediate access to the most up to date quality-controlled data will be granted to respective SCRS working groups and participants of workshops organized by the research programme in question (e.g. capacity building workshops). Any other users wishing to access such data must follow the procedure outlined in section 17bis (c) below.

4. Dissemination of non-public domain data

4.1 Definition of non-public domain data

14. Subject to the decisions of the Commission, all types of data not described in paragraph 11 shall be referred to as non-public domain data.

15. A list of examples of non-public domain data can be found in **Appendix 2 to ANNEX 6**.

4.2 General rules for dissemination of, and access to, non-public domain data

16. Access to and dissemination of non-public domain data shall be authorized in accordance with these Rules and Procedures and the policies of confidentiality and security established in the Commission's Information Security Policy (ISP).

17. The ICCAT Secretariat shall log and report to the Commission all access and dissemination of non-public domain data, including the name and affiliation of the person, the type of data accessed or disseminated, the purpose for which the data were requested, the date when the data were requested, the date when the data were released and authorizations that may have been required.

<u>*17 (bis) In the case data gathered within ICCAT Research and Data Collection Programmes:*</u>

<u>a) Data will be accessible, once checked by ICCAT staff for quality control, to related SCRS subsidiary body (e.g. Species group) and the research teams directly involved in data generation, authorizing their use for scientific purposes as stipulated by the terms of the contract related to the collection of these data.</u>

<u>b) Metadata relating to such data should be periodically updated on the ICCAT website.</u>

<u>c) Data requests may be submitted by any person(s) or institutions(s) using the form found in this Addendum. Each request will be considered by an evaluation committee (composed of the Chair and Vice Chair of the SCRS, Rapporteur of the respective Species Group, and programme Coordinator if still available) to guarantee adherence to the ICCAT Publication Policy and alignment with the respective research programme priorities. The Evaluation Committee will consult with the data provider(s) to decide whether to authorize the data request. If the data provider(s) confirm that there is no conflict of interest, the data will be released after signing the Confidentiality Agreement (**Attachment 2 to Appendix 3 of ANNEX 6**). Should the data provider(s) seek preferential use of the data, this request will be considered and granted up to a maximum period of XX months/years, or for the period of time specifically agreed in the contract. The Secretariat will be responsible for coordinating and facilitating this process. The Evaluation Committee will strive to return a decision within 30 days of the request. The Secretariat will provide to the SCRS Plenary meeting a list of data requests and decisions in the annual report of activities.</u>

4.3 Access to non-public domain data by the Staff of the Secretariat, the ICCAT service providers, and Officers of the Commission and its subsidiary bodies

18. Persons duly authorized by the Executive Secretary, within the ICCAT Secretariat and service providers, including scientific experts within the SCRS, shall have access to the data necessary to perform their ICCAT duties. Officers of the Commission and its subsidiary bodies shall have access to the data necessary to perform their ICCAT duties. All such persons shall sign a Confidentiality Agreement with the Executive Secretary and maintain the data security standards of the Commission in respect of data to which they have access. The Executive Secretary shall maintain a register of all such persons (including the purpose for which they require access to the data) and make the register available to a CPC on written request.

4.4 Access to non-public domain data by CPCs

19. CPCs shall have access to non-public domain data to serve the purposes of the Convention, including data:

    a) Covering vessels flying their flag in the ICCAT Convention area
    b) Covering any vessels fishing in waters under their jurisdiction
    c) Covering vessels applying to fish in their national waters, unloading in their ports or transshipping fish within waters under their jurisdiction
    d) For the purpose of scientific and other research, if the CPC that originally provided that data authorizes the Commission to release them. In cases where a CPC elects to provide an ongoing authorization for the release of such data, the CPC may at any time cancel this authorization by notifying the Secretariat that it has revised its earlier decision.

20. CPCs shall notify the Secretariat of a small number of representatives (preferably only 2) authorized to receive non-public domain data. Such notification will include name, affiliation, and contact information (e.g. telephone, facsimile, email address). The ICCAT Secretariat will maintain a list of such authorized representatives. CPCs and the Secretariat shall ensure the list of CPC representatives is kept up to date and made available.

21. The authorized representative(s) of the CPCs are responsible for ensuring the confidentiality and security of the non-public domain data according to its risk classification and in a manner consistent with security standards established by the Commission for the ICCAT Secretariat.

22. The non-public domain data described in paragraph 19 will be made available by the Secretariat to authorized representatives of the CPCs for release by the Commission on request and, where appropriate, downloading from the Commission's website in accordance with the Commission's ISP.

23. For the purpose of compliance and enforcement activities on the high seas, non-public domain data will be made available subject to separate rules and procedures for the access and dissemination of such data, that the Commission will adopt for these purposes.

24. VMS data will be made available for scientific purposes, subject to the separate rules and procedures referred to in paragraph 23 above.

25. Access to non-public domain data by CPCs shall be administered by the Executive Secretary on the basis of these Rules and Procedures and the framework at **Appendix 3 to ANNEX 6**.

26. The Executive Secretary will implement the Framework and authorize access to and dissemination of non-public domain data.

27. Unless otherwise decided by the Member or CPC responsible for its external affairs, participating Territories shall have the same access rights to data as CPCs.

28. A CPC that has not fulfilled its obligations to provide data to the Commission for two consecutive years shall not be granted access to Non-Public Domain data until all such matters are rectified. A CPC whose representative, authorized in accordance with paragraphs 20 and 21 above, failed to observe the rules stipulated in these Rules and Procedures shall not be granted access to Non-Public Domain data until the appropriate actions have been taken.

4.5 Exchange of data with other regional fisheries management organizations

29. If the Commission enters into agreements for the exchange of data with other regional fisheries management organizations (RFMOs) or other organizations, such agreements must include requirements that the other RFMO provides equivalent data on a reciprocal basis and maintains the data provided to them in a manner consistent with the security standards established by the Commission. The data that may be exchanged is specified in **Appendix 4 to ANNEX 6**. At each annual session the Executive Secretary will provide copies of data exchange agreements that exist with other RFMOs and a summary of the data exchanges that occurred during the previous 12 months under such agreements.

4.6 Disseminations of non-public domain data in other circumstances

30. Non-Public Domain data will be made available by the Secretariat to any persons if the CPC that originally provided that data authorizes the Commission to release them. In cases where a CPC elects to provide an ongoing authorization for the release of such data, the CPC may at any time cancel this authorization by notifying the Secretariat that it has revised its earlier decision. Unless otherwise requested by the provider of the data:

Including universities, researchers, NGOs, media, consultants, industry, federations, etc.

a) Persons that request non-public domain data shall complete and sign the Data Request Form and sign the Confidentiality Agreement and provide them to the Commission in advance of obtaining access to said data.
b) The Data Request Form and Confidentiality Agreement shall then be forwarded to the CPC that originally provided the requested data and the provider shall be requested to authorize the Commission to release the data.
c) Such persons shall also agree to maintain the data requested in a manner consistent with the security standards established by the Commission for the ICCAT Secretariat.

31. CPCs that have provided non-public domain data to the Commission shall notify the Secretariat regarding their representatives with the authority to authorize the release of non-public domain data by the Commission. Decisions whether to authorize the release of such data shall be made in a timely manner.

4.7 Force majeure

32. The Executive Secretary may authorize the release of Non-Public Domain data to rescue agencies in cases of *force majeure* in which the safety of life at sea is at risk.

5. Periodic Review

33. The Commission or its subsidiary bodies will periodically review these Rules and Procedures, and subsidiary documents, and the rules and procedures referred to in paragraphs 23 and 24 above, and amend these if necessary.

6. Final Clause

34. These Rules and Procedures do not prevent a CPC from authorizing the release of any data it has provided to the ICCAT.

Table 1. Types of information and confidentiality classification. Certain types of information such as Task I and Task II already have mandatory reporting and are publically available through the ICCAT web site and the ICCAT *Statistical Bulletin*.

Information Type	*Risk Classification*
Operational level catch and effort data (e.g. set-by-set CPUE)	High
Annual catch estimates stratified by gear/flag and species for the ICCAT statistical areas (Task I)	mandatory reporting already in place
Aggregated catch and effort data stratified by gear/year/month, 5x5 (LL) or 1x1 (surface), and flag (Task II catch/effort)	mandatory reporting already in place
Records of vessel unloading and logbooks	Medium
Transshipment consignments by species	Medium
Biological data (if adequate time has passed to allow the scientists that organized the for collection of such data to publish a paper analyzing it)	mandatory reporting already in place
Conventional tagging data	No risk
Detailed electronic tagging data	Medium
ICCAT Record of Fishing Vessels (vessels authorized to fish; vessels authorized to transport; support vessels; carrier vessels)	mandatory reporting already in place
Vessel and gear attributes from other open sources	No risk
Oceanographic and meteorological data	No risk
Movements of fishing vessels recorded at a fine resolution/VMS vessel position, direction and speed	High
Boarding and Inspection Reports	High
Certified observer personnel	Medium
Certified inspection personnel	High
Catch Documentation Scheme	Medium
Port State Inspection Reports	Medium
Violations and infringements, detailed	High
Annual number of active vessels, by gear type and flag	mandatory reporting already in place
Economic data	[unassigned]
[Social data]	[unassigned]
Fisheries intelligence-sharing information	High
Weekly catch reports	High
Caging declarations	Medium

Table 2. Annotations on information types mentioned in **Table 1**.

Information Type	*Annotations*
Operational level Catch Effort data	Collected on fishing vessel logbooks and by observers.
Compliance-related observer data	Excludes operational catch and effort data, biological data and vessel and gear attributes.
Biological data	Biological data include size data, data on gender and maturity, genetic data, data on hard parts such as otoliths, stomach contents, and isotopic N15/C14 data collected by observers, port samplers and other sources. "Biological data" in this context does not include information identifying the fishing vessel, for example, which would otherwise alter its security classification.
Conventional tagging data	Conventional tagging data include species, release and recapture positions, lengths and dates. "Tagging data" in this context does not include information identifying the fishing vessel that recaptured the tagged tuna, for example, which would otherwise alter its security classification.
Electronic tagging data	Detailed electronic tagging data include detailed records from pop-up or archival tags such as date, time, depth, temperature, light intensity, etc.
ICCAT Record of Vessels	Covers vessels authorized to fish in the ICCAT Convention area also covers records of transport and other types of vessels
Vessel and gear attributes from other sources	Includes data collected by observers and port inspectors. Covers all vessels (i.e. includes vessels restricted to national jurisdiction–domestic fleets). Includes electronic equipment.
Oceanographic and meteorological data	"Oceanographic and meteorological data" in this context does not include information identifying the fishing vessel that collected the information, for example, which would otherwise alter its security classification.
Certified observer personnel	If identified by individual then risk classification would be assigned to HIGH.
Certified inspection personnel	If identified by individual then risk classification would be assigned to HIGH.
Violations and infringements, detailed	May cover individual violations and infringements pending investigation and/or prosecution. Summarized information included in Biannual ICCAT Report from CPCs. Includes compliance information collected by observers.
Economic data	Insufficient information currently available to determine Risk Classification.

Appendix 1 to ANNEX 6

Public Domain Data

The following types of data are considered to be in the public domain:

1. Annual catch estimates (Task I) stratified by gear, flag and species for the ICCAT statistical area;
2. The annual numbers of vessels active in the ICCAT Convention area stratified by gear type and flag;
3. Catch and effort/data (Task II) aggregated by gear type, flag, year/month and, for longline, 5° latitude and 5° longitude, and, for surface gear types, 1° latitude and 1° longitude – and made up of observations from a minimum of three vessels;
4. Biological data (if adequate time has passed to allow the scientists that organized for the collection of such data to publish a paper analyzing it);
5. Conventional tagging data;
6. The ICCAT Records of Fishing Vessels;
7. Information on vessel and gear attributes;
8. Any vessel record established for the purpose of the Commission's VMS;
9. Oceanographic and meteorological data;
10. [Social data].

Appendix 2 to ANNEX 6

Examples of Non-Public Domain Data

The following are examples of types of data considered to be Non-Public Domain:

1. Operational level catch-effort data (detailed set-by-set information)
2. Records of vessel unloading
3. Transshipment consignments by species
4. Data describing (at a fine resolution) the movement of vessels including near- real time Commission VMS data (vessel position, direction and speed)
5. Boarding and Inspection Reports
6. Certified inspection personnel
7. Raw data from any Catch Documentation Scheme or Trade Documentation Scheme
8. Port State Inspection Reports
9. Violations and infringements, detailed
10. Economic data
11. Fisheries intelligence-sharing information
12. Detailed electronic tagging data
13. Data that reveal the individual activities of any vessel, company or person, including caging declarations and weekly catch reports.

Appendix 3 to ANNEX 6

Framework for Access to Non-Public Domain Data

1. In accordance with the policies for data protection, security and confidentiality established by the Commission's Information Security Policy (ISP), a Contracting Party or non-Contracting Cooperating Entity or Fishing Entity (CPC) shall have access to non-public domain data types covering describing the activities of any vessels:
   a) covering vessels flying their flag in the ICCAT Convention area or;
   b) covering any vessels fishing in waters under their national jurisdiction or;
   c) covering vessels applying to fish in their national waters, unloading in their ports or transshipping fish within waters under their national jurisdiction;
   d) for the purpose of scientific and other research, if the CPC that originally provided that data authorizes the Commission to release them. In cases where a CPC elects to provide an ongoing authorization for the release of such data, the CPC may at any time cancel this authorization by notifying the Secretariat that it has revised its earlier decision.

2. For the purposes of compliance and enforcement activities on the high seas, non-public domain data will be made available subject to separate rules and procedures for the access and dissemination of such data, that the Commission will adopt for these purposes. VMS data will be made available for scientific purposes, subject to these same separate rules and procedures.

3. In regard to paragraph 1:
   a) CPCs shall provide a written request for access to such data to the Executive Secretary, specifying the purpose of the Convention by reference to the relevant article(s). In so doing, CPCs shall use the Commission Data Request Form **(Attachment 1 to Appendix 3 to ANNEX 6)***.*
   b) The CPC shall undertake to only use such data for the purpose described in the written request. The CPC shall also complete and sign the Commission Confidentiality Agreement *(***Attachment 2 to Appendix 3 to ANNEX 6***).*
   c) The Executive Secretary shall not authorize the release of more data than is necessary to achieve the purpose described in the written request.

4. The Executive Secretary shall not authorize access to non-public domain data by any CPC that has not fulfilled its obligations to provide data to the Commission for two consecutive years until all such matters are rectified. The Executive Secretary also shall not authorize access to a CPC whose authorized representative failed to observe the Rules and Procedures for the Protection, Access to and Dissemination of Data Compiled by the Commission until the CPC informs the Executive Secretary that appropriate actions have been taken.

5. The Executive Secretary may attach conditions appropriate for the access to such data (such as that the data be deleted upon achievement of the purpose for which it was released or by a pre-determined date, that a register of persons accessing the data be maintained and furnished to the Commission upon request, etc.)

6. Requests may be made for a standing authorization, such that CPCs may have multiple accesses to the requested data for the same purpose as of the original written request.

7. Dissatisfaction with the Executive Secretary's decisions in regard to access to non-public domain data by CPCs shall be resolved by the Chair of the Commission.

Attachment 1 to Appendix 3 to ANNEX 6

Data Request Form

To the Executive Secretary of the International Commission for the Conservation of Atlantic Tunas (ICCAT)

I wish to submit the following request to receive and analyse data collected by ICCAT. I have read the above Data Policy, noting in particular, the matters relating to data confidentiality and usage specified in Annex 6 of the ICCAT REPORT for biennial period, 2010-2011, Part I (2010) – Vol. 1, "Rules and Procedures for the Protection, Access to, and Dissemination of Data Compiled By ICCAT", and providing an appropriate acknowledgement in the case of any publications arising from the use of these data, and agree to all the conditions listed.

Name of the person(s) or institution(s) requesting the data and contact details
Purpose/Project outline *If non-public domain data are being requested, the use of the data shall be authorized only for the purpose described below.*
Data requested *If applicable, the specification of data being requested should refer to the type of data and any parameters relevant to the type of data, which may include, inter alia, the gear types, time periods, geographic areas and fishing nations covered, and the level of stratification of each parameter.*
Name(s), job title(s) and affiliation(s) of the person(s) requesting access to the data; the use of the non-public domain data shall be authorized only for the person(s) listed. *Note, the Secretariat expects to be informed of any changes to the data users list*.
Intentions with respect to publication of the results of the proposed work

Signature and date: ______________________________

Name:

Position:

Organisation:

Approved / Not Approved ______________________________ Signature and date:

Attachment 2 to Appendix 3 to ANNEX 6

Confidentiality Agreement

Confidentiality Agreement for the Dissemination of Non-Public Domain Data by the International Commission for the Conservation of Atlantic Tunas (ICCAT).

Applicants name(s) and full contact details and signatures

Full name Institution, address and

Contact details

Signature and Date

I/we agree to the following:

- To abide by any conditions attached to use of the data by the Executive Secretary;
- That the data shall be used only for the purpose for which the data are being requested, be accessed only by the individuals listed in Item 3 of the Data Request Form, and be destroyed upon completion of the usage for which the data are being requested;
- To make no unauthorized copies of the data requested. If a copy of all, or part, of the data requested is made by the applicant, all copies, or part thereof, will be registered with the Executive Secretary and will be destroyed upon completion of purpose for which the data was requested;
- To abide by the Commission's data security standards as specified in the Commission's Information Security Policy and the Rules and Procedures for Protection, Access to, and Dissemination of, Data Compiled by the Commission;
- That prior to the publication of any report of an analysis for which the requested data will be used, the report shall be provided to, and cleared by, the Executive Secretary of the ICCAT, who shall ensure that no non-public domain data will be published;
- To provide copies of all published reports of the results of the work undertaken using the data released shall be provided to the ICCAT Secretariat and to the relevant subsidiary body of ICCAT;
- Applicant(s) will not disclose, divulge, or transfer, either directly or indirectly, the confidential information to any third party without the written consent of the Executive Secretary;
- Applicant(s) shall promptly notify the Executive Secretary, in writing, of any unauthorized, negligent or inadvertent disclosure of confidential information of the ICCAT.
- Applicant(s) assume all liability, if any, in respect of a breach of this Confidentiality Agreement, once the data requested is released to the applicant(s).
- Pursuant to paragraph 28 of the Rules and Procedures for the Protection, Access to, and Dissemination of, Data Compiled by the Commission, CPC(s) shall not be granted access to non-public domain data until the appropriate actions have been taken to account for any disclosure in violation of the Agreement by the applicant or, *inter alia*, its affiliates, employees, attorneys, accountants, consultants, contractors, or other advisers or agents; and.
- That this Agreement may be terminated by giving written notice to the other party.

Appendix 4 to ANNEX 6

Data that May be Disseminated to Other Regional Fisheries Management Organizations (RFMOs)

Operational level data

1. Operational-level tuna fisheries data may be disseminated to other regional fisheries management organizations (RFMOs), subject to the terms of the agreement specified in paragraph 29 of these Rules and Procedures. Such data includes catch and effort (including by-catch of mammals, turtles, sharks and billfish), observer, unloading, transshipment and port inspection data.

Aggregated data

2. Aggregated catch and effort data may be disseminated to other RFMOs. Such data includes:
   – Data for long line gear aggregated by flag State by 5º latitude and by 5º longitude by month
   – Data for surface gear (including purse seine) aggregated by flag State by 1º latitude and by 1º degree longitude by month
   – Aggregated observer data (made up of observations from a minimum of three vessels).

Other data

3. Monitoring, control, surveillance, inspection and enforcement data may be disseminated to other RFMOs. Such data includes:
   – The names and other markings of 'Vessels of Interest' to each organization;
   – Transshipment verification reports for vessels transshipping in the Convention area of one RFMO but which have fished within the Convention area of the other.

Appendix 12

2019 Report of the Sub-committee on Statistics
(ICCAT Secretariat, 23-24 September 2019)

1. Opening, adoption of Agenda and meeting arrangements

The Sub-committee on Statistics met at the ICCAT Secretariat (Madrid, Spain) on September 23-24, 2019. The ICCAT Executive Secretary Mr. Camille Jean Pierre Manel welcomed the Sub-committee and highlighted the importance of its work and the commitment of the Secretariat to support the work of SCRS and the Commission. The meeting was chaired by Dr Guillermo Diaz (USA). The Agenda was discussed and adopted without any modifications.

2. Review of fisheries and biological data submitted during 2019

The Secretariat presented information contained in the 2019 Secretariat Report on Statistics and Coordination of Research related to fisheries and biological data submitted for 2018 including revisions to historical data.

The activities and information included in this report refer to the period between October 1, 2018 and September 16, 2019 (the reporting period). All the basic fisheries and biological statistics have been presented by the Secretariat to the SCRS Working Groups during SCRS intersessional meetings. After 5 years of continuous improvement, the Secretariat observed some decline in data completion quality of the latest data submissions. The Secretariat had to correct more datasets so they pass the SCRS filtering criteria and there were a number of submissions that did not use the 2019 version of the electronic forms.

Regarding the activities conducted by the Secretariat, in the most recent years, in addition to the normal activities developed on statistics, publications, data funds management and others, the Secretariat is dedicating (apart from the usual preparation of the majority of the datasets required by each stock assessment) a lot of additional work to stock assessment activities, whether participating actively in the assessment or coordinating and managing external support to the SCRS work. In addition, the statistical work requested of the Secretariat, together with some lack of adherence to deadlines established for data submission, continues to constitute an enormous amount of work for the Secretariat.

The Secretariat applied to the 2018 datasets reported the SCRS filtering criteria to accept/reject statistical forms (Filters 1 & 2, Addendum 2 to Appendix 8 to *Report for the Biennial Period, 2012-2013, Part II (2013) Vol. 2*) adopted in 2013. The results are based on a total of 76 flag related CPCs (51 CP + 1 CP [16 EU Member States] + 1 CP [4 UK Overseas Territories Member States] + 5 NCC) with reporting obligations. The forms submitted with errors that the Secretariat was unable to correct were considered unreported data and shall require CPC revisions.

2.1 Basic Task I (T1FC and T1NC) and Task II (T2CE and T2SZ) statistics

The Secretariat presented 2018 data reporting status (Table 1 and 2 of the Secretariat report) of the two datasets of Task I statistics (T1FC: fleet characteristics; T1NC: nominal catches). The Secretariat reminded the Sub-committee once again of the new structure of the T1FC electronic form (ST01) used to collect information on individual vessels (sub-form ST01A) and summarized information for vessels less than 20 m LOA (sub-form ST01B). The T1FC 2018 report card is presented in Table 1 of the Secretariat report. Overall reporting of T1FC was 74% in 2019; while it was 75% in the previous year 2018 (56 flags). Three flags reported after the submission deadline. The Secretariat made corrections to the information reported by 4 flags CPCs, and, 3 invalid forms should be completely revised.

The T1NC (nominal catches) dataset was presented for the major ICCAT species (major tunas, major sharks, 13 species of small tunas and dolphin fish). The Secretariat once again reminded the Sub-committee that the ST02-T1NC electronic form has 2 sub-forms: ST02A used to report positive catches (landings, dead discards, and live releases) and ST02B used to report "zero" catches. The T1NC 2018 report card is presented in Table 2 of the Secretariat report. Like the T1FC reporting, 2018 reports were similar (64 flags corresponding to 84%) compared to 2017 (83%). Nine flags reported late and the Secretariat made corrections to 7 datasets. Twelve CPCs (16%) have yet to report their T1NC data. The number of CPCs that did not report is similar to the number in the previous year.

The T2CE (catch and effort) report card is presented in Table 3 of the Secretariat Report on Statistics and Coordination of Research in 2019.

A total of 49 flags (64%), including 4 late reporting-flags, reported T2CE. This represents a significant decrease in T2CE reporting compared to 2018 (68% reporting) and to 2017 (76%). Twenty-seven flag CPCs have yet to report T2CE data.

The Secretariat presented the Task II size data (combining T2CS and T2SZ) card report in Table 4 of Secretariat report. A total of 48 flag CPCs (63%), including 4 late reports, submitted 2018 size data. Some of the submitted data are pending review and corrections by the Secretariat. A total of 28 CPCs have yet to submit 2018 size data. The submission of 2018 and 2019 size data was similar, but was significantly lower compared to 2017 (70%).

2.2 Tagging

The different laboratories and scientific institutions conducting electronic tagging in the ICCAT Convention area reported a total of 481 releases and 83 recoveries made in late 2018 and during 2019. With respect to conventional tagging, a total of 123,335 tags were deployed and 17,362 were recovered during the same period. From September 2018 to September 2019, the Secretariat distributed about 3,850 conventional tags, primarily under the tagging projects of the GBYP. These figures include any tags deployed and recovered by the AOTTP.

2.3 Complementary data obtained within ICCAT data collection and research programs (GBYP, AOTTP, EPBR, SMTYP and SRDCP)

The data recovery activities made within ICCAT research programmes (GBYP, AOTTP, EPBR, SMTYP and SRDCP) have contributed historically with great improvements to the ICCAT fisheries statistics, in particular by recovering missing or incomplete catch series and biological samples.

During 2018 and 2019, within GBYP Phase 8, data recovery included: new and improved estimates of annual catches (historical and recent years) of five Italian tuna traps; and b) recovery of the 1962-1978 landings of some flags reported at ICES meetings (data available in paper), which were incomplete or not available in ICCAT-DB. This work, presented in Pagá *et al*., 2018 was evaluated and approved by the SCRS. The GBYP is working with the Secretariat on the integration of this information in ICCAT-DB. The other two tasks have consisted in the provision of two electronic tags datasets: one including data from 41 tags deployed in 2016-2017 by Dr Barbara Block's team and the second including data from 220 tags deployed by Dr Molly Lutcavage team between 2002 and 2009. These data sets will be integrated into the ICCAT common electronic tagging database, which is under development by GBYP, AOTTP and the Secretariat. Once this database becomes available it will also include the available data sets from the e-tagging activities on northern albacore, swordfish and sharks being conducted since 2017.

The information recovered under the SMTYP research programme during 2018 (Mauritania (2006-2018), S. Tomé e Principe (2009-2017) and Liberia (2011-2017)) were already integrated into ICCAT-DB. These catch series were evaluated and adopted by the Small Tunas Species Group (Anon. 2019l).

To be included in ICCAT-DB is the information recovered under the 2016 Spanish artisanal Mediterranean small tuna fisheries historical data recovery (Anon. 2017j). The Secretariat is working with the EU-Spain scientists on the best way to classify that information with ICCAT gear codes.

The Secretariat is working with GBYP coordination team on a new project, aiming to consolidate the stereoscopic cameras size data (provided between 2014 and 2018) and make them available to the next bluefin stock assessment session. This work, which is now in its first phase, has shown to be extremely time consuming given the heterogeneity and large number of raw files that have to be inventoried and processed. However, this work has been given a high priority. This work will result in unique BFT size information from purse seine fisheries in the Mediterranean Sea. The first datasets are expected to be available by April 2020.

Finally, upon the 2018 SCRS request, the Secretariat issued a short-term contract to recover Mediterranean swordfish data. This data recovery aims to improve the available catch and CPUEs time series currently in use in the stock assessment models for Mediterranean swordfish, which currently start in 1985. This data recovery should allow to gather data for early period of the fisheries (1972-1984) and add some new data for the period 1985-1989. This task is scheduled to be finalized later in the year.

2.4 Other relevant statistics (observer data, VMS, BCDs, ISSF, etc.)

The Secretariat indicated that for 2019, 24 CPCs reported observer data using the revised ST09 form (an increase of 3 from 2018 and 8 from 2017). As was the case in previous years, several forms were submitted with very little information. The Secretariat also summarized the reported data on seabirds and sea turtles which are extremely limited and sparse. For example, of the 24 CPCs that reported observer data, only 12 provided data on sea turtles and only 6 on seabirds. However, the Sub-committee is unable to determine at this time if the low reporting rate is due to some fleets not interacting with these species, or the data are not being collected and reported, or a combination of both. At this time, the ST09 form does not permit the reporting of 'zero interactions'. As has already been recognized by the Sub-committee on Ecosystems (SC-ECO), this Sub-committee once again reminds CPCs of their obligations to report bycatch data collected by their observer programs.

The Sub-committee reiterated the utility of VMS data for assessing fishing activity in the Atlantic Ocean. It was noted that the ICCAT FAD Working Group had also stressed the need to access VMS data in order to better characterize fishing effort of purse seiners and therefore improve the corresponding CPUE indices. The Sub-committee noted that scientists should have access to these data to improve their analyses.

ISSF participating companies continue to provide the Secretariat with detailed information on catches (by vessel trip, species and commercial size category) for all their purchases. These correspond to unloading of catches of tropical tunas (bigeye, yellowfin, skipjack) and albacore to canning plants around the world. This information has previously been used by the SCRS. In 2019 the Secretariat was informed by ISSF that the Secretariat of the Pacific Community (SPC, Science Provider to WCPFC) receives the same types of data files from ISSF participating companies as the ICCAT Secretariat does. SPC has developed code to semi-automatically input the data into their database. SPC has expressed willingness to process the ICCAT data, at no cost to ICCAT, and export them in a format that the Secretariat can use effectively. The Secretariat will soon contact SPC to see how to make this happen. ISSF also noted that it has amended its requirement for cannery data submissions to RFMOs, so that a single data reporting format must be used starting in 2020. This should solve the problem found with multiple submission formats.

3. Review of Secretariat's standard (yearly based) datasets estimations

3.1 CATDIS and EFFDIS

The Secretariat continues to improve the CATDIS estimations on two main fronts, the level of detail and the automation process aiming to reduce the time to estimate it. A full revision of CATDIS (1950 to 2017) was made available in August 2018 for the nine main species and includes all the historical revisions of T2CE catch series, and changes in Task I catches. Some LL fleets might need some revisions and CATDIS for SMA and BSH still need to be completed due to data limitations. CATDIS can be improved if historical T2CE series are recovered and updated. The resulting maps were published in the ICCAT Statistical Bulletin Vol. 45.

The Secretariat presented to the Sub-committee an update on the current status of EFFDIS. The Secretariat will continue to review the methodology used for EFFDIS and it is expected to provide an update on the progress of estimating a new EFFDIS at the 2020 meeting of the Sub-committee on Ecosystems.

3.2 CAS (catch-at-size) and CAA (catch-at-age)

The Secretariat informed the Sub-committee that the CAS database is now complete and functional and it continues to have an active connection between the size data and the substitution tables used for the CAS estimations. The Secretariat did not update the CAS and CAA matrices for the 2019 YFT stock assessment because it was not considered to be a priority. The Secretariat requested that the species working group review their needs for CAS and CAA estimates for their work as these estimations significantly increase the workload of the Secretariat.

4. Evaluation of data deficiencies pursuant to Rec. 05-09

4.1 2018 report cards with SCRS validation criteria (filters 1 and 2)

The Secretariat applied, for the sixth consecutive year, the SCRS filtering criteria (Filters 1 & 2, Addendum 2 to Appendix 8 to *Report for the Biennial Period, 2012-2013, Part II (2013) Vol. 2*, updated by the SCRS in 2016) to validate and accept Task I (form ST01 and ST02) and Task II (forms ST03, ST04 and ST05) statistics received under those official forms. The filtering criteria are also embedded (most updated SCRS version) in each one of these forms.

For 2018 data, Filter 1 was effectively applied and the results are presented in the SCRS Report Cards (Tables 1, 2, 3, 4, and 5, with a summary in Figure 1 of the Secretariat report). The "orange" cells indicate the datasets that have not passed Filter 1. However, the majority of the Task I forms rejected were corrected by the Secretariat and provisionally (marked for revision) integrated into the ICCAT database system (ICCAT-DB). Task II forms not passing Filter 1 were not corrected (left for posterior revisions with the respective CPCs). Filter 2 was used for testing purposes and the results presented to the SCRS. Both filters were used on every Task I and Task II dataset received (scenario 2, methodology described in Palma and Gallego, 2015).

Although during the last 2 years the level of reporting has remained relatively constant, overall during the last seven years the Sub-committee and the Secretariat observed improvements in the level of reporting (CPCs reporting ratios), in the reduction of "late-reporting", and also some progress in the level of completeness of the forms (less errors) and level of detail of some information (in particular Task II). This tool has proven to be very effective in imposing strict reporting obligations and minimum data quality standards that will benefit the work of ICCAT in the future.

4.2 SCRS Scorecards and catalogues of major ICCAT species (last 30 years)

The Secretariat presented in Appendix 1 of the Secretariat report, the Task I/Task II data SCRS catalogues for the major ICCAT species (1999 to 2018). The Sub-committee acknowledged that data submissions have greatly improved during the last decade. However, major deficiencies still exist for some ICCAT stocks particularly for the historical data. Once again, the Sub-committee agreed that this information should be reviewed by the species groups, in particular by those that are scheduled to conduct stock assessments in 2020.

Rec. 05-09 recognized the need to establish a clear process and procedures to identify data gaps, particularly those that limit the ability of the SCRS to conduct robust stock assessments and to find appropriate means to address those gaps and evaluate the effectiveness of the ICCAT conservation and management measures. Particularly to evaluate how reducing uncertainty can help reduce the risk of failing to meet management objectives.

Despite the multiple recommendations made by the Sub-committee and different species working groups the reporting of total dead discards and live releases (see *Section 2.1*) continues to be very poor which impact the estimates of total removal and total mortality needed to conduct stock assessments.

4.3 Report on data recovery and improvements, new plans, and improvements on national data collections systems

Diaz and Cortés, 2019 presented a revised time series (1986-2017) of U.S. commercial landings of blue shark. The revision was conducted to update the dressed weight-whole weight conversion factor used by the U.S. (1.96) with the new conversion factor adopted by the shark working group (2.46).

Diaz 2019 answered a request by the Small Tunas Species Group and the Secretariat that the U.S. update its king mackerel time series of landings. The document presented a time series of king mackerel commercial landings for the 2009-2017 that was estimated for a U.S. domestic stock assessment of this species.

Cass-Calay and Diaz, 2019 presented a revised time series (2004-2017) of U.S. recreational landings for species other than blue and white marlin, sailfish, swordfish, and bluefin tuna. The review was conducted to include improvements that were incorporated to the marine recreational surveys used to estimate recreational landings. The discussion and presentation of the review of US recreational statistics was for a given set of spp (BON, BSH, ALB, POR, BET, YFT) as the methodology was reviewed and updated by an external scientific panel, however for other spp (BFT, BUM, WHM, SAI, SWO) those recreational catches were not affected as the recreational sampling is from different sources and methodologies.

The Sub-committee reviewed and discussed the new information presented by the U.S. and it agreed to officially include the new time series of landings in the ICCAT-DB.

All the other T1NC, T2CE and T2SZ dataset revisions (details in Tables 13, 16 and 17 of the Secretariat report, respectively) were presented and approved by the respective species groups in the 2019 intersessional meetings (WHM , YFT, SWO, and, small tunas).

5. Review of existing practices for data submission and validation by the Secretariat

5.1 Proposals for improving ICCAT eFORMS, codes, and deadlines

The Sub-committee indicated that no changes have been made to the official deadlines to report Task I and Task II data, July 31. However, the Sub-committee continues to recommend that CPCs make their utmost effort to report their data in advance of the official deadline to help the Secretariat with its workload. For the late submissions (after July 31), the Secretariat informed the Sub-committee that, updating the ICCAT-DB system with data received until just one week before the start of the SCRS annual meeting leaves a very short time to prepare the SCRS annual meeting. Thus, the Secretariat proposed September 1 each year, as the last day for accepting and updating the ICCAT-DB system. Accordingly, all the information arriving afterwards shall be presented to the species groups as “preliminary official data” not covered in the Secretariat report on statistics.

With respect to providing data for intersessional meetings, in the past the Sub-committee recommended that CPCs made an effort to provide the requested data by the provided deadlines. However, many CPCs do not have the capability of providing Task I and II data for intersessional meetings prior to the July 31 deadline. As a result, it has been very rare that data from the prior year were complete enough to be included in stock assessments conducted before July 31. The Secretariat has indicated that the practice of requesting data for intersessional meetings that include the data from the previous year greatly increases the Secretariat’s workload. This is an undesirable consequence of such requests, particularly when considering that in most cases that data are not included in the stock assessments mostly due to the low proportion of data submissions. Therefore, the Sub-committee recommends that species groups abstain from requesting data from the previous year to use in their intersessional meetings.

The Sub-committee agreed with a proposal from the Shark Species Group to include in the ST02-T1NC electronic form 2 columns to indicate the conversion factors used to estimate landings in whole weight and dead/live discards, respectively.

Following the recommendation from this Sub-committee and the Sub-committee on Ecosystems, the Secretariat work intersessionally with a group of national scientists to develop a new version of the ST09 form. The revised form is flexible enough to allow for different levels of data resolution (i.e., set by set or aggregated data). It also merges the current ST11 form, which will be discontinued in 2020. The Sub-committee requested that the form be slightly modified for CPCs to report if seabird mitigation measures were used or not in a specific ‘notes’ field to describe the mitigation measures used.

The Secretariat informed the Sub-committee on the progress made to update the coding system. This includes ongoing work to reclassify deprecated gears SURF/UNCL in the ICCAT-DB system. Good progress has been made on this issue, particularly for BFT. The Sub-committee and the Secretariat also discussed approaches to reduce the number of codes used to describe LL gear. Reclassification of FL length type into SFL was finished. The Secretariat informed the Sub-committee on the work being conducted to reclassify some of the sampling areas, but it was indicated that the input from different species working groups is needed. Finally, records in Task II data that corresponded to large grids (10x10 and 20x20 grids, already removed from the forms) are continuously being replaced by revised and more detailed datasets reported by CPCs.

Finally, the Sub-committee recommended that CPCs and the Secretariat adopt the dressed weight-whole weight conversion factors for SMA and BSH that were estimated and published by Mejuto *et al*., 2008. These conversion factors should be included in the list of conversion factors published in the ICCAT website.

6. ICCAT Online Management System (IOMS)

6.1 Progress on the work developed by the ICCAT Online Reporting Technology Working Group

The ICCAT Online Reporting Technology Working Group did not meet during 2019, but it did maintain discussions through electronic communications. The Group drafted Terms of Reference for its work that will be introduced for their discussion at the upcoming meeting of the ICCAT Compliance Committee meeting this November.

6.2 Progress on the work on the IOMS

In May 2019, the Secretariat started the development of the IOMS. The IOMS is a system designed to manage online all the ICCAT data requirements. This is a long-term project that will entirely replace the current ICCAT data reporting system. The Secretariat presented to the Sub-committee an example of how the system is currently working and its capabilities. At this time, the IOMS is in the first half of the Phase 1 development, planned for 1 year. It covers the IOMS core web application (the entry portal to all the future modules/web-applications) and, the module that will manage Sections II and III of the CPCs' Annual Reports.

7. Review of the ICCAT relational database system (ICCAT-DB)

7.1 Improvements, ongoing work, and documentation work (technical manuals, Java docs, user guides, etc.)

In 2019, the Secretariat redesigned 3 databases to store information related to tropical support vessels, FAD deployments, and port sampling for tropical tunas that were reported using the ST-07, ST-08, and ST-10. Four additional databases (Task I, Task II, Vessels, and Tagging) are also being redesigned to be integrated into the IOMS.

The full documentation associated with the ICCAT-DB is composed of various elements including database manuals, "javadocs" for JAVA documentation, user guides, and REST API documentation. This documentation is under a merging process with the documentation related to the IOMS implementation. This work is now being continuously merged and updated in parallel with the improvements made to the ICCAT-DB and the progress of the IOMS.

7.2 Plans to publish some ICCAT-DB data in the ICCAT cloud infrastructure

No major progress was made in this field, once most of the effort was directed to put online the ICCAT Statistical Online Reporting System (a web application developed by the Secretariat during 2017 to integrate, validate, and store statistical forms online). Following the SCRS recommendation, this web application was deployed online in April 2018 (as a prototype) for testing by ICCAT Statistical Correspondents during 2018.

8. International and inter-agency cooperation on statistical activities (FAO, CWP, FIRMS, CLAV)

Representatives of the ICCAT Secretariat participated in the following activities:

1) In 2018, Secretariat staff attended the FAO Coordinating Working Group on Fishery Statistics (CWP) technical workshop on global harmonization of tuna fisheries statistics.

2) ICCAT is a partner of the FAO/FIRMS that provides access to information on the global monitoring and management of fishery marine resources. As such, the Secretariat provides regular updates of the stock status of ICCAT species assessed by the SCRS. In 2019, the Secretariat updated information for blue marlin, bigeye tuna, swordfish, Mediterranean albacore, and shortfin mako populations that were assessed by the SCRS during the last 2 years.

3) The Secretariat is also a member of the iMarine extended board. The iMarine is an initiative to support the implementation of the ecosystem approach to fisheries management and the conservation of marine living resources.

4) The Bycatch Coordinator attended the third meeting of the ABNJ seabird bycatch assessment in tuna fisheries which was held from 25 February to 3 March, 2019 in Kruger National Park South Africa.

5) FAO Common Ocean/ABNJ Tuna project/ISSF International Workshop on Mitigating Environmental Impacts of Tropical Tuna Purse Seine Fisheries. The meeting was held in Rome, Italy, from 12-13 March 2019.

6) FAO Common Ocean/ABNJ Tuna Project Workshop on Options to Operationalize the Ecosystem Approach to Fisheries Management in tuna RFMOs. The workshop was held at FAO Headquarters, Rome on 17-19 September 2019.

7) In 2018 the ICCAT Secretary attended a meeting of the Mediterranean Advisory Council (MEDAC, Rome, Italy, 11 October, 2018) and provided a presentation on the recent findings of the SCRS as regards the status of the stock of eastern Atlantic and Mediterranean bluefin tuna, as well as for the Mediterranean albacore and swordfish stocks.

8) International Council for the Exploration of the Sea (ICES). Considering the fruitful experience ICCAT and ICES have had in recent years regarding scientific collaboration, in 2018 both organizations expressed their willingness to strengthen this cooperation and explore new initiatives and discussions which have commenced between the Secretariats.

9) Global Environment Facility (GEF) – FAO Common Oceans/ABNJ Tuna Project. In 2015 the Commission decided to continue with the cooperation between FAO Common Oceans/ABNJ Tuna Project and ICCAT. To this end, since the 2018 SCRS plenary, the ICCAT Secretariat has participated in several FAO Common Oceans/ABNJ Tuna Project initiatives. These include participation in the following meetings that were funded or partially funded by the project:

   - Joint t-RFMO FAD Working Group Meeting 8-10 May 2019, held in California, USA;
   - Sixth Project Steering Committee (PSC) meeting of the Common Oceans ABNJ tuna project held in Rome, 8-10 July 2019.

   A Joint tRFMO meeting on by-catch, mainly focusing on sharks and in collaboration with other tRFMOs, is currently being organized by the ICCAT Secretariat with the support of the European Union with a contribution of the FAO Common Oceans/ABNJ Tuna Project. It will take place in Porto (Portugal) 16-18 December 2019.

10) Collaboration with Western Central Atlantic Fishery Commission (WECAFC). In 2018, contacts were made between the ICCAT Secretariat and the WECAFC Secretariat to enhance the collaboration between the two organizations regarding the collection and reporting of tuna fisheries data to ICCAT

9. Considerations on the Sub-committee on Statistics recommendations

9.1 Progress with prior year recommendations of theSub-Committee

- The Sub-committee reiterates the request that the information of the vessels included in the ST01-T1FC form be only from active vessels instead of information from licensed vessels that could include inactive ones. In addition, it is requested that, when possible, CPCs also report on the fishing days of these vessels.

The Secretariat indicated that this is an issue that it is very difficult to assess. As a result, the Sub-committee develop a new recommendation for CPCs to make an effort to report 'fishing days' in their submission of ST01.

- The Sub-committee reminds CPCs that the statistical forms should be filled only using ICCAT codes. The Secretariat has identified cases where non-ICCAT codes have been used in the forms. In addition, some CPCs have used sampling areas that do not correspond to the species being reported. Finally, CPCs that do not provide information for a particular variable in the statistical form should leave the cells blank instead of using meaningless strings such as 'NA', 'NAN', or 'NULL'.

The Secretariat informed the Sub-committee that some of these problems still persist in data submissions and no significant progress has been made.

- The Secretariat informed the Sub-committee of submission of CAS data for species for which this information is not required. The Sub-committee is requesting that the Secretariat keep these data in the ICCAT-DB.

Task completed.

- The Sub-committee requests that the WGSAM and the Sub-committee on Ecosystems review the current 'data scoring system' developed by the Secretariat and, if necessary, provide advice on potential improvements. For this end, the Secretariat will make a presentation on the details of the data scoring system during the next meeting of the WGSAM and SC-ECO.

The Secretariat made the required presentations (including the method in Anon. 2019f) and both the WGSAM and the SC-ECO endorsed the use of the scoring system. Following an additional WGSAM request the scores were extended to the small tuna species. The results were presented to the respective Small Tunas Species Group 2019 intersessional meeting. The final scorecard adopted by WGSAM (updated with 2018 statistics) is presented in Table 6 of the Secretariat report, as the SCRS scorecard on Task I/II data availability.

Task completed, but:

- Even though data reporting has improved during the past several years, there are still significant gaps in the historical data. Hence, the Sub-committee recommends that CPCs review the most recent SCRS catalogues (Appendix 1 of the Secretariat report) to identify data gaps that could be filled through data recovery efforts.

Ongoing task.

- The Sub-committee reiterates previous recommendations for CPCs to review their T2SZ/CS data submission in particular for those species for which stock assessments will be conducted.

Some CPCs have conducted such review and some progress on this issue has been made.

- The Sub-committee reviewed the latest version of the ST09 form and it did not identify any major concerns. The Sub-committee recommends that the current format of this form be maintained, but it also recommends that the Sub-committee on Ecosystems review this form during its next meeting.

The SC-ECO reviewed the ST-09 form during its 2019 meeting and a revised version was presented, discussed, and approved during the Sub-committee on Statistics meeting (see Section 5).

- The Secretariat and the SCRS will compile the information and recommendations provided in the reports on artisanal fisheries in West Africa and in the Caribbean/Central America regions to prepare a work plan and provide recommendations to the Commission.

This work is in progress.

- The Sub-committee reiterates once again that CPCs have an obligation to report total discards and live releases. The Sub-committee also recommends that the SCRS explores ways to provide capacity building to those CPCs that need it to comply with the discard reporting requirements.

Very little progress has been made on the reporting of dead discards and live releases. In addition, the SCRS have not taken any steps towards improving CPCs' capabilities to estimate discards.

- The Sub-committee recommends that CPCs that report T2CE data for intersessional meetings for a particular species also include the full species catch composition in the T2CE data submitted by the deadline of July 31.

The Secretariat informed the Sub-committee that this problem still persists.

- The Sub-committee reiterates its support for the developing of the ICCAT Integrated Online Management System (IOMS) and the work of the Online Reporting Technical Working Group. As such, the Sub-committee recommends that the Commission fully supports this effort.

The Commission is fully supporting the work of the Online Reporting Technical Working Group.

9.2 Review ofrecommendations from 2019 inter-sessional meetings

The following recommendations for statistics from the 2019 intersessional meetings were reviewed and endorsed by the Sub-committee.

SWO

- Given that sometimes size data are reported at relatively low resolution (e.g., 5cm size classes) even when it is collected at higher resolution (e.g., 1cm), which may substantially impair the conversion of CAS to CAA, the Group recommended that size measurements are reported at the highest resolution available.

BIL

- Improvements in ICCAT data: CPCs that have historic reports of unclassified billfish and unclassified gear should continue to review such reports with the purpose of improving the precision of the ICCAT database.

- The Group noted that to date only 7 CPCs (out of 68 CPCs or fishing entities) have ever reported billfish discards and using such limited information the estimates of dead discards are around 2-3%. On the other hand, by using statistical analysis within the stock assessment models it was noted that unaccounted IUU catches, including dead discards may reach values of around 27% of the reported catches. Having the total catches, including dead discards and live releases (estimates of post-release mortality) is important for stock assessment purposes. As such, the Group emphasized the need for all CPCs to comply with the mandatory requirements to report discards (both dead and alive) for billfishes.

YFT

- Improvements of historical catch and effort data series continue to happen under the leadership of the Secretariat and with the collaboration of some CPCs. There is still a need for CPCs to continue to review historical data series to improve the quality of the reports, especially for data sets which contain gaps that have been temporarily replaced with "carry-overs".

- The Group noted that size frequency from the longline fishery of Chinese Taipei suggests substantial changes in gear selectivity, availability or retention of small yellowfin tuna in the early 2000s. As no scientist from Chinese Taipei attended the data preparatory meeting, it was not possible to obtain answers to the questions raised. The Group recommended that the Secretariat reach out to data correspondents of Chinese Taipei to determine the appropriate use of size frequency data in the yellowfin tuna stock assessment.

- The Group noted the importance of information on fishing effort from the tropical tuna surface fleets. The Group recommends that the Sub-Committee on Statistics consider requesting all CPCs with surface fleet fisheries targeting tropical tuna fleets to provide information on the active vessels with the corresponding fishing days and the specific vessel characteristics (using form ST01-T1FC).

SHK

- The Group recommended that the Secretariat include on the list of published conversion factors on the ICCAT web site and the ICCAT Manual, the conversion factors for dressed-weight to whole-weight (live-weight) for blue shark and shortfin mako developed by Mejuto *et al*., 2008.

- The Group recommended that the Sub-Committee on Statistics discuss and approve the use of the Mejuto *et al*., 2008 conversion factors for application for blue shark and shortfin mako.

- The Group recommended that the Secretariat develop a proposal on potential changes to the ST02-T1NC form to include information on the conversion factors used by CPCs to report catches in whole weight. Such proposal shall be presented at the 2019 meeting of the Sub-committee on Statistics for its discussion and potential adoption.

- The Group recommended that the Secretariat adopt the time series of catches of shortfin mako by Chinese Taipei estimated by the Group as the official Task I catch statistics.

- The Group recommended that the Secretariat adopt the time series of catches of porbeagle estimated in the 2009 stock assessment (Anon. 2010b) meeting as the official Task I catch statistics for this species.

- The Group recommended that the Secretariat contact the Statistical Correspondents of Namibia and Morocco to confirm the 2017 reported shortfin mako catches.

- The Group emphasized that the report of all sources of mortality is an essential element to decrease the uncertainty in stock assessment results, and particularly the report of estimated dead discards for all fisheries. Although the reporting of dead discards is already part of the ICCAT data reporting obligations, the requirement has been ignored by many CPCs. The report of dead discards and live releases is of the utmost importance particularly if the Commission adopts a non-retention strategy.

SMT

- Statistical Correspondent and/or national scientists should revise, update, complete and submit their small tuna T1NC series to the Secretariat. This revision should take into account Appendix 5 (SCRS catalogues for small tuna species), the split of “unclassified” gear catches to specific gear codes, and the completeness of Task I gaps identified. The Statistical Correspondent and/or National Scientists of CPCs should correct inconsistencies identified in T2SZ series. For the 13 species of small tuna, the T2SZ revision should have as reference, the stratification of the samples by gear, month, 1°x1°or 5°x5° squares, and, SFL size classes of 1 cm (lower limit). CPCs should further improve their estimates of total catches, as there are still important gaps in the basic data available. These data are required inputs for most of the data limited stock assessment methods. The Secretariat should continue its work on the data recovery and inventory process of tagging data for small tuna species. This process will require active participation of the national scientists that hold such data.

ECOSYSTEMS

- Upon review of the EFFDIS estimates, the Sub-Committee noted significant discrepancies with the Task II reported catch and effort. Given the wide use of this product, it is recommended that the Secretariat pull the existing EFFDIS dataset from the web site to review it and correct the estimation methodology. The progress of this work should be presented at the 2019 meeting of the Sub-Committee on Statistics.

- The Sub-Committee recommends that a group of National Scientists and the Secretariat work intersessionally to develop a revised version of the ST09 form following the guidelines provided in this report. This new form will be presented at the 2019 meeting of the Sub-Committee on Statistics for its discussion and approval.

WGSAM

- The Group recognized the importance of the scorecard and SCRS catalogues as useful instruments for tracking fisheries data availability and improvements over time. The Group recommended that ICCAT CPCs should use these tools to revise/complement their data and that the error in the catch be given careful consideration in stock assessment and management advice development. It is recommended that the proper place to report the scorecard with three time series (10, 20, and 30 years) of all stocks is in the report of the Sub-committee of Statistics.

10. Replies to the Commission related to Rec. 16-14, paragraph 12, *c* and *d*

The Sub-committee had not received any additional information to change the response that it gave to the Commission in 2018 (see below).

c) provide the Commission with a summary of the scientific data and information collected and reported pursuant to this recommendation and any relevant associated findings;

In 2018, the ICCAT Secretariat reviewed and compiled all National Observer Program data that had been reported to the Secretariat since 2016. It included records from National Observer Programs from fishing activities from 2012 to 2019. The information that was reported has not the same format/structure in all years since the ST09 form has changed over time. This required the creation of three different data models in the National Observers database in the ICCAT-DB system. Whereas data entries before 2019 received visual inspections only, the Secretariat developed a JAVA software application in 2019 to validate form completeness and errors. As a result of this, data submissions could be verified before being compiled. In 2019 therefore, all data submissions with potential problems were fixed through re-submission in August-September 2019 so that all 2019 ST09 submissions could be uploaded into the ICCAT database system.

But, not all the pre-2019 submissions of National Observer Program data could be uploaded into the ICCAT database system. As part of the compilation process, data submissions were evaluated to determine if they could be entered into the database or not. The evaluation process excluded the uploading of form data submitted to the Secretariat where the data were rated as having No data or as being not useable. **Table 1** and **2** show the number of records by species and the number of operations that were observed, respectively, and that were entered into the database.

Table 1. Summary of national observer program data records by species group.

Species groups	2012	2013	2014	2015	2016	2017	2018	Grand Total
1-Tuna (major sp.)	49322	141655	65492	24100	25854	8658	4175	319256
2-Tuna (small)	1488	1429	4527	1623	12100	4310	4868	30345
3-Tuna (other)	3722	1884	1265	491	2116	560	455	10493
4-Sharks (major)	8145	9732	13051	3187	4649	2134	939	41837
5-Sharks (other)	251	194	2113	724	5564	2495	3248	14589
Grand Total	**62928**	**154894**	**86448**	**30125**	**50283**	**18157**	**13685**	**416520**

Table 2. Summary of distinct fishing operations observed by year and gear.

Gear groups	2012	2013	2014	2015	2016	2017*	2018*	Grand Total
BB						4	5	9
GN						7	12	19
HL							29	29
HP							3	3
LL	2214	6368	3374	1285	213	400	467	14321
OT						1		1
OTH							17	17
PS			266		1323	3339	6694	11622
RR						2		2
TN						8	13	21
TP						3		3
TR							2	2
TW						144	161	305
Grand Total	**2214**	**6368**	**3640**	**1285**	**1536**	**3908**	**7348**	**26299**

In general, the rate of reporting of observer data using the ST09 form has increased in the past 2 years. However, the number of CPCs that reported data on seabirds and sea turtles remains low. At the time, the Sub-committee cannot determine if the low number of CPCs reporting sea turtles and seabird data is because most CPCs do not interact with this species, or because that data are not being collected/reported, or a combination of both.

d) make recommendations, as necessary and appropriate, on how to improve the effectiveness of scientific observer programs in order to meet the data needs of the Commission, including possible revisions to this Recommendation and/or with respect to implementation of these minimum standards and protocols by CPCs.

In order for the Committee to further develop a response to the Commission, CPCs are encouraged to:

- Resubmit old data in new format including the 2018, 2019 submissions as well as old submission that could not be stored in the ICCAT-DB system
- Clear instructions on how aggregated fields should be interpreted for sampling and mitigation measures.
- Encourage all CPCs to resubmit/submit any National Observer Program data

The SCRS has already adopted and recommended the implementation of minimum standards for the use of Electronic Monitoring System for purse seine vessels in the Tropical tuna fishery.

11. Other matters

The convener of the Sub-committee, Dr. Guillermo Diaz (USA) informed of his decision to step down as Chair of the Sub-committee. He thanked the attendees for their participation in the meetings and he particularly thanked the ICCAT Secretariat for the support he received during his tenure.

12. Future plans and recommendations

Future work

Unlike other SCRS working groups, the Sub-committee on Statistics does not have a work plan. Instead, the Sub-committee reviews and comments on the workplan of the Secretariat which is the following:

- Replace the stand-alone MS-ACCESS Task II databases on the web by SQLite equivalent ones.
- Improve the 'client applications' that manage the databases of the ICCAT-DB system.

- Continue the tagging database redesign, including the addition of the model structure for electronic tagging, TG forms standardization, and automatic data integration of TG forms.
- Continue the development of the GIS project (create a PostGIS server and geo-reference all the ICCAT data available in the ICCAT-DB).
- Continue the standardization of electronic forms of compliance and statistics for automatic data integration.
- Adapt all the databases of ICCAT-DB to the ICCAT IOMS.
- Finalize the BFT stereo-camera size data integration.

Recommendations

- The Sub-committee recommends that the Secretariat adopt a new denomination of Task III, as the annual Task to handle (compile and manage) all the datasets (obtained using forms ST07, ST08, ST09, and ST10) that are not included in Task I and Task II, except for the tagging data.

- The Sub-committee recommends that the Secretariat adopts September 1 as the end date of the reporting period. However, the official deadline for CPCs to report all required data to ICCAT continues to be July 31.

- The Sub-committee once again recommends that CPCs make an effort to provide 'fishing days' in their submission of the ST-01A from (fleet characteristics).

- The Sub-committee reminds CPCs that the submission of the ST01B sub-form is mandatory (fleet characteristics for vessels <20 m).

- The Sub-committee reminds CPCs that the submission of the ST02B sub-form (zero catch matrix) is mandatory (Res. 15-09).

- The Sub-committee recommends that the species working groups provide the Secretariat with the range of lengths and weights that are considered biologically acceptable for each species.

- The Sub-committee recommends the Secretariat to contact EU National Scientists to obtain a document to support the time series of BUM catches 1985-2013 by Guadeloupe-Martinique. Without such supporting document the data cannot be integrated into the ICCAT-DB.

- The Sub-committee reminds CPCs of the previous recommendation that only the latest format of the electronic forms should be used to report data.

- The Sub-committee recommends that the different species working groups and sub-committees discuss if they have a need for the Secretariat to estimate CAS, CAA, and mean weights for their analyses. This discussion should be included as part of their workplans for 2020.

- The Sub-committee recommends that species working groups and CPCs review the CATDIS, particularly for historical periods and decide the time periods for which CATDIS should be estimated for.

- The Sub-committee recommends that the Secretariat present at the next meeting of SC-ECO an update on the progress made to estimate EFFDIS.

- The Sub-committee recommends that species working groups do not request data from the previous years for stock assessments conducted before July 31. These requests greatly increase the Secretariat's workload and the data reported are usually incomplete and, therefore, they are not included in the analyses.

13. Adoption of the report and closure

The Chair thanked the participants for their attendance to the meeting and he thanked the Secretariat staff for their continued support of the Sub-committee's work. The Sub-committee acknowledged how difficult its work would be without the full assistance of the Secretariat.

The Secretariat showed its deepest appreciation towards Dr Guillermo Diaz for the work carried out during his five years as convener of the Sub-committee and highlighted the major improvements achieved under this period. Mr. Camille Jean Pierre Manel also thanked Dr Diaz for the trust he placed in the Secretariat and expressed his appreciation towards the Secretariat staff for their efforts in supporting the Sub-committee work throughout the last five years and during the meeting.

The report of the meeting was adopted.

Appendix 13

Workplans

Tropical Tunas Workplan for 2020/2021

Work will focus on six activities:

A. Assessment of skipjacks stocks
B. Management Strategy Evaluation
C. Evaluation of effectiveness of management measures
D. Estimation of bycatch contributions of the main gears harvesting tropical tunas
E. Contribute to the AOTTP
F. Contribute to the Joint tRFMO FAD Working Group

A. Assessment of skipjacks stocks

Conduct a data preparatory meeting (ideally immediately following the AOTTP Symposium in June 2020) and an assessment in early 2021. The following tasks will be completed prior to the meeting:

1) Update catches (T1 and T2CE: catch and effort, T2SZ: size frequency) for all CPCs and fleets up until the year 2019, including new estimates of PS catch from T3+

2) Estimate catches of "faux poisson" (refer to methodology proposed in Duparc *et al.*, 2019)

3) Prepare CAS by fleet or alternatively compile size samples by fleet

4) Estimation of relative abundance indices:
   a. Update of baitboat and longline indices
   b. Estimation of index from FOB/FAD buoy data
   c. Estimation of index from FOB/FAD purse seine
   d. Other indices (sport, larval…)

5) Update of biological parameters:
   a. Estimation of growth with available AOTTP data
   b. Development of hypotheses about stock structure from AOTTP data
   c. Estimation of natural mortality from AOTTP data

During the meeting, the Group will agree on the data to be used in the assessment in 2021 and on:

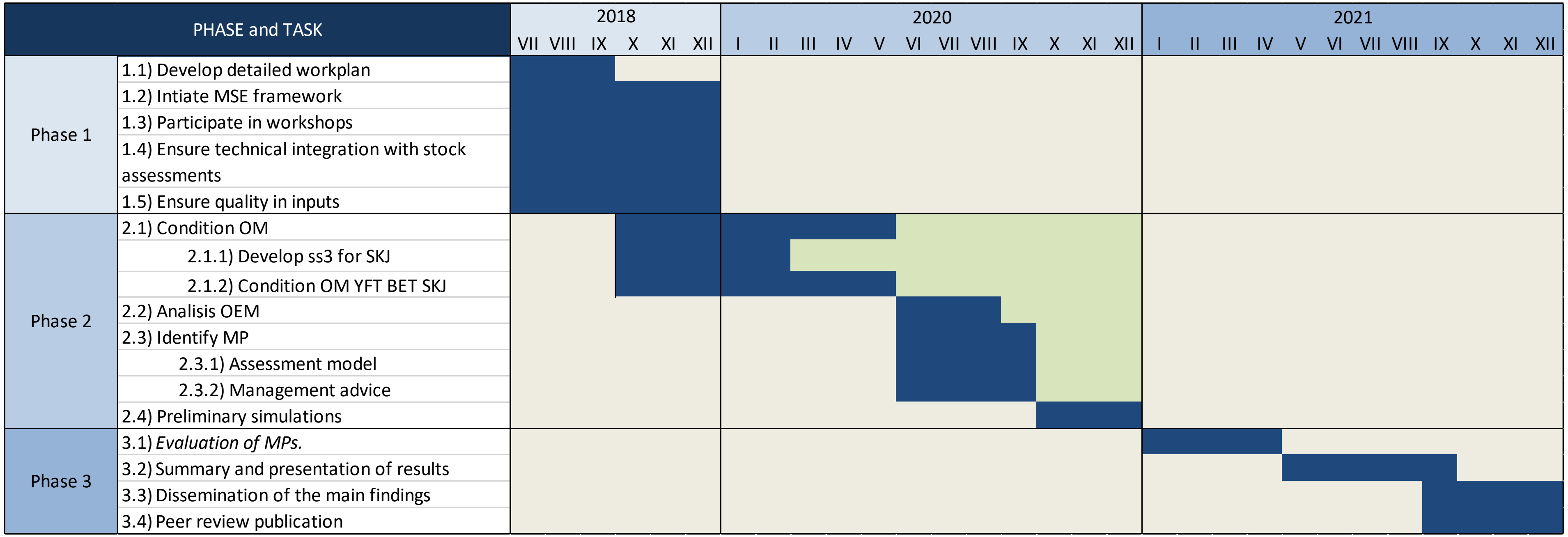
6) Alternative assumptions for assessment models relating to:
   a. Stock structure alternatives
   b. Fleet structure
   c. Possible structure of spatial models
   d. Uncertainty grid

7) Assessment models to be used in 2021 meeting:
   a. Production models
   b. Statistically integrated models
   c. Alternative data limited models

8) Preliminary runs of assessment models to be conducted prior to the assessment

B. Management Strategy Evaluation

The Group will restart the work on the tropical tuna MSE to complete activities planned for phase II of the MSE project according to the following schedule:



This will require funding by the Commission with a budget of €125,000 in each 2020 and 2021.

C. Evaluate the effectiveness of management measures in the tropical tuna fisheries

As per request of the Commission, the Group will progress in the evaluation of effectiveness of existing and newly proposed measures for tropical tuna fisheries (e.g. effort limits (closures) for purse seine vessels, gear specific catch limits, spatio-temporal closures, operational limits for FAD/FOBs…). In order to advance this work the Group will:

- Identify data needs to evaluate these measures
- Develop a list of selected fishery indicators that will be used to evaluate their performance
- Review methods available to evaluate effects of effort measures on stock status[1]

D. Estimation of bycatch contributions of the main gears harvesting tropical tunas

The Group will collaborate with the ICCAT Secretariat, Sub-committee on Statistics and the Sub-committee on Ecosystems to respond to the request of the Commission regarding the bycatch contributed by the tropical tuna fisheries. This will be done by supporting the Secretariat review of statistics provided in ST-09 and reviewing the estimates of bycatch obtained from these forms for each of the main gears used in tropical tuna fisheries (purse seine, longline and baitboat).

E. Contribute to AOTTP

a. Continue with recovery efforts of tagged tuna
b. Continue with analysis of AOTTP data to support:

   i. Estimation of population parameters
   ii. Collecting and ageing small yellowfin
   iii. Ageing and validation of skipjack spines
   iv. Remaining ageing of all tropical tunas
   v. Evaluation of effectiveness of current seasonal FAD closure

c. Contribute to AOTTP symposium
d. Contribute to the AOTTP exit strategy

F. Contribute to the tRFMO FAD Technical Group

a. Progress in the adoption of those standardized terms from the tRFMO FAD Glossary that are relevant and appropriate for ICCAT
b. Identify indicators related to FADs which are useful to ICCAT SCRS working groups
c. Seek to integrate ICCAT research activities related to FADs into the research activities of other tRFMOs

[1] The SCRS may be able to extend the work to complete evaluation of the effectiveness of some of the measures that the Commission may adopt in 2019 depending on the complexity of the measure and availability of data.

Albacore Workplan for 2020

In 2016, the North and South Atlantic albacore stocks were assessed, and TACs are set until 2020. Recommendations 17-04 and 16-07 indicate that the next stock assessment for these stocks will take place in 2020.

During 2018, an independent review of the North Atlantic albacore MSE was conducted. In general, the review was positive and identified several recommendations that were accommodated in 2019, as the adoption of a long-term HCR is scheduled also in 2020.

During 2017, the Mediterranean albacore stock was assessed, and several research lines were identified in order to improve future stock monitoring.

In 2020, the Albacore Species Group plans to assess both the northern and southern stocks. In the case of the northern stock, the assessment will allow to iterate the harvest control rule and set the TAC for the next three years. The Albacore Species Group will also provide advice towards the adoption of a long-term HCR. The Albacore Species Group will also focus on improving biological knowledge for Mediterranean albacore and improve CPUE series for all three stocks. One intersessional meeting is envisaged (6 days in June).

During 2020, the Albacore Species Group will work on a coordinated Atlantic and Mediterranean research program, focused on the three stocks, which will build upon the current North Atlantic Research Program and recent discussions on research needs for Mediterranean albacore.

North Atlantic Stock Proposed Work Plan

The intention is to, at a minimum, update the surplus production model used in the 2016 assessment, with data up until 2018. Following is a list of actions, responsibilities and deadlines:

- Prepare T1, and mean weights per fishery and year. Responsibility: Secretariat. Deadline: one month before the meeting.
- Update (till 2018) at least the following yearly standardized CPUEs, in weight (if possible). Deadline: one month before the meeting. Deliverable: SCRS documents, following the standards provided by the WGSAM. Responsibility: CPCs.

  - Japanese longline
  - Chinese Taipei longline
  - US longline
  - Venezuela longline
  - Spanish baitboat

- Evaluate the indices against the standards provided by the WGSAM: ALB Chair and ICCAT Secretariat. Deadline: Stock assessment meeting.
- Update the surplus production model up until 2018, following the 2016 assessment specifications, and apply the harvest control rule. Responsibility: EU-Spain. Deadline: Stock assessment meeting. Deliverable: SCRS document.

In addition, given the uncertainty on the results obtained in the last 2016 assessment, the Group reiterates the need for a comprehensive Research Programme (see **Addendum** to albacore workplan). The main research objectives identified by the Albacore Species Group are:

1. Improved knowledge of the biology and ecology;

2. Improved monitoring of stock status;

3. Development of Management Strategy Evaluation framework.

The Committee endorses the proposed research plan and recommends continued funding over a four-year period.

For 2020, it is envisaged to complete the reproductive biology study as well as the electronic tagging study. Deadline: one week before the Species Group meeting. Deliverable: SCRS documents. Responsibility: V. Ortiz de Zarate (reproductive study) and H. Arrizabalaga (e-tagging study).

South Atlantic Stock Proposed Workplan

The intention is to, at a minimum, update the surplus production models, up until 2018, following the procedures of the 2016 stock assessment. Following is a list of actions, responsibilities and deadlines:

- Prepare T1, and mean weights per fishery and year for South Atlantic albacore. Responsibility: Secretariat. Deadline: one month before the meeting (except CATDIS).
- Update (till 2018) the following yearly standardized CPUEs. Deadline: one month before the meeting. Deliverable: SCRS documents, following the standards provided by the WGSAM. Responsibility: CPCs.

  - Uruguayan longline
  - Japanese longline
  - Chinese Taipei longline
  - South African baitboat
  - Brazilian longline
  - Namibian baitboat

- Evaluate the indices against the standards provided by the WGSAM: ALB Chair and ICCAT Secretariat. Deadline: Stock assessment meeting.
- Update the surplus production models up until 2018. Responsibility: Japan, external expert, Brazil and South Africa (JABBA). Deadline: Stock assessment meeting. Deliverable: SCRS documents.

Mediterranean Albacore Stock Proposed Work Plan

Given the uncertainty on the results obtained in the last 2017 assessment, the main research objectives identified by the Albacore Species Group are:

1. Improved knowledge of the biology (reproduction, growth and age) and ecology;

2. Improved monitoring of stock status, including update of the CPUE series used in the assessment (EU-Spain longline, EU-Italy longline, Balearic larval survey) to confirm recent stock trends;

3. Explore alternative stock assessment methods suitable for data poor stocks.

Addendum to the Albacore Work Plan

North Atlantic Albacore Tuna Research Programme

The Albacore Species Group proposes to pursue a coordinated, comprehensive four-year long research programme on North Atlantic albacore to advance knowledge of this stock and be able to provide more accurate scientific advice to the Commission. This plan is based on the plan presented in 2010, which was based on document Ortiz de Zárate, 2011 that has been revised according to new knowledge, reconsidering the new most important priorities and reducing the total cost.

The research plan will be focused on three main research areas: biology and ecology, monitoring stock status and management strategy evaluation, during a four-year period.

Biology and Ecology

The estimation of comprehensive biological parameters is considered a priority as part of the process of evaluating northern albacore stock capacity for rebounding from limit reference points. Additional biological knowledge would help to establish priors for the intrinsic rate of increase of the population as well as the steepness of the stock recruitment relationship, which would facilitate the assessment. Among the key biological parameters are ones related to the reproductive capacity of the northern albacore stock, which include sex-specific maturity schedules (L50) and egg production (size/age related fecundity). In order to estimate comprehensive biological parameters related to the reproductive capacity of the northern albacore stock, an enhanced collection of sex-specific gonad samples need to be implemented throughout the fishing area where known and potential spawning areas have been generally identified. The collection of samples need to be pursued by national scientists from those fleets known to fish in the identified areas and willing to collaborate in the collection of samples for the analysis. Potential CPCs that could collaborate with the sampling programme may include (but not limited to): Chinese Taipei, Japan, USA and Venezuela. Expected results will include a comprehensive definition of sex-specific maturity development for albacore, spatial and temporal spawning grounds for northern albacore, estimate of L50 and size/age related fecundity.

The Albacore Species Group also recommended further studies on the effect of environmental variables on CPUE trends of surface fisheries. The understanding of the relationship between albacore horizontal and vertical distribution with the environment will help disentangle abundance signals from anomalies in the availability of albacore to surface fleets in the North East Atlantic.

It is also proposed to conduct an electronic tagging experiment to know more about the spatial and vertical distribution of albacore throughout the year. Given the typically high cost of this kind of experiment, and the difficulties to tag albacore with electronic tags, it is proposed to deploy 50 small size pop up tags in different parts of the Atlantic where albacore is available to surface fisheries (to guarantee good condition and improve survival), namely the Sargasso Sea and off Guyanas, off USA/Canada, Azores-Madeira-Canarias, and the Northeast Atlantic.

Last, the existence of potential subpopulations in the North Atlantic has been largely discussed in the literature. While recent genetic studies suggest genetic homogeneity (Laconcha *et al.* 2015), otolith chemistry analyses (Fraile *et al.* 2016) suggested the potential existence of different contingents, which could also have important management implications. Thus, in order to clarify the existence of potential contingents, we propose to expand the limited study area in Fraile *et al.*, 2016 to the entire North Atlantic, as well as to address inter-annual variability through multiyear sampling and analysis of otolith chemistry.

Monitoring of stock status

The Group recommends the joint analysis of operational catch and effort data from multiple fleets be undertaken, following the example of other species working groups. This would provide a more consistent view of population trends, compared to partial views offered by different fleets operating in different areas. The analysis is suggested for both longline fleets operating in the central and western Atlantic, and surface fleets operating in the Northeast Atlantic.

Finally, given the limitations of the available fishery dependent indicators, the Group mentioned the need to investigate fishery independent abundance indices. Although the Group is aware that, in the case of albacore, there are not many options to develop such fishery independent indices of abundance, it is proposed to conduct a feasibility test using acoustics during baitboat fishery operations to improve the currently available indices. A fine scale analysis for surface fisheries catch of albacore recruits (Age 1) is suggested to analyse the feasibility of designing some transect based approach for a recruitment index.

Management Strategy Evaluation

The Albacore Species Group recommends that further elaboration of the MSE framework be developed for albacore, considering the recommendations by the 2018 external review, the Methods and the Albacore tuna Working Groups, as well as the guidance of the Commission and the tRFMO initiative. Among other things, work should be promoted towards exploring additional operation models (e.g. considering auto correlated recruitment or regime shifts), improving observation error models, considering alternative management procedures (e.g. empirical harvest control rules, alternative stock assessment models, and CPUEs with different characteristics, such as very noisy CPUEs or CPUEs that track only some age classes).

The total requested funds to develop this research plan have been estimated at €842,000, with €542,000 to cover priority 1 tasks. The research programme will be an opportunity to join efforts of an international multidisciplinary group of scientists currently involved in specific topics and fisheries.

Budget

Research aim	***Priority***	*Approximate 4 year cost (€)*
Biology and Ecology		
Reproductive biology (spawning area, season, maturity, fecundity)	1	100,000
Environmental influence on NE Atlantic surface CPUE	2	20,000
Distribution throughout the Atlantic (e-tags)	1	350,000
Population structure: contingents	3	100,000
Monitoring stock status		
Joint Atlantic longline CPUE	1	30,000
Joint NE Atlantic surface CPUE	1	12,000
Feasibility of fisheries independent survey	3	180,000
Management Strategy Evaluation		
Development of MSE framework	1	150,000
	Total	**842,000**

Timeline

Research aim	*Year 1*	*Year 2*	*Year 3*	*Year 4*
Biology and Ecology				
Reproductive biology (spawning area, season, maturity, fecundity)	x	x	X	
Environmental influence on NE Atlantic surface CPUE	x	x		
Distribution throughout the Atlantic (e-tags)	x	x	X	x
Population structure: contingents	x	x	X	x
Monitoring stock status				
Joint Atlantic longline CPUE	x	x		
Joint NE Atlantic surface CPUE	x	x		
Feasibility of fisheries independent survey		x	X	x
Management Strategy Evaluation				
Observation error:				
- CPUE error structures and age classes	x			
Operating models:				
- Regime shifts	x			
- Changes in selectivity		x	X	
- Auto correlated recruitment		x	X	
- Broader scenarios using MFCL or SS			X	x
Management Procedure:				
- Delay difference models	x			
Communication:				
- Determine additional minimum standards for performance metrics (currently only prob(Green)>0.6)	x	x	X	x

Bluefin Tuna Workplan for 2020

Given the priority placed upon the MSE process the SCRS recommends four meetings: first a very technical meeting focused on reviewing operating models, then a bluefin tuna intersessional meeting focused on finalizing the reference grid and reviewing initial update assessment results, third, a candidate management procedure developers workshop and fourth, a 3-day meeting prior to the Species Group meeting to compile CMP recommendations and assessment results. While the meetings are open to all participants it is envisaged that only the intersessional meeting and the 3 day meeting prior to the BFT Species Group would require full participation of the BFT Species Group (additional information in *An updated schedule for BFT MSE Roadmap and 2020 Stock Assessment* - **Appendix 15**).

The workplan for 2020 is as follows:

1. Conduct update stock assessment;

2. Update the scientific advice at the Species Group meeting preceding the 2020 SCRS plenary based on updated stock assessment. With the exception of indices that require updating as outlined in Anon. 2019p, further updating of indices until 2019 is not required by the BFT Species Group. *Action: National scientists and Secretariat*.

3. Hold four meetings:

   a) Small MSE Technical Group meeting (February);

   b) Bluefin intersessional meeting (April);

   c) MSE CMP developers small meeting (July);

   d) Extended Bluefin SG meeting (prior to September SCRS).

4. Engage in research to address key uncertainties in the assessment, such as:

   a) Noting the potential role of ecosystem factors in affecting the interpretation of many indices, the Committee recommends that effort be directed towards both identifying environmental factors that affect catchability at basin and local scales and incorporating these factors in the index standardization or modeling. The Committee recommends that the Bluefin Tuna Species Group index analysts attend the Working Group of Stock Assessment Methods (WGSAM) workshop focused on incorporating habitat modeling and environmental considerations into indices and surveys;

   b) Building on the joint CPUE modeling workshop to develop a joint longline index for the Gulf of Mexico between Mexico and United States.

Billfish Workplan for 2020

The Billfish Species Group considered the following activities in its workplan for 2020:

Catch and Effort Data (Task I and II)

Important white marlin catches occur in the tropical and subtropical central Atlantic in both CPC and non-CPC fisheries, mainly in the Caribbean Sea and off West Africa. Catch and effort statistics for billfish species remain incomplete for many of the coastal and industrial fishing countries. Therefore, all countries catching billfishes (directed or by-catch) should report species-specific catch, catch-at-size, and effort statistics by as small area as possible, and by month.

- Two regional workshops in West Africa and the Caribbean for CPC statistical correspondents on artisanal fisheries data collection. Objective: documents describing their fishery(ies) and suggestions to improve data collection and submission of billfish spp. (~ €50,000).

Discards

The Group noted that to date only a few countries have ever reported billfish discards and using such limited information, the estimates of dead discards are around 2-3%. Having the total catches, including dead and live discards, and estimates of post-release mortality is important for stock assessment purposes. As such, the Group emphasized the need for all CPCs to comply with the mandatory requirements to report discards (both dead and alive) for billfishes.

Life history parameters

Continue the sampling of hard parts for the growth study on billfish caught off West Africa:

- Organize a workshop on age reading of billfish to enhance current expertise in the East and West Atlantic billfish and to standardize processing and reading protocols between laboratories in 2020 (~ €25,000).

- Continue the research and biological sampling of blue marlin from the Gulf of Mexico Mexican longline fisheries (~ €5,000).

- Continue Growth study billfish in the eastern Atlantic (~ €35,000) focusing on analysis of samples collected since 2018.

Atlantic and Mediterranean Swordfish Workplans for 2020

North and South Atlantic

Assessments for North and South Atlantic swordfish were conducted in 2017. The next assessment will likely be scheduled for 2021. The Group requests to conduct an intersessional Swordfish Species Group meeting in 2020, with the major focus on the progress of the swordfish biological and stock structure projects and the development of the North Atlantic swordfish MSE process. This meeting should be conducted together with the swordfish Mediterranean 2020 data preparatory meeting.

A list of recommended work for the swordfish Working Group was identified as high priority areas where continued efforts are required for North and South Atlantic swordfish:

***Life history Project*:**
- *Background/objectives:* An understanding of the species biology, including age, growth and reproductive parameters is crucial for the application of biologically realistic stock assessment models and, ultimately, for effective conservation and management. Given the current uncertainties that still exist in those biological parameters, the Group recommends more studies on swordfish life history are carried out. Those should be integrated with an ICCAT swordfish research plan that is provided in the recommendations with financial implications.
- *Priority:* High priority.
- *Leader/Participation:* A consortium led by Canada (currently with 22 institutes; 15 countries, both Atlantic and Mediterranean) started this work in 2018. The work progressed during 2019 and is scheduled to continue in 2020.
- *Timeframe:* Started in 2018; request funds to continue in 2020 (see **Table 1** at the end for estimated costs).

***Size/Sex distribution study*:**
- *Background/objectives:* The Group recommends that a detailed size and sex distribution study is started in order to better understand the spatial and seasonal dynamics of swordfish in the Atlantic. This study should be carried out in a cooperative manner between scientists, involving as many fleets as possible and preferably using detailed fishery observer data. This is particularly important if future alternative management measures are considered, for example when considering spatial/seasonal protection areas for juveniles. Additionally, such study would also provide a contribution for the stock delimitation work.
- *Priority:* High priority.
- *Leader/Participation:* EU-Portugal, with collaboration of CPCs willing to participate/share data on size/sex/location from observer programmes.
- *Timeframe:* Started in 2018. *Deadline* for the next stock assessment.

***PSAT tag data request for joint analysis*:**
- *Background/objectives:* The Group encourages all CPCs to provide their swordfish PSAT tag data to an *ad hoc* study Group. At a minimum the data should include the temperature and depth by hour, date and one-degree latitude*longitude square. This will contribute to support the improvement of CPUE standardization through the removal of environmental effects as well as for the better definition of stock boundaries.
- *Priority:* High priority.
- *Leader/Participation:* Lead by US, with the participation of CPCs with PSAT tag data.
- *Timeframe:* Started in 2018, ongoing in 2019, to continue in 2020.

***Larval index work*:**
- *Background/objectives:* An initial swordfish larval index was presented in the swordfish data preparatory meeting. The Group recognized the value of adding fishery-independent indexes to the stock assessment, but there were still concerns about the surveyed area. Therefore, the Group recommended to include this work into the swordfish work plan to determine if those issues can be solved and this or other fishery independent indexes can be improved and used in the future.
- *Priority:* High priority.
- *Leader/Participation:* Lead by the United States.
- *Timeframe:* Should be completed for the next stock assessment.

Continuing work on environmental effects:

- *Background/objectives:* Given the possibility of spatial and environmental effects being partially responsible for the conflicting directions of some of the influential indices of abundance, the Group should further study into this hypothesis during the coming years, use existing PSAT data to compliment this work, and to determine how best to formally include these environmental covariates into the overall assessment process. The U.S. has taken a lead role in this investigation and likely collaborators would include scientist from Canada, Japan, EU (Spain and Portugal) as their indices were the most appropriate for this work. Expected deliverables would include quantified reduction in the conflicting indices of abundance from the temperate and tropic regions, which in turn should lead to a more stable assessment. Other products could include an increased understanding of the distribution of swordfish and perhaps a revisiting of the geographic structure of the data and the assessment. Ideally, these works should be done before the next stock assessment.
- *Priority:* High priority.
- *Leader/Participation:* Lead by U.S., with participation of other CPCs.
- *Timeframe:* Ongoing, to be considered at the next stock assessment.

***Continue N-Atlantic MSE process*:**

- *Background/objectives:* The Group agreed to take a more in-depth look at the base case SS3 model through more extensive diagnostics, so that the model is configured most appropriately for the MSE work and to continue the MSE development.
- *Priority:* High priority.
- *Leader/Participation:* Stock assessment and MSE modellers.
- *Timeframe:* To start now. Results to be provided at the 2020 meeting.

Activities to complete until the end of 2019

1. Provide OM non-convergence diagnostics to the WGSAM Rapporteur to revise base case OM to identify conditions leading to non-convergence;
2. Share MSE design document with Group for comment and feedback (Google document with Group adding comments);
3. Update SWOMSE with additional example MPs (e.g., surplus production MP, F_{MSY} reference MPs);
4. Share SWOMSE package and user manual with Group for comment and feedback;
   a) Question: push SWO MSE package to ICCAT Github (confirm with ICCAT Secretariat);
5. Develop initial Shiny app for presenting MSE results and share with Group for comment and feedback;
6. Share a Google sheet with Group with progress on deliverables, list of proposed MPs, performance metrics, etc.

Proposed activities for 2020

1. Finalize the OM grid (inputs from Swordfish Species Group, including the SS3 modeler and grid developers);
2. Produce diagnostic reports for OMs – for OM selection/weighting. Identify key OMs spanning range of uncertainty axes (e.g., 8 OMs) and produce pair-wise OM comparison reports;
3. Report impact of OM uncertainty to MSE results, i.e. MP performance and selection. Uncertainty in:
   a) Gear selectivity
   b) Length composition effective sample size
   c) Steepness
   d) Natural mortality
   e) Catchability increase (historical)
   f) Environmental effects

4. Report impact of uncertainty scenarios in OM projection for MP performance/selection;
    a) Impact of hypothesized spatial structure/mixing (requires hypothesized spatial structure/movement rates)
    b) Environmental considerations – cyclic trends or regime shift in recruitment
    c) Effect of minimum size recommendation – discard mortality & implementation options
    d) Future increases in catchability
    e) Implementation error in TAC overages

5. Update Shiny app with new OMs, performance metrics;
6. Attend and provide an update at the Intersessional SWO meeting in March/April 2020;
7. Attend and provide an update Species Group meeting in September 2020;
8. Reporting and SCRS drafting/submissions;
9. Misc: Webinars, contingencies, individual calls/support with MSE package;

Remaining activities from 2018 Species Group report (Items not likely in current MSE framework or uncertain of best approach, so need further discussion during 2020).

1. Environmental considerations: for example: oxygen minimum zone – vertical displacement, cyclic movement of adult swordfish;
2. Seasonal dynamics;
3. Spatial sexual segregation of the stock;
4. Consider CPUE conflicts by area.

***Improvements on input data to the South Atlantic assessment*:**
- *Background/objectives:* Given the uncertainties with regards to CPUE inclusion in the assessment models noted in the previous South Atlantic assessment (Anon. 2017f.), the Group strongly encourages national scientists to progress on CPUE development. Additionally, other data (e.g., sizes, biology) that can improve the assessment should also be provided.
- *Priority:* High priority.
- *Leader/Participation:* CPC scientist and stock assessment modellers.
- *Timeframe:* For the next stock assessment.

Activities pertaining to the 2017 External Assessment Reviewer (specific work for progressing MSE for N-Atl SWO and other activities to take in consideration in the next stock assessment)

MSE work

- *Background/objectives:* MSE needs to be able to incorporate AMO effect and spatial distribution and changing catchability in the operating model. From this, it seems feasible to test whether a simple combined CPUE could be an accurate indicator of stock trends. MSE could either take a detailed and technical approach (e.g. spatial and oceanographic effects on the CPUE indices and subsequent effect on the assessment), or it could take a management-oriented approach to investigate possible changes in the HCR. While both goals could be done at the same time, it might be better to tackle these as different projects in order to have high client engagement in the HCR project. With regards to the management-oriented approach which has been requested by the ICCAT Commission, the work has started in 2018 with an initial development of an MSE framework. A new contract (new contractor) was awarded in 2019, and the work continued mostly to develop the framework for the conditioning of the Operating Model. The work planned for 2020 is to finalize the conditioning of the Operating Model and start testing alternative management procedures. The full and detailed documentation of the MSE framework and a Trial Specifications document should be produced.
- *Priority:* High priority.
- *Leader/Participation:* A Contractor started this work in 2018. A new contract (different contractor) was awarded in 2019, which should continue this work in 2020.
- *Timeframe:* Process started in 2018. Funds requested to continue in 2020, taking into account the ICCAT Commission schedule regarding swordfish MSE work (see **Table 1** at the end for estimated costs).

Clear presentation on CPUEs

- *Background/objectives:* The reviewer encouraged more explicit, clear presentation and comparison of CPUE trends by fleet and area and season. Outliers need to be identified and potentially down-weighted in combined indices and assessments.
- *Priority:* High priority.
- *Leader/Participation:* All CPCs that present CPUE series for the next assessment.
- *Timeframe:* Next stock assessment.

Sensitivity analysis for catches/discards

- *Background/objectives:* Conduct sensitivity analysis with estimated total catch, including plausible degree of discard/retained catch ratio changing over time.
- *Priority:* High priority.
- *Leader/Participation:* Stock assessment modellers and scientists involved in the assessment
- *Timeframe:* Next stock assessment.

Road map for Northern Atlantic Swordfish MSE

SWO MSE - PHASE and TASK		2019								2020												2021												2022											
		V	VI	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
PHASE 1: Framework and initial developments	1.1) Development of detailed workplan	■	■	■	■	■																																							
	1.2) Initiate MSE framework	■	■	■	■	■																																							
	1.3) Development of initial SS models grid	■	■	■	■	■																																							
	1.4) Ensure technical integration with stock assessment and quality of inputs	■	■	■	■	■	■	■	■																																				
	1.5) Condition initial OM		■	■	■	■	■	■	■																																				
	1.6) Examples of OM diagnostics and validation		■	■	■	■	■	■	■																																				
	1.7) Develop initial Shiny app for presenting MSE results					■	■	■	■																																				
	1.8) Participation of contractor in 2019 Species group meeting					■																																							
PHASE 2: OM conditioning	2.1) Continue work with SS3 modeler and grid developer to identify conditions leading to non-convergence and develop a new final grid						■	■	■	■	■	■																																	
	2.2) Finalize OM conditioning with final grid									■	■	■	■	■	■	■	■																												
	2.3) Produce diagnostic reports for OMs									■	■	■	■	■	■	■	■																												
	2.4) Continue work and additional examples of MPs												■	■	■	■	■	■	■	■	■																								
	2.5) Impact of uncertainty not considered in the OM grid in projections and MP performance / selection												■	■	■	■	■	■	■	■	■																								
	2.6) Update Shiny app with new OMs, performance metrics												■	■	■	■	■	■	■	■	■																								
	2.7) Contractor attend and provide an update at the Intersessional SWO and Species meetings											■						■																											
PHASE 3: Evaluation of MPs	3.1) Dialogue with Commissison Panel 4 on management objectives																					■	■																						
	3.2) Finalize OM with any improvements identified in previous phases																							■	■	■																			
	3.3) Evaluation of MPs based on performance statistics																							■	■	■	■	■	■	■															
	3.4) Selection of MPs																							■	■	■	■	■	■	■															
	3.5) Tunning of proposed MPs																											■	■	■	■	■	■												
	3.6) Contractor attend and provide updates at dialogue, Intersessional and Species meetings																					■	■		■					■															
PHASE 4: Finish work and provision of advice	4.1) Complete any remaining issues from previous Phases																																	■	■	■	■	■							
	4.2) Summary and presentation of results																																			■	■	■	■						
	4.3) Dialogue with Commission Panel 4 to provide results on MP performance																																					■	■						
	4.4) Dissemination of the main findings																																							■	■	■	■	■	
	4.5) Peer review publication																																							■	■	■	■	■	

Table 1. Summary of funds requested for 2020 to continue the biological and stock structure work on Atlantic and Mediterranean swordfish, as well as the North Atlantic MSE development.

Project	*Task*	*Leader*	*Participating CPCs*	*Budget request (EUROS, 2020)*	*Notes*
Sampling and Biology Project/consortium (Proj. leader: Canada; Med. coord: Univ. Genova, Italy)	Sampling collection, shipping and consumables	Atl: Canada; Med: Italy	Consortium (participating CPCs/Institutes)	€40,000	Ongoing consortium work for continuing collection and shipping of age and growth, reproduction and genetic samples.
	Biology - Age and growth	EU.Portugal		€45,000	Continue consortium work on spine and otolith processing and provide preliminary results
	Biology - reproduction	EU.Spain		€25,000	Continue consortium work on processing samples and provide preliminary results
	Biology - Genetics	EU.Italy		€100,000	Continue consortium work on processing genetic samples and provide preliminary results

ICCAT/CPCs directly	Workshop on Ageing and Histology Reference Set	ICCAT Secretariat with the Consortium	Consortium labs working on biology and experts on SWO biology	€20,000	Workshop organization (including attendance of external experts on SWO biology) to establish an ageing reference sets (both spines and otoliths) and creating reference sets reproductive stages (histology).
ICCAT/CPCs directly	Satellite tagging	Managed by SWO SG (represented by the Chair)	Any CPC with possibility to deploy satellite tags in the stocks mixing areas and the core habitat areas (temperate NW, SW, SE)	€50,000	Purchase PSAT tags and satellite transmission. Deploying PSAT. Reserve 5,000 for released fish payments and 500 for tagging equipment (poles, applicators, etc.)
N-Atl SWO MSE project	Continue N-SWO MSE work	MSE contractor	Inputs and dialogue with the SWO SG and CPCs interested in the MSE development	€90.000	Continue the work started with the 2019 contractor
TOTAL				**€370.000**	

Mediterranean

- For the Mediterranean stock, the last assessment was conducted in 2016. The next assessment should take place in 2020. Additionally, a data preparatory meeting should be previously conducted to analyze and prepare data for the stock assessment.

- Given the questions raised during the latest assessment the preparatory meeting should include:

    - Review of available data
    - Updated estimates of standardized CPUE indexes for the most important fisheries
    - Estimates of discard misreporting
    - Updated information on species biology
    - Identification of appropriate stock assessment approaches
    - Exploration of the potential of using alternative indicators and reference points (L_{opt}, measures based on reproductive potential, etc.).

Additionally, the Group should develop a workplan aiming:

- To achieve the collection and recovery of historical data to increase the period covered by time series, the nominal data presented in past studies (e.g. De Metrio *et al*. 1999) should be recovered and evaluated for possible standardization.

    - Time-frame: 2020
    - Priority: high, depends on funding. 10.000€ requested for this work in 2020
    - Participation: mainly EU-Italy in collaboration with other CPs

- To better identify the effects of the environment on swordfish biology, ecology and fisheries. Future CPUE analyses should evaluate the benefits of incorporating environmental factors on the distribution of spawners and juveniles.

    - Time-frame: 2020
    - Priority: medium
    - Participation: all CPs

Small Tunas Workplan for 2020

This workplan foresees both short and long-term objectives (see specific timeframes).

Progress on the Small Tunas Year Programme (SMTYP):

- ***Background/objectives:*** The SMTYP started in 2016-2017 with the initial aim of recovering small tuna historical data (statistical and biological data) from the main ICCAT fishing areas. The programme is ongoing and currently lists various activities in terms of sampling and biological works.
- ***Priority:*** High
- ***Leader/Participation:*** A consortium led by Spain (Univ. Girona) was set in 2018 for the collection of samples aiming biological studies (reproduction and aging) and stock differentiation.
- ***Timeframe:*** Ongoing work with annual updates scheduled to be provided to the SMT Species Group.

Revision of small tunas L/W relationships at stock level:

- ***Background/objectives:*** There are several L/W equations available for small tunas at local level, and several more are being currently developed by various CPCs/national scientists. The Group recommends that joint analyses are carried out using detailed observed data, so that L/W relations representative of the stocks at regional level can be presented and adopted by ICCAT.
- ***Priority:*** High
- ***Leader/Participation:*** EU-Spain, with collaboration of CPCs willing to participate/share observed L/W data from observer and sampling programmes. EU-Portugal, Morocco, Brazil has already committed to participate.
- ***Timeframe:*** The leader will circulate data template by September 2019. CPCs should submit data up to May 2020. A SCRS paper will be presented to the Species Groups in September 2020.

Updating the biological meta-database:

- ***Background/objectives:*** The SMT Group started in 2016 a biological meta-database. The Group recognized the importance to continuously update this database as new biological information becomes available, also developing criteria for replacing existing parameters when available. Such information is then provided to update the SMT Executive Summaries and will eventually be used for both qualitative and quantitative assessments.
- ***Priority:*** High
- ***Leader/Participation:*** EU-Portugal, with collaboration of CPCs willing to participate, will continue to update the meta-database and provide updated information (in the form of SCRS papers) to the Species Group. The next update is planned for 2020 Species Group September meeting. Scientists that have access to recent literature on SMT biology that can inform this database are encouraged to send that information to the coordinator and the SMT Chair.
- ***Timeframe:*** A SCRS paper will be presented annually to the Species Groups or Intersessional meeting.

Updating and/or apply the Data-Limit Models:

- ***Background/objectives:*** The SMT Group started applying Data Limited methods in 2016 and, although the Group has improved in applying a range of models, the robustness still need to be evaluated before they can be used to provide management advice.
- ***Priority:*** High
- ***Leader/Participation:*** Brazil and Morocco will continue to update the application of Data-Limited methods to SMT, with collaboration of CPCs willing to participate.
- ***Timeframe:*** SCRS paper to be presented annually to species Group meetings or Intersessional meetings.

Sharks Workplan for 2020

Hold a joint ICES-ICCAT intersessional meeting to:

1. i) Assemble and review all available porbeagle information including:

    - ICCAT fisheries
    - Non-ICCAT fisheries that interact with porbeagle
    - Biology, life history, tagging, length/age composition, genetics, relative abundance indices

    ii) Update any information from research projects (SRDCP and others)
    iii) Review the ABNJ Southern Hemisphere porbeagle assessment
    iv) Attempt to assess stock status of Atlantic porbeagle stocks

2. Review of the SRDCP activities and progress

3. Conduct exploratory analysis for the use of Close-kin Mark Recapture techniques for the shortfin mako stock assessment and other shark species

Working Group on Stock Assessment Methods Workplan (WGSAM) for 2020

1) Plan to conduct a CPUE standardization workshop during the 2020 WGSAM meeting including how to include environmental covariates into the standardization.

2) Complete the swordfish Species Distribution Model as a stand-alone model as well as to add a simulated directed fishery to the Longline Simulator tool.

3) Continue to make progress on CPUE level of aggregation study.

4) Continue work on problems associated with use of localized CPUE and/or Shifting Distributions.

5) A comparison study of MCMC and bootstrapping to MVN techniques to characterize stock assessment uncertainty.

6) A document outlining the recommended standard diagnostics for stock assessment models.

7) Options paper for stock assessment software use and inclusion into the ICCAT software catalogue.

8) To explore how to measure and quantify catchability increases over time that currently cannot be easily captured in the CPUE standardization. Recommendation to establish a program for data that need to be collected and how to model time varying catchability in the CPUE standardization or assessment process.

Sub-committee on Ecosystems and By-Catch Workplan for 2020

Pertaining to Ecosystems:

Consistent with the ongoing exercise of developing an Ecosystem report card, the Sub-committee drafted the following workplan. The plan indicates specific tasks to be completed by the Ecosystem report card working groups prior to the 2020 Sub-committee on Ecosystems meeting.

Short to medium term plan:

Date	***Component***	***Task***	***Who***
2019 SCRS meeting		Produce Report Card for Annual Report	Sub-committee
2019 Sub-com. Stats Meeting	Form ST09	Revisions to ST09	National Scientists and the Secretariat
Nov 2019 to April 2020		Update prototype report card components with new indicators	
	Retained Species: Assessed	Update Bratio and/or Fratio values from recent assessments and deal with F0.1 issue	Committee participants
	Retained Species: Not assessed	Perform PSA for select retained unassessed species	Committee participants By-catch Coordinator
	Non-Retained Sharks	Increase the scope of the data used in the analysis. Include other gear types	Committee participants
	Turtles	Perform risk assessment for loggerhead and leatherback turtles	Committee participants
	Seabirds	Create indicator based on the total interactions, total mortality or alternatives	Committee participants
	Mammals	Review ICES and Whaling Commission data and literature for BPUE	Committee participants
	Trophic structure, Community and diversity indicators	Create diversity indicator. Create indicator reflective of the trophic restructuring using size-based indicators	Committee participants
	Habitat	Create an indicator based on impact of fisheries on habitat (e.g. lost FADs)	Committee participants
	Socio economic	Develop a process to extract the socio-economic data	Committee participants By-catch Coordinator
	Fishing Pressure	Develop an indicator	Committee participants Secretariat
	Environmental Pressure	Create an indicator based on impact of habit on fisheries	Committee participants
Nov 2019 to April 2020	Case Studies	NW Atlantic Ocean indicators for Habitat, Environmental Pressures, Fishing Pressure. Develop Atlantic Ocean tropical area indicators.	Committee participants
2020		Review updated report card at Sub-com Eco	Sub-committee

2020 meeting plan:

1. Review the progress that has been made in implementing ecosystem-based fisheries management and enhanced stock assessments.

2. Review the progress on developing an Ecosystem Report Card for ICCAT including the development of status and pressure indicators, reference levels.

   a) Review adequacy of existing indicators against proposed new ones.

   b) Review development of ecoregions.

3. Review feedback received from Species Groups regarding their needs and contributions towards incorporating/developing ecosystem considerations and discuss additional mechanisms to effectively coordinate, integrate and communicate ecosystem-relevant research across the ICCAT Species Groups and within the SCRS.

4. Elaborate on the needs and contributions of the Sub-committee to individual Species Groups.

Pertaining to by-catch:

1. Continue the ongoing collaborative work related to seabirds and marine turtles.

2. Develop a list of by-catch species that are not retained and select the species to be used as indicators.

3. Support the development of indicators for the Ecosystem report card.

4. Form a small group to revise and change the 2018 version of ST09 that have flexible spatio-temporal resolution. Request that CPCs re-submit their 2018-2019 data on this form. Secretariat to develop software to import these revised data submissions.

Sub-committee on Statistics Workplan for 2020

Unlike other SCRS working groups, the Sub-committee on statistics does not have a work plan. Instead, the Sub-committee reviews and comments on the work plan of the Secretariat which is the following:

- Replace the stand-alone MS-ACCESS Task II databases on the web by SQLite equivalent ones.
- Improve the 'client applications' that manage the databases of the ICCAT-DB system.
- Continue the tagging database redesign, including the addition of the model structure for electronic tagging, TG forms standardization, and automatic data integration of TG forms.
- Continue the development of the GIS project (create a PostGIS server and geo-reference all the ICCAT data available in the ICCAT-DB).
- Continue the standardization of electronic forms of compliance and statistics for automatic data integration.
- Adapt all the databases of ICCAT-DB to the ICCAT IOMS.
- Finalize the BFT stereo-camera size data integration.

Appendix 14

2019 Ecosystem Report Card

Introduction

The SCRS continues to develop indicators for the Ecosystem Report Card in accordance with ICCAT Res. 15-11. This report card has multiple purposes:

- to provide to the Commission and stakeholders a succinct summary of the state of selected ecosystem components,
- to increase the visibility and usefulness of important ecosystem data and research,
- to strengthen ties between ecosystem research and fisheries management,
- to provide the context that will allow the Commission to incorporate ecosystem considerations into their management decisions,
- to represent the progress of management actions in achieving Ecosystem-Based Fisheries Management (EBFM) objectives, and
- to encourage a more holistic, integrated and transparent approach to the management of ICCAT fisheries.

The current version of the Ecosystem Report Card features 11 ecosystem components: 1) Assessed Retained Species, 2) Non-Assessed Retained Species, 3) Seabirds, 4) Marine Turtles, 5) Marine Mammals, 6) Non-Retained Sharks, 7) Trophic Relationships, 8) Socio Economic, 9) Habitat, 10) Fishing Pressure and 11) Environmental Pressure. The SCRS has developed a protocol that formalizes the review and adoption of indicators for each of the components. In addition, the SCRS also created an indicator checklist which catalogues and characterizes the indicators that were adopted. Details on the protocol and checklist can be found in the report of the 2019 meeting of the Sub-committee on Ecosystems (Anon. 2019m).

The goal of this Ecosystem Report Card is to demonstrate, through the use of pressure and state indicators, the potential for assessing the impacts of ICCAT fisheries and management decisions on different components of the ecosystem. This report card is still in development and subject to an iterative process involving consultation with the Commission and continued science review and revision.

Scope

The initial scope of the report card is the entire ICCAT Convention area. However, to help operationalise EBFM the SCRS recognizes that future iterations of this report may focus on the impacts of ICCAT fisheries and management actions for a limited number of regional case studies. In support of providing a more regional perspective on high risk ecosystem impacts, the Sub-committee has recommended to initially focus on two regions: i) the tropical Atlantic and ii) the Sargasso Sea areas of the Atlantic Ocean.

Once these regional assessments have been completed, this section of the report card will provide a brief overview of the major physical and biological attributes of the areas in addition to the major pressures on the ecosystem services that the areas provide.

Status of Ecosystem Components

Retained assessed species

Objective: Using biomass (B) and fishing mortality (F) ratio indicators, determine if the number of retained assessed stocks in a healthy, cautious or critical state is improving over time.

The trends over time in B/B_{MSY} (B ratio) and F/F_{MSY} (F ratio) of the stocks assessed by ICCAT (**Figure 1**) indicate progress in reducing overfishing, however, an important fraction of these stocks still remain in an overfished condition. Mediterranean swordfish, North Atlantic shortfin mako, East Atlantic sailfish, southwest Atlantic porbeagle and Atlantic bigeye tuna are currently considered overfished and experiencing overfishing.

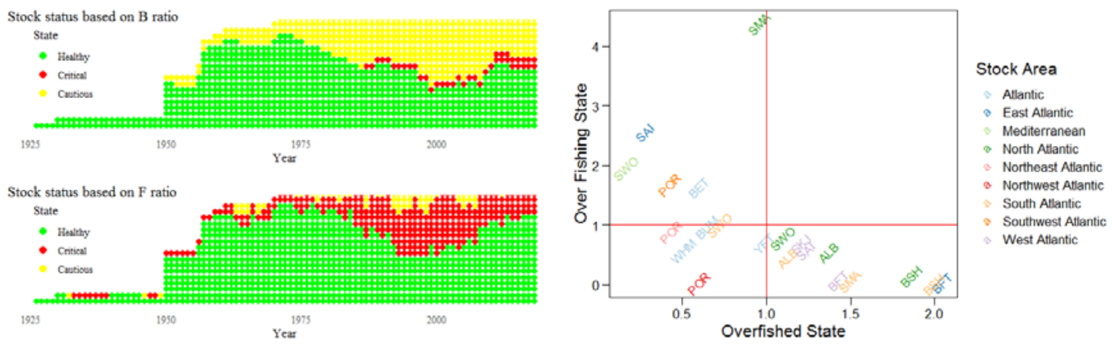


Figure 1. Stock status of all assessed ICCAT species based on B/B$_{MSY}$ and F/F$_{MSY}$ (left). States of the F ratio are defined by values of 1.4 and 1; B ratio reference points are 1 and 0.4. Kobe phase plot indicating status in 2018 (right). Note that the stock status determinations are carried forward from the terminal year of the most recent assessment of the stocks.

Future work will involve developing a separate category or indicator plot for those stocks in which the SCRS adopted an F$_{0.1}$ strategy (e.g., bluefin tuna). The advent of MSE based advice and its effect on future updates also needs to be considered.

Retained unassessed species

Objective: Determine if the catch biomass of retained unassessed species in the Convention area relative to total retained catch biomass of species in the Convention area is increasing over time.

Upon review, the Sub-committee proposed an alternative to the indicator provided in the 2018 report. It was proposed that the new indicator be based on a productivity/susceptibility analysis where the productivity is based on life history traits of the retained unassessed species and the susceptibility is based on the spatial and temporal overlap between these species' distributions and fishing effort.

Seabirds

Objective: Determine if the interaction rates and/or total estimated mortality are being reduced over time.

This indicator is still under development and awaits a recommendation from the seabird component of the Common Oceans Tuna project as to the type of indicator to use, as well as a revision by the ICCAT Secretariat of the EFFDIS database. It is expected that an indicator will be available in 2020.

Mammals

Objective: Determine if interaction rates are being reduced over time.

The current version of this indicator reflects the 2018 recommendations for the marine mammal indicator (**Figure 2**) to cover an extended area and be more species specific. It currently shows declining trends in the vulnerability of Orcas (*Orcinus orca*) to surface longline gear in 5 regions of the Convention area. Given that this indicator depends on EFFDIS, which is currently under revision, the trends described here are strictly provisional. It should also be noted that limited interactions of Orcas with surface longline gear have been reported and consequently the SCRS recommends investigating mammal interactions with gill nets.

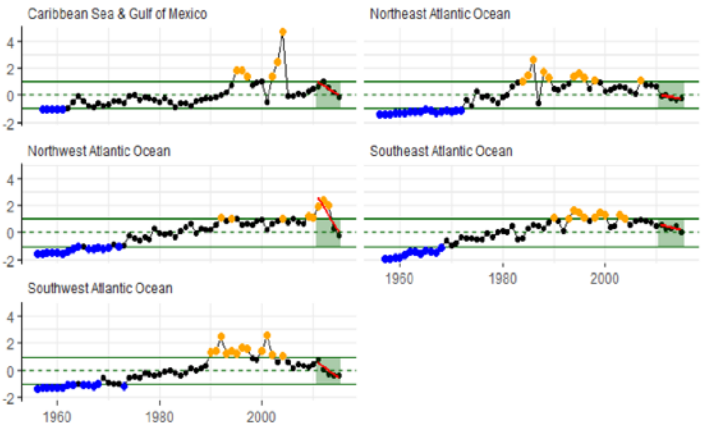


Figure 2. Indicators of *Orcinus orca* vulnerability to longline gear by geographic area. The vulnerability scores were scaled and centered on the respective series mean. Values >= 1 std are orange. Values <= -1 std are blue. Red trend lines are for the last 5 years and were fit with a linear model.

Sea turtles

Objective: Determine if the BPUE estimates for loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) turtles are decreasing over time.

Upon review, the Sub-committee determined that the sea turtle indicator would be based on semi-decadal risk assessment analyses. This approach is similar to a stock assessment in that it will provide the relative impacts of by-catch while accounting for population-level considerations.

Non-retained sharks

Objective: Determine if there are no negative trends in relative biomass over time.

The Sub-committee requested that the SCRS Sharks Species Group develop indicators for bigeye thresher (*Alopias superciliosus*) caught by longline fleets and silky sharks (*Carcharhinus falciformis*) caught by purse seine fleets. **Figure 3** provides a BPUE indicator for bigeye thresher developed from EU-Portugal longline fleet data. An ERA identified this shark species as being at highest risk due to its vulnerability to longline gear and its low productivity, making it an ideal representative species for this ecosystem component.

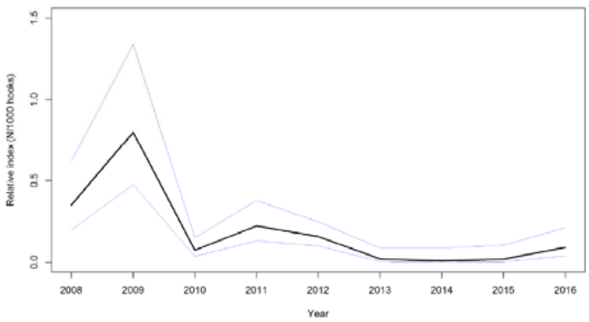


Figure 3. Bigeye thresher standardized CPUE series between 2008 and 2016, with the respective confidence intervals.

The SCRS requested that the analysis be expanded to cover more fleets, but this requested analysis is to be limited by the tropical/subtropical distribution of the species.

Trophic relationships/structure

Objective: Determine if trophic interactions and inter-dependencies involving species that are affected by fishing are being maintained.

Three preliminary indicators reflecting the potential ecological effects of the purse-seine fishery on the tropical Atlantic food web structure and functioning were discussed by the Sub-Committee on Ecosystems. It was noted that purse seines may be too selective to represent broad ecosystem level effects and that consideration should be given to data from less selective fishing strategies. It is expected that a revised indicator will be available in 2020.

Habitat

Objective: Determine if ICCAT fisheries impact the critical habitat of ICCAT species.

This indicator is still under development. The Sub-Committee still considers that critical habitats can be impacted by abandoned and lost gear such as drifting FADs and GPS buoys, but also requested that, in addition to monitoring the number lost, the fate of these lost gears must also be quantified since they could become stranded in vulnerable coastal habitat.

Socio-economic

Objective: Determine if the socio-economic benefits obtained from the ICCAT resources is being maintained.

Economic indicators were developed to reflect the number and proportion of ICCAT Contracting Parties that experienced a reduction of year over year economic benefits obtained from ICCAT resources. Economic benefit was measured using a) production value of tuna catch from the ICCAT area and b) the cash value earned through export of tuna and sharks and their processed commodities (**Figure 4**).

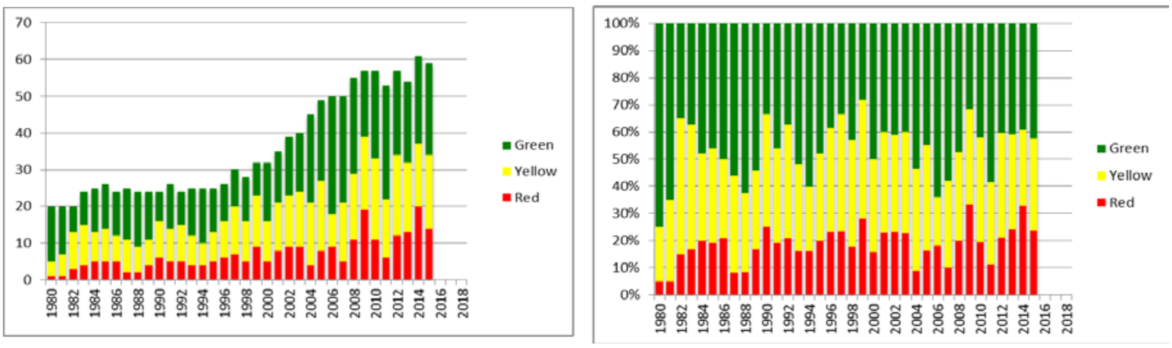


Figure 4. Economic indicators that show the number (left) and proportion (right) of ICCAT Contracting Parties experiencing a greater than 10% decline in production value of tuna catch from the ICCAT area and the cash value earned through export of tuna and sharks and their processed commodities. Green indicates neither cash value earned or production value declined while red indicates both did. Yellow indicates that one of the two declined.

The proportion of Contracting Parties with neither declines in cash value earned or production value (green) has remained relatively consistent, indicating no substantial deterioration of the proportion of Contracting Parties obtaining economic benefits from ICCAT resources. In recent years, ICCAT tuna catches have not been increasing and the global economic situation has not shown growth, consequently one would expect that many CPCs would have barely succeeded in maintaining economic gains from ICCAT tuna resources and this expectation is reflected in the trends of the indicator.

Fishing pressure

Objective: Determine if overall fishing effort and fishing pressure are increasing over time.

Upon review by the Sub-committee, it was proposed to use fishing mortality derived from the single species stock assessment models as an overall indicator of fishing pressure rather than indicators based on the fleet characteristics database which was deemed to be incomplete.

Environmental pressure

Objective: Determine if environmental pressures are impacting the state of the different ecosystem components.

It was determined that the Sub-committee should consider partnering with organizations better versed in working with environmental data. In particular, it was suggested to follow the efforts of ICES and the EU sponsored "Copernicus' initiative. It was recommended to develop indicators informing on the environmental variability affecting the ecology of particular species or species groups.

Outlook

The ecosystem report card is still in a very preliminary state, therefore a comprehensive evaluation of the impact of ICCAT fisheries and management actions on the ecosystem would be premature. Despite the absence of indicators for many of the report card components, the Sub-committee has made many important decisions that will facilitate more complete reporting in the future. Importantly, the exercise of providing indicators for review has helped to identify shortcomings in some of the data collected by ICCAT (e.g., scientific observer data, fleet characteristics, catch and effort) and some of the products estimated by the Secretariat (e.g. EFFDIS). This exercise also identified important methods of work and external data sources that will greatly simplify future indicator development and updates.

Effect of current regulations

The decline in the number of stocks that are subject to overfishing could be attributed to the adoption of management measures that are consistent with the scientific advice. If this trend is maintained, a commensurate decline in the number of overfished stocks is expected to follow.

Management recommendations

Emphasis should be placed on supporting the development of tools that provide an integrated ecosystem wide perspective of ICCAT fishery impacts on the ecosystem.

Research recommendations

- Various collaborative efforts to assemble and analyze shark, seabird, and sea turtle by-catch data collected by scientific observers are currently underway. The Sub-committee continues to encourage national scientists to collaborate with these data-gathering initiatives including the seabird component of the Common Oceans Tuna project and the collaborative work being done by ICCAT CPCs on seabirds and sea turtles and to report their progress to the Sub-committee.

- The Sub-committee continues to recommend investigations into the best way to regionalize the components of the ecosystem report card. In that regard it recommends the development of two regional case studies (Atlantic Ocean tropical area, Sargasso Sea area) to demonstrate the implementation of EBFM principles including the identification of high-risk ecosystem impacts in the Convention area.

- The Sub-committee recommends improving the ICCAT data sources and products on which indicator development depends (e.g. EFFDIS, ST09, fleet characteristics) and identifying external data sources which could validate ICCAT data.

- The Sub-committee recommends investigating the development of fisheries independent and model-based indicators and methods on how to validate indicators and establish reference points.

Indicator references

Retained Assessed Species: Tsuji *et al.*, 2019
Retained Unassessed Species: Hanke and de Bruyn, 2019
Mammals: Hanke and Domingo, 2019
Non-retained Sharks: Coelho *et al.*, 2019
Trophic Relationships/Structure: Juan-Jorda *et al.*, 2019
Socio-economic component: Gaertner *et al.*, 2019

Appendix 15

An Updated Schedule for BFT MSE Roadmap and 2020 Stock Assessment

This roadmap (see **Table** below) represents the necessary steps and deliverables that the Committee needed to achieve the presentation of a Candidate Management Procedure (CMP) to the Commission. The steps are incremental in that each deliverable is necessary for each subsequent step. Any delay in an individual step will likely incrementally delay the process further.

Table. Description of proposed BFT/BFT MSE meetings for 2019-2020.

Meeting	*Task*	*Attendees*
1. Dec (2hrs): Webinar	Review OM development	BFT WG
2. Feb (5d): Small MSE TT	Technical review of OMs models, code and diagnostics. No weighting authority	9*
3. April (5d): BFT WG	Decide OM reference grid. View initial VPA/SS progress	BFT WG
4. July (4d): CMP Developers	Refine and tune CMPs	9 + 1 from current teams = 14*
5. Sept (3d): BFT WG	Compile CMP results, Compile VPA/SS results	BFT WG, need not be full WG
6. Sept (3d): BFT WG	TAC advice for 2021. Vet initial CMPs	BFT WG
7. Oct-Nov (present initial CMPs to PA2/COM)	Dialogue on CMPs, performance objectives, once tangible results are available	Scientists and Managers

*Only requires small group, though the meeting is open to all, meetings in Green are 'official'.

The Committee notes that the high complexity of the current Operating Models (OMs) may not allow the Group to conduct effective and timely diagnostic evaluations to approve a final reference set of OMs in April. The Committee requests that the Bluefin Working Group (BFT WG) immediately ask the contractor for an estimate of the time required to reduce the dimensionality (e.g. reducing the number of spatial, temporal-strata) of the OMs. The Committee also requests that, if it was answered to be possible to develop reduced-dimension OMs within the time between October 2019 and February 2020, in addition to the already requested tasks on the current OMs, revised OMs with reduced dimensionality be constructed and also brought for consideration by the February MSE Technical Team. If it cannot be provided by February, and, if the Reference OM set is not adopted by the April 2020 meeting, the BFT Group should reconsider the costs and benefits of reducing the complexity of the current MSE framework. At this time (April), the BFT Group should also stipulate how this would delay the existing MSE roadmap on bluefin tuna.

The Committee considers that, provided each step is achieved according to the time scale, it might be possible to present a CMP to the Commission in 2021 for consideration for adoption for 2022 TAC advice. While the meeting schedule and timing appears intensive, the main meeting that will require attendance by the Bluefin Tuna Species Group (BFT SG) is the April meeting and the extended September Species Group meeting as these are the meetings tasked with decision making authority. The remaining meetings are envisioned to only require a smaller group of participants several of which will be funded by the GBYP for their participation.

The Working Group requests the following from the contractor, in order of priority:

1. A time/feasibility estimate for OMs with reduced dimensionality;
2. Requested OM conditioning and robustness tests outlined for the current OM dimensionality;
3. OMs in (2) above with reduced dimensionality in time for the February meeting.

Roadmap

1. Webinar (December 2019) to review OM developments since the September Bluefin MSE Technical Group meeting in 2019.

2. Mini technical review meeting (5 days; +- February 2020)

The following paragraph in *italics* is in the form of draft text for possible inclusion in the main text of a meeting report.

The meeting considered that to advance the process of finalising the Operating Models (OMs) for the bluefin MSE process, it would be important for a very small group of technical experts in constructing and conditioning OMs to meet early in 2020 for a week with the Contractee. The meeting would be to review the operating models in detail with the following objectives:

i) Investigate possible modifications;
ii) Finalise those changes following further computer runs;
iii) Critically review OMs to confirm their conditioning as being satisfactory;
iv) Develop a full proposal for a complete set of OMs for consideration for adoption at a subsequent meeting as detailed below; and
v) Provide suggestions for approaches (e.g. a Delphi method) to plausibility-weight these OMs for review at that subsequent meeting.

Nine persons: The Contractee, BFT MSE TG rapporteur (Butterworth), SCRS Chair (Melvin), BFT SG Chairs (Gordoa and Walter), Secretariat staff (Kimoto), rapporteur (Fernández) with two persons nominated by the BFT SG are needed for this mini technical review meeting, for which funding from the GBYP is to be sought.

This meeting would not have any authority to make final decisions. Rather its purpose is to prepare the material required by the April BFT SG meeting. The meeting will also be broadcasted by electronic means to allow remote participants to follow the discussions.

Electronic exchanges with MSE Technical attendees (possibly including webinars) may be needed before and after this meeting to inform and to assist progress in reaching consensus on the final OM selection.

Deliverables: Candidate Reference set of OMs (and associated standard HTML reports for each OM and comparing amongst OMs) will need to be provided at an appropriate time prior to the April meeting of the BFT SG.

3. 15 March - Provision of CAS, size composition and age data for Stock Synthesis and VPA;
4. BFT SG intersessional meeting (5 days; +- April 2020).

Note that this meeting would form part of the bluefin tuna stock assessment meeting needed to conduct the simple update.

The primary purpose (of the MSE component) is to thoroughly review the output from the mini-meeting in February above for a complete set of OMs, to amend this if necessary, and then to have the Bluefin Tuna Species Group adopt these as the *final* set to be used in testing the CMPs advanced from which one is eventually intended to be adopted by the Commission in October 2021.

This meeting will also need to agree on a process to plausibility-weight these OMs.

Review initial progress of Update Assessment.

Deliverables: Final Reference grid of OMs and major robustness trials. Final set of candidate indices recommended for use as input to CMPs. A process to plausibility-weight OMs. Revised roadmap and timeframe, if no reference set of OMs can be adopted.

5. CMP developers' mini-meeting (4 days; +- July 2020)

Following 2), the Contractee would update the "package" for CMP testing, which CMP developers would then use intersessionally to further develop their CMPs. At this meeting their results are tabled and discussed to assist these developers in subsequently refining their CMPs further.

Note that this might be either a "mini" meeting constituted similarly to that in 1) above, or a meeting of the MSE TG, but the core target attendees are the CMP developers.

One member of each of the five current CMP development teams will be funded for their participation in this meeting. It is envisaged that that funding will be sought for the same participants of the mini meeting (9+5=14).

Deliverables: CMPs from each development team, summarized performance results across the Reference grid and major robustness test OMs. These are to be presented in an agreed common format, making use of the existing shinyapp, and in terms of a tuning process agreed by the meeting.

6. Webinar to review progress on Assessment update (July timeframe)

7. BFT Species Group intersessional meeting (3-4 days before BFT SG session, September 2020)

Revised CMPs are reviewed and reduced to provide a set of probably 2-3 to take further through to, in turn, the bluefin session, the SCRS, and then the Commission. Each remaining CMP might be taken forward for a range of utilization vs conservation trade-offs.

This meeting also will allow assessment analysts time to compile assessment results.

8. BFT Species Group meeting (September 2020)

Review assessment results and develop management advice.

Deliverables: 2-3 CMPs, each tuned to 2 or 3 agreed different conservation levels, with tables and plots of performance statistics. Provide assessment advice for 2021.

9. October 2020 to October 2021

An appropriate series of meetings between scientists and stakeholders/managers/decision makers to refine and reduce the number of CMPs further. This process would aim to present one or at most, a few options to the 2021 Commission meeting, for that meeting to then make a selection (if necessary) and adopt the MP to be used to recommend future TACs.

Note that advice has already been received from Panel 2 regarding CMP objectives. It is envisaged that the next such interaction would take place only after October 2020, when tangible results for CMPs are available to illustrate the trade-off space.

Appendix 16

Road map for the Development of Management Strategy Evaluation (MSE) and Harvest Control Rules (HCR)

This schedule is intended to guide the development of harvest strategies for priority stocks identified in Rec. 15-07 (North Atlantic albacore, North Atlantic swordfish, eastern and western Atlantic bluefin tuna, and tropical tunas). It provides an aspirational timeline that is subject to revision by the Commission, and should be considered in conjunction with the stock assessment schedule that is revised annually by the SCRS.

	Northern Albacore	*Bluefin tuna*	*Northern Swordfish*	*Tropicals Tunas*
2015	- Commission established management objectives in Rec. 15-04			
2016	- SCRS conducted stock assessment - SCRS evaluated a range of candidate HCRs through MSE **- PA2 identified performance indicators**			- Commission identified performance indicators (Rec. 16-01)
2017	- SCRS evaluated the performance of candidate HCRs through MSE, using the performance indicators developed by PA2 - SWGSM narrowed the candidate HCRs and referred to Commission - Commission selected and adopted an HCR with associated TAC at the Annual Meeting (Rec. 17-04)	- SCRS conducted stock assessment - Core modeling group completed development of modeling framework	- SCRS conducted stock assessment	- SCRS reviewed performance indicators for YFT, SKJ, and BET - SWGSM recommended a multispecies approach for development of MSE framework

	Northern Albacore	*Bluefin tuna*	*Northern Swordfish*	*Tropicals Tunas*
2018	- Call for Tenders issued for peer review - Independent expert completed peer review of code - SCRS tested the performance of the adopted HCR, as well as variations of the HCR, as requested by Rec. 17-04 - SCRS developed criteria for the identification of exceptional circumstances	- SCRS conducted joint meeting on BFT/SWO MSE - SCRS reviewed but could not adopt reference set of operating models - SCRS begins testing candidate management procedures but could not develop further - SWGSM consider qualitative management objectives - WG reviewed progress and developed detailed road map	- SCRS conducted joint meeting on BFT/SWO MSE - Contract with MSE technical expert: develop OM framework; define initial set of OMs; initial conditioning of OMs - SWGSM to consider qualitative management objectives	- Contract with technical experts: start development of MSE framework (phase I) - [SCRS to conduct stock assessment for bigeye tuna] - SWGSM/Panel 1* to consider qualitative management objectives
2019	- Recommendations of the peer reviewer addressed by the SCRS - Performance of the interim HCR as well as variants updated by the SCRS - Consolidated report on MSE produced by the SCRS - Exceptional circumstances represented by the SCRS - Commission may refine the interim HCR	- BFT MSE Technical Group meeting - Initiate independent peer review of MSE code postponed - OM reference set could not be adopted, postponed until 2020 - plans for simple update stock assessment in 2020 initiated - SCRS to evaluate additional management procedures[1], postponed until 2020 **- SWGSM/PA2 meeting:** reviewed initial operational management objectives but could not adopt final objectives - WG revised road map - December Webinar to review OM progress	- SWO Species Group meeting with MSE Session - New Contract with MSE technical expert - Initiate MSE framework with development of SS models grid - Ensure technical integration with stock assessment and quality of inputs - Condition initial OM - Examples of OM diagnostics and validation	- Stock assessment of yellowfin tuna

[1] If progress is not appropriate start planning for a stock assessment of BFT in 2020.

	Northern Albacore	*Bluefin tuna*	*Northern Swordfish*	*Tropicals Tunas*
2020	- Stock assessment to be conducted by the SCRS - Existence of exceptional circumstances to be evaluated by the SCRS - Commission to set TAC based on the HCR - Commission to adopt a long-term management procedure	- **BFT MSE Technical meeting** to review OM diagnostics, technical specifications and build candidate OMs for consideration by BFT WG - **BFT WG meeting** to review and adopt OM reference grid (if possible) and review initial progress on update stock assessment - Initiate independent peer review of MSE code -**BFT MSE technical meeting** of CMP developers to refine and tune CMPs and test candidate management procedures - **BFT WG and Species Group meeting** SCRS refines CMPs to set of 2-3 options. Update assessment results reviewed and TAC advice for 2021 developed. - **Commission/Panel 2** - Initial CMPs and progress reported to Panel 2 and Commission	- SWO Species Group meeting with MSE Session - Extend the Contract to continue work with the MSE expert - Continue work to identify conditions leading to non-convergence and development of models - Finalize OM conditioning with final grid - Produce diagnostic reports for OMs - Continue work and additional examples of MPs - Impact of uncertainty not considered in the OM grid in projections and MP performance[2]	- Data preparatory for assessment for skipjack - Finalize reference set of OMs, complete their conditioning and start development of candidate management procedures - Conduct independent peer review of MSE code -TROP MSE session during species group week

[2] If progress is not appropriate start planning for stock assessments of N-SWO in 2021.

	Northern Albacore	*Bluefin tuna*	*Northern Swordfish*	*Tropicals Tunas*
2021	- Commission (through SWGSM/Panel 2) to develop guidance on a range of appropriate management responses should exceptional circumstances occur - Alternative Management Procedures to be tested by the SCRS - Alternative OM diagnostics to be checked by the SCRS	**- SWGSM/PA2 meeting to** finalize operational management objectives and performance indicators for adoption by the Commission taking into account trade-offs inherent in initial CMP results. **- BFT WG meeting** - SCRS proposes final exceptional circumstances for advice to Commission[3] - BFT WG conducts plausibility weighting for OMs in reference grid **- Scientists and Managers Dialogue meeting** - Additional dialogue between scientists and stakeholders/managers/decision to refine and reduce the number of CMPs **- Commission/Panel 2** - Commission to adopt an interim management procedure, provided prior milestones are met. -Commission can choose to set TAC for 2022-24 based on CMP	**- SWGSM/PA4* meeting/dialogue** - Agree on operational management objectives and performance indicators for adoption by the Commission - SWO Species Group meeting with MSE Session - Extend the Contract to continue work with the MSE expert - Finalize OM with any improvements identified in previous phases - Evaluation of MPs based on performance statistics - Conduct independent review of SWO MSE process - Data-prep and stock assessment (if decided in 2020 to be needed; can be an update of the 2017 assessment)	-Assessment of Skipjack TRO MSE Technical Group meeting **-SWGSM/Panel 1 meeting** to agree on operational management objectives for adoption by the Commission - SCRS to finalize evaluation of CMPs and proposal for determination of exceptional circumstances[4]

[3] If MSE not completed as planned SCRS to conduct stock assessment for BFT 2020.
[4] If progress on MSE is not appropriate conduct stock assessments of BET in 2022 and YFT in 2023, otherwise assessment of.

	Northern Albacore	*Bluefin tuna*	*Northern Swordfish*	*Tropicals Tunas*
2022	- Benchmark assessment to be conducted by SCRS - Reference set of OMs to be revised by the SCRS		- SWO Species Group meeting with MSE Session - Complete and finalize any remaining issues (including from the peer-review) - Summary and presentation of results **- SWGSM/Panel 4* meeting/dialogue** - Dialogue with Commission to provide and present results **- Commission to adopt an interim management procedure**	- TRO MSE Technical Group meeting - Conduct final independent review of TRO MSE process and develop final advice for the Commission **Commission to adopt an interim management procedure**
2023	- Stock assessment to be conducted by the SCRS - Existence of exceptional circumstances to be evaluated by the SCRS - Commission to set TAC based on the HCR	Stock assessment of BFT		- Stock assessment of BET

* Panels may meet intersessionally, as appropriate.

Appendix 17

SCRS Follow-up of the Performance Review

Chapter	Recommendations	LEAD	SCRS Secondary	Timeframe	Proposed Next Steps	Observations	Action to be taken, or already taken	Completion status following Annual meeting	Comments
Data Collection and Sharing	6bis. The Panel concludes that ICCAT scores well in terms of agreed forms and protocols for data collection but, while progress has been made, more needs to be done particularly for bycatch species and discards.	SCRS		M					• Billfish have catch limits and are often bycatch. These limits may have changed the discarding practices of fishing fleets. Unfortunately few CPCs report discards (dead or alive). • Accurate discard information for reporting Task I and II, requires observers at-sea. Billfish species are rare occurrences, therefore, need more observer coverage and complete reporting than presently provided. • Marlin species are under a rebuilding program that requires to live releases. Therefore, marlin species require information on live discards more than any other ICCAT species. • There are ongoing capacity building initiatives (e.g. JCAP, US Data Fund) that aim to improve data collection and reporting to ICCAT in developing coastal countries. Such data collection can be focused on various Species Groups, namely the main tunas, but also include by-catch species such as sharks and billfishes. • For proper recording and reporting of all by-catch (including discards) there is the need to establish onboard observer programs. In cases where establishing such programs is problematic, it is possible to consider alternative methods such as EMS.
Data Collection and Sharing	7. The Panel considers that major progress in data availability is necessary and recommends that substantial improvements in data quality and data completeness can only be achieved by simplifying and automating the process of collecting data in a systematic and integrated way. This may not be possible for artisanal fleets, but should be possible for most of the fleets in developed CPCs.	SCRS		S	Secretariat and SCRS should collaborate to identify the existing shortcomings in data collection and reporting processes, procedures, and mechanisms at the Commission level as well as possible improvements.	Improvements should also be considered by CPCs in their domestic data collection programs, where appropriate.			• It is possible to improve data for artisanal/small scale fleets. The recent ICCAT initiatives for improving the data collection for these fleets in West Africa and Caribbean have been effective but need to continue to be supported and expanded. • There are ongoing capacity building initiatives (e.g., JCAP and US Data Fund) that aim to improve data collection and reporting to ICCAT in developing coastal countries.
Rebuilding Plans	49. The Panel recommends that ICCAT agree a work plan across all the stocks for the SCRS and Commission, as has been agreed by WCPFC. Apart from the obvious advantage of ensuring consistency of approach across the stocks, it would also engage all the CPCs simultaneously in this key process.	SCRS		S	Refer to SCRS to engage as appropriate with other tRFMOs and gather and evaluate relevant information.	The road map adopted by the Commission in 2016 provides the foundation for this work.			• It is possible to improve data for artisanal/small scale fleets. The recent ICCAT initiatives for improving the data collection for these fleets in West Africa and Caribbean have been effective but need to continue to be supported and expanded.

Seaturtles	52. The Panel considers that this issue affects all tuna RFMOs, and knowledge and experience should continue to be pooled between the RFMOs.	SCRS		S/M	Refer to SCRS to engage as appropriate with other tRFMOs and gather and evaluate relevant information.	Should be considered within Kobe process.			
	53. The Panel noted that there are no reliable estimates of the mortality caused by longlines on these species and recommends that a time-limited program be designed to estimate seabird and turtle mortality in ICCAT longline fisheries. This programme should be of at least one year duration and involve increased observer coverage deemed sufficient to estimate turtle and seabird mortality by all major fleets. Such increased observer coverage would also provide information on the impact of ICCAT fisheries on other components of the ecosystem.	SCRS		M	Refer to SCRS to assess the rationale for this recommendation and if necessary and appropriate, to consider development of a program of data collection for the fisheries concerned.	Some work in this area is already ongoing within SCRS.	Commission to continue financial support for the ongoing collaborative work among Scientist specifically for sea turtle interactions Commission to encourage the participation of other CPCs in this collaborative process • There are plans to start organizing in 2020 a series of workshops for CPCs/national scientists that are interested in colaborating in joint analysis of detailed observer data related to sea turtles.		The SCRS estimate of the level of coverage required to estimate the number of interactions with rare species is above 85%, in contrast to the current requirement of 5% which is not fully achieved. The first priority is for all CPCs to fullfil the current observer requirement with complete reporting to ICCAT.
Seabirds	55. The Panel considers that this issue affects all tuna RFMOs, and knowledge and experience should continue to be pooled between the RFMOs.	SCRS		S	Refer to SCRS to engage as appropriate with other tRFMOs and gather and evaluate relevant information.	Should be considered within Kobe process.			
	56. The Panel reiterates its recommendation on a time-limited programme to estimate seabird and turtle mortality in ICCAT longline fisheries.	SCRS		M	See recommendation 53 above for proposed action.		Commission to continue financial support for the ongoing collaborative work among Scientist specifically for sea birds interactions Commission to encourage the participation of other CPCs in this collaborative process • A series of workshops have been carried out in 2018 and 2019 with various national scientists from various ICCAT CPCs, that have started to work on joint analysis to evaluate the efectiveness of current seabird mitigation measures. The aim is to finish the analysis by 2020 and provide an answer to the Commisssion and in a scientific paper. Similar work is planned to start in 2020 for sea turtles.		• The SCRS estimate of the level of coverage required to estimate the number of interactions with rare species is above 85%, in contrast to the current requirement of 5% which is not fully achieved. The first priority is for all CPCs to fullfil the current observer requirement with complete reporting to ICCAT.

Best Scientific Advice	111. The Panel notes that aerial survey estimates in the spawning areas could be very useful in the East Atlantic and Mediterranean bluefin tuna and recommends that efforts be made to derive a usable index and that data continue to be collected.	SCRS		S	Refer to SCRS for appropriate action.	SCRS continues to emphasize the need for developing fishery independent indices of abundance like this aerial survey.			• The use of larval indices from fishery-independent surveys were attempted in the last swordfish assessment (2017), but not used at the time. The swordfish workplan states that work will continue regarding that index and consider its use in the next stock assessment.
	112. The Panel re-iterates the recommendation of the 2008 Panel that a better balance of scientists with knowledge of the fishery and modelling expertise be sent to the assessment meetings of the SCRS.	SCRS		S/M	Refer to SCRS to advise CPCs/Commission on key participants needed at science meetings and any other relevant matters. STACFAD should assess any financial implications.				• The Billfish SG notes that there as the lack of participation in recent times from countries that contribute significant proportions of the catch of Billfish species, and that have produced indices in abundances that now are not been updated. The Group wants to encourage participation of all CPCs that have fisheries interacting with billfish. The SCRS should consider mechanisms to encourage scientists from all CPCs to engage in the work which supports the Billfish SG.

Best Scientific Advice	113. The Panel recommends that Management Strategy Evaluation should be used on a few stocks to estimate the costs and benefits of collecting more detailed information.	SCRS		S/M	Refer to SCRS to consider this issue specifically when conducting MSEs and advise SWGSM on the findings.				• The Billfish SG agreed that MSE for Billfish species should consider the overall strategic plan for MSE before the SCRS could be asked to engage in such MSE process. Many of the experts engaged in Billfishes assessments and that potentially could engage in Billfishes MSE are already involved in the other MSE processes in ICCAT.
Capacity Building Initiatives	119. The Panel recommends that specific mentoring projects to include trainees in stock assessment teams be implemented.	SCRS		M/L	Refer to SCRS to advise on the merits of this idea and how it might be implemented effectively. STACFAD should assess any financial implications.	SCRS has conducted some training on stock assessment techniques in the past.			JCAP-2 has plans for longer term training of scientists from developing countries, integrated in Masters or PhDs.
	120. The Panel recommends that ICCAT develop specific mechanisms to ensure that more scientists with knowledge of the fisheries participate in stock assessment meetings and are directly involved in assessment teams.	SCRS		S/M	Refer to SCRS to advise CPCs/Commission on key participants needed at science meetings and any other relevant matters. STACFAD should assess any financial implications.	Related to Rec. 112			The SCRS has requested aditional funds be made available by the Commission to reinforce the Meeting Participation Fund and allow more fisheries scientists from developing CPCs to attend the SCRS meetings. In addition, the SCRS has also encouraged developed CPs to include more fisheries scientists in their delegations attending SCRS meetings.
	121. The Panel also recommends that formal training in stock assessment be provided, possibly in cooperation with other organizations.	SCRS		M	Refer to SCRS to advise on the merits and how it might be implemented effectively. STACFAD should assess the financial implications.		Secretariat is working with the SCRS on a plan for training on stock assessment to be implemented through 2019.		Funding will be required for implementation. Related with point 119 above. JCAP-2 has the possibility of longer term funding and training. The SCRS requested the Secretariat that the population dynamics expert at the Secretariat develop a plan for capacity building. However, the SCRS recognize that the current workload of the Secretariat staff make this task difficult.
Implementation Res 11-17	123. The Panel recommends that model runs that are the basis of the SCRS advice should be available on the ICCAT website and easy to find. This should include the most recent model runs, but as assessments are updated, older runs should also be available.	SCRS		S	Refer to SCRS for action	This work is already underway in 2017.			The Secretariat to update all relevant data sets using in the assessments in a repository (github).
	124. The Panel recommends that ICCAT cooperates with other stock assessments organizations to develop an integrated stock assessment framework where all current models could be run and new models could be integrated, while being transparent on what data and parameters have been used under what assumptions.	SCRS		S	Refer to SCRS to consider and advise on this matter. The Secretariat should assist with this work as needed.				
	125. The Panel recommends that ICCAT considers adopting a system with scientists from external organisations, universities or otherwise are contracted to review SCRS assessments.	SCRS		S	Refer to SCRS to review and update the current TORs for these reviewers	A mechanism already exists for external reviewers to participate in SCRS stock assessments.			ICCAT regularly invites external independent experts to review the SCRS stock assessments (e.g. 2018 BET SA; 2019 YFT SA).

Trends in the Status of Non-Target Species	4. The Panel recommends that the precautionary approach be consistently applied for associated species considering that the assessments for these species are highly uncertainty and that their status is often poorly known.	PA4	SCRS	M	While led by Panel 4, refer to SCRS to provide advice to assist in applying a precautionary approach to relevant non-target species.	This refers to relevant associated species as defined in the Review.			• The catch advice provided for billfishes has, in general, been followed by the Commission. • However, billfishes assessments tend to be under the most uncertain of all assessments conducted at ICCAT. Therefore catch limits should be more precautionary than for other species. In general the Commission has not exerted more precaution for BILL than for other species. • In addition, recent blue marlin harvests have exceeded the levels of catch that in 2011 the SCRS had predicted would allow the stock to rebuild (2,000 t or less, including dead discards). The SCRS emphasizes to the Commission that persistent over-harvest will compromise stock rebuilding and potentially lead to further stock declines. • The Commission should consider other management measures such as time/area closures or gear modifications (circle hooks) to reduce fishing mortality of blue marlin. • The new ICCAT Convention Amendment mentions precautionay approach.
Bigeye	12. The Panel recommends that bigeye, which is fished in association with juvenile yellowfin and skipjack on FADs, should form part of the long term management strategy for the tropical tuna stocks.	SWGSM	SCRS	S/M	Refer to SWGSM where work is already ongoing.	FAD WG should also work on this in association with Panel 1			
	15. The Panel, noting that ICCAT has established a working group on FADs, recommends that ICCAT prioritise this work and, in parallel, pursue the initiative across all tuna RFMOs to pool the information, knowledge and approaches on how to introduce effective management of FADs into the tropical tuna fisheries on a worldwide scale.	PA1	SCRS	S	Work on matters related to FADs is already underway, in particular within the context of the FAD WG. This should continue and Panel 1 should consider this work when discussing conservation and management measures for tropical tuna fisheries.	FAD WG should also work on this in association with Panel 1			The SCRS will conduct an analysis to be presented to the Commission.
Yellowfin	18. The Panel recommends that yellowfin, which is fished in association with juvenile bigeye and skipjack on FADs, should form part of the long term management strategy.	SWGSM	SCRS	S/M	Refer to SWGSM where work is already ongoing.	FAD WG should also work on this in association with Panel 1			In 2017 ICCAT hosted the first meeting of the joint t-RFMOs FAD Working Group meeting. In 2019 delegates from ICCAT CPC's attended the second meeting of the FAD Tecnical Working Group held in San Diego
Skipjack	21. The Panel recommends that skipjack, which is fished in association with juvenile yellowfin and bigeye on FADs, should form part of the long term management strategy.	SWGSM	SCRS	S/M	Refer matter to SWGSM where work is already ongoing.	FAD WG should also work on this in association with Panel 1			

South Atlantic Swordfish	27. The Panel notes the high underage permitted to be transferred from year to year of 30%, and indeed 50% from 2013. The Panel finds this inconsistent with sound management given the high uncertainty in the assessment, and the more modest underage/overage allowed for other ICCAT stocks (10 or 15%).	PA4	SCRS	S/M	Refer to Panel 4 for consideration during 2017 discussion of conservation and management measures, but may need input from SCRS in medium term.	Rec. 16-04 expires in 2017.	The current SWO Atlantic Executive Summary notes that "*The Committee also recognizes that the above advice does not account for (...), quota carryovers (15% in the North Atlantic), quota transfers across the North and South stock management boundaries nor the total cumulative quota, which includes that allocated to "other CPCs" and would fall above the TAC if achieved. The Committee emphasizes the importance of this uncertainty particularly given that the current (2015) estimated biomass is close to BMSY*".		The current Atlantic SWO Executive Summary notes and alerts the Commisssion on those issues.
Mediterranean Swordfish	30. The Panel encourages ICCAT to intensify its efforts to improve the scientific and fisheries database for this stock and endorses the SCRS recommendation that the fishery be closely monitored and that every component of the Mediterranean swordfish mortality be adequately reported to ICCAT by the CPCs.	PA4	SCRS	M	Refer to Panel 4 to consider shortcomings in data collection and reporting and ways to address them.	COC, SCRS, the Secretariat, and/or CPCs may also have roles to play in implementing this Rec. SCRS will carry out an assessment in 2019.	A stock assessment for Med SWO is scheduled for 2020.		In 2019 ICCAT issued a short-term contract aiming at the recovery of historical data on Mediterranean swordfish data from the EU-Italy longline fishery.
Mediterranean Albacore	35. The Panel reiterates the 2008 Panel recommendation that ICCAT assures itself that the stock is not overfished and over fishing is not occurring.	PA2	SCRS	S	Refer to Panel 2 for consideration in 2017 of conservation and management measures in light of assessment outcome.	Work by SCRS is being carried out.	Stock assessement carried out in 2017 and Rec. 17-07 adopted, with significant but gradual increase in TACs.		A new stock assessment is being planned for 2020.
Blue and White Marlins	38. The Panel supports the SCRS advice that ICCAT actively encourage, or make obligatory, the use of non-offset circle hooks on long line fisheries to reduce the mortality of released marlin.	PA4	SCRS	S/M	Refer to Panel 4 for consideration when discussing stock conservation and management based on new stock assessments.				The billfish SG continues to support the use of non-offset circle hooks because it will reduce the mortality of live releases and increase the probability of fish to be alive upon haulback.
Rebuilding Plans	47. The Panel recommends that ICCAT move away from the current re-active management to re-redress the status of stocks through re-building plans, to a more pro-active policy of developing comprehensive long term management strategies for the main stocks. Such management strategies would encompass management objectives, harvest control rules, the stock assessment method, fishery indicators and the monitoring programme.	SWGSM	SCRS	S/M	Refer to SWGSM where work is already underway; also relevant to the future work of the Panels.				
	48. The Panel recommends that ICCAT should prioritise the development of a long term management strategy for the tropical tuna stocks.	SWGSM	SCRS	S/M	Refer to SWGSM and Panel 1 where work is already underway.				

Seabirds	54. The Panel commends ICCAT on the measures it has introduced to date and recommends that it pursues its stated goal of further reducing bird mortality through the refinement of existing mitigation measures.	PA4	SCRS	S/M	Refer to Panel 4 for consideration based on input from SCRS, as needed.		A series of workshops were carried out in 2018 and 2019 to use national observer data from various CPCs to evaluate the efectiveness of the mitigation measures that are in place for sea birds mortality mitigation. Final results are expected in 2020.		
Pollution, Waste and Discarded Gears	57. The Panel notes the measures adopted by ICCAT to date and recommends that ICCAT expands the range of its measures addressing these policy matters. In this regard, the Panel would refer to CCAMLR CM 26-01 on general environmental protection during fishing.	COM	SCRS	M	Refer to the Commission for consideration. FAD WG also addressing this issue, and should be guided by Panel 4. Work also being carried out through Kobe process.				
Confidentiality	97. Considers further improvements, for instance by making more of its data and documents publicly available and - as regards documents - explaining the reasons for classifying certain documents as confidential.	COM	SCRS	M	Refer the issue to the Commission / PWG and SCRS to begin a review of ICCAT's rules on confidentiality and their application and needed adjustments can be identified, if any.				
	98. Conducts a review of its Rules and Procedures on Data Confidentiality as envisaged in its paragraph 33, taking into account the need for harmonization among tuna RFMOs consistent with Rec KIII-1. As part of this review, it should adopt an ICCAT's Information Security Policy (ISP), where appropriate.	PWG	SCRS	M	Refer the issue to the PWG and SCRS to begin a review of ICCAT's rules on confidentiality and their application and needed adjustments can be identified, if any.				The SCRS is currently revising the Rules and Procedures for the "Protection, Access to, and Dissemination of Data" compiled by Secretariat.
Presentation Scientific Advice	115. The Panel recommends that the development of harvest control rules through Management Strategy Evaluation should be strongly supported.	SWGSM	SCRS	S	Refer to SWGSM and the Panels for consideration; work is already ongoing regarding this matter.				
Adequacy SRCS and Secretariat	117. The Panel recommends that clear guidelines / processes on how the scientific resources of the Secretariat should be allocated to species should be agreed.	COM	SCRS	S	Commission to consider appropriate action, including referring to SCRS for input on this matter.				
	118. The Panel recommends that ICCAT evaluates the benefits of outsourcing its stock assessments to an external science provider while retaining the SCRS as a body to formulated the advice based on the stock assessments.	COM	SCRS	M	For additional information, SCRS could advise on the pros and cons from a scientific perspective and STACFAD from a financial perspective. Commission to coordinate action among the bodies.				• The SCRS does not support the outsourcing of the whole assessment. The current system ensures broad input from scientists familiar with relevant knowledge on the fish and fisheries been assessed. • The SCRS supports the use of external experts with special knowledge when this is required and also support the current peer review process. • The presence of peer reviewers during the assessment is strongly preferred.

Appendix 18

List of statistical and tagging correspondents by country

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Appendix 19

List of acronyms

ABNJ	Areas Beyond National Jurisdiction
ALK	Age length key
ALR	Aquatic Living Resources
AMO	Atlantic Multidecadal Oscillation
BPUE	Bycatch-per-unit effort
AOTTP	Atlantic Ocean Tropical tuna Tagging Programme
ASPIC	A Stock Production Model Incorporating Covariates
AZTI	Centro Tecnológico Experto en Innovación Marina y Alimentaria
B	Biomass
BAI	Buoy associated index
BOT	British Overseas Territory
CAA	Catch at age
CAS	Catch at size
CATDIS	Catch 5x5 distribution
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CEFAS	Centre for Environment Fisheries and Aquaculture Science (UK)
CI	Confidence Interval
CIPA	Centro de Investigacao Pesqueira Aplicada (Guinea-Bissau)
CISEF	Cap-Vert, Cote d'Ivoire, Senegal, Espagne, France
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
CKMR	Close Kin Mark Recapture
CMG	GBYP Core Modelling MSE Group
CMM	Conservation and management measures
CMP	Candidate Management Procedure
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COMHAFAT(ATLAFCO)	Ministerial Conference on Fisheries Cooperation among African States Bordering the Atlantic
CONAPESCA	National Commission of Aquaculture and the Fisheries (Mexico)
CPCs	Contracting Parties and Cooperating Contracting Parties, Entities or Fishing Entities
CPUE	Catch-per-unit effort
CRO-CI	Centre de Recherches Océanologiques (Côte d'Ivoire)
CRODT	Centre de Recherche Océanographique de Dakar-Thiaroye (Senegal)
CWP	Coordinating Working Group on Fishery Statistics (FAO)
DBSRA	Depletion Based Stock Reduction Analysis
DFC	Data Collection Framework
DGPA-G	Direction Générale des Pêches et de l'Aquaculture (Gabon)
DINARA	Dirección Nacional de Recursos Acuáticos (Uruguay)
DP-STP	Direcao das Pescas de Sao Tome e Principe
DST	Decision Support Tool
EBFM	Ecosystem Based Fisheries Management
EFFDIS	Fishing effort 5x5 distribution
EPBR	Enhanced Programme for Billfish Research
EEZ	Exclusive Economic Zone
ERAs	Ecological Risk Assessments
F	Fishing mortality
FADURPE	Fundação Apolonio Salles de Desenvolvimento Educacional (Brazil)
FAO	Food and Agriculture Organization (United Nations)
FIRMS	Fisheries and Resources Monitoring System (United Nations)
FOBs	Floating objects
FSSD	Fisheries Scientific Survey Division (Ghana)
GBYP	ICCAT Atlantic-Wide Bluefin Tuna Research Programme
GEF	Global Environment Facility (FAO Common Oceans/ABNJ Tuna Project)
GFCM	General Fisheries Commission for the Mediterranean
GIS	Geographic information system
ICES	International Council on the Exploration of the Sea
IEO	Instituto Español de Oceanografía

IMAR	Instituto do Mar (Azores)
IMROP	Institute Mauritanien de Recherches Océanographiques et des Pêches
INAPESCA	National Fisheries and Aquaculture Institute (Mexico)
INDP	Instituto Nacional para Desenvolvimento das Pescas (Cabo Verde)
INRH	l'Institut National de Recherche Halieutique (Morocco)
IOMS	Integrated Online Management System
IOTC	Indian Ocean Tuna Commission
IPMA	Instituto Português do Mar e da Atmosfera
IPR	Independent Peer Review
IRD	Institute de recherche pour le développement (France)
ISSF	International Seafood Sustainability Foundation
JABBA	Just Another Bayesian Biomass Assessment
JCAP	ICCAT-Japan Capacity-Building Assistance Project
K2SM	Kobe II Strategy Matrix
LIME	Length-based integrated mixed effects model
LJFL	Lower jaw fork length
LPRC	Large Pelagic Research Center (USA)
LSPR	Length-based Spawning Potential Ratio
MBP	Maximum Biological Production
MCMC	Markov chain Monte Carlo
MEDAC	Mediterranean Advisory Council
MFAD	Moored Fish Aggregating Device
MFRD	Marine Fisheries Research Division (Ghana)
MiniPAT	Pop-up archival transmitting tag
MOU	Memorandum of Understanding
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
Multifan-CL	Length-based, age structured assessment model
NAO	North Atlantic Oscillation
NAFO	Northwest Atlantic Fisheries Organization
NGS	Next generation sequencing
NOAA	National Oceanic and Atmospheric Administration
NOAA SEFSC	National Oceanic and Atmospheric Administration Southeast Fisheries Science Center
NRIFSF	National Research Institute of Far Seas Fisheries (Japan)
OMs	Operating Models
OTC	Oxytetracycline
PCR	Polymerase chain reaction
PFRP	Pelagic Fisheries Research Program (USA)
PSA	Productivity and Susceptibility Analysis
REST API	Representational State Transfer Application Programming Interface
RMA	Research Mortality Allowance
SADER	Secretariat of Agriculture and Rural Development (Mexico)
SEAFO	South East Atlantic Fisheries Organisation
SLU	Swedish University of Agricultural Sciences
SMTYP	Small Tuna Year Programme
SNP	Single Nucleotide Polymorphism
sPAT	Survivorship Popup Satellite Archival Transmitting Tag
SPC	Secretariat of the Pacific Community
SRDCP	Shark Research and Data Collection Programme
SS	Stock Synthesis
SS3	Stock Synthesis III
SSB	Spawning stock biomass
SSPAC	Système de Suivi de la Pêche Artisanale et Côtière (Mauritania)
TAC	Total Allowable Catch
TRO	Tag Recovery Officer
UCP	University of Cape Town
UNIBO	University of Bologna
VBGF	von Bertalanffy growth function
VIMS	Virginia Institute of Marine Science (USA)

YOY	Young of the Year
VPA	Virtual Population Analysis
WCPFC	Western Central Pacific Fisheries Commission
WECAFC	Western Central Atlantic Fishery Commission
Z	Total mortality

Appendix 20

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