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 2018)

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, 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 (People's Rep.), Côte d'Ivoire, Curaçao, El Salvador, Equatorial Guinea, European Union, France (St. Pierre & Miquelon), Gabon, Ghana, Guatemala, Guinea (Rep.), Guinea Bissau, Honduras, Japan, Korea (Rep.), Liberia, Libya, Mauritania, Mexico, Morocco, Namibia, Nicaragua, Nigeria, Panama, Philippines, Russia, São Tomé & Príncipe, Senegal, Sierra Leone, South Africa, St. Vincent & the Grenadines, Trinidad & Tobago, Turkey, United Kingdom (Overseas Territories), United States, Uruguay, Venezuela.	Côte d'Ivoire
-2- *Temperate tunas, North*	Albania, Algeria, Belize, Brazil, Canada, China (People's Rep.), Egypt, European Union, France (St. Pierre & Miquelon), Iceland, Japan, Korea (Rep.), Libya, Mauritania, Mexico, Morocco, Norway, Panama, St. Vincent and the Grenadines, Syria, Tunisia, Turkey, United States, Venezuela.	Japan
-3- *Temperate tunas, South*	Belize, Brazil, China (People's Rep.), European Union, Japan, Korea (Rep.), Mexico, Namibia, Panama, Philippines, Senegal, South Africa, Turkey, United States, Uruguay.	South Africa
-4- *Other species*	Algeria, Angola, Belize, Brazil, Cabo Verde, Canada, China (People's Rep.), Côte d'Ivoire, Egypt, Equatorial Guinea, European Union, France (St. Pierre & Miquelon), Gabon, Guatemala, Guinea (Rep.), Guinea Bissau, Honduras, Japan, Korea (Rep.), Liberia, Libya, Mauritania, Mexico, Morocco, Namibia, Nigeria, Norway, Panama, São Tomé & Príncipe, Senegal, South Africa, St. Vincent & the Grenadines, Trinidad & Tobago, Tunisia, Turkey, United States, Uruguay, 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 I (2018)"***, which describes the activities of the Commission during the first half of said biennial period.

This issue of the Biennial Report contains the Report of the 21st Special Meeting of the Commission (Dubrovnik, Croatia, 12-19 November 2018) 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). Volumes 3 and 4 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

STANDING COMMITTEE ON RESEARCH AND STATISTICS (SCRS)

(Hotel Weare Chamartin - Madrid, 1-5 October 2018)

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

(Madrid, Spain – 1 to 5 October 2018)

1. Opening of the meeting

The 2018 Meeting of the Standing Committee on Research and Statistics (SCRS) was opened on Monday, 1 October, at the Weare Chamartín Hotel in Madrid by Dr David Die, Chair of the Committee. Dr Die 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 2018, 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 2018. Finally, the Executive Secretary highlighted 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 aiming to reduce the current workload of scientists and the Secretariat. The Opening Address of the Executive Secretary is attached as **Appendix 18**.

The Chair of the SCRS, welcomed the Executive Secretary and thanked him and the Secretariat for their cooperation and work throughout 2018 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 1**). Full assessments were carried out this year on blue marlin (BUM) and bigeye tuna (BET). Additionally, intersessional meetings were held for small tunas (SMT) and sharks (SHK), Sub-Committee of Ecosystems and, as well as the Standing Working Group on Dialogue between Fisheries Scientists and Managers (SWGSM). Additionally, meetings of Panel 1 and the ICCAT Working Group on Stock Assessment Methods (WGSAM) were held, as well as of the Bluefin Tuna and Swordfish MSE.

The following scientists served as rapporteurs of the various species sections (Agenda Item 9) of the 2018 SCRS Report.

YFT	-	Yellowfin tuna	S. Cass-Calay
BET	-	Bigeye tuna	H. Murua
SKJ	-	Skipjack tuna	J. Amandé (East), P. Travassos (West)
ALB	-	Albacore	H. Arrizabalaga, J. Ortiz de Urbina (Med.)
BFT	-	Bluefin tuna general	J. Walter (West), A. Gordoa (East)
BIL	-	Billfishes	F. Ngom Sow
SWO	-	Swordfish	R. Coelho (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 27 Contracting Parties present at the 2018 meeting: Algeria, Brazil, Cabo Verde, Canada, Côte d'Ivoire, El Salvador, European Union, Gabon, Ghana, Japan, Korea (Rep.), Liberia, Mauritania, Mexico, Morocco, Namibia, Nigeria, Norway, Russian Federation, São Tomé and Príncipe, 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 2**.

4. Introduction and admission of observers

Representatives from the following Cooperating non-Contracting Party, Entity, or Fishing Entity (Chinese Taipei), inter-governmental organizations (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, The Ocean Foundation, The Shark Trust and World Wild Fund – WWF) were admitted as observers and welcomed to the 2018 meeting of the SCRS (see **Appendix 2**).

5. Admission of scientific documents

The Secretariat informed the Committee that 173 scientific papers and 61 scientific presentations had been submitted at the 2018 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, 47 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 3.**

6. Report of Secretariat activities in research and statistics

The Secretariat presented the information contained in the 2018 Secretariat Report on Research and Statistics related to fisheries and biological data submitted for 2017, including revisions to historical data. The activities and information included in this report refer to the period between 1 October 2017 and 13 September 2018 (the reporting period). 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 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.

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 overall reporting status for 2017, shows that 83% of the 75 flag CPCs (52 with catches: 69%; 10 with no fishing activity: 19%) have reported fisheries and biological information for 2017. In the reporting period 17% of the flag CPCs: Albania, Equatorial Guinea, EU-Germany, EU-Latvia, EU-Lithuania, Grenada, Guinea-Bissau, Guinea (Rep.), Honduras, Mauritania, Panama, Philippines, and Bolivia did not submit statistical fisheries information. In general, the Secretariat noted a slight decrease of the reporting rates of Task I and Task II, and improvements in the quality of Task II data, particularly with better spatio-temporal resolution of T2SZ data. However, deficiencies and problems with the Task II Catch and effort data (T2CE) were still noted, which hampers the estimation of related datasets such as CATDIS, EFFDIS, CAS and CAA. In 2017, form ST08 for collecting FAD deployment information was modified to include additional fields as required by Rec. 16-01. However, the changes have resulted in some confusion amongst CPCs, resulting in a limited submission of data.

For the reporting period, the Secretariat has received by-catch and discard information, mainly in the ST09 form used to submit observer data, as generally the by-catch information recorded by CPCs comes from observer programmes. The Secretariat has received most of the information on the 2018 version of ST09 form adopted by the SCRS in 2017. However, datasets were also received in older ST09 versions with different and more complex structures, which hinders the integration of the data.

The Committee was presented with an update of the various ICCAT publications. Complying with the new deadline for documents has increased but still met with less than optimal success. Currently, the deadline is seven and five days before the meeting to submit titles and documents for the species groups. In 2016 and 2017 more than 50% of the documents were submitted after the deadlines, whereas in 2018, 53% of the documents were submitted in due time. The Secretariat has expanded the use of web-based services to provide access, storage and services to the SCRS and Commission meetings. For example, the OwnCloud server has now been used for three years for posting and sharing data, documents and other information prior to and during the meetings of the SCRS and Commission greatly facilitating the work of these groups.

During 2018, the Secretariat undertook an exhaustive work plan in terms of statistical related tasks, to complete all the major SCRS requests and priorities for 2018 activities. All major tasks were finalised in a timely manner, and outcomes were used by the SCRS during 2018. However, in order to complete these tasks, other ongoing activities and projects were re-prioritized (e.g. the ICCAT-DB documentation framework, full revision of the tagging database and the respective frontend applications, the ICCAT GIS system, and the deployment of statistical databases on the ICCAT Cloud) which have been partially implemented or postponed.

The upgrade of ICCAT DB applications to a modern compatible software (JAVA project) initiated in 2015 was finalised in 2017, and all developments have been incorporated into the ICCAT-DB system. Furthermore, in 2017 the ICCAT Secretariat hired a Database Programming Expert to collaborate with the project of "online reporting process", a request from the Commission to facilitate CPCs data submission for both statistical and compliance related information. For this purpose, the Secretariat started to adapt all the databases for the future ICCAT Online Reporting System. In 2017, The Secretariat has been working in the SCRS Statistical Online Reporting System, a web application aiming to integrate, validate, and store most of the fisheries statistical forms online. Following the SCRS recommendation, a web application prototype was deployed online on April 2018 for testing by ICCAT Statistical Correspondents during 2018. Albeit the participation in the trial was limited, most of the comments were very positive and the SCRS continues to endorse its development and implementation. However, extending this work to all the ICCAT statistics and compliance related reporting requirements is an extremely large undertaking that requires time and resources not currently available at the Secretariat. Therefore, the Secretariat is currently working with the ICCAT Online Reporting Technology Working Group and the SCRS to ensure that the various initiatives are coordinated and planned with the proper support and endorsement from the Commission (see ANNEX 4.2 to the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 1*).

The Secretariat has continued the series of periodic publications developed throughout the history of ICCAT, which includes: Volume 74 (5 issues) and 75 (3 issues) of the *ICCAT Collective Volume of Scientific Papers*; *Part II of the Biennial Period 2016-2017*, corresponding to Volume I (Commission meeting report), Volume II (SCRS Plenary meeting report), Volume III (Annual Reports) and Volume IV (Secretariat reports); and Volume 44 of the Statistical Bulletin.

In 2014 *Aquatic Living Resources* has changed its editorial line towards an ecosystem approach to fisheries management, which considerably reduced the possibilities of publishing the documents presented to the SCRS in this peer review journal. The field of interest of the journal in its new phase will continue to have an ecosystem approach, but with a broader outlook than in its last phase, which will open the publication up to a larger number of SCRS documents. In 2016 the Secretariat contacted the new ALR editorial team. ALR expressed their 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 two years (only 2 papers were selected in 2016 and none in 2017). To revert this situation the Secretariat together with the SCRS Chair prepared an alternative option for consideration of the SCRS.

The Committee acknowledged the extensive workload conducted by the Secretariat and thanked them for their support of the SCRS documentation processes. The Committee noted that although there are still issues with the deadlines for submission of documents, in general the process has facilitated the access to documents prior to the start of intersessional meetings. It was noted that documents that arrived late were not excluded from the meetings although their submission by the deadlines was encouraged as requested by the SCRS in 2015. It was stressed, however, that the late submission of data was extremely problematic and this should continue to be improved to facilitate the work of the SCRS.

In June 2017 a new ICCAT web page was deployed, an upgrade with a more dynamic format and compatible with different mobile devices such as phones, tablets and portable computers. The ICCAT web content, in the three official languages of the Commission, continues also to be updated on a regular basis to provide better service to users. Further developments are being made, including an engine search for the ICCAT documents.

The Secretariat continues its participation and support to the ICCAT research and data collection programmes, which consists mainly in administrative and scientific support. As regards the latter, the Secretariat has a major role between the SCRS and the programme Coordinator for the design of research proposals, calls for tenders, evaluation of proposals, coordination of research and database management, as well as IT support to each of the programmes.

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 2018 the funds managed by the Secretariat have been used support of the following SCRS activities;

- Participation at SCRS meetings: 78 scientists from Algeria, Brazil, Cabo Verde, Côte d'Ivoire, Gabon, Ghana, Liberia, Mauritania, Mexico, Morocco, Namibia, São Tomé and Príncipe, Senegal, South Africa, Tunisia, and Uruguay, were funded to attend the SCRS scientific meetings.

- Improvement of statistics: Training course to build the capacity of data collection in the semi-industrial, artisanal and recreational fisheries, and rebuilding of fisheries data collection systems.

- Scientific capacity building courses: Two scientists from developing CPCs (Tunisia and Mauritania) received training in SS3 and BSP Stock Assessment models, at U.S. institutions (NOAA and University of Miami). In addition three training workshops in MSE development were carried out to enhance participation of scientists in the ICCAT MSE processes.

- Other SCRS activities funded include short-term contracts for developing: i) a comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/Central American region; ii) four studies on different biological aspects of albacore, swordfish, small tunas and sharks; iii) development of the ongoing three MSE processes (albacore, northern swordfish and tropical tunas); iv) collaborative analysis using longline operational data to standardize Atlantic bigeye CPUE indices; v) electronic PSAT tagging of Atlantic swordfish, northern albacore and Atlantic pelagic sharks; vi) participation of experts to specific workshops (e.g. evaluate the impact of fishing on seabirds).

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 2018 JCAP supported training courses to build the capacity of data collection in the semi-industrial, artisanal and recreational fisheries in São Tomé and Príncipe and Angola (to be held in November 2018) and the rebuilding of the statistical and fisheries data collection system in São Tomé and Príncipe and Liberia. The SCRS Chair and CPCs welcomed the outcome of the activities carried out this year and expressed their gratitude to the support of the JCAP 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 next phase of the JCAP 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 programmes

In accordance with the Revised Guidelines for the Preparation of Annual Reports (ICCAT Ref. 12-13), only information relative to new research programmes (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

For 2017, the Algerian catches of tuna and tuna-like species are around 550 t of swordfish, 1,037 t of bluefin tuna including 4,275 kg of dead individuals and 1,270 t of small tunas. Following improvements to the statistical data system made since 2015, it has been possible to collect catch data on three species of shark taken as by-catch, i.e. the blue shark (*Prionace glauca)*, the common thresher shark (*Alopias vulpinus*) and the shark of the family Carcharhinidae.

In 2017, 14 purse seine tuna vessels flying the Algerian flag have participated in the live bluefin tuna campaign which has been divided into two (2) joint fishing groups, with vessel lengths of between 22 and 40 m. In 2017, Algeria caught 1,037 t of bluefin tuna of the 1,038 t quota granted to tuna purse seiners. In addition, in 2017, Algeria reserved a quota of 5 t for by-catch, which has not been fished.

54 dead individuals of bluefin tuna, weighing 4,275 kg, were taken onboard tuna purse seine vessels during the fishing campaign. These individuals have been measured for size and weight and sexed. Sizes ranged from 115 to 230 cm.

As to swordfish (*Xiphias gladius)*, 157 individuals have also been sampled for size and weight at landing ports, with sizes ranging from 100 cm to 215 cm.

The mechanism in place at national level for collecting statistical data is constantly being improved and strengthened through exploitation of data obtained during fisheries resources assessment campaigns. These actions help to effectively feed and update the database of the General Directorate of Fisheries and Aquaculture and of the National Centre of Fisheries and Aquaculture Research and Development.

Brazil

In 2017, 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 54,450.63 t (live weight), slightly higher than catches recorded in 2016, when 50,957.84 t were landed. Most of the catches were taken by the handline fishery (28,038.56 t; 51.5%), in associated schools, targeting tropical tunas, mainly YFT (16,878.48 t). The baitboat fishery accounted for the second largest catch in 2017, representing 29.6% (16,125.87 t) of the total tuna and tuna like-fish caught this year, with SKJ being the most abundant species (14,576.60 t). Longline catches reached 8,143.52 t, representing 15.0% of the total, being made up mainly of SWO (2,391.33 t), BSH (2,073.87 t), BET (1,850.96 t), and YFT (1,103.87 t). About 50% 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. Due to the discontinuity of the financial support provided by the Secretary of Aquaculture and Fisheries (SEAP) to the Scientific Subcommittee of the Standing Committee for the Management of the Tuna Fisheries in Brazil, several scientific activities were suspended in 2017, such as the collection of biological data, including the size of the fish caught. However, at the beginning of this year (2018), the financial support needed to support the development of research on tuna species caught, for the next three years, was secured and provided. 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.

Cabo Verde

In 2017, the tuna fleet of Cabo Verde comprised three categories: the artisanal fishery with a fleet of 1,363 vessels and 4,500 fishers; the industrial fishery with a large purse seiner measuring 60 m, and finally, the coastal semi-industrial fishery with 71 small vessels measuring between 6 and 25 m and with a total of 1,092 fishers. The most exploited species included yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), skipjack tuna (*Katsuwonus pelamis*) and small tunas, in particular, the species *Auxis* *thazard*, *Auxis rochei* and *Acanthocybium solandri*. In addition, some artisanal fisheries and the sport fishery also catch billfish, i.e. marlins and swordfish, respectively. The total preliminary catch of tuna in 2017 was approximately 13,901 t, taken mainly by purse seiners, in the industrial and semi industrial fisheries, and with handline in the artisanal fishery. Compared with the previous year, there has been a decrease of 53%. This may be connected with the decrease in the number of vessels operating with purse seines outside of national waters, i.e. in the region of Côte d'Ivoire and Gabon. Apart from the catches of tuna taken by the local fleet, significant tuna catches have also been taken by foreign fleets operating in Cabo Verde's EEZ within the framework of existing fishing agreements with third countries, i.e. those of the European Union (Spain, France and Portugal). According to the data provided to the Cabo Verde authorities, in 2017, 45 vessels held licences, and took nearly 10,000 t of catches. In this foreign fishery, the most common fishing gears used were purse seine (PS) (21 vessels), baitboats (BB) (8 vessels) and longliners (LL) (16 vessels). Given the improvements in chilling and conservation infrastructure, and in the increase in processing capacity, foreign fleets are experiencing strong development in the Atlantic and are increasing their landings and transhipments of tuna and shark in Cabo Verde. The INDP is the body responsible for research activities and regular monitoring of statistical data, through a sampling plan for the artisanal fishery and comprehensive collection (census) in the industrial and semi-industrial fisheries. Information on fleet licenses, catch certificates, product quality are produced with the collaboration of other institutions such as the General Directorate of Marine Resources, Customs and fish processing and conservation plants.

Canada

Bluefin tuna are harvested in Canadian waters from July through December. The adjusted Canadian quota for 2017 was 488.61 t which includes a 55.98 t transfer from Mexico. A total of 489 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 397.4t. An additional 74.3t was harvested as bycatch in the pelagic longline fleet in the swordfish and other tunas fishery. There were 1.4t of observed dead discards in 2017.

The swordfish fishery in Canadian waters takes place from April to December. Canada's adjusted swordfish quota for 2017 was 2070.2 t with landings reaching 1,188.2t. The tonnage taken by longline gear was 1,013.0 t while 175.2 t were taken by harpoon. Of the 77 licensed swordfish longline fishermen, 46 were active in 2017. Only 30 of 1,138 harpoon licenses reported swordfish landings in 2017.

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 2017, other tunas accounted for approximately 19%, 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: Updating the relative index of abundance created from the Gulf of St. Lawrence herring acoustic survey for bluefin tuna targets and expanding the work for the development of a similar German Bank index; 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. For 2018, Canada will help 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. 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 to assess the post-release mortality associated with the Canadian pelagic longline fleet and a fixed station longline survey designed to give abundance and distribution information for porbeagle shark.

Côte d'Ivoire

The artisanal vessels and the tuna vessels flying the Côte d'Ivoire flag landed in 2017 the total amounts of 11.349,334 t of tunas, 651,567 t of shark and 487,427 t of billfish. The catches for all species categories have been substantially higher than those taken in 2016. This increase in production is due to monitoring in the new large-scale landing areas of artisanal fishers. Skipjack and sailfish are the dominant species and no quota overrun has been observed for the different species with limitations. Côte d'Ivoire continues to urge its vessels to fish responsibly but also strictly monitors compliance with recommendations.

El Salvador

The Republic of El Salvador has been present in the area of the International Commission for the Conservation of Atlantic Tunas (ICCAT) since 2015, having acceded in late 2014 to the ICCAT Convention. Prior to accession, El Salvador had never carried out fishing activities in the jurisdictional waters of the Commission.

El Salvador regulates fishing and aquaculture through enforcement 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 2017, four purse seiners have engaged in fishing activities, which carried out a total of 35 fishing trips, and took a total catch - according to fishing logbooks - of 26,862 t of tropical tunas, with the following breakdown: 14,330 t of SKJ, 10,580 t of YFT, 959 t of BET, and 993 t of frigate tuna (*Auxis thazard*), in 1047 sets.

51.46% of the catches were taken in international waters and 48.54% in the exclusive economic zones of countries that have granted fishing licences to two Salvadoran vessels, including: Angola, Côte d'Ivoire, Cabo Verde, Gabon, Guinea-Bissau, Guinea (Rep.), Equatorial Guinea, 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 2017.

The EU is one of the major players in the ICCAT area and its catches represent around 40% of the total catches of the ICCAT Contracting Parties.

The EU Member States with fleets actively fishing in the ICCAT Convention area in 2017 were the following: Croatia, Cyprus, France, Greece, Ireland, Italy, Malta, the Netherlands, Portugal, Spain, and the United Kingdom.

Gabon

There are no tuna fleets in Gabon. The species taken by the national fleet (trawlers) as by-catch weighed 64 t. Moreover, the administration issued licenses to foreign purse seiners. These purse seiners mainly targeted yellowfin tuna (*Thunnus albacores*), bigeye tuna (*Thunnus obesus*) and skipjack (*Katsuwonus pelamis*). Over the course of the year, collection of historical national fishery data has been strengthened. In additon, a capacity building programme for agents assigned to collection and information processing is in the process of being launched in order to improve the quality of fishing statistics.

Ghana

The tuna industry in Ghana comprises the skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*). 20 baitboats, and 17 purse-seiners are currently fishing within the EEZ of Ghanaian coastal waters and beyond exploit these tuna species amongst other minor tuna-like species such as the black skipjack (*Euthynnus alletaratus*).

A total catch of the three main tuna species for the year 2017 was 85559 t as against 77601 t in 2016. The decline in catches by approximately 8000 t can be attributed to the moratorium during the first two months of the years and also the due to changes in fishing patterns from July 2017 where collaborative fishing was prohibited. The purse seine fleet accounted for 81% in the year under review whist the baitboats 19%. Skipjack catches (68%) were the most dominant followed by yellowfin (24%), and bigeye (5%) and other species 3%. Both fleets employ Fish Aggregating Devices (FADs) in fishing. Over 85% of catches are conducted off FADs.

Recent improvements in sampling coupled with the provision of more logbook information from the fishery has contributed to a better understanding of the spatio-temporal distribution of the species. It is envisaged that to complement efforts made a new processing tool for Ghana's statistics would soon be completed for further synthesis of the database.

The ICCAT moratorium on the use of FADs was observed by 12 vessels from January-February 2017 with no infractions observed.

Beach sampling of billfishes continued off the western coastline of Ghana from artisanal drift gill operators with stable catches of swordfish and increased catches of the sailfish. Virtually no white marlin species were observed.

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 few sharks mostly caught off purse seiners during observer missions were released alive.

Ghana is part of a pilot project –ABNJ-EMS, which implements video footage to help improve observance of fishing activities for prompt analysis for compliance and scientific purposes, aimed at effectively managing the tuna fishery. The 5 year project is being sponsored by the ISSF/WWF and implemented by the FAO.

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 a logbook and, for bluefin tuna, daily catch information. All Japanese longline vessels operating in the Convention area have been 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 SWO, BET and BFT species. Records of fishing vessels larger than 20 meters in length overall (LSFVs) have been established. One patrol vessel was dispatched to the North Atlantic to monitor and inspect Japanese tuna vessels catching bluefin tuna and also to observe fishing activities of fishing vessels from other nations. FAJ also inspected landings of Japanese fishing vessel 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 2017, Korea has only longline fishery for tunas and tuna-like species in the Atlantic Ocean, and the coverage of data reporting was 100%. 12 Korean longline vessels engaged in fishing in this area, and fishing effort (fishing days) was 1,750 days, which is very similar with that of 2016. Total catch of tunas and tuna-like species was 2,486 t, almost similar to that of 2016 as well. The catches of bigeye tuna, yellowfin tuna and bluefin tuna were 432 t (15.3%), 411 t (14.5%) and 181 t (6.4%), respectively. The distribution of the Korean longline fishing effort in 2016 and 2017 had similar patterns, however, that of 2017 relatively increased in the north of the equator compared to 2016. 10 satellite tags were used for bluefin tuna tagging activity as a part of ICCAT GBYP tagging activities and biological studies. The observer coverage in 2017 was 14% based on the total efforts (fishing days).

Liberia

Some management measures have been put in place to ensure the proper management of Liberia's tuna fisheries such as: tuna fisheries access agreement for foreign tuna fishing fleet, 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 catch by individual vessel to Liberia Fisheries Monitoring Center (FMC). Liberia signed a Sustainable Fisheries Partnership Agreement (SFPA) with the European Union (EU) in June 2015 for access and other private tuna agreements to exploit tropical tuna resources in its EEZ.

Mauritania

In Mauritania, high seas tuna species are targeted only by foreign fleets working within the framework of bilateral agreements and operating under the open licence regime. The fleets of these Contracting Parties, which reached around 47 tuna vessels in 2017, land their products in foreign ports.

Coastal tuna species are taken as by-catch by high seas small pelagic vessels. Statistics show that by-catch of high seas tuna taken by the high seas fisheries amounted to 11,619 t in 2017 (i.e. an increase of 40% compared to 2016) and essentially comprised Atlantic bonito (*Sarda sarda*) (58%), little tunny (Euthynnus sp.) (30%) and frigate tuna (*Auxis thazard*) (12%).

Catches landed by the artisanal and coastal fisheries have decreased slightly in 2017. It should be noted that tuna taken by purse seine in Mauritania are generally landed at night, and are therefore 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 certain tuna species were launched by the IMROP in 2016 and 2017 with the financial support of ICCAT; in particular, a programme which aims to collect available data and information on the presence of bluefin tuna in the area of Mauritania in 2016 and another programme which aims to collect biological data in order to study the size structures and growth parameters and develop approaches to recover catches of these species from 2000 to 2016.

Mexico

This 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 enforcement of the recommendations and resolutions adopted by the International Commission for the Conservation of Atlantic Tunas (ICCAT).

The yellowfin tuna (*Thunnus albacares*) fishery in the Gulf of Mexico is carried out by midwater longline vessels. In addition to the target species, other species are also caught incidentally 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, Livestock, Rural Development, Fisheries and Food (SAGARPA) 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 Institute (INAPESCA) is responsible for carrying out scientific research and collecting data on the longline tuna fishery in the Gulf of Mexico.

Morocco

Fishing of tuna and tuna-like species attained a production of 9,563 t in 2017, compared to 9,703 t in 2016, which is a volume decrease of 1.5%. However, the bluefin tuna quota allocated by ICCAT was fully exhausted. The main species exploited off the Moroccan coasts are bluefin tuna, swordfish, bigeye tuna, yellowfin tuna, skipjack tuna, small tunas, shark and dogfish. Statistical data collection 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 the Atlantic and Mediterranean coasts of Morocco. A control is also carried out subsequently by the Exchange Office on exports of fishing products. In terms of science, the National Institute of Fisheries Research (INRH), through its Regional Centres (6), covering the entire Moroccan coastline, has strengthened the collection of biological data of the main species (bluefin tuna and swordfish). The Regional Centre of the INRH in Tangier coordinates the collection and analyse of all these data. In recent years, monitoring of other species has begun, in particular tropical tuna species (bigeye tuna among others), small tunas and pelagic sharks, in particular in located in southern Morocco. As a result, significant success has been achieved in terms of statistical and biological data collection, as evidenced by the number of scientific documents, as well as the Task II data submitted by Moroccan researchers to the different SCRS scientific meetings, for the purpose 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 RFMO's or International Organisation. 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 2017, 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 2017 (Task I and Task II). The landings for some species, namely; Albacore (ALB), Bigeye Tuna (BET) Shortfin Mako (SMA), Longfin Mako (LMA) (YFT), Blue Sharks (BSH), and Oil fish (OIL) have significantly decreased in 2017, while those of Swordfish (SWO), have increased in 2017 when compared to 2016. Other species, such as Skipjack tuna (SKJ) were also recorded in 2017.

Fisheries observers were also deployed on board large pelagic vessel 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 RFMO's and International Organisations. Namibia has also ratify in June 2017 to the FAO Port State Measures agreements.

Norway

Norway was allocated a quota of 52.48 t of eastern bluefin tuna (*Thunnus thynnus*) for 2017. The quota was exhausted in a directed ICCAT fishery and as bycatch in non-ICCAT fisheries. Numerous observations of Atlantic bluefin tuna were made along the coast and offshore waters of Norway from 58° to 70°N during July-October 2017. Norway put a lot of effort into obtaining biological, ecological and genetic samples and data for all individual Atlantic bluefin tuna caught in 2017. Norway continuously works on present and historical data on tuna and tuna-like species and aims to incorporate the data on these species into an ecosystem perspective. Norway participated in the SCRS annual science meeting in 2017.

Russia

Fishery. In 2017 and 2018 a specialized (purse seine) tuna fishery fleet flying the Russian flag did not carry out any operations. In 2017 trawl vessels caught 993 t of 4 tuna species and 666 t of Atlantic bonito as by-catch in the Eastern-Central Atlantic. In the first half of 2018 trawl vessels caught 268 t of 3 tuna species and 358 t of Atlantic bonito.

Research and statistics. In 2017 "AtlantNIRO" observers collected biological and fishery materials on tunas onboard trawl vessels in the Eastern-Central Atlantic (area SJ71 according to the ICCAT classification). Fish were measured for length and weight, and sexed, and in addition, the maturity stage of gonads and degree of stomach fullness were determined. Species of the group "Small Tunas" occurred in trawls as a by-catch from one individual specimen or up to a few tonnes. Material from 3726 specimens of frigate tuna, bullet tuna, Atlantic black skipjack, oceanic skipjack and Atlantic bonito was collected for weight measurements and 2103 for biological analyses.

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

São Tomé and Príncipe

It is important to highlight that the country has made some improvements to its fleet but the desired standard has not yet been attained because it is still very much artisanal and semi-industrial-based. The country currently has 2,305 artisanal vessels operating in the artisanal fishery in the EEZ, 12 to 15 miles off the coast.

In terms of highly valuable commercial species, the tuna and tuna-like fishery is of major importance to Sao Tomé and Príncipe. Fishing for tuna and tuna-like species is carried out in Sao Tomé and Príncipe by artisanal vessels. Those with the highest capacity are Cariocos, boats and some semi-industrial fishing boats; 75 boats use purse seine and troll and 10 semi-industrial vessels with industrial applications use troll.

In 2017, the quota was not exceeded for the species with an allocated quota and the recommendations were implemented as far as possible. In addition, given the importance of tuna and the species caught in association in the national economy and for the purpose of improving management of the existing stock, it is essential to advance knowledge on biology and strengthen the research staff. In addition, Sao Tomé and Principe needs urgently to be allowed to participate henceforth in the statistical monitoring programme through the presence of beach observers.

Within the framework of the Enhanced Research Programme for Billfish, data collection (catches and fishing effort by number of trips) and sampling are always carried out in the main artisanal fishing ports.

Senegal

In 2017, the Senegalese industrial tuna fleet was comprised of five (5) baitboats and five (5) purse seiners that mainly targeted Atlantic tropical tunas, in particular yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*) and skipjack (*Katsuwonus pelamis*), and two (2) longliners and three (3) cord boats targeting swordfish. However, a portion of the artisanal fisheries that use fishing gears such as handline, troll, purse seine and nets catch billfish (marlins and sailfish) and small tunas (Atlantic black skipjack, mackerel, bonito, frigate tuna, etc.) and shark.

In 2017, total catches of tropical tunas taken by Senegalese baitboats and purse seiners amounted to around 32,051 t. The total catch of five (5) Senegalese baitboats is estimated at 3,349 t, with 2,779 t of skipjack, 289 t of bigeye tuna, 240 t of yellowfin tuna and 41 t frigate tuna. Catches of tropical tunas by Senegalese purse seiners are estimated at 28,702 t, with 96% of catches made off floating objects (FADs). The fishing effort deployed in 2017 by Senegalese baitboats and purse seiners totalled 1,085 and 1,073 fishing days, respectively.

For the Senegalese longline fishery targeting swordfish, the 2017 catches amounted to 241 t, with 160 t of swordfish, 38 t of blue shark, 17 t of blue marlin and 16 t of yellowfin tuna. It should be noted that there has been a 56% decrease in catches, compared to 2017 (375 t). For the artisanal small tunas fisheries and associated species, catches are estimated at 5,346 t in 2017, i.e. a decrease of 63% compared to 2016.

South Africa

South African tuna and billfish resources are exploited by baitboat (tuna pole-line) and longline fisheries (large pelagic longline). In 2017, the baitboat fleet comprised 92 active vessels of an average length of 16 m overall (LOA). The total baitboat effort of 3062 catch days within the ICCAT Convention area represents a substantial decrease by 38% compared to 2016 and resulted in further decreases of albacore and yellowfin tuna catches to 1640 t (-18%) and 235 t (-61%), respectively. In 2017, 18 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 seeing a decrease between 2015 and 2016, total longline effort in the Atlantic has notably increased again from 924 thousand hooks to 1308 thousand hooks in 2017. The 2017 longline catches of swordfish (189 t), yellowfin tuna (152 t), bigeye tuna (235 t) and blue sharks (418 t) were higher than in 2016, while albacore (145 t) and shortfin mako shark (305 t) decreased slightly. 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. The observer effort for the large pelagic longline fishery was increased from two observed trips in 2016 to 15 observed trips in 2017, which resulted in an increase from 2% to 8.5% coverage of the longline effort in the Atlantic. The South African National Department of Agriculture, Forestry and Fisheries (DAFF) is 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 included collaborations on modelling bird bycatch rates from observer data and publication and application of the Bayesian Surplus Production modelling software 'JABBA', which was utilised during Atlantic blue marlin and bigeye tuna assessments and in several other RFMO and country assessments. Collaborative research projects investigating the stock origin and intermixing of tuna and swordfish and shark populations at the boundary between the Atlantic and Indian Oceans are ongoing and remain a high research priority in South Africa.

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 2017, as in previous years, these plans have been supported by implementation of all the control programmes (onboard observers programme) and the at-sea and in-port inspection programmes in particular during periods of prohibition on fishing for bluefin tuna and swordfish.

In preparation for the 2017 bluefin tuna fishing campaign, Tunisia adjusted its fishing capacity in accordance with the methodology adopted by ICCAT (paragraph 41 of Rec. 14-04). On the basis of this methodology, Tunisia established a fishing plan and allocated individual quotas to 27 vessels to fish for bluefin tuna in 2017.

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 by-catch and discards in the tuna and swordfish fisheries, the relevant authority, in addition to catch documentation, has achieved a scientific observer coverage of 5% of its tuna and artisanal fisheries. The allocation of quotas for bluefin tuna fishing and fine-tuning of gears targeting swordfish have greatly reduced incidental catches; in 2017, no by-catch of sea turtles or sea mammals was reported by the national observers programme.

Total catches of bluefin tuna in 2017 amounted to 1,791 t, with 1,755.133 t taken by vessels authorised to fish 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

Turkey's total catch of marine species was 322,172.5 t for the year 2017. The portion of tuna and tuna-like fish in the total catch was 10,531.2 t, including Mediterranean swordfish. In 2017, the amounts of catch of bluefin tuna, swordfish, albacore, bullet tuna, Atlantic bonito and little tunny was 1,514.7 t, 441.0 t, 44.0 t, 474.1 t, 7,577.6 t and 479.8 t, respectively. Most bluefin tunas were caught by purse seiners, which have an overall length of 32-62 meters. Fishing operations were conducted intensively off Antalya Bay in the south of Turkey and in the Eastern Mediterranean region. Bluefin tuna were caught from the end of May to the end of June. Conservation and management measures for the swordfish and bluefin tuna fisheries and farming are regulated by national legislation through notifications, and take into account ICCAT related regulations.

United Kingdom – OTs

The level of fishing effort in the United Kingdom Overseas Territories (UKOTs) engaged in ICCAT during 2017 was similar to that of previous years. The total tonnage of ICCAT species caught in the UK OTs has remained modest when compared to more developed fisheries, with less than 500 t caught in total. Bermuda and St Helena continue to represent the largest contributors to the total UK OT catch, with much smaller catches in the British Virgin Islands and the Turks and Caicos Islands.

UKOT fishing activity is primarily artisanal or sports-related. There is no fishing involving larger scale methods such as purse seines, and only very limited deployment of longlines. However, the UKOTs continue with their interest in developing commercially viable fisheries to aid their economic development. Two UKOTs, the Turks and Caicos Islands and British Virgin Islands, experienced two major (Category 5) hurricanes during September 2017, which devastated the islands' infrastructure and prevented submission of data to ICCAT.

The total catch of ICCAT species in St Helena in 2017 was 316 t, principally comprised of yellowfin and bigeye tuna, with small catches of skipjack and wahoo. In Bermuda the total catch of ICCAT species was 142 t in 2017, mainly comprised of yellowfin and blackfin tuna and wahoo. No data was available for TCI or BVI, but historical catches in these territories are less than 5 t per year.

St Helena has established a tagging programme, which has now tagged in excess of 1,000 fish (predominantly yellowfin) and shows that yellowfin tuna remain in St Helena waters for extended periods. St Helena has improved data collection on ICCAT species and will be submitting more detailed data in future.

Turks and Caicos Islands and British Virgin Islands are slowly recovering from the effects of the hurricanes and the ability of the Government to conduct routine work, including collecting and storing fishery catch and effort data, is currently severely compromised. The Governments of Turks and Caicos Islands and Virgin Islands are committed to reinstating fishery data collection and aim to resume this during 2018 for inclusion in the 2018 annual report.

United States

Total (preliminary) reported U.S. catch of tunas (YFT, SKJ, BET, ALB, BFT) and swordfish, including dead discards, in 2017 was 6,826 t, an increase of about 2% from 6,707 t in 2016. Swordfish catches (including estimated dead discards) decreased from 1,497 t in 2016 to 1,377 t in 2017, and provisional landings from the U.S. fishery for yellowfin tuna increased in 2017 to 3,326 t from 3,272 t in 2016. U.S. vessels fishing in the northwest Atlantic caught in 2017 an estimated 998 t of bluefin tuna, a decrease of about 29 t compared to 2016. Provisional skipjack tuna landings decreased by about 34 t to 99 t from 2016 to 2017, bigeye tuna landings increased by 264 t compared to 2016 to an estimated 788 t in 2017, and albacore landings decreased from 2016 to 2017 by 15 t to 237 t.

U.S. government (NOAA) and university scientists, working independently or in collaboration (including collaborations with scientists from other CPCs), conducted research in 2017 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 2017, the Uruguayan tuna fleet did not carry out any activity. So far in 2018 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 in 2019. The analysis of catch and effort statistics of the species of interest to the Commission continued. Two research campaigns were carried out onboard DINARA's B/I, aimed at large pelagic resources. During these campaigns, 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, Thunnus obesus* and *Isurus oxyrinchus*) continued. Uruguay participated in the ICCAT AOTTP and SRDCP programmes tagging tropical tunas and shark onboard of the B/I of DINARA. In addition, experiments were performed to evaluate by-catch mitigation measures. Uruguay participated in and contributed papers to several SCRS meetings, including the Swordfish Data Preparatory Meeting (3 documents), the intersessional meeting of the Shark Species Group (5 documents), the Atlantic Swordfish Stock Assessment Meeting (1 document), and the intersessional meeting of the Sub-committee on Ecosystems (1 document). 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 the vessel documentation. All the ICCAT recommendations adopted at the 2017 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 2017, the number of authorized fishing vessels was 84 with 54 targeting bigeye tuna and 30 targeting albacore, and the total catch of tuna and tuna-like species was about 28,365 t. Bigeye tuna was the most dominant species, which accounts for 42% of the total catch in weight, followed by albacore with catch accounting for 40% of the total catch. In general, Chinese Taipei fully implemented ICCAT conservation and management measures in 2017. 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. The captain of the fishing vessel was required to fill in the catch logbook and electronic logbook completely and accurately. 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, northern and southern Atlantic albacore and swordfish. The catches of those species were well below catch limits allocated by ICCAT for 2017. 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 and silky sharks. We have carried out a scientific observer program for the tuna fishery in ICCAT waters since 2002. In 2017, there were 26 observers deployed on fishing vessels operating in the Atlantic Ocean, and the observer coverage on albacore and bigeye vessels was 7.27% and 15.27%, respectively. The research programs conducted by scientists in 2017-2018 included research on CPUE standardizations and assessments of bigeye tuna, yellowfin tuna, albacore, swordfish and sharks; the impact of climatic change on major tuna stocks; studies of shark by-catch and abundance index; age and growth of sharks; and research on incidental catch of ecological related species. The research results were presented at the inter-sessional working group meetings and regular meetings of 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 2018 were presented.

8.1 Bigeye tuna data preparatory and stock assessment meetings

The bigeye tuna data preparatory meeting was held in Madrid, Spain from 23-27 April 2018. The objective of this meeting was to revise the available catch and tagging data (including the ICCAT/AOTTP project), as well as indices of abundance and other relevant biological and fisheries information aiming at the Atlantic bigeye tuna stock assessment in 2018. Significant revisions were made to the fisheries statistics, particularly as regards overall catches and catch-at-size data, resulting in an improvement of the data set available for the assessment. Additional improvements were also made as regards the indices of abundance from longline gear, including a combined index for major fleets. In addition to these objectives, the models to be used during the assessment and their assumptions and remaining issues in preparation for the July stock assessment meeting were discussed.

The detailed report was presented (Anon. 2018a).

The bigeye tuna stock assessment meeting was held in Pasaia (San Sebastian), Spain from 16-20 July 2018. The objective of this meeting was to perform a stock assessment for Atlantic bigeye tuna stock. Four models were used for the 2018 bigeye stock assessment: production models (mpb and JABBA), VPA-2box and Stock Synthesis (SS3). The Group agreed that SS3, an integrated statistical assessment model that allows the incorporation of more detailed information, both for the biology of the species as well as fishery data, be the preferred model to be used for the management advice. The substantial revisions made to historical fishery data and new information on life history were applied to the assessment. The models show consistent results both in absolute magnitude of the stock and in stock status, and it was agreed to apply a novel approach, "uncertainty grid" developed from the SS3-Reference Case to better integrate multiple sources of uncertainty in the management advice provided.

The detailed report was presented (Anon. 2018b).

The Tropical Tuna Species Group work plan for 2019 is attached as **Appendix 12**.

Discussion

In 2018, data preparatory and stock assessment meetings were held. The development of a joint standardized index of Japanese, Chinese Taipei, Korea and USA longline fleets was an important change made to the bigeye stock assessment in 2018. The assessment was done with an age-structured model (stock synthesis) as the base case with two production models for sensitivity cases, uncertainty for main factors (natural mortality, steepness, indices of abundance and variability in recruitment sigmaR) was evaluated by including a full grid of 18 sensitivity combination cases. The stock assessment results show that the stock is both overfished and that overfishing is occurring. It was noted the projections and uncertainty evaluation were done intersessionally after the assessment and following the recommendation of the Species Group. The Committee agreed to add an addendum to the assessment report to record the details of projections and uncertainty evaluation.

The Committee inquired about the apparent changes in mean weight of bigeye catches, in particular for the purse seine fleet free-school and FAD operations. It was noted that many possible reasons could explain these changes, but that the stock assessment model was able to include changes in selectivity and population dynamics that allowed to fit the size composition data very well. The Committee also discussed whether it was appropriate to represent the state of the stock as the spawning stock biomass relative to the spawning stock biomass that produces MSY, as opposed to the biomass that produces MSY. The Group Rapporteur and others noted that the assessment models such as stock synthesis and surplus production models implicitly had a stock recruitment relationship that permitted the estimation of this quantity.

8.2 Blue marlin data preparatory and stock assessment meetings

The blue marlin data preparatory meeting was held in Madrid, Spain, from 12-16 March 2018. 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 blue marlin stock assessment in 2018. In addition to these objectives, the models to be used during the assessment and their assumptions and remaining issues in preparation for the June stock assessment meeting were discussed. Finally the Group took the opportunity to revise the Enhanced Program for Billfish Research (EPBR) and define the Terms of Reference for collection of biological samples for the study of growth of billfish in the eastern Atlantic.

The detailed report was presented (Anon. 2018c).

The meeting was held in Miami, USA from 18-22 June 2018. The objective of this meeting was to perform a stock assessment for Atlantic blue marlin stock. Three models were used for the 2018 blue marlin stock assessment: Stock Synthesis (SS3), ASPIC 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 resulting combination of results would reflect more of the uncertainty associated with the estimates of stocks status. The stock was estimated to be below B_{MSY} and therefore catches would need to be reduced to ensure that Commission objectives of maintaining the stock at a level that will support MSY. In particular, it was noted that in recent years, blue marlin catches have surpassed the recommended TACs adopted by the Commission within the recovery plan for this stock. The Group highlighted the uncertainty in the landings, discard data and fate of live discards, requesting a better reporting by all CPCs.

The detailed report was presented (Anon. 2018d).

The Billfish Species Group work plan for 2019 is attached as **Appendix 12**.

Discussion

The Rapporteur of the Billfish Species Group presented the results for the data preparatory and blue marlin stock assessment intersessional meetings held in April in Madrid, and in June in Miami, respectively. The Rapporteur noted the increased participation of scientists from a wider number of CPCs. New information on biological research on ageing and growth was presented, indicating an older age for blue marlin (37 years for males, 30 year for females) compared to prior estimates. This new information was used to estimate an updated natural mortality by age vector for the assessment. The stock assessment results indicated that blue marlin is currently overfished and fishing mortality has decreased recently to levels about F_{MSY}.

The Committee inquired why the stock shows a trend moving from the green quadrant to the red quadrant in the Kobe plot. It was noted, however, that the high fishing pressure and catches in the early years substantially reduce the stock biomass to levels below B_{MSY}, and although fishing effort has declined, the stock still continues to be below B_{MSY} and overexploited.

8.3 Bluefin tuna MSE intersessional meeting

The meeting was held in Madrid, Spain from 16-20 April 2018. The objective of this meeting was to advance the MSE work conducted for bluefin tuna, namely by engaging more scientists in the process. The Group reviewed the work that has been developed by the Core Modelling Group. The Group reviewed possible amendments to the MSE coding package and defined a work plan for the Bluefin Tuna MSE Technical Working Group to report on further trials and results during the Bluefin Tuna Species Group meeting. Proposals for candidate Management Procedures (CMP) were considered and a trials specification document was recommended to summarize and compare outcomes, standardization of results for presentation and comparison among CMPs was also discussed. Finally a number of recommendations were brought forward aiming at encouraging participation in the bluefin tuna MSE process, as well as in other MSE processes currently ongoing in ICCAT.

The detailed report was presented (Anon. 2018e).

The Bluefin Tuna Species Group work plan for 2019 is attached as **Appendix 12**. Additional information is provided in Agenda item 15.2.

8.4 Northern swordfish MSE intersessional meeting

The meeting was held in Madrid, Spain from 16-20 April 2018. The objective of this meeting was to initiate the ICCAT North Atlantic swordfish MSE process. A session was held together with the Bluefin Tuna Species Group, aiming to learn from a more advanced MSE process. A review was also made related to work done to date on other swordfish MSE processes. The Swordfish MSE Technical Working Group discussed the MSE roadmap for North Atlantic swordfish (N-SWO) emphasizing the importance of clear objectives, communication among stake holders, deadlines for key milestones in the process and overall time extension with continued support for successful implementation of the N-SWO MSE. The potential Operating Models applicable for N-SWO was also discussed, defining biological and fisheries characteristics required in the models. These conclusions were forwarded to the contractor that is currently engaged in the development of the N-SWO MSE process.

The detailed report was presented (Anon. 2018f). Additional information is provided in Agenda item 15.4.

The Swordfish Species Group work plan for 2019 is attached as **Appendix 12**.

Discussion

The Species Group Rapporteur reported on progress made in updating information on stock structure and biological information from preliminary analyses of research contracted in 2018. In addition, the Committee reported on progress made for the MSE North Atlantic stock unit, including developing an Operating Model for swordfish during the MSE workshops. In addition, an MSE contract was awarded in 2018, with the objective to develop Operating Models for including uncertainty for nine main effects identified by the Group.

The Committee noted the importance of maintaining documentation that records decisions and progress made on MSE development. With the objective of addressing the effect of minimum sizes established for Atlantic swordfish (Recs. 17-02 and 17-03) and Mediterranean swordfish (Rec. 16-05), the Species Group noted the need to sample these small fish.

8.5 Small tunas species group intersessional meeting

The meeting was held in Madrid, Spain, 2-6 April 2018. 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 assessment and the provision of future advice related to stocks of wahoo (*Acanthocybium solandri,* WAH), bonito (*Sarda sarda,* BON) and little tunny (*Euthynnus alletteratus,* LTA). Finally the status of the Small Tuna Year Programme was discussed and the work plans for 2018 and 2019 drafted, with a particular emphasis on the enhancement of coordination and collaboration between scientists.

The detailed report of the meeting was presented (Anon. 2018g).

The Small Tunas Species Group work plan for 2019 is attached as **Appendix 12**.

Discussion

The Small Tunas Species Group Rapporteur summarized the intersessional meetings. It had considered many documents including new fisheries indices, and many submissions on biology and stock structure. She noted some improvements to the Task I data summaries but noted that 70-90% still contained unclassified gears and poor availability of Task II data. The Group noted the need to improve growth, maturity, and genetics knowledge in order to improve these data-poor stock assessments. To that end, the Group hopes to run a workshop on data sources and methods to apply these data-poor methodologies. It put forward a proposed Call for tenders for 13 CPCs in order to continue to collect this key life history data with a cost of €100,000. During the questions, the Committee thanked the Species Group and noted that it had made much positive progress.

The Committee concluded that the Rapporteur should improve the language in the Management recommendations section in order to reflect the need to improve data quality. The Species Group Chair agreed to provide such language before the summary is adopted and to fix tables and one figure of the small tunas Executive Summary.

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

The meeting was held in Madrid, Spain, 7-11 May 2018. The objectives of the meeting were to continue developing best practices for CPUE standardization, work on how best to bring spatially changing oceanographic, environmental conditions and climate change into the assessment process, focus on discussions regarding the Management Strategy Evaluation (MSE) Process and address Harvest Control Rules, Limit, Threshold and Target Reference points. Finally, the WGSAM looked at the usefulness of alternative Data Limited Methods of stock assessment for ICCAT species.

The detailed report of the meeting was presented (Anon. 2018h).

The WAGSAM work plan for 2019 is attached as **Appendix 12**.

Discussion

The Committee discussed some of these recommendations. It was noted that some proposed recommendations related to the review process and specific meetings were in place for several species. The Committee discussed the need for a more general framework for structured reviews of MSE within the practical limits of various species working groups in order to keep pace with the sometimes very rapid computer code development that occurs. It was suggested that the Terms of Reference should be unified across ICCAT species. Further discussion about how best to review MSE was deferred to item 15 of the SCRS agenda.

The Committee emphasized the importance of collaboration to share/learn stock assessment and MSE process with other organizations, e.g. ICES and other tRFMOs. It was noted that the ICES Methods Working Group meeting is often held at the same time as the ICCAT Species Groups meeting in September or the plenary meeting in October. It was pointed out that some specific requests/questions have arisen to the WGSAM from the Sub-committee on Statistics and Species Groups that could be considered.

8.7 Sharks species group intersessional meeting

The meeting was held in Madrid, Spain from 2-6 July 2018. The objective of this meeting was to prepare the update of the shortfin mako stock assessment in 2019. As such, the Group reviewed the activities and progress of the Shark Research and Data Collection Programme (SRDCP), namely as regards spatio-temporal distribution and biology (age and growth, reproduction, maturity) of shortfin mako. The Group also updated statistical data available at the Secretariat and reviewed new data received from national scientists and new indices of abundance. The 2017 stock assessment was revisited and the application of an alternative projection approach for Stock Synthesis to evaluate the probability of success of the measures contemplated in ICCAT Rec. 17-08 was explored. Finally, the Group reviewed the effectiveness of potential mitigation measures to reduce by-catch and mortality of shortfin mako, draft a number of responses and recommendations to the Commission, as well as the work plan for 2019.

The Detailed Report of the Sharks Species Group intersessional meeting was presented (Anon. 2018i).

The Sharks Species Group work plan for 2019 is attached as **Appendix 12**.

Discussion

The Sharks Species Group Rapporteur provided a summary of the intersessional meeting, which reviewed the conventional catch and tagging data as well as other fishery indicators. The Rapporteur noted the Group plan to do an assessment for shortfin mako in 2019 and further highlighted the need for CPCs to report on how they implemented Rec. 17-18 in their respective fisheries. The Group noted the need for addition research to respond to the Commission's request. Given the need to prioritize the work on mako shark, postponing the ICCAT assessment on porbeagle stocks was also proposed that will be evaluated during the SCRS scheduling session. The Species Group Rapporteur provided a summary of the SRDCP. Several projects are underway including those on population genetics, electronic tagging, age and growth.

Several changes to the sharks Executive Summary were made, namely in the introduction, fisheries indicators, outlook and recommendations sections. Tables were updated with provisional yield information for blue shark and for North and South Atlantic shortfin mako shark. It was noted that while catch tables were not updated with stock assessment projections, there were updates to the porbeagle total catch series that had not been updated since 2008. The Committee requested that sentences be added describing the catch trends and to move the description of model fitting conflicts that might arise from similar catch and CPUE trends to more appropriate sections of the sharks Executive Summary.

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 2016, at which time catch and effort data through 2014 were available. 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, 2017a) were updated in order to include the last three years (2015 to 2017) using the same methodology as in 2016. 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 2016 Yellowfin Stock Assessment Session (Anon. 2017a). The Tropical Tunas Work Plan (**Appendix 12**) 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 (from west to east) indicated by conventional tagging and longline catch data that indicates yellowfin are distributed continuously throughout the tropical Atlantic Ocean. However, movement rates and timing, routes, and local residence times remain highly uncertain. 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.

A recent study in the eastern Atlantic Ocean further described the reproductive traits of female yellowfin tuna including, sex-ratio, size at maturity, spawning seasonality, fish condition and fecundity. Size at 50% maturity was estimated at 103.9 cm fork length when cortical alveoli were used as a maturity threshold, however a larger size of around 120 cm at 50% maturity was estimated when more advanced oocytes were used. The conclusions of this research were incorporated in the 2016 stock assessment of yellowfin tuna.

Tagging studies of yellowfin in the Pacific and Indian Oceans suggest that natural mortality is age-specific, and higher for juveniles than for adults. Nevertheless, uncertainties remain as to the exact parameterization of the age-specific natural mortality function. As was applied for the recent bigeye tuna assessment, an age-specific natural mortality function (e.g. Lorenzen) was developed and applied to the 2016 assessment of yellowfin tuna. 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.

It is generally agreed that growth rates are relatively slow initially, increasing at the time the fish leave the nursery grounds. This interpretation is supported by analyses of size frequency distributions as well as tagging data. Regardless, questions remain concerning the most appropriate growth model for Atlantic yellowfin tuna, as analyses of hard part growth increments support somewhat different growth patterns.

Younger age classes of yellowfin tuna (40-80 cm) exhibit a strong association with floating objects (FOBs: natural or artificial fish aggregating devices). The Committee noted that this association with FADs, 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. Preliminary results suggest that data collected by Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP) will help 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 (193,600 t) to 109,000 t estimated for 2013 but have recently increased to as much as 151,200 in 2016. The most recent catch distribution is given in **YFT-Figure 1**. However, it should be noted **YFT-Table 1** and **YFT-Figure 1** incorporate scientific estimates of Ghanaian catches for 2006-2017. The Committee noted that recent revisions to Ghanaian landings generally increased the proportion of the catch assumed to be yellowfin, while the proportion of bigeye decreased.

In the eastern Atlantic, purse seine catches declined between 1990 and 2007 (129,000 t to 48,000 t) but have subsequently increased to 91,070 t in 2017 (**YFT-Table 1; YFT-Figure 2**). Baitboat catches declined between 1990 and 2013 (from 19,648 t to 6,921 t) but increased to 8,323 t in 2017. Longline catches, which were 10,300 t in 1990, declined to 4,600 t in 2017. In the western Atlantic, purse seine catches (predominantly from Venezuela) were as high as 25,700 t during the mid-1980s but have since declined to 4,351 t in 2017. Baitboat catches also declined since a peak in 1994 (7,100 t), and for 2017 were estimated to be about 900 t. Since 1990, longline catches have generally fluctuated between 10,000 t and 15,000 t.

The number of estimated active purse seiners (Ghana, EU and other CPCs) declined by more than half from 1994 until 2006, but then increased as some vessels returned from the Indian Ocean to the Atlantic (**SKJ-Figure 9**). By 2010, overall carrying capacity of the purse seine fleet had increased significantly, to about the same level as in the 1990s, and has continued to increase (by nearly 50%) since that time. FAD 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 FADs 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 FADs). 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. 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.

Eight longline indices were selected for use in the stock assessment based on meeting specific criteria for inclusion. Indices with similar characteristics were grouped together using a cluster analysis. The two "clusters" represent unique hypotheses regarding trends in abundance of yellowfin tuna. Cluster 1 indices showed an initial decline, with nearly constant relative abundance since 1990, while Cluster 2 indices suggest increased abundance during the 1990s, followed by a general decline through 2014 (**YFT-Figure 3**). The two trends represent a major source of scientific uncertainty regarding the abundance of yellowfin tuna. Abundance indices from surface fleets, particularly those that capture newly recruited fish could be useful if properly adjusted for changes in fishing power. Future work to develop, document and maintain indices from these fleets is desirable.

The average weight trends by fleet (1970-2014) are shown in **YFT-Figure 4**. 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 2016, applying three age-structured models and a non-equilibrium production model to the available catch data through 2014. As has been done in previous stock assessments, stock status was evaluated using both surplus production and age-structured models. Models used to develop management advice considered two primary sources of scientific uncertainty, the use of index clusters that reflect two disparate hypotheses regarding trends in abundance of yellowfin tuna, and alternative model structures as implemented using four model platforms. Surplus production models that used Cluster 2 indices did not converge and were not considered. Management advice was developed using a joint distribution of the results of seven models (ASPIC Cluster 1; ASPM-Clusters 1 and 2, VPA Clusters 1 and 2, SS Clusters 1 and 2) which were weighted equally. Additional uncertainties in growth, age-slicing, mortality, index selection and data weighting were explored in sensitivity runs. Trends in biomass (**YFT-Figure 5**) and fishing mortality (**YFT-Figure 6**), relative to the levels that produce MSY, were generally similar for all models used to develop management advice, although small differences in current stock status were noted (**YFT-Figures 5** and **6**). Model specific Kobe status plots (**YFT-Figure 7**), with the annual trajectories of stock status, indicate that for most models the 2014 stock status was near B_{MSY} and below F_{MSY}. Annual trajectories should be interpreted with caution because they are not adjusted for known changes in selectivity.

The estimated MSY (median = 126,304 t) may be below what was achieved in past decades because overall selectivity has shifted to smaller fish. The impact of this change in selectivity on estimates of MSY was clearly seen in the results from age structured models (e.g. **YFT-Figure 8**). Bootstrapped estimates of the current status for the seven models, which reflect the variability of the point estimates given assumptions about uncertainty in the inputs, are shown in **YFT-Figure 9**. When the uncertainty around the point estimates from all models was taken into account, there was an estimated 45.5% chance that the stock was healthy (not overfished and overfishing not occurring) in 2014, a 41.2% probability that the stock was overfished, but not experiencing overfishing, and a 13.3% chance that the stock was both overfished and undergoing overfishing (**YFT-Figure 10**).

In summary, 2014 stock biomass was estimated to be about 0.95 B_{MSY} (overfished) and the fishing mortality rate was about 0.77 F_{MSY} (no overfishing).

YFT-4. Outlook

Projections conducted in 2016 considered a number of constant catch scenarios (**YFT-Figures 11-12**). In most cases, catches less than 120,000 t led to, or maintained a healthy stock status through 2024. The results from the seven models were summarized to produce estimated probabilities of achieving the Convention objectives ($B>B_{MSY}$, $F<F_{MSY}$), for a given level of constant catch, for each year up to 2024 (**YFT-Table 2**). Maintaining catch levels at the current TAC of 110,000 t was expected to result in healthy stock status ($B>B_{MSY}$, $F<F_{MSY}$), 2017 with at least 68% probability, increasing to 97% by 2024. As the actual 2016 and 2017 catches exceeded the values assumed for projections and the TAC, the percentages above (and in **YFT-Table 2**), are likely to be optimistic.

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 year, 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^{o}x1^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 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 5-6%. Since then, overages have increased substantially, to 17% (129,000 t) in 2015, 37% (151,200 t) in 2016 and 27% (139,300 t) in 2017.

YFT-6. Management recommendations

Based on the 2016 stock assessment, the Atlantic yellowfin tuna stock was estimated to be overfished (0.95 B_{MSY} in 2014) The Committee recommended that catch levels at or below the current TAC of 110,000 t were expected to maintain healthy stock status through 2024. The Committee noted that the most recent catch estimates suggest that overall catches have exceeded TAC in every year but one since 2012. In the most recent years overall catches have exceeded the TAC by 17-37%. The Committee expressed strong concern that these overages may have further degraded the condition of the yellowfin stock. Also, noting that for 2015-2017 catches have exceeded TAC, it is possible that overfishing is now occurring. To address this concern, the Committee recommends a stock assessment of yellowfin tuna be conducted in 2019. Furthermore, given that significant overages continue to occur, 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 and bigeye tuna could have negative consequences. 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 and bigeye tuna (e.g. FAD-related and other fishing mortality of small yellowfin tuna).

ATLANTIC YELLOWFIN TUNA SUMMARY

Maximum Sustainable Yield (MSY)	126,304 t (119,100 - 151,255 t)[1]
2017 Yield	139, 316 t
Relative Biomass B_{2014}/B_{MSY}	0.95 (0.71-1.36)[1]
Relative Fishing Mortality: $F_{CURRENT\ (2014)}/F_{MSY}$	0.77 (0.53-1.05)[1]
2014 Total Biomass	464,712 t (308,287 – 731,485 t)[1]
Stock Status (2014)	Overfished: Yes Overfishing: No ***

[Rec. 16-01]
- Revised time-area closure for FAD associated surface fishing
- 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

NOTE: $F_{CURRENT(2014)}$ refers to F_{2014} in the case of ASPIC, ASPM and SS, and the geometric mean of F across 2011-2013 in the case of VPA. Relative biomass is calculated in terms of spawning stock biomass in the case of ASPM, SS and VPA and in total biomass in the case of ASPIC.

[1] Median (10th-90th percentiles) from joint distribution of age-structured and production model bootstrap outcomes considered.

*** **NOTE**: Overall catches have exceeded TAC by 17-37% since 2015. The stock status may have degraded since 2014, and overfishing may be occurring.

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

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				163451	173744	154588	149152	137375	144496	136325	132154	153455	134427	122448	119407	101592	105800	100417	111736	117558	118316	112288	115396	108507	116773	129106	151221	139316
	ATE			124706	125530	119314	116096	105034	113576	105615	96531	113139	104767	97467	88169	75524	77528	76250	93613	98782	97462	94494	93742	85067	92859	105088	117432	106228
	ATW			38745	48215	35274	33056	32341	30919	30710	35623	40317	29660	24982	31238	26068	28272	24167	18123	18777	20855	17794	21654	23440	23914	24017	33789	33088
Landings	ATE		Bait boat	18471	15652	13496	11365	12695	14265	16729	10022	14034	11145	9967	14639	9725	12407	12461	9227	8879	9578	12035	8855	6921	9433	9452	10070	8323
			Longline	8537	14638	13723	14236	10483	13872	13561	11369	7576	5869	9183	11537	7206	7234	13437	8562	6684	5024	6117	5319	5659	4743	4340	4860	4557
			Other surf.	1941	1905	1854	1945	2027	1550	1465	2301	1951	1624	2309	2661	2110	2988	2534	1693	3012	1890	1446	2035	3030	1550	1596	2470	2278
			Purse seine	92310	90276	87732	87737	78334	82401	72079	70787	89191	85808	74702	57797	55429	54152	46982	73122	78782	79102	71875	75660	68124	75732	87709	98342	89852
	ATW		Bait boat	6383	7094	5297	4560	4275	5511	5364	6753	5315	6009	3764	4868	3867	2695	2304	886	1331	1436	2311	1299	1602	513	743	1216	866
			Longline	12129	11790	11185	11882	11554	11671	13326	15760	14866	11921	10166	16019	14449	14249	13557	13192	12782	14882	10837	13302	11864	8939	7434	11084	8778
			Other surf.	4152	9719	12454	5830	4801	4581	5330	5241	7027	3763	6445	7134	5118	6880	5959	1973	3285	1806	2381	3754	6336	11878	13505	16153	19090
			Purse seine	16081	19612	6338	10784	11710	9157	6523	7870	13108	7966	4607	3217	2634	4442	2341	2067	1370	2722	2256	3292	3635	2581	2332	5334	4351
Landings(FP)	ATE		Purse seine	3447	3059	2509	813	1495	1488	1781	2051	387	321	1305	1534	1054	747	836	1008	1423	1869	3021	1872	1332	1401	1855	1691	1155
Discards			Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	137	0	63
	ATW		Longline	0	0	0	0	0	0	167	0	0	0	0	0	0	5	6	5	9	8	9	7	3	3	3	3	3
			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	211	137	216	78	70	115	170	35	34	34	34	34	0	0	405	98	0	0	0	0	0	0	0	0	2
			Belize	0	0	1	0	3	963	0	326	406	0	0	0	0	0	0	0	405	1794	3172	5861	5207	7036	7132	3497	5802
			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	1612	1943	1908	1518	1783	1421	1663	1851	1684	1802	1868	3236	6019	5648	4568	7905	4638	5856	6002	4603	7513	4507	7823	6990	2756
			China PR	139	156	200	124	84	71	1535	1652	586	262	1033	1030	1112	1056	1000	365	214	169	220	170	130	20	78	286	346
			Curaçao	0	0	0	3183	6082	6110	4039	5646	4945	4619	6667	4747	24	1939	1368	7351	6293	5302	4413	6792	3727	5152	6140	7905	6535
			Côte d'Ivoire	0	0	0	0	2	0	0	673	213	99	302	565	175	482	216	626	90	470	385	1481	2077	324	251	315	952
			EU.Denmark	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	40403	40612	38278	34879	24550	31337	19947	24681	31105	31469	24884	21414	11795	11606	13584	24409	32793	25560	21026	18854	11878	14225	21094	19266	12308
			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	
			EU.France	36064	35468	29567	33819	29966	30739	31246	29789	32211	32753	32429	23949	22672	18940	11330	16115	18923	20280	22037	18506	20291	21087	19443	26198	25831
			EU.Ireland	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.Latvia	16	0	55	151	223	97	25	36	72	334	334	334	334	334	0	0	0	200	143	15	0	0	23	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	
			EU.Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	128	126	231	288	176	267	177	194	4	6	4	5	16	274	865	300	990	537	452	355	335	69	76	112	67
			EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	21	22	1	0	0	0	0
			El Salvador	0	0	0	0	0	0	0	0	933	0	0	0	0	0	0	0	0	0	0	0	0	0	2750	8252	10259
			Gabon	12	88	218	225	225	295	225	162	270	245	44	6	2	44	0	1	0	0	0	0	0	0	0	1	3
			Ghana	13283	9984	9268	8182	15087	13850	21450	12673	23845	18546	15839	15444	13019	14037	15570	16521	15858	20252	18501	18775	15974	22842	22568	23593	22622
			Guatemala	0	0	0	0	0	0	0	0	0	0	2207	1588	2906	5265	3461	3736	2603	3124	2803	2949	4023	3754	5200	2703	3647
			Guinea Ecuatorial	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	892	892	199	0	2	11	9	6	
			Guinée Rep.	0	0	208	1956	820	0	0	0	0	0	0	0	0	0	0	0	0	298	292	1559	1484	823	0	0	
			Honduras	0	0	4	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Japan	2627	4194	4770	4246	2733	4092	2101	2286	1550	1534	1999	5066	3088	4206	8496	5266	3563	3041	3348	3637	3843	3358	2855	2914	2715
			Korea Rep.	169	436	453	297	101	23	94	142	3	8	209	984	95	4	303	983	381	324	20	26	97	77	36	356	408
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	71	89	100	88	76	68
			Libya	0	0	0	0	0	0	0	0	208	73	73	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Maroc	2396	3017	2290	3430	1947	2276	2307	2441	3000	2111	1675	814	1940	222	102	110	110	44	272	55	137	107	72	115	113
			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	
			Namibia	0	35	14	72	69	3	147	59	165	89	139	85	135	59	28	11	1	9	90	0	6	15	42	53	53
			Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	3	1	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	10973	12066	13442	7713	4293	2111	1315	1103	626	1112	0	1887	6170	8557	9363	6175	5982	5048	4358	5004	3899	4587	3202	4305	5090
			Philippines	0	0	0	0	0	126	173	86	0	50	9	68	13	30	88	53	152	89	134	5	56	0	0	0	
			Russian Federation	2160	1503	2936	2696	4275	4931	4359	737	0	0	0	0	4	42	211	42	33	0	0	0	0	0	0	0	**0**
			S. Tomé e Príncipe	181	125	135	120	109	124	114	122	122	122	122	134	145	137	0	160	165	169	173	177	182	186	301	301	266

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		Senegal	19	6	20	41	208	251	834	252	295	447	279	681	1301	1262	819	588	1279	1212	1050	1683	1247	612	1883	6850	3957
		South Africa	266	486	183	157	116	240	320	191	342	152	298	402	1156	1187	1063	351	303	235	673	174	440	1512	925	706	355
		St. Vincent and Grenadines	5391	2476	2142	2981	3146	3355	2668	2113	3715	194	56	14	0	101	209	83	74	28	0	0	0	0	0	0	71
		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	0
		UK.British Virgin Islands	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
		UK.Sta Helena	171	150	181	151	109	181	116	136	72	9	0	0	0	344	177	97	104	65	163	149	53	152	178	181	221
		Uruguay	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Vanuatu	1624	2357	2357	1130	576	0	228	0	0	0	0	0	24	145	483	450	331	23	10	124	21	0	0	0	0
		Venezuela	0	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	1301	3851	2681	3985	2993	3643	3389	4014	2787	3363	4946	4145	2327	860	1707	807	1180	537	1463	818	1023	902	927	761	563
	NCO	Benin	1	1	1	1	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cambodia	0	0	0	0	0	0	7	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	17	14	13	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	541	238	212	257	269	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	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	
		Georgia	10	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)	388	477	1847	0	148	0	0	0	1510	1345	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	1157	2524	2975	3588	3368	5464	5182	3072	2019	43	466	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Seychelles	0	0	0	0	0	0	0	6	0	11	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	161	156	255	160	149	150	155	155	142	115	178	211	292	197	154	156	79	129	131	195	188	218	262	324	270
		Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	143	1164	1160	940	264	42	41	38	33	0	2163	368
		Brazil	5131	4169	4021	2767	2705	2514	4127	6145	6239	6172	3503	6985	7223	3790	5468	2749	3313	3677	3615	4639	7277	11645	13643	16682	18362
		Canada	71	52	174	155	100	57	22	105	125	70	73	304	240	293	276	168	53	166	50	93	74	34	59	19	193
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	81
		China PR	0	0	0	0	0	628	655	22	470	435	17	275	74	29	124	284	248	258	126	94	81	73	91	182	232
		Curaçao	170	155	140	130	130	130	130	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	127	107	126
		EU.España	989	7	4	36	34	46	30	171	0	0	0	0	0	1	84	81	69	27	33	32	138	155	105	360	357
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	122	456	712	412	358	647	632	403	346
		EU.Netherlands	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.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	151	60	88	179	260	115	127	92	4	2	0	15	70
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	381	321
		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	858	385	410	523	302	484	430	403	759	593	749	460	492	502	633	756	630	673	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	18	71
		Japan	469	589	457	1004	806	1081	1304	1775	1141	571	755	1194	1159	437	541	986	1431	1539	1106	1024	734	465	613	462	416
		Korea Rep.	11	0	0	84	156	0	0	0	0	0	0	0	580	279	270	10	52	56	470	472	115	39	11	12	3
		Mexico	855	1093	1126	771	826	788	1283	1390	1084	1133	1313	1208	1050	938	890	956	1211	916	1174	1414	1004	1045	968	1279	1241
		Panama	0	0	0	0	0	0	5	0	20	28	0	0	0	2804	227	153	119	2134	0	0	1995	902	210	1863	
		Philippines	0	0	0	0	0	36	106	78	12	79	145	299	230	234	151	167	0	0	0	30	72	76	0	0	
		St. Vincent and Grenadines	65	16	43	37	35	48	190	1989	1365	1160	568	4251	0	2680	2989	2547	2274	854	963	551	352	505	153	434	701
		Trinidad and Tobago	4	120	79	183	223	213	163	112	122	125	186	224	295	459	615	520	629	788	799	931	1128	1141	1179	1057	890
		U.S.A.	6283	8298	8131	7745	7674	5621	7567	7051	6703	5710	7695	6516	5568	7091	5529	2473	2788	2510	3010	4100	2332	2630	2074	3273	3326
		UK.Bermuda	58	44	44	67	55	53	59	31	37	48	47	82	61	31	30	15	41	37	100	66	36	12	10	9	25
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	3	10	5	0	0
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	2	0	0	0
		Uruguay	20	59	53	171	53	88	45	45	91	91	95	204	644	218	35	66	76	122	24	6	7	0	0	0	0
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	681	689	661	555	873	816	720	330	207	124	17	0	0	0
		Venezuela	16663	24789	9714	13772	14671	13995	11187	11663	18687	11421	7411	5774	5097	6514	3911	3272	3198	4783	4419	4837	5050	3772	3122	4198	5054
	NCC	Chinese Taipei	2895	2809	2017	2668	1473	1685	1022	1647	2018	1296	1540	1679	1269	400	240	315	211	287	305	252	236	139	293	181	213
		Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	183	181
		Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1943	1829	0	0	0	0
	NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	327	327	0	0	0	5	0	0	0	0	0	0	0	
		Colombia	2404	3418	7172	238	46	46	46	46	46	46	46	46	46	46	0	0	0	0	0	0	0	0	0	0	
		Cuba	1	14	54	40	40	15	15	0	0	65	65	65	65	65	0	0	0	0	0	0	0	0	0	0	

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			Dominica	30	31	9	0	0	0	80	78	120	169	119	81	119	65	103	124	102	110	132	119	120	256	194	179	209
			Dominican Republic	0	0	0	0	0	89	220	226	226	226	226	226	226	226	0	0	0	0	0	0	0	0	0	0	
			Jamaica	0	0	0	21	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	1514	1880	1227	2374	2732	2875	1578	2197	765	14	112	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	5	29
			Seychelles	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	92	130	144	110	110	276	123	134	145	94	139	147	172	103	82	106	97	223	114	98	136	93	175	0	
Landings(FP)	ATE	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	50	71	27	109	35	0	0	
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	77	28	39	40	103	152	58	35	82	256	0	0	
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	15	25	22	16	176	95	89	114	86	78	0	0	
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	267	116	24	0	0	
			EU.España	1149	910	559	87	384	494	733	714	0	0	335	368	142	154	67	270	279	352	358	140	146	353	0	0	
			EU.France	1554	1461	1074	472	658	703	832	914	344	309	672	597	244	128	33	52	203	181	344	347	129	115	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	57	35	17	32	9	34	8	12	13	19	0	0	
			Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	72	0	66	20	67	95	389	876	487	461	0	0	
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	155	125	177	114	99	54	101	54	163	59	0	0	
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
		NCO	Mixed flags (EU tropical)	744	688	876	254	452	291	216	423	42	13	298	570	292	251	416	464	467	857	1601	0	0	0	1855	1691	1155
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	137	0	63
			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**
			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	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	**0**
			Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	5	9	8	9	7	3	3	3	3	3
			U.S.A.	0	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	**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**

YFT-Table 2. Kobe II matrices giving the probability that $F<F_{MSY}$, $B>B_{MSY}$ and the joint probability of $F<F_{MSY}$ and $B>B_{MSY}$, in given years, for various constant catch levels based on combined model results. These matrices are from the 2016 assessment which included data through 2014. Catches since then, and revisions to historic catches since that time have not been accounted for.

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

Catch	2017	2018	2019	2020	2021	2022	2023	2024
60,000	99%	100%	100%	100%	100%	100%	100%	100%
70,000	99%	99%	100%	100%	100%	100%	100%	100%
80,000	98%	99%	99%	99%	99%	100%	100%	100%
90,000	95%	98%	99%	99%	99%	99%	99%	99%
100,000	91%	96%	98%	98%	99%	99%	99%	99%
110,000	84%	89%	93%	96%	97%	98%	98%	98%
120,000	74%	79%	83%	80%	81%	82%	83%	84%
130,000	60%	61%	62%	62%	58%	54%	51%	48%
140,000	46%	44%	39%	33%	31%	31%	31%	30%
150,000	32%	25%	21%	20%	19%	20%	20%	20%

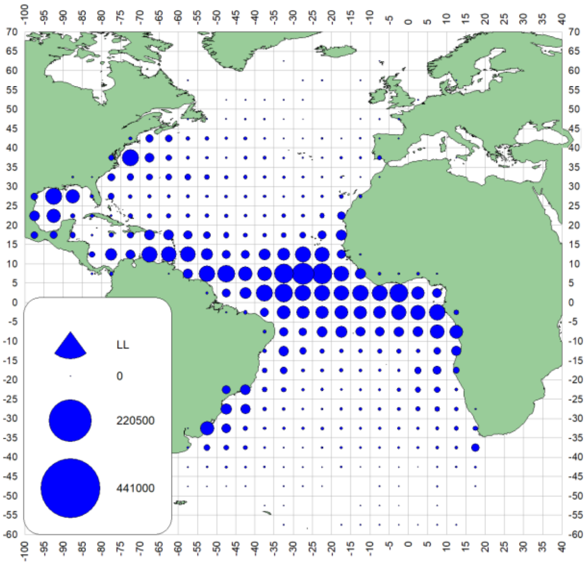
b) Probability that $B>B_{MSY}$

Catch	2017	2018	2019	2020	2021	2022	2023	2024
60,000	75%	91%	99%	99%	99%	99%	100%	100%
70,000	74%	87%	97%	99%	99%	99%	99%	99%
80,000	73%	86%	96%	99%	99%	99%	99%	99%
90,000	71%	82%	91%	97%	99%	99%	99%	99%
100,000	70%	80%	89%	92%	96%	97%	99%	99%
110,000	68%	78%	85%	90%	93%	95%	96%	97%
120,000	67%	75%	80%	80%	81%	82%	84%	84%
130,000	64%	68%	72%	70%	69%	67%	65%	62%
140,000	63%	64%	63%	59%	53%	46%	40%	38%
150,000	61%	59%	55%	47%	34%	30%	28%	27%

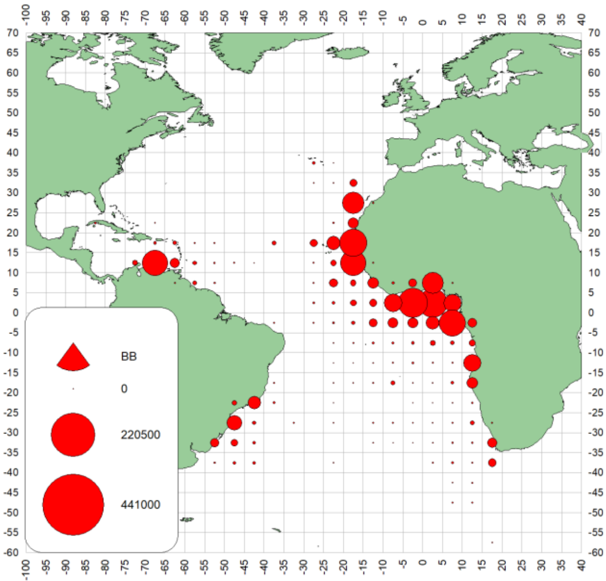
c) Probability that $F<F_{MSY}$ and $B>B_{MSY}$

Catch	2017	2018	2019	2020	2021	2022	2023	2024
60,000	75%	91%	99%	99%	99%	99%	100%	100%
70,000	74%	87%	97%	99%	99%	99%	99%	99%
80,000	73%	86%	96%	99%	99%	99%	99%	99%
90,000	71%	82%	91%	97%	99%	99%	99%	99%
100,000	70%	80%	89%	92%	96%	97%	99%	99%
110,000	68%	78%	85%	90%	92%	95%	96%	97%
120,000	65%	73%	79%	78%	79%	80%	82%	82%
130,000	57%	59%	61%	61%	57%	54%	50%	48%
140,000	45%	44%	38%	33%	31%	31%	31%	30%
150,000	31%	24%	21%	20%	19%	20%	20%	20%

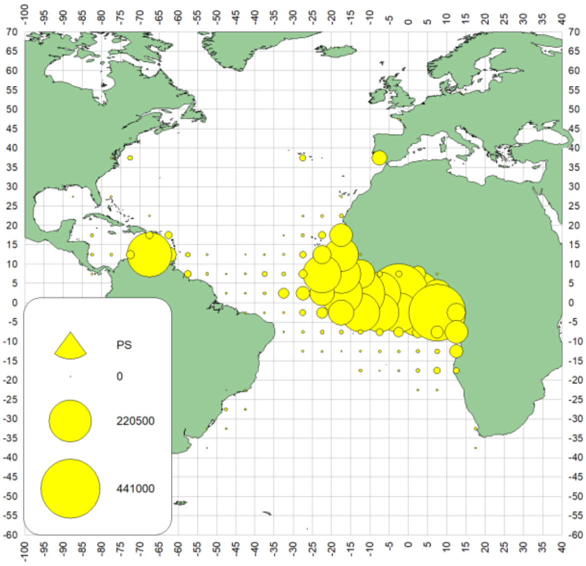
Note: SS, VPA and ASPIC projections applied an assumed catch of 110,337 (2015 estimate with carry-overs) to 2015 and 2016, prior to the application of the constant TACs of 60,000 to 150,000 t in 2017-2024. Due to a software constraint, ASPM projections applied constant TACs beginning in 2015.



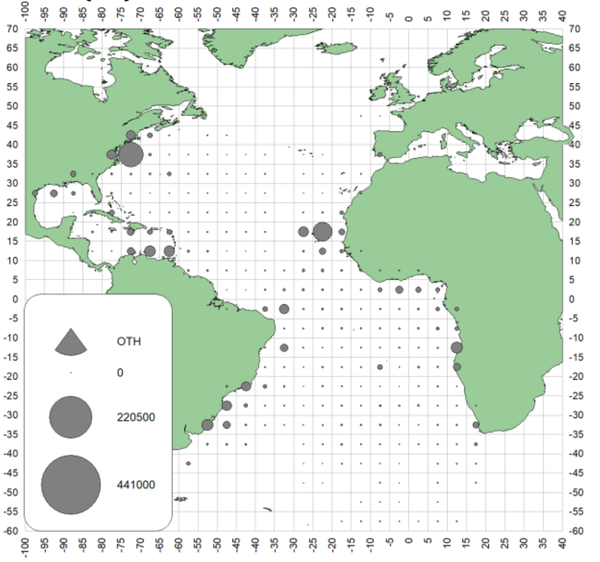
a. YFT (LL)



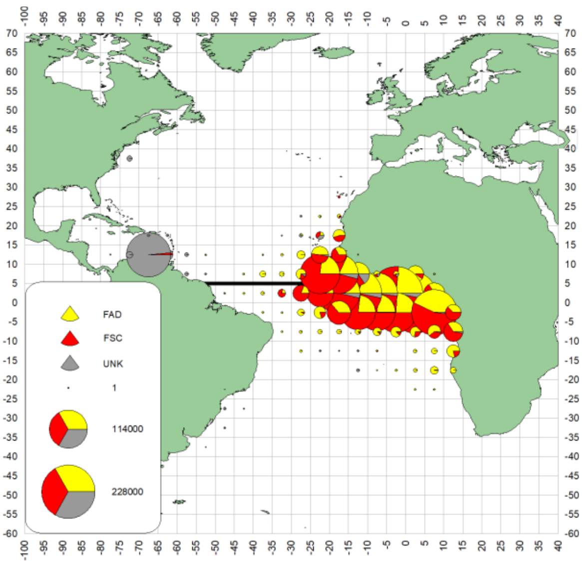
b. YFT (BB)



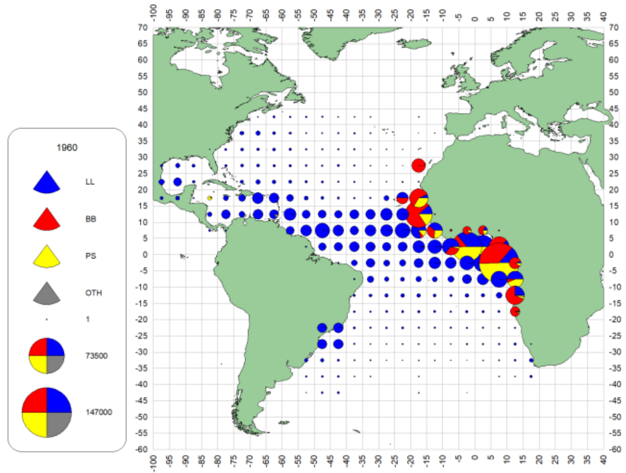
c. YFT (PS)



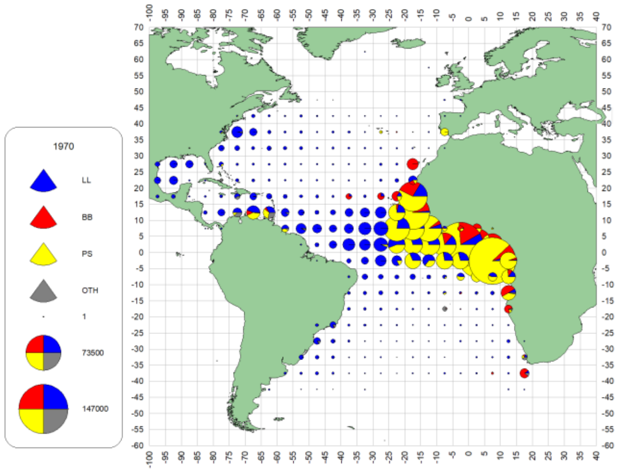
d. YFT (oth)



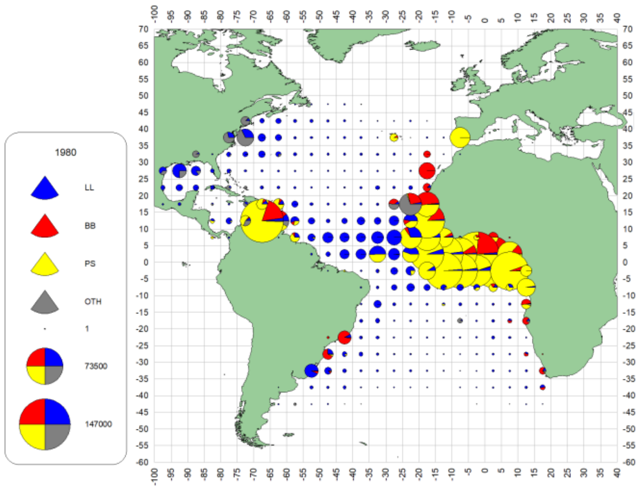
e. YFT (FAD/FREE 1991-2016)



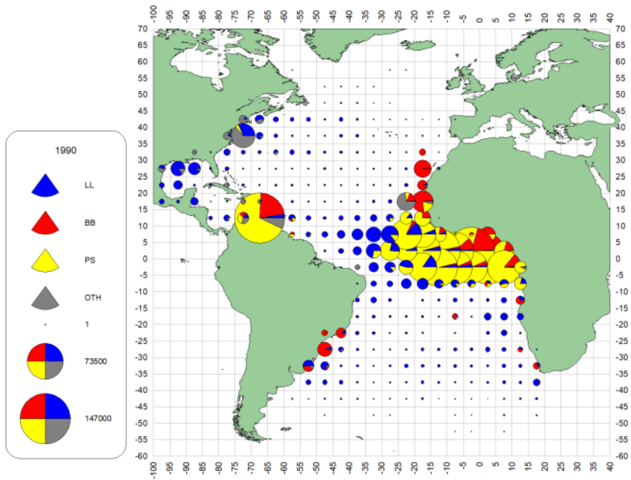
f. YFT (1960-69)



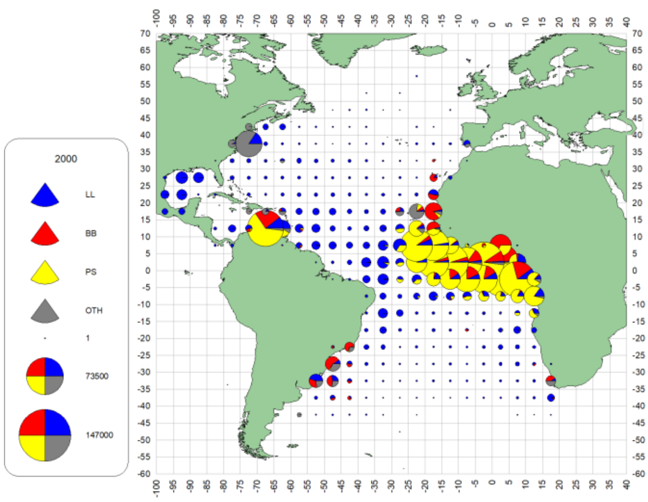
g. YFT (1970-79)



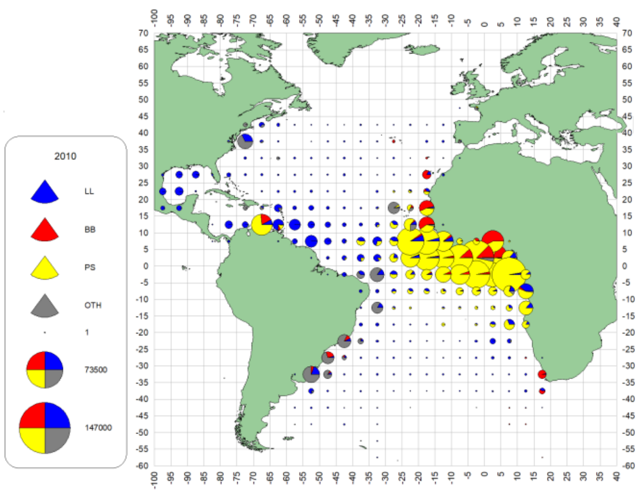
h. YFT (1980-89)



i. YFT (1990-99)

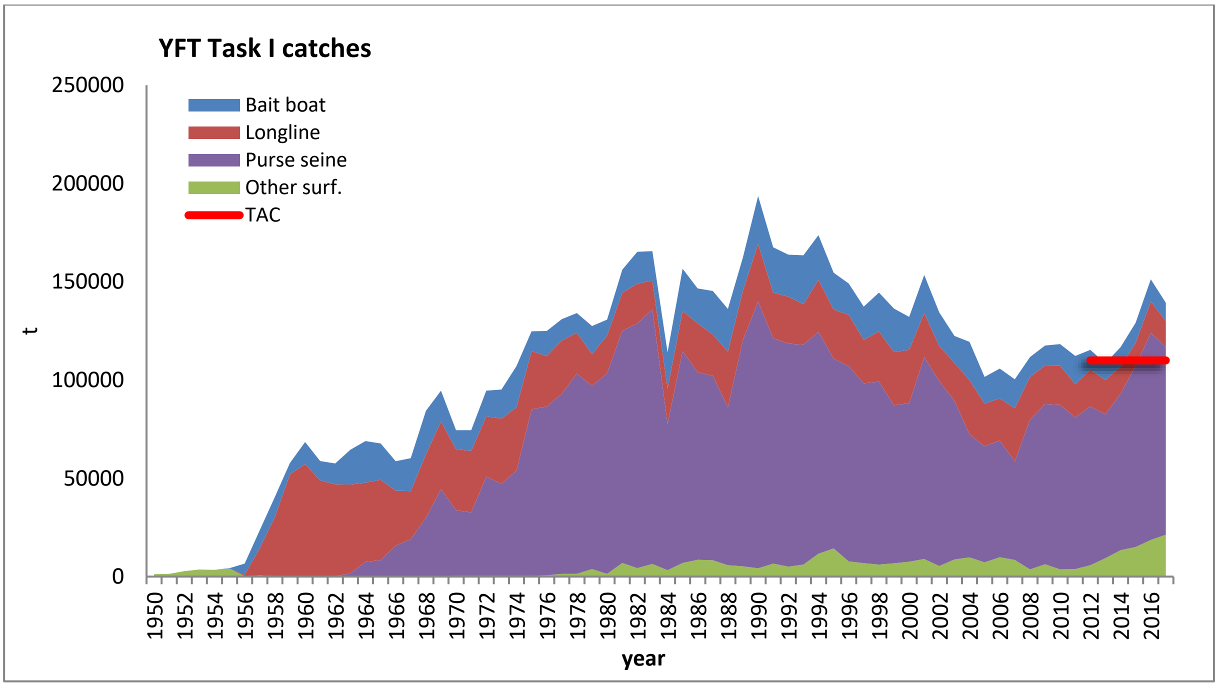


j. YFT (2000-09)

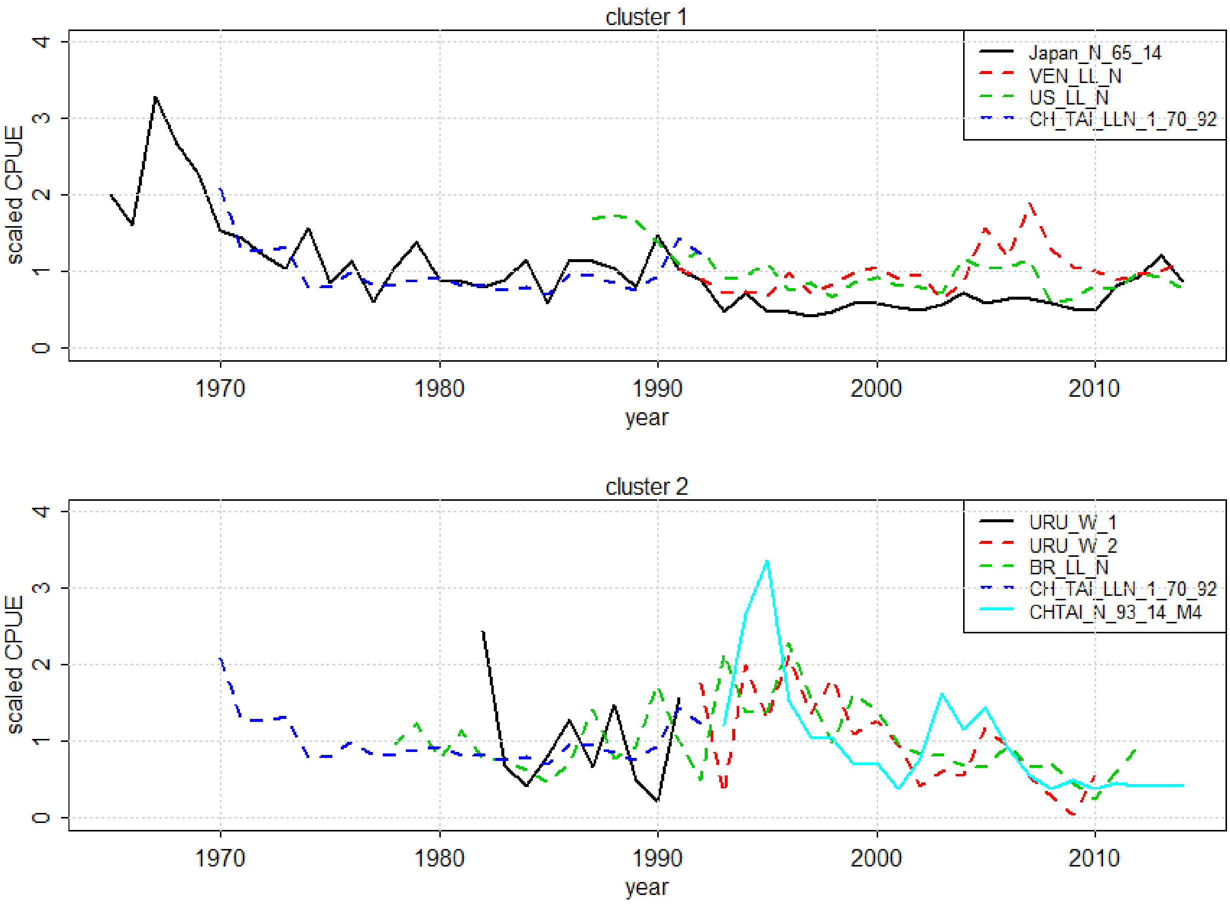


k. YFT (2010-16)

YFT-Figure 1. 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 1960-2016. Note: the last panel (k) shows only 7 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 2010-2016.

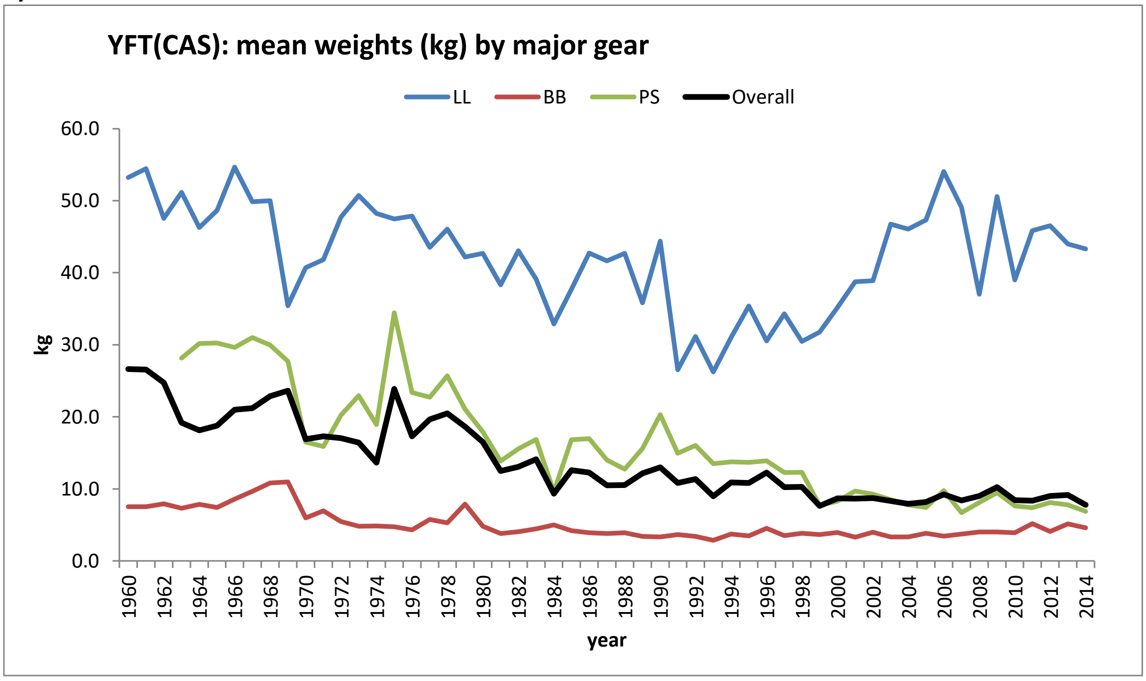


YFT-Figure 2. Estimated annual catch (t) of Atlantic yellowfin tuna by fishing gear, 1950-2017. A TAC of 110,000 t has been in place since 2012 (Rec. 11-01).

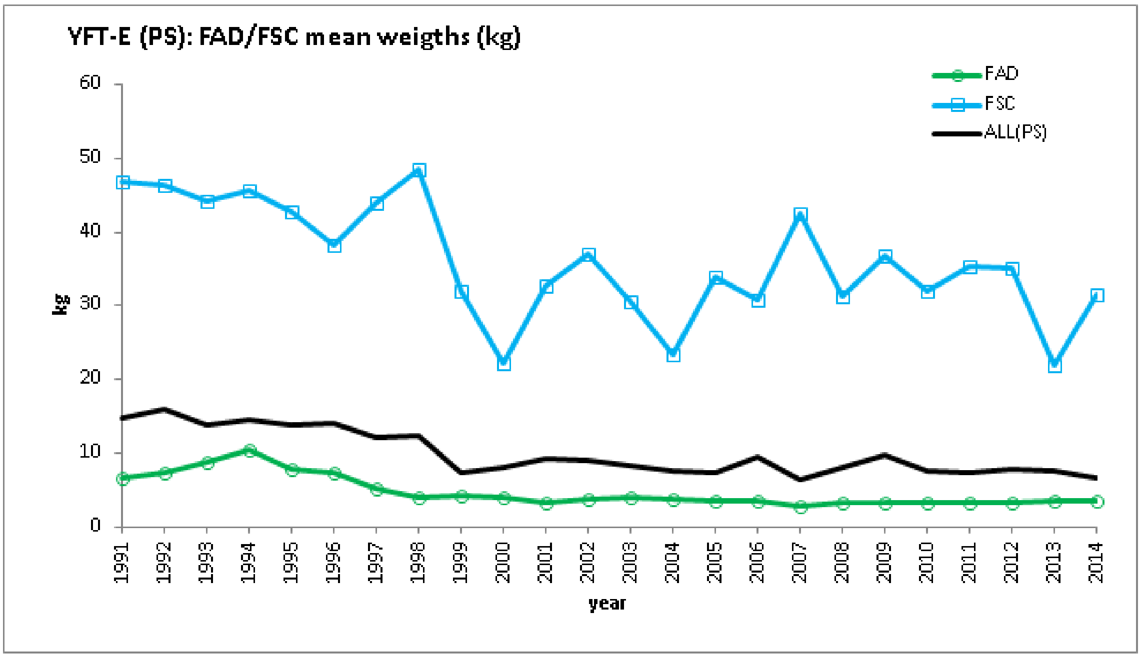


YFT-Figure 3. Yellowfin standardized catch rate trends from cluster 1 (top panel) and cluster 2 (bottom panel) indices of abundance used in the 2016 assessment.

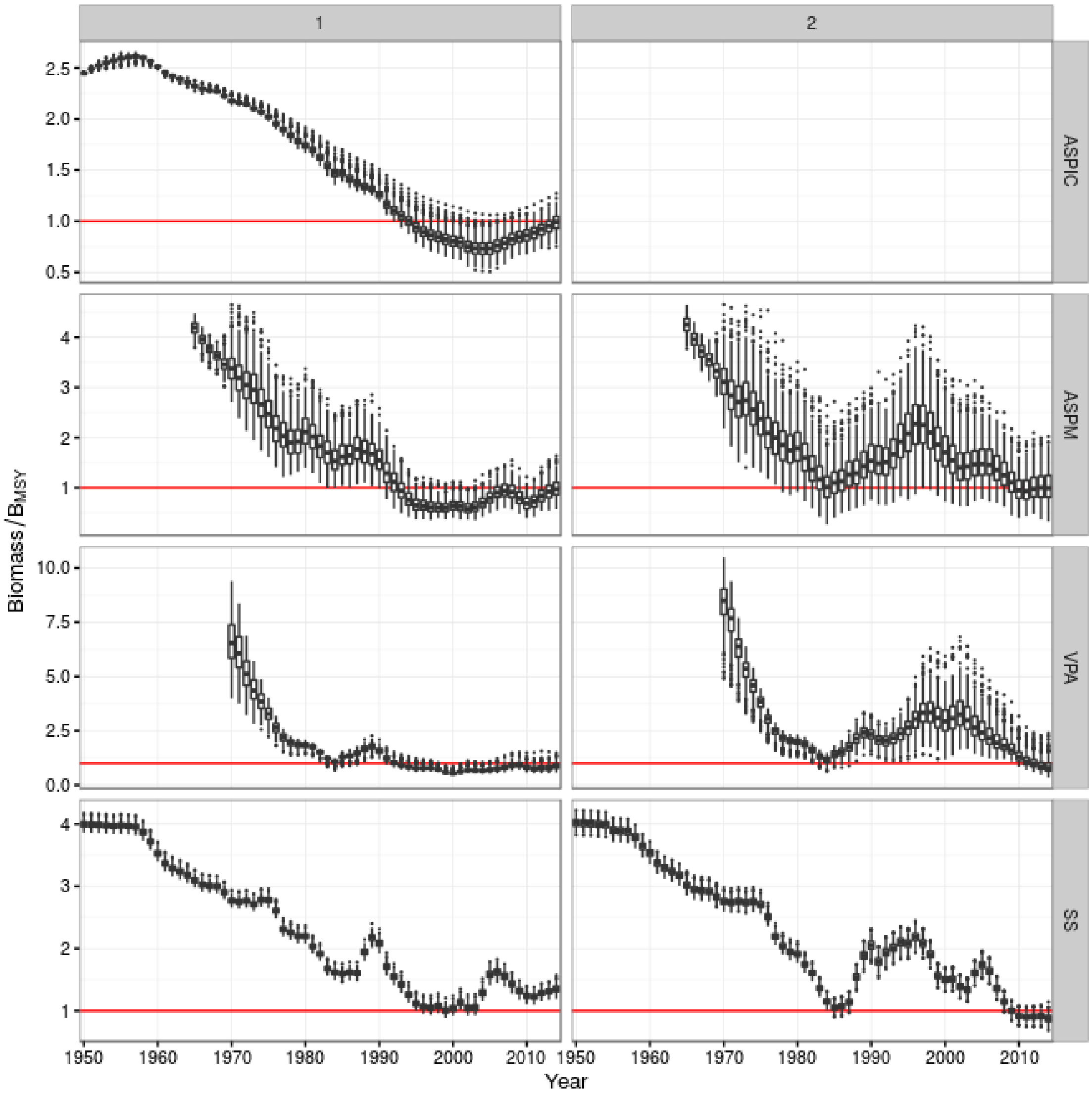
a)



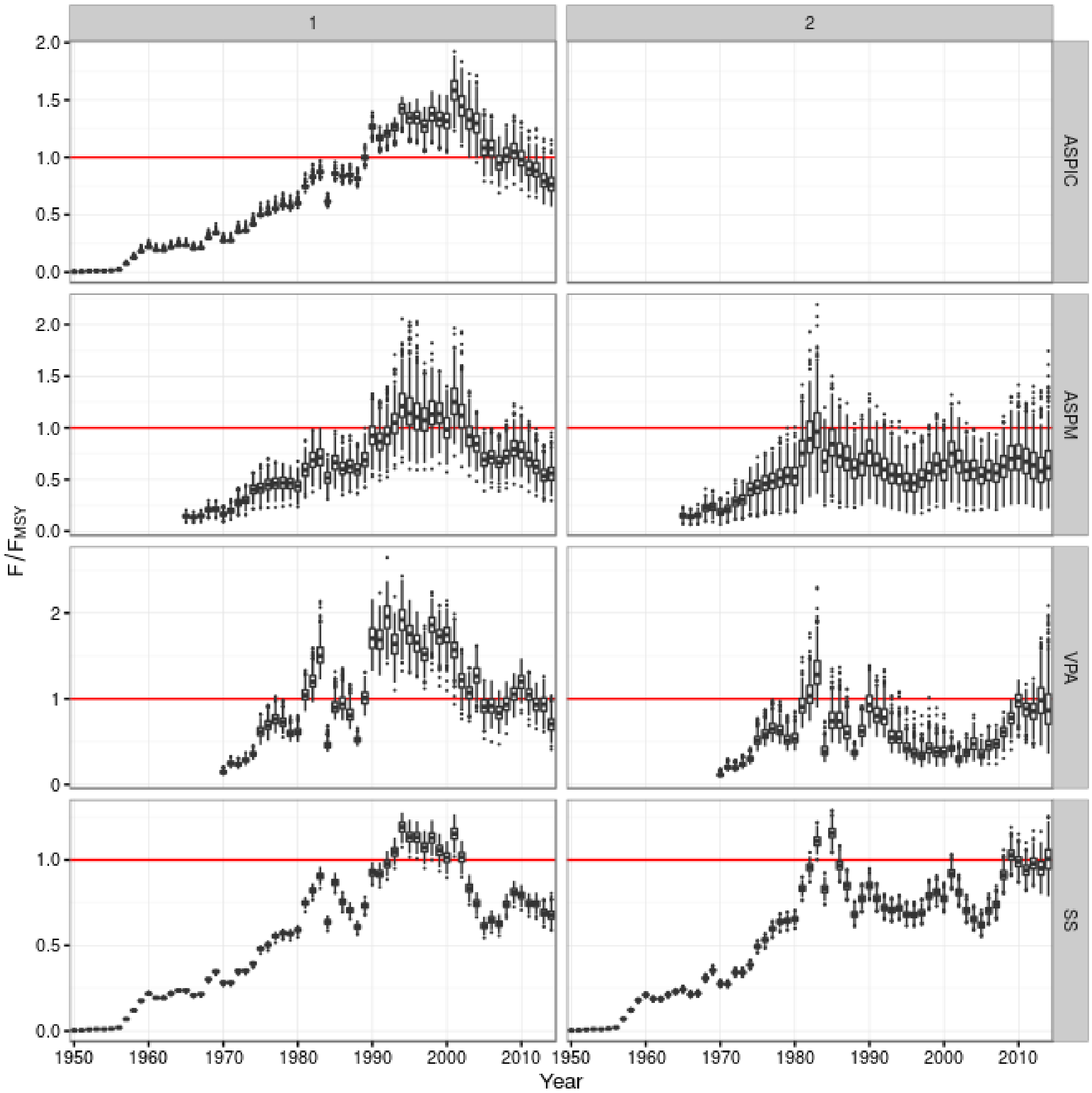
b)



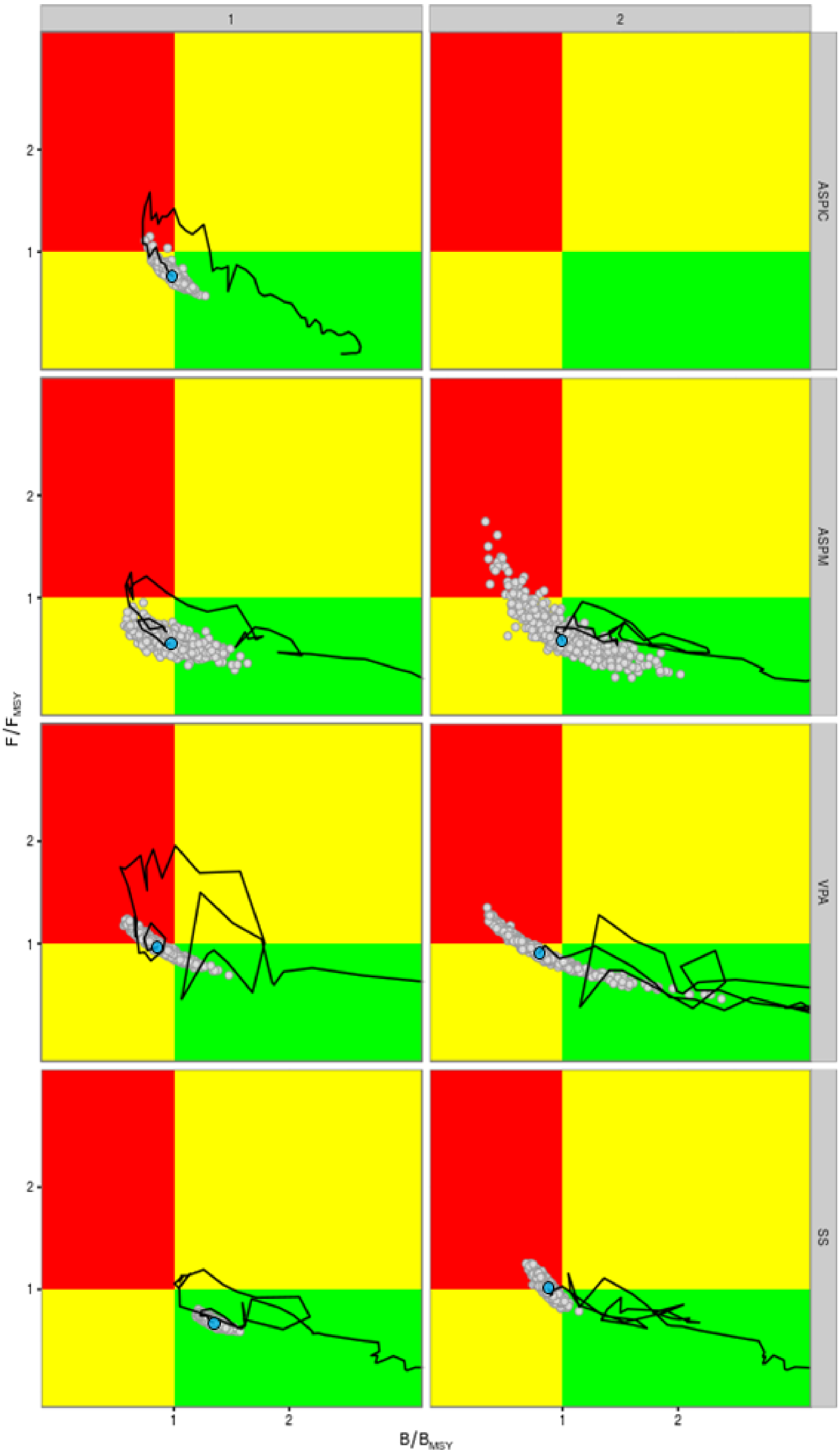
YFT-Figure 4. Trends in estimated mean weight (kg, weighted by respective catches) of yellowfin tuna: a) Overall, by major gear (1960-2014); b) Only eastern purse seine fishery (1991-2014), by operation mode (FSC: free schools; FAD: associated schools). Note: The mean weight of the baitboat fishery (panel a) reflects various baitboat fleets operating in different areas of the Atlantic Ocean.



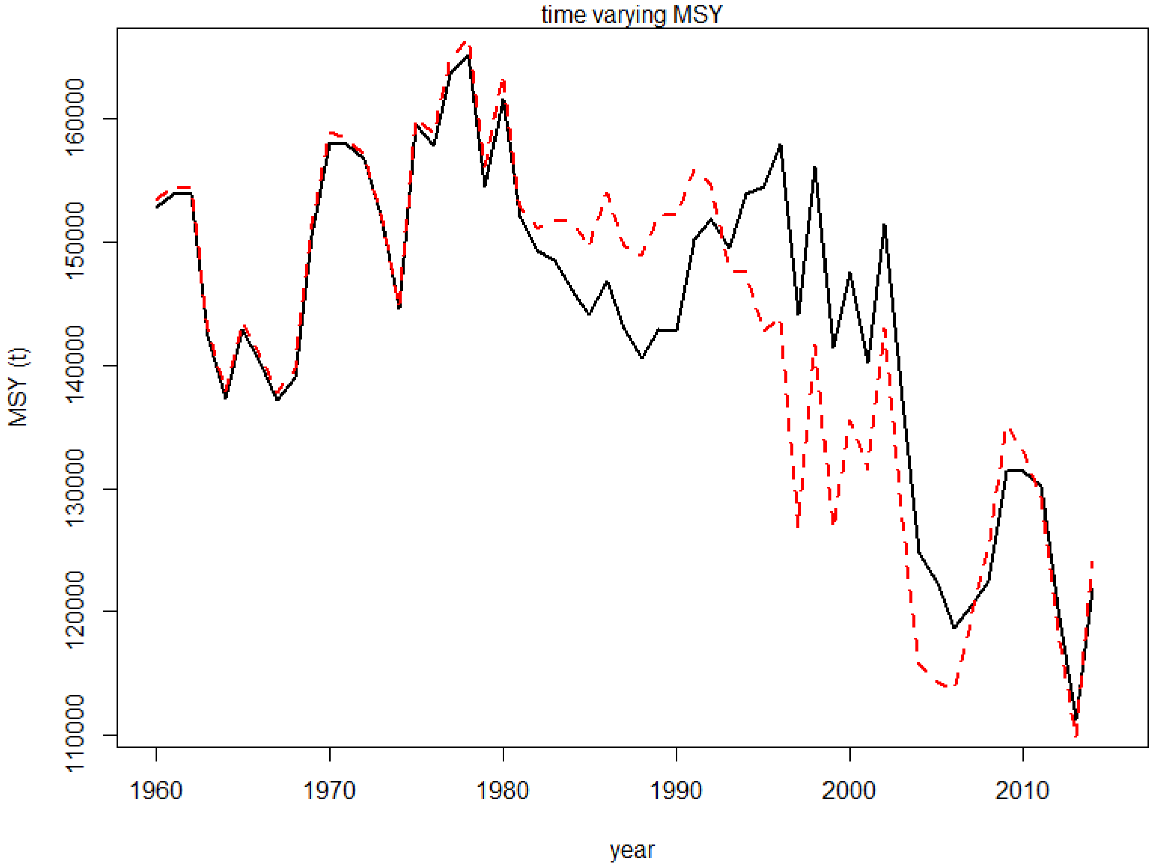
YFT-Figure 5. Trends in biomass relative to the level that produces MSY (red) for the model runs used to develop management advice. Box and whisker plots indicate the uncertainty in bootstrap estimates. (Boxes indicate the annual median estimates, 25th and 75th percentiles; whiskers and points indicate the range of more extreme outcomes), Cluster 1 (left column) Cluster 2 (right column).



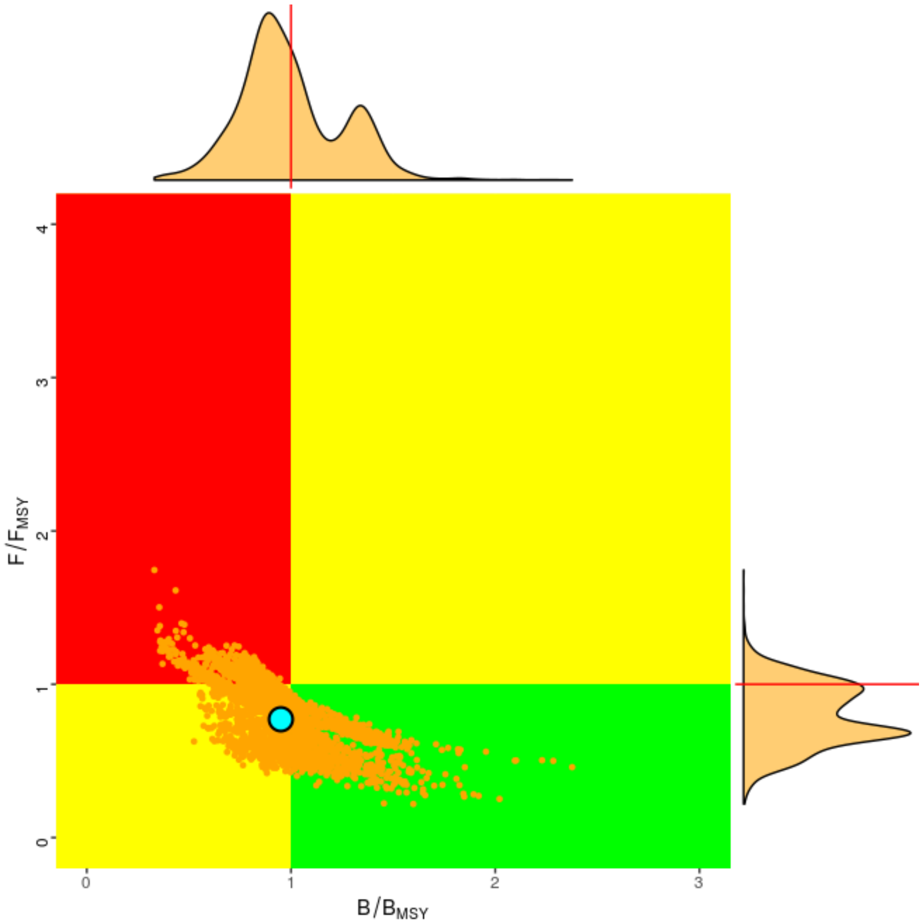
YFT-Figure 6. Trends in fishing mortality relative to the level that produces MSY (red) for the model runs used to develop management advice. Box and whisker plots indicate the uncertainty in bootstrap estimates. (Boxes indicate the annual median estimates, 25th and 75th percentiles; whiskers and points indicate the range of more extreme outcomes), Cluster 1 (left column) Cluster 2 (right column).



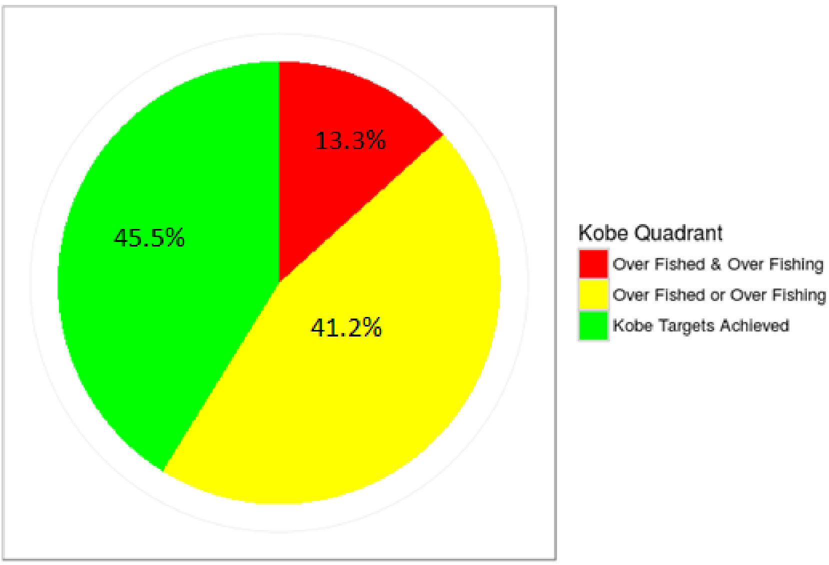
YFT-Figure 7. Kobe Status Plot for each model with 500 bootstrap estimates of the uncertainty in current stock status. The trajectories are intended to demonstrate general trends in stock status, but do not account for known changes in selectivity, Cluster 1 (left column) Cluster 2 (right column).



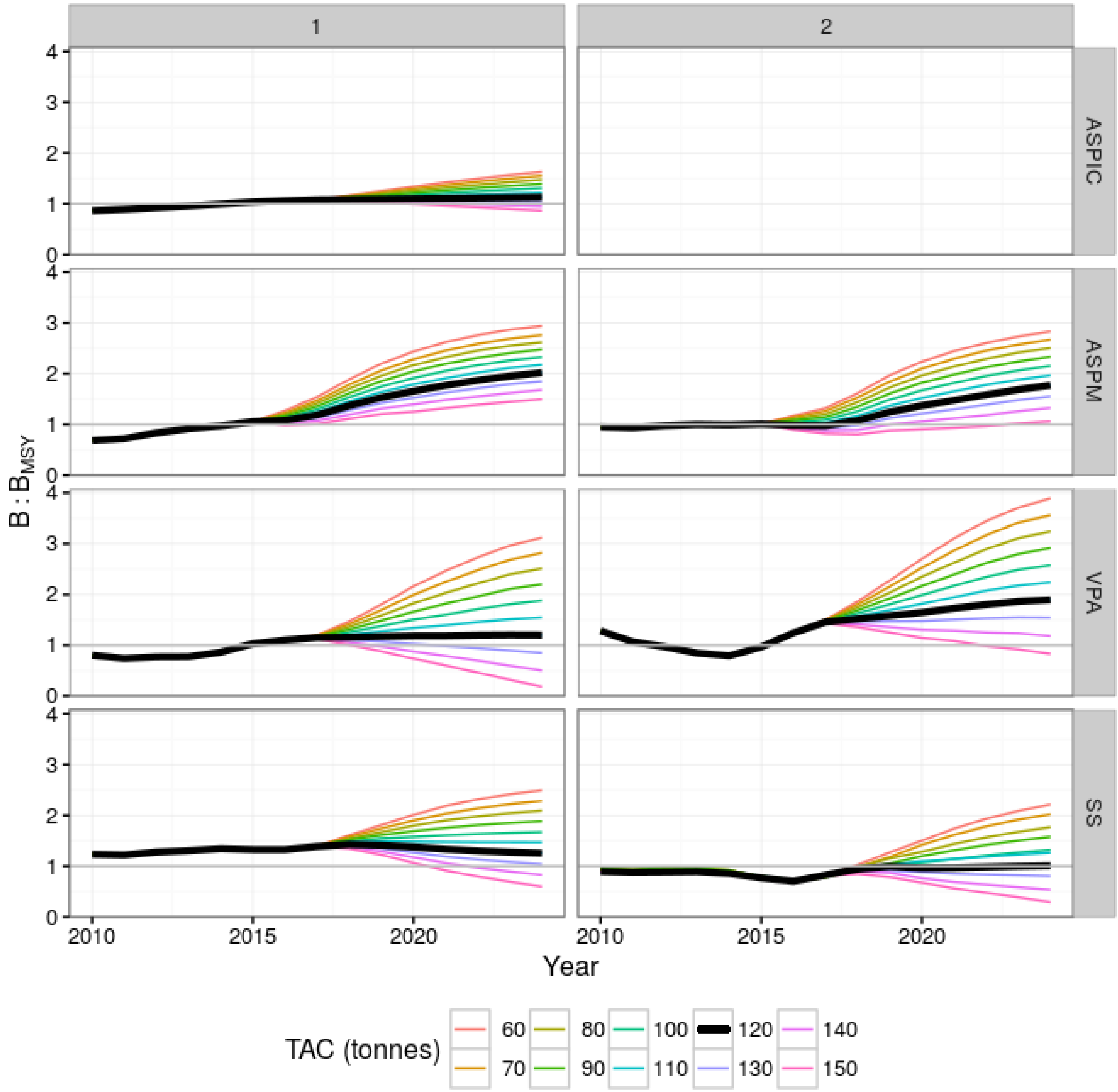
YFT-Figure 8. MSY estimated annually from an age structured stock assessment (SS) using cluster 1 (solid line) and cluster 2 indices (broken line).



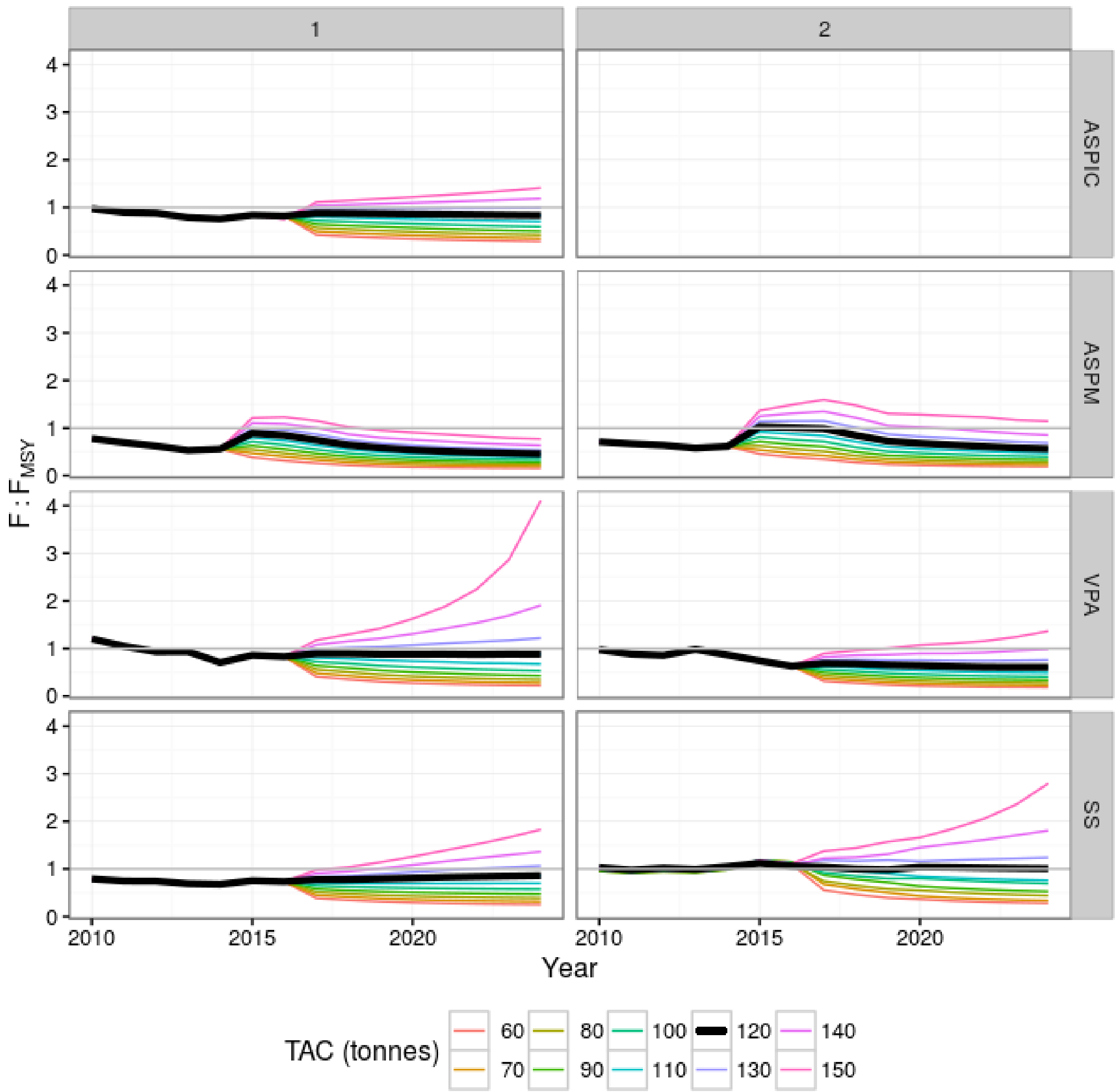
YFT-Figure 9. Kobe Phase Plot and marginal density for all models (used to develop management advice) combined.



YFT-Figure 10. Summary of current status estimates for the yellowfin tuna stock based on age structured and production models making use of the catch and effort data through 2014.



YFT-Figure 11. Median B/B_{MSY} (2010 – 2024) for projections of constant TACs of 60,000 to 150,000 t. SS, VPA and ASPIC projections applied an assumed catch of 110,337 (2015 estimate with carry-overs) to 2015 and 2016, prior to the application of the constant TACs of 60,000 to 150,000 t in 2017-2024. Due to a software constraint, ASPM projections applied constant TACs beginning in 2015. Cluster 1 (left column) Cluster 2 (right column).



YFT-Figure 12. Median F/F_{MSY} (2010 – 2024) for projections of constant TACs of 60,000 to 150,000 t. SS, VPA and ASPIC projections applied an assumed catch of 110,337 (2015 estimate with carry-overs) to 2015 and 2016, prior to the application of the constant TACs of 60,000 to 150,000 t in 2017-2024. Due to a software constraint, ASPM projections applied constant TACs beginning in 2015. Cluster 1 (left column) Cluster 2 (right column).

9.2 BET – BIGEYE TUNA

A new stock assessment for bigeye tuna was conducted in 2018 (Anon. 2018b) 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 also constructed through 2017. This Executive Summary reports the fishery indicators, stock status and management advice for bigeye in 2018. 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. 2018a) and the Report of the 2018 ICCAT Bigeye Tuna Stock Assessment Meeting (Anon. 2018b) 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. Bigeye tuna over 200 cm are relatively rare. The growth rates of bigeye tuna by sex are different 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 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, suggest an Atlantic-wide single stock for this species, which is currently accepted by the Committee. However, the possibility of other scenarios, such as north and south stocks, 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) will contribute to reduce 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 and 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 1, 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. A new "vessel associated-school" fishing method using handline, where the vessels acts as a fish aggregating device, has been recently developed in Brazil, especially since 2013, with bigeye catches increasing from 555 t in 2012 to 2,012 t in 2013 and some further around 5,000 t in the last three years (study presented for the first time to the Tropical Tunas Species Group in Silva *et al*., 2018 and Hazin *et al*., 2018). The tropical purse seine fleets operate in the Gulf of Guinea in the East Atlantic. In the eastern Atlantic, these fleets are comprised of vessels flying the flags of Ghana, EU-France, EU-Spain and others. The longline fleets operated across a broader geographic range, covering tropical and temperate regions (**BET-Figure 1**). 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 47%, while purse seine fleets represent 35% and baitboat and other surface fleets represent 18% of the total (**BET-Table 1**). In 2017, landings of bigeye in weight caught by longline represent 45%, while purse seiner and baitboat plus other surface fleets represent 36% and 20%, respectively.

The total annual Task I catch (**BET-Table 1**, **BET-Figure 2**) 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 59,141 t 2006. From 2006 catches have increased and fluctuated between around 75,000 t and 80,000 t, with the exception of 2007, 2008, 2012 and 2013 (around 70,000 t). The catches increased to around 80,000 t in 2015 and have remained at this level since then. The preliminary catch estimated for 2017 was 78,482 t. Nominal catches in the last two years have exceeded the agreed TAC (65,000 t) by around 20%.

The Committee noted the large difference between preliminary catch of 2016 (72,375 t) reported in the 2017 SCRS compared to the 2016 catch level used in the stock assessment (79,958 t). This was mainly due to the preliminary nature of 2016 catches reviewed in the 2017 SCRS meeting, the new Brazilian "vessel associated-school" handline fishery for which catch was reported for the first time in 2018, Ghanaian revision of catches as well as new bigeye catches reports from various CPCs.

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. The number of estimated active purse seiners (Ghana, EU and other CPCs) declined by more than half from 1994 until 2006, but then increased as some vessels returned from the Indian Ocean to the Atlantic (**SKJ-Figure 9**) and since 2014, the number of these purse seine vessels has remained stable. 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 Brazilian handline vessel associated-school fishery.

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 were larger for yellowfin. 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 channeled 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 for the main purse seine fleet in the ICCAT Task I data used for the assessment up to 2017.

Mean average weight of bigeye tuna decreased prior to 2004 but has remained relatively stable at around 10 kg for the last decade (**BET-Figure 3**). 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 weighted 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*., 2018) instead of each individual CPC's standardized CPUE indices used in the 2015 assessment; some of them showing conflicting trends. The joint longline standardized index was constructed using operational detailed data of longline major fleets (Japan, Korea, United States and Chinese Taipei) from 1959-2017 (**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 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 to produce the standardized index. 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 with 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). The results of different model formulations considered to be plausible representations of the stock dynamics were used to characterize stock status and the uncertainties in the 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 K2SM 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 and the current selectivity pattern is 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 the catches in 2016 and 2017 have exceeded the TAC by 20% (i.e. catches around 78,000 t), which contributed to a further decline in stock size since the 2015 assessment. Note that because this TAC does not affect all countries that can catch bigeye tuna, in theory the total catch removed from the stock could 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 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.

BET-6. Management recommendations

The Atlantic bigeye tuna stock was estimated to be overfished and that overfishing was occurring in 2017. Maintaining the catches at 2016 and 2017 levels (around 78,000 t) in the future, which exceeded the TAC of 65,000 t by 20%, the probability of achieving Convention objectives by 2033 ($B>B_{MSY}$, $F<F_{MSY}$) is expected to reduce to around 1% (**BET-Table 4**).

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. Furthermore, the Committee notes that the necessary reduction of fishing mortality could be not achieved with current and previous FAD time area closures and/or changes to fleet allocation alone.

The Commission should be aware that increased harvests on small fishes by FADs and other fisheries as well as the development of new fisheries 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 (2017) Yield	78,482 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 Overfishing: Yes
Conservation & management measures in effect:	[Rec. 16-01] – Total allowable catch for 2016-2018 is 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 2017 reflect most recent data but should be considered provisional.

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

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL	A+M		113862	134936	128028	120751	110266	107935	121643	103727	91201	75726	87702	90058	67889	59141	69510	63364	76324	75930	76366	71059	67849	75029	79949	79958	78482
Landings		Bait boat	16467	20361	25576	18300	21276	19131	22301	12365	14540	8523	11450	20336	13058	10554	9827	6499	11446	7731	12420	10257	9236	8732	8003	6788	8445
		Longline	62871	78898	74862	74930	68311	71856	77227	72010	56122	47351	55356	49325	37960	34182	46231	41063	43533	42520	37899	34930	32245	36769	40141	36321	35096
		Other surf.	648	977	561	353	535	428	673	451	766	221	447	361	716	552	449	220	258	477	1003	1152	2761	4917	5706	6342	6980
		Purse seine	31586	32668	25361	26628	19152	15531	20258	17537	19516	19418	19582	19016	15129	13310	12311	14810	20007	24209	23767	23883	22975	24002	25073	29319	26951
Landings(FP)		Purse seine	2290	2032	1667	540	993	989	1184	1363	257	214	867	1019	1026	542	692	772	1081	994	1277	823	632	609	989	1187	972
Discards		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	2	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	36	0	38
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	3
		Barbados	0	0	0	0	24	17	18	18	6	11	16	19	27	18	14	14	7	12	7	15	11	26	30	19	16
		Belize	0	0	10	0	5	195	0	134	96	0	0	0	0	4	60	70	234	249	1218	1242	1336	1502	1877	1764	1961
		Brazil	1256	601	1935	1707	1237	776	2024	2768	2659	2582	2455	1496	1081	1479	1593	958	1189	1173	1841	2120	3623	6456	7750	7660	7258
		Canada	124	111	148	144	166	120	263	327	241	279	182	143	187	196	144	130	111	103	137	166	197	218	257	171	214
		Cape Verde	319	385	271	299	228	140	9	2	0	1	1	1	1077	1406	1247	444	545	554	1037	713	1333	2271	2764	1680	1107
		China PR	70	428	476	520	427	1503	7347	6564	7210	5840	7890	6555	6200	7200	7399	5686	4973	5489	3720	3231	2371	2232	4942	5852	5514
		Curaçao	0	0	0	1893	2890	2919	4016	3098	3757	2221	3203	3526	27	416	252	1721	2348	2688	3441	2890	1964	2315	2573	3598	2844
		Côte d'Ivoire	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	790	576	47	507	635	441	12	544	1239
		EU.España	16782	22096	17849	15393	12513	7110	13739	11250	10133	10572	11120	8365	7618	7454	6675	7494	11966	11272	13100	10914	10082	10736	10058	11469	11544
		EU.France	12719	12263	8363	9171	5980	5624	5529	5949	4948	4293	3940	2926	2816	2984	1629	1130	2313	3329	3507	3756	3222	3549	2548	4566	4039
		EU.Ireland	0	0	0	0	4	0	0	0	10	0	0	0	33	0	0	0	0	0	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	5616	3099	9662	5810	5437	6334	3314	1498	1605	2590	1655	3204	4146	5071	5505	3422	5605	3682	6920	6128	5345	3869	3135	2187	3146
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	32	0	0	0	0	0	0	0	0
		El Salvador	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	992	1450	959
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	90	21	0	28	6	0	2	3	0	2	0	0	0	0	0	0	**0**
		Gabon	1	87	10	0	0	0	184	150	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Ghana	3577	4738	5517	4751	10174	10647	11704	5632	9864	6480	9061	17888	8860	2307	2559	3372	4515	6253	3541	4276	3818	4216	6815	6096	4826
		Grenada	20	10	10	0	1	0	0	0	0	0	0	0	0	0	10	31	0	0	0	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	736	831	998	949	836	998	913	1011	282	262	163	993	340	1103	1602
		Guinea Ecuatorial	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	50	0	58	0	3	10	17	4	11
		Guinée Rep.	0	0	334	2394	885	0	0	0	0	0	0	0	0	0	0	0	0	328	322	1516	1429	902	0	0	
		Honduras	0	0	61	28	59	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Iceland	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Japan	35053	38503	35477	33171	26490	24330	21833	24605	18087	15306	19572	18509	14026	15735	17993	16684	16395	15205	12306	15390	13397	13603	12168	10365	10980
		Korea Rep.	377	386	423	1250	796	163	124	43	1	87	143	629	770	2067	2136	2599	2134	2646	2762	1908	1151	1039	675	562	432
		Liberia	65	53	57	57	57	57	57	57	57	57	57	0	0	0	0	0	0	0	0	0	0	0	0	27	
		Libya	1085	500	400	400	400	400	400	400	31	593	593	0	0	4	0	0	0	0	0	0	0	0	0	0	**0**
		Maroc	774	977	553	654	255	336	1444	1160	1181	1154	1399	1145	786	929	700	802	795	276	300	300	308	300	309	350	410
		Mauritania	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	1	4	0	2	6	8	6	2	2	7	4	5	4	3	3	1	1	3	1	1	2	1	2	2	3
		Namibia	0	715	29	7	46	16	423	589	640	274	215	177	307	283	41	146	108	181	289	376	135	240	465	359	141
		Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	10138	13234	9927	4777	2098	1252	580	952	562	211	0	1521	2310	2415	2922	2263	2405	3047	3462	1694	2774	2315	1289	2337	1664
		Philippines	0	0	0	0	0	1154	2113	975	377	837	855	1854	1743	1816	2368	1874	1880	1399	1267	532	1323	1964	0	0	
		Russian Federation	0	0	0	13	38	4	8	91	0	0	0	0	1	1	26	73	43	0	0	0	0	0	0	0	**0**
		S. Tomé e Príncipe	4	3	6	4	5	6	5	4	4	4	4	11	6	4	0	92	94	97	100	103	107	110	633	421	393
		Senegal	9	126	237	138	258	730	1473	1131	1308	565	541	574	721	1267	805	926	1042	858	239	230	646	371	1031	1500	2978
		Sierra Leone	0	0	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		South Africa	88	79	27	7	10	53	55	249	239	341	113	270	221	84	171	226	159	145	153	47	435	332	193	121	218
		St. Vincent and Grenadines	1740	812	519	596	545	1937	2940	1921	1143	130	103	18	0	114	567	171	293	396	38	25	16	30	496	622	889
		Trinidad and Tobago	3	29	27	37	36	24	19	5	11	30	6	5	9	12	27	69	56	40	33	33	37	59	77	37	25
		U.S.A.	1090	1402	1209	882	1138	929	1263	574	1085	601	482	416	484	991	527	508	515	571	722	867	881	859	831	525	788
		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	1	1	0	0	0	0	0	0	0	0	0	0	0	**0**
		UK.Sta Helena	6	6	10	10	12	17	6	8	5	5	0	0	0	25	18	28	17	11	190	51	19	17	44	77	70
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	**0**
		Uruguay	48	37	80	124	69	59	28	25	51	67	59	40	62	83	22	27	201	23	15	2	30	0	0	0	**0**
		Vanuatu	1807	2713	2610	2016	828	0	314	0	0	0	0	104	109	52	132	91	34	42	39	23	9	4	0	0	**0**
		Venezuela	809	457	457	189	274	222	140	221	708	1241	847	1060	243	261	318	122	229	85	264	98	94	169	132	156	318
	NCC	Chinese Taipei	13426	19680	18023	21850	19242	16314	16837	16795	16429	18483	21563	17717	11984	2965	12116	10418	13252	13189	13732	10805	10316	13272	16453	13115	11845
		Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	25	34
	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	8	9	9	9	30	13	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cambodia	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Congo	14	9	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	36	7	7	5	0	0	0	0	0	16	16	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Dominica	0	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	0	11	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (ETRO)	42	356	915	0	7	0	0	0	362	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	4378	8964	10697	11862	16565	23484	22190	15092	7907	383	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	1
		Seychelles	0	0	0	0	0	0	0	58	0	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Sta. Lucia	0	0	0	0	0	0	0	0	1	2	2	0	2	0	0	0	0	0	0	0	0	0	6	0	
		Togo	86	23	6	33	33	33	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	0	12	46	42	16	41	23	0	0	
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	75	28	37	38	61	102	40	22	45	97	0	0	
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	13	25	20	13	117	59	46	60	34	42	0	0	
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	95	45	0	0	0	
		EU.España	764	605	371	58	255	328	487	474	0	0	223	244	143	88	49	190	250	211	216	98	80	143	0	0	
		EU.France	1032	970	713	314	437	467	553	607	229	205	446	397	222	79	26	51	150	122	394	192	56	54	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	56	28	15	26	9	18	6	11	5	15	0	0	
		Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	72	0	60	20	22	74	203	288	245	209	0	0	
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	151	106	135	97	85	38	70	41	80	27	0	0	
	NCO	Mixed flags (EU tropical)	494	457	582	169	301	193	143	281	28	8	198	378	294	189	348	337	375	324	257	0	0	0	989	1187	972
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	0	36	0	38
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	0	14	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 Ocurring (F <= F_{MSY})

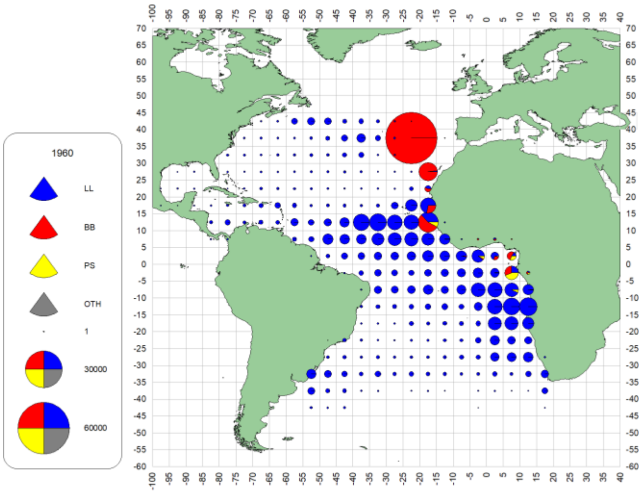
Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
35	93	98	99	100	100	100	100	100	100	100	100	100	100	100	100
37.5	88	95	98	99	100	100	100	100	100	100	100	100	100	100	100
40	80	91	96	98	99	100	100	100	100	100	100	100	100	100	100
42.5	72	85	92	96	98	99	100	100	100	100	100	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})

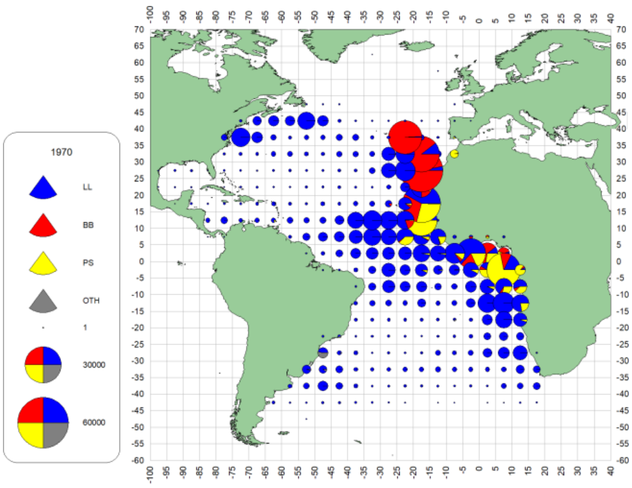
Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
35	0	3	11	26	46	62	77	88	94	97	99	100	100	100	100
37.5	0	3	10	24	41	58	73	82	90	95	98	99	100	100	100
40	0	2	9	21	37	53	67	78	87	93	96	98	99	100	100
42.5	0	2	9	19	33	49	62	73	81	89	94	96	98	99	100
45	0	2	8	17	30	43	56	67	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 >= SSBmsy) and Overfishing not occurring (F <= F_{MSY})

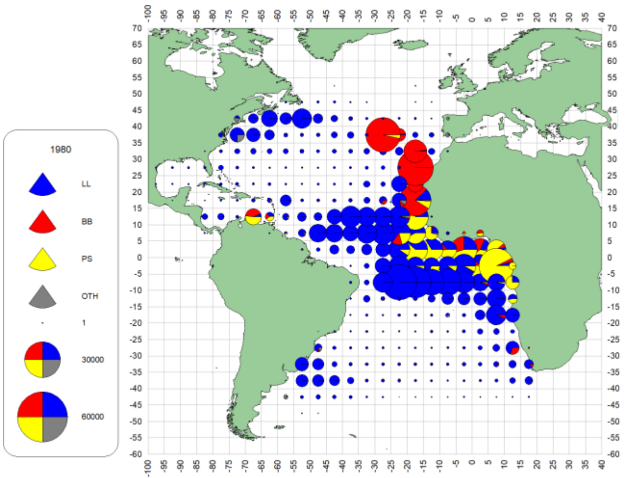
Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
35	0	3	11	26	46	62	77	88	94	97	99	100	100	100	100
37.5	0	3	10	24	41	58	73	82	90	95	98	99	100	100	100
40	0	2	9	21	37	53	67	78	87	93	96	98	99	100	100
42.5	0	2	9	19	33	49	62	73	81	89	94	96	98	99	100
45	0	2	8	17	30	43	56	67	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



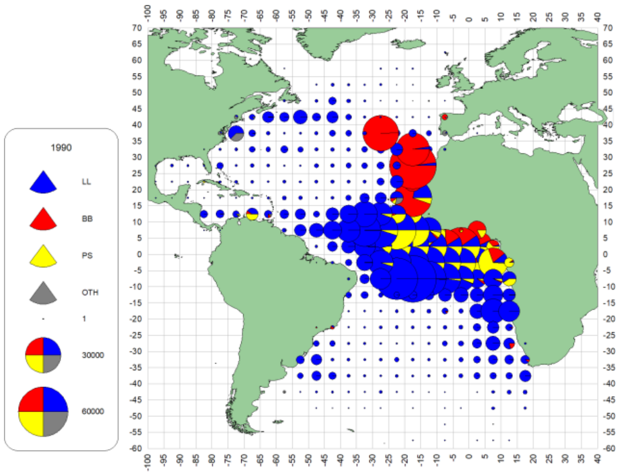
a. BET (1960-69)



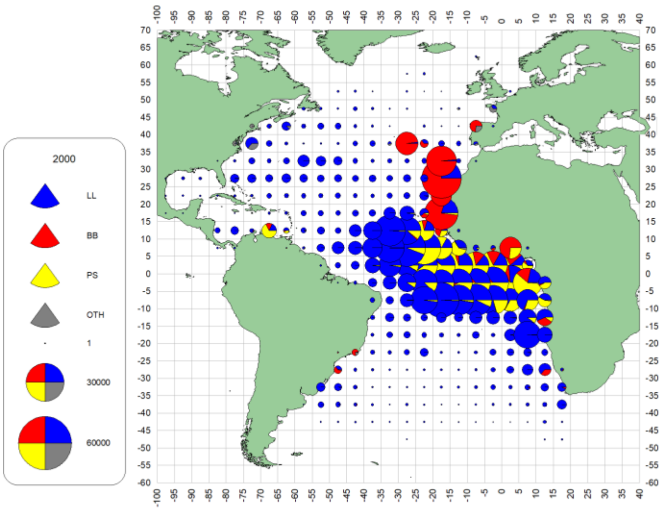
b. BET (1970-79)



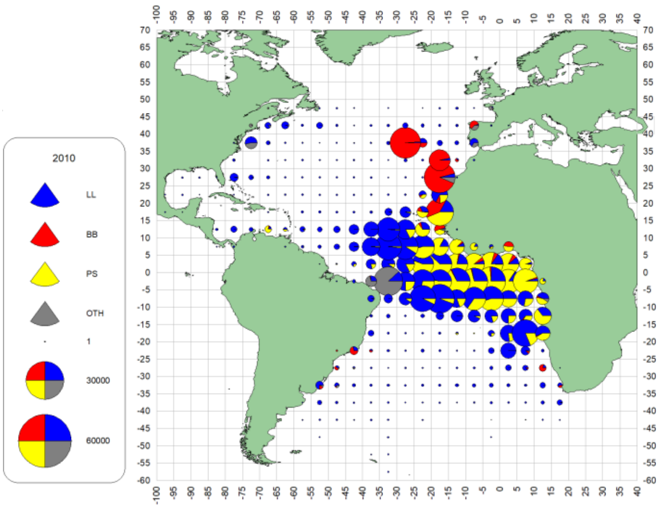
c. BET (1980-89)



d. BET (1990-99)

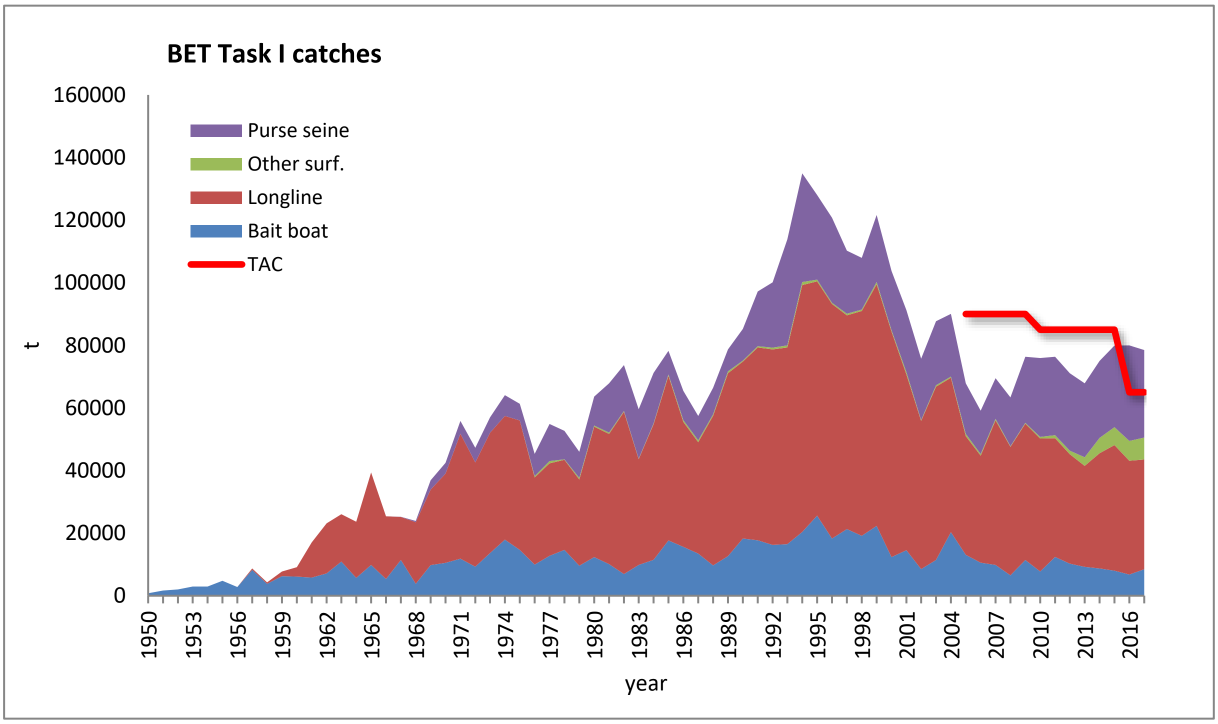


e. BET (2000-09)

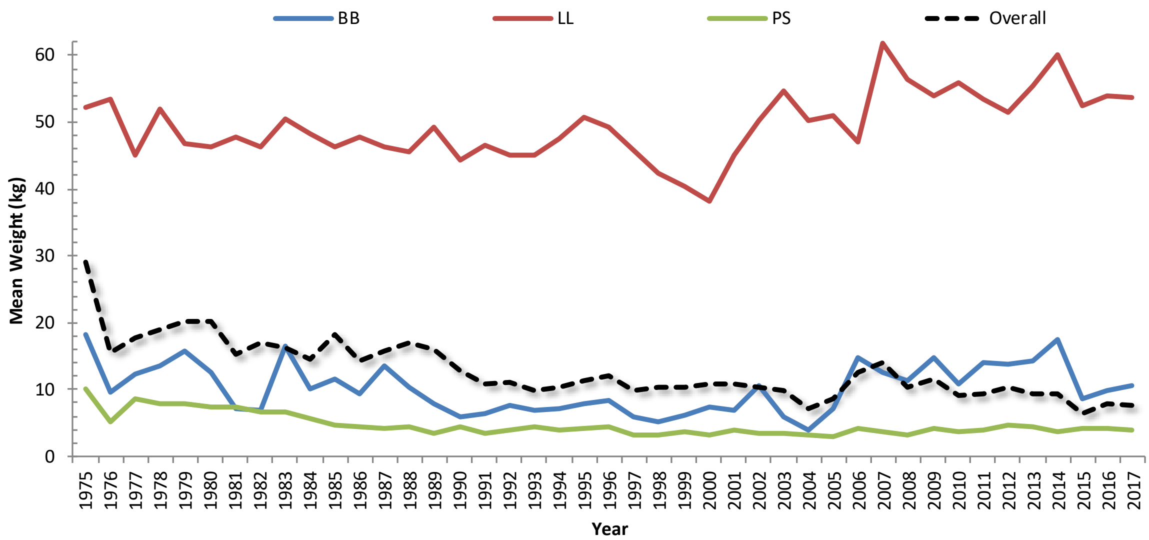


f. BET (2010-16)

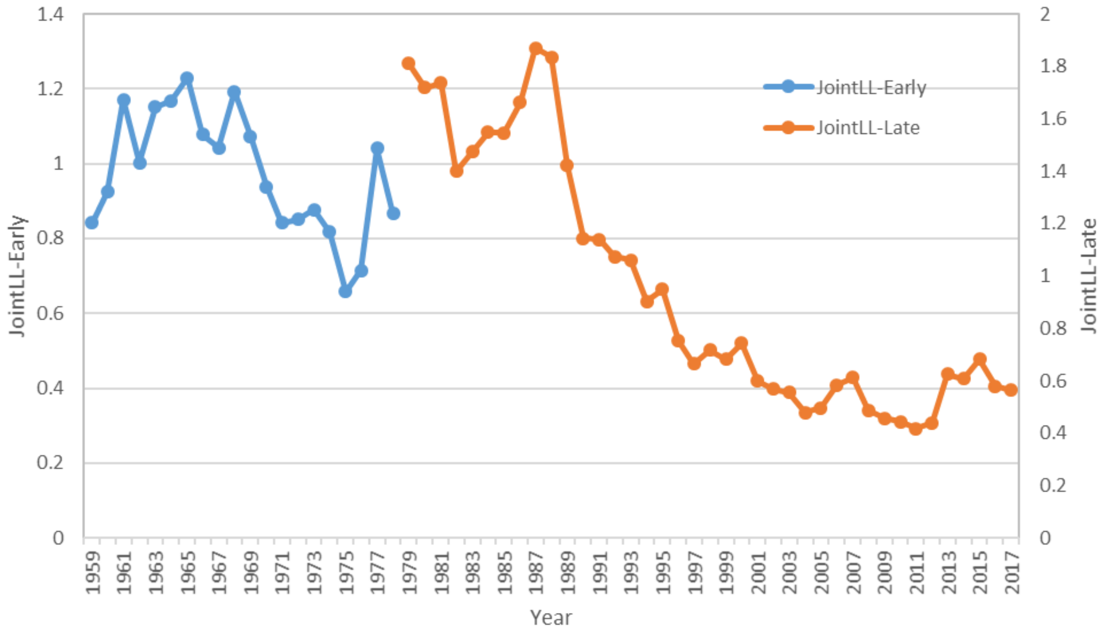
BET-Figure 1 [a-f]. Geographical distribution of the bigeye tuna catch by major gears and decade. The maps are scaled to the maximum catch observed during 1960-2016 (the last decade only covers 7 years).



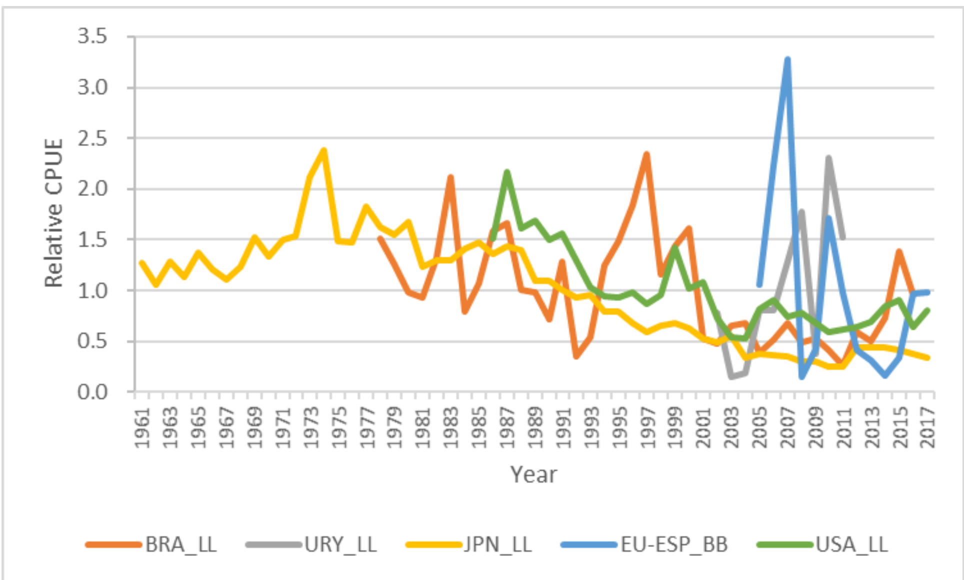
BET-Figure 2. Bigeye estimated and reported catches for all the Atlantic stock (t). The value for 2017 represents preliminary estimates because some countries have yet to provide data for this year or are under revision.



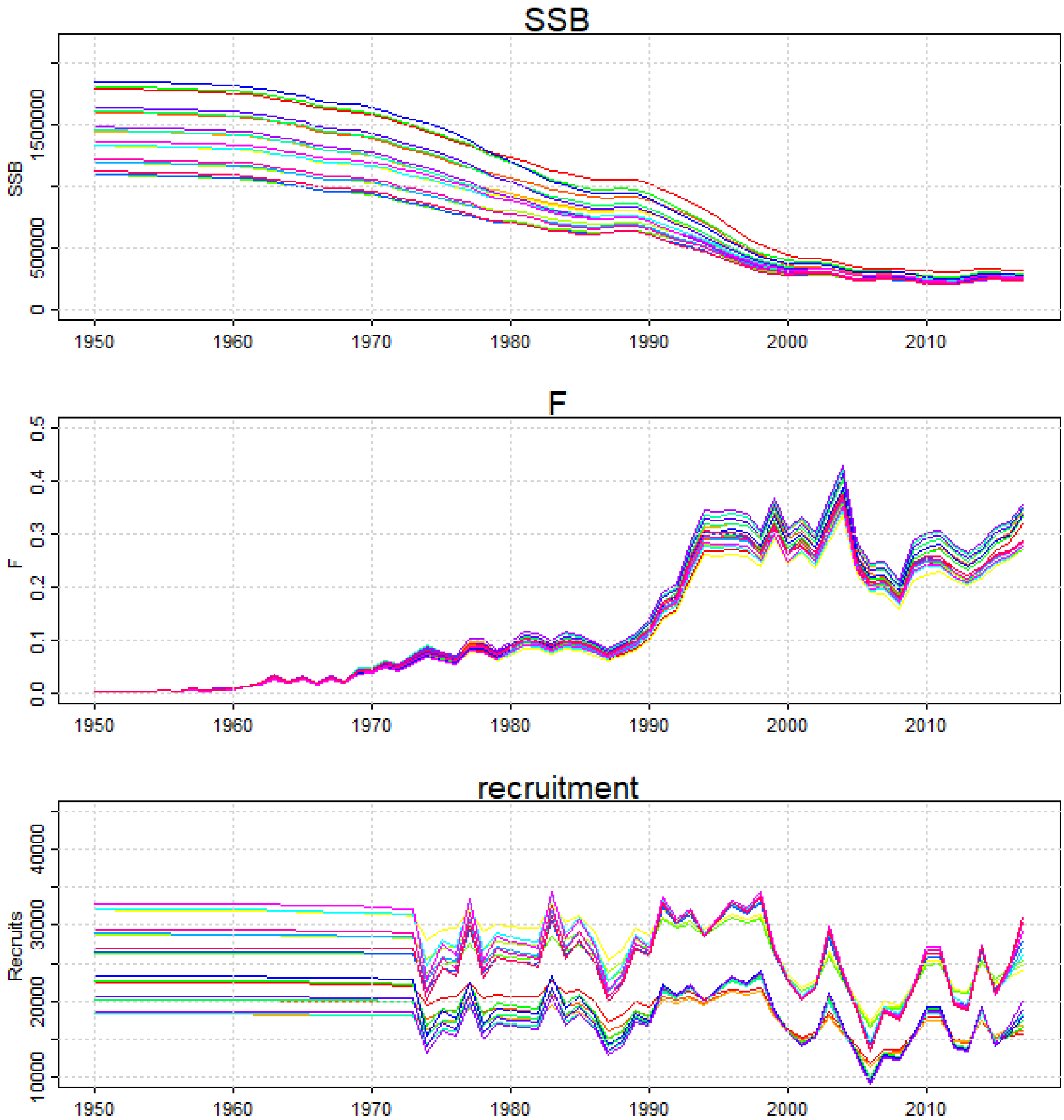
BET-Figure 3. Trend of mean weight for bigeye based on the catch-at-size data for 1975-2017 by major fisheries (BB=Baitboats, LL=Longlines, PS=Purse seine). The mean weight of the baitboat fishery (BB) reflects various baitboat fleets operating in different areas of the Atlantic Ocean.



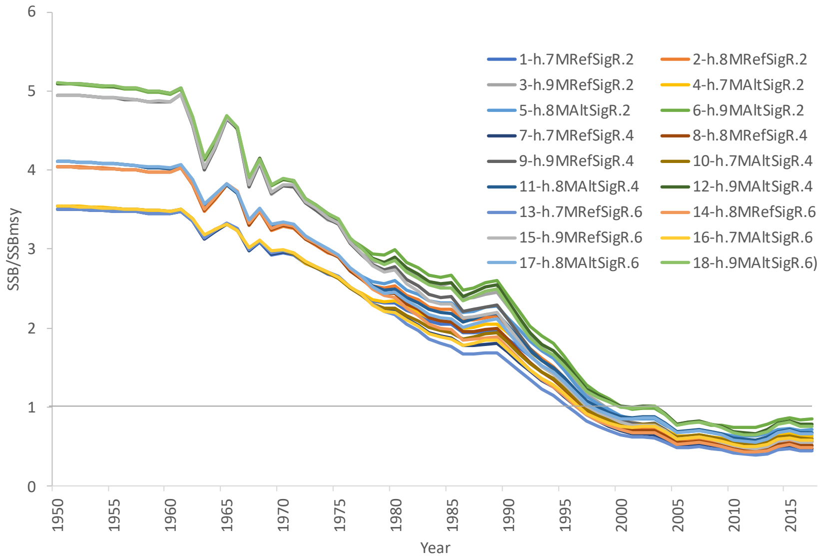
BET-Figure 4. Joint Longline index (1959-1978 without vessel identification and 1979-2017 with vessel identification included in the standardization) used in the integrated stock assessment models and the production assessment models. Note that the second time period of the split index is on the second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

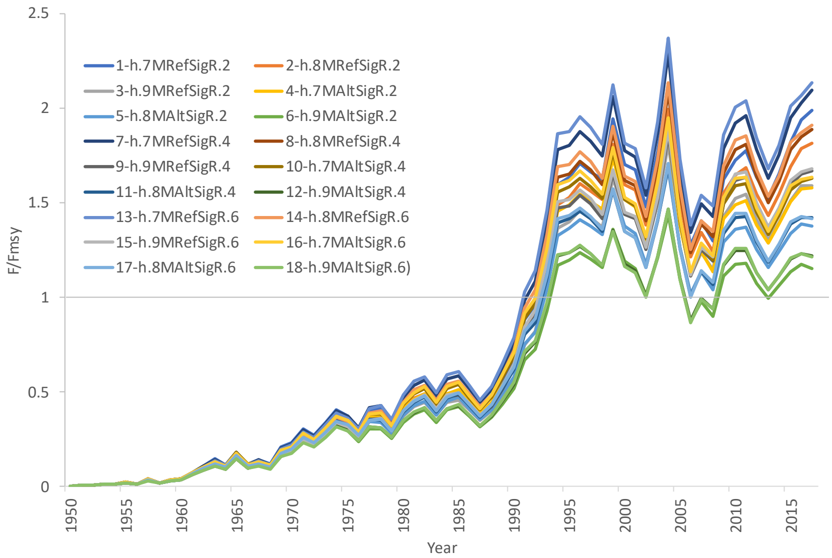


BET-Figure 5. Annual relative indices of abundances for bigeye tuna from different fleets used in the stock assessment as sensitivity runs.

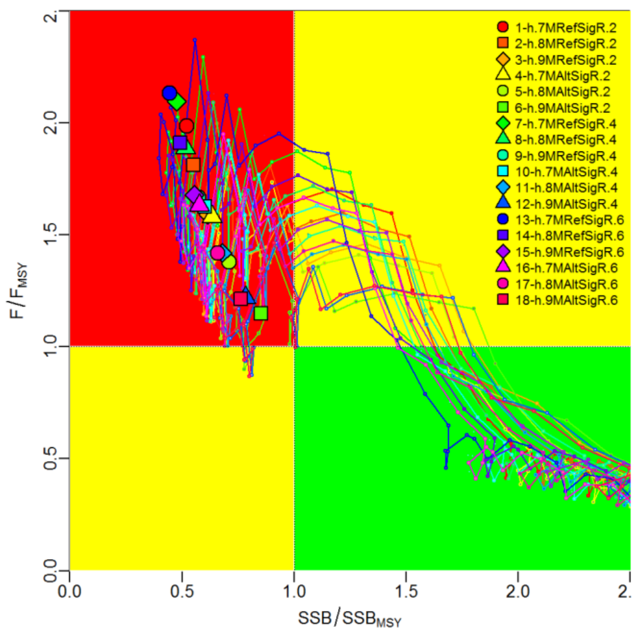


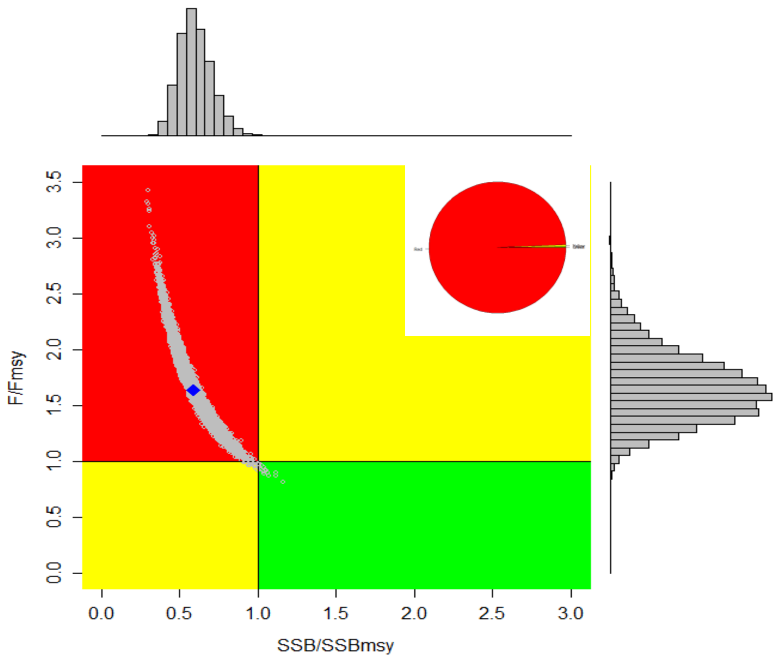
BET-Figure 6. Trajectories of Spawning Stock Biomass (SSB), Fishing mortality (average F on ages 1-7) and recruitment (age 0) for the 18 Stock Synthesis uncertainty grid runs for Atlantic bigeye tuna.



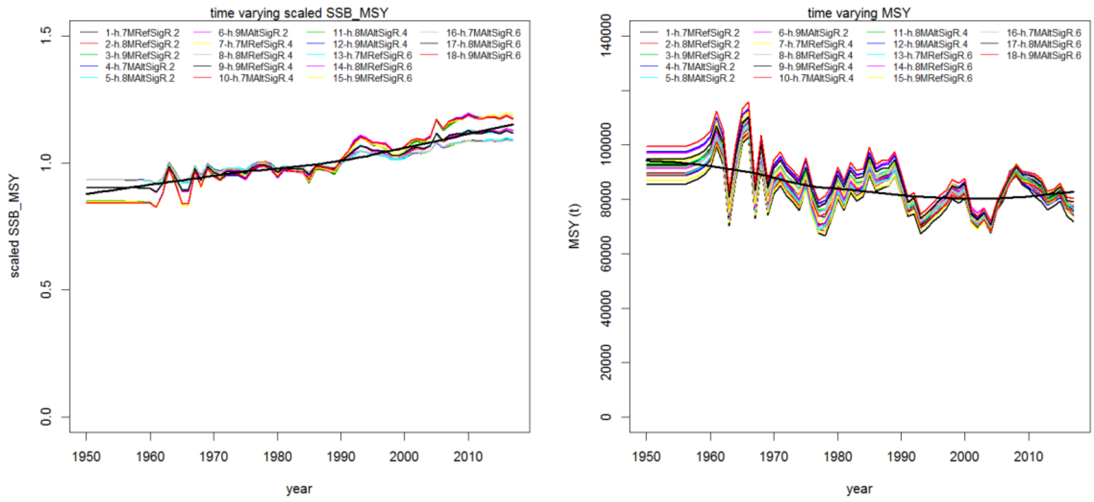


BET-Figure 7. Trajectories of SSB/SSB_{MSY} and F/F_{MSY} estimated from the 18 Stock Synthesis uncertainty grid runs for Atlantic bigeye tuna. For each run the benchmarks are calculated from the year-specific selectivity and fleet allocations.





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 2017 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 FADs 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 East 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 East 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 (FADs) 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 FADs. Furthermore, the association with FADs 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 (254,852 t), the total catches of skipjack throughout the Atlantic Ocean (including catches of *faux poissons* landed in Côte d'Ivoire) remain high, reaching 265,565 t in 2017 (**SKJ-Table 1, SKJ-Figure 3**). This represents a very sharp rise compared to the average catches of the five years prior to 2010 (152,165 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 FADs 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, Guinea, Panama, and Cabo Verde, followed by the baitboat fisheries of EU-Portugal, EU-Spain, Ghana, and Senegal. The preliminary estimates of catches made in 2017 in the East Atlantic amounted to 242,289 t, which is an increase of about 91% 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 FADs since it involves single species schools composed of large individuals off the coast of Mauritania (**SKJ-Figure 1B**). 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 FADs 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 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 2017 made in the West Atlantic amounted to 23,276 t (against 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 FAD fishing (targeting skipjack) in the East Atlantic because the fishing strategies can change from one year to the next and in addition, the sea time devoted to activities on FADs 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 East 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**). The number of purse seiners follows this trend but seems to have remained steady since 2010; 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. FAD 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 FADs, 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 East 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 FADs, 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 FADs 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 FADS, 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 East 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 FADs 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 East 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 West Atlantic is higher than in the East (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 FADs (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 East Atlantic but the intended aim was to protect yellowfin and bigeye tuna juveniles.

The Recommendation (Rec. 15-01) establishes a moratorium on FAD 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 FADs and on the ongoing AOTTP) which are necessary to improve the stock assessment, the Committee recommends that the catch and effort levels do not exceed the level of 2012-2013 catch or effort. The provisional catch in 2017 exceeds this level by 11%. 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 (Anon. 2017a)). 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

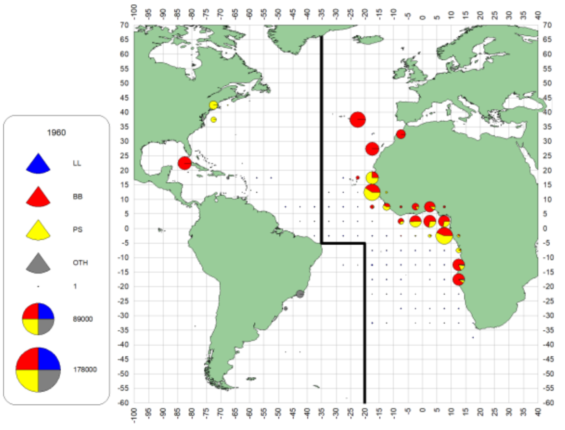
	East Atlantic	**West Atlantic**
Maximum Sustainable Yield (MSY)		Around 30,000-32,000 t
Current yield (2017[1])	242,289 t	23,276 t
Current Replacement Yield	Unknown	Somewhat below 32,000 t
Relative Biomass (B_{2013}/B_{MSY})	Likely >1	Probably close to 1.3
Mortality due to fishing (F_{2013}/F_{MSY})	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 2017 should be considered provisional.

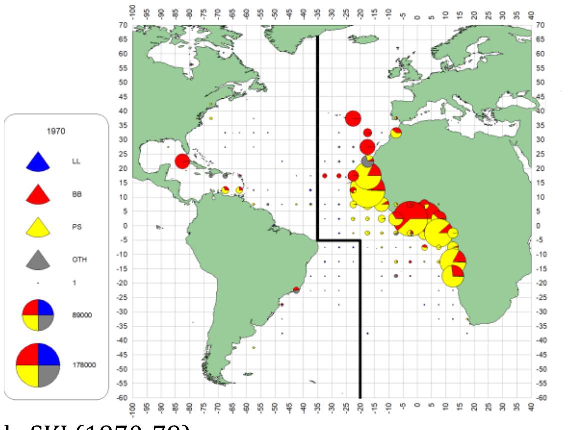
SKJ-Table 1. Estimated catches (t) of skipjack tuna (*Katsuwonus pelamis*) by area, gear and flag.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				209807	191381	174529	157116	148955	161452	180687	155671	163620	122524	155483	181705	172082	138052	141361	145720	163610	189444	218845	249736	254852	226562	237649	251262	265565
	ATE			176587	161432	152669	129554	117243	132365	153331	126477	132169	100924	130734	154243	143566	111600	115918	123698	137835	163579	186455	216888	219979	199473	216954	229362	242289
	ATW			33221	29949	21860	27562	31712	29087	27356	29193	31451	21600	24749	27461	28517	26453	25443	22022	25774	25866	32390	32848	34872	27089	20695	21900	23276
Landings	ATE		Bait boat	31656	37817	33691	35872	37314	46784	44762	33909	56689	31076	34445	54602	48185	44376	41068	32479	35111	38311	37467	44649	30257	25884	23770	28998	26072
			Longline	2	10	3	7	47	85	42	48	53	59	83	67	83	204	428	199	59	46	35	58	79	54	21	540	498
			Other surf.	1013	311	308	323	131	930	288	2335	662	534	385	1008	2351	5270	3432	3794	6361	5098	5862	6769	7206	2158	2521	2490	4770
			Purse seine	126043	107434	105657	89135	72002	76849	99003	79552	72760	67589	89053	90610	87659	58570	65764	81431	87835	111919	133696	158503	176145	164458	179051	184550	199658
	ATW		Bait boat	19697	22645	17744	23741	26797	24724	23881	25641	25142	18737	21990	24082	26028	23749	22865	20617	22770	22803	29468	30693	32187	24814	17538	16810	14647
			Longline	21	16	34	21	12	21	58	22	60	349	95	206	207	286	52	49	20	854	352	62	1194	464	206	804	291
			Other surf.	709	1577	2023	450	556	516	481	467	951	398	367	404	316	372	1317	455	950	265	710	511	584	730	693	1336	5452
			Purse seine	12794	5712	2059	3349	4347	3826	2936	3063	5297	2116	2296	2769	1967	2045	1209	901	2035	1943	1859	1582	908	1081	2259	2950	2886
Landings(FP)	ATE		Purse seine	17873	15860	13010	4217	7749	7716	9237	10634	2004	1666	6769	7956	5288	3181	5226	5796	8471	8205	9395	6909	6293	6918	10960	12785	11196
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	0	1	0	0	0	631	0	94
	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	
Landings	ATE	CP	Algerie	0	0	0	0	0	171	43	89	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Angola	13	7	3	15	52	2	32	14	14	14	14	10	0	0	0	0	50	636	44	91	514	0	1	1	1
			Belize	0	0	0	0	0	720	0	229	278	0	0	0	0	0	0	0	1373	2714	7429	15554	6218	10779	12599	7730	9958
			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	1138	1176	1585	581	858	1245	1040	789	794	398	343	1097	7157	4754	5453	4682	4909	5155	7883	5535	16016	15254	17600	10925	7823
			China PR	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Curaçao	0	0	0	7096	8444	8553	10045	11056	15450	7246	12084	10225	101	3042	1587	6436	9143	9179	11939	12779	17792	18086	19621	22180	20660
			Côte d'Ivoire	0	0	0	0	0	0	0	1173	259	292	143	559	1259	1565	1817	2328	2840	2840	5968	10923	8063	2365	254	675	1534
			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	63660	50538	51594	38538	38513	36008	44520	37226	30954	25466	44837	38751	28178	22292	23723	35124	36722	41235	56908	67040	66911	51628	46085	52110	57458
			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	
			EU.France	33735	32779	25188	23107	17023	18382	20344	18183	16593	16637	19899	21879	14850	7034	4168	4439	7789	14749	13067	13139	16242	17406	20563	19435	16574
			EU.Germany	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.Greece	0	0	0	0	0	0	0	0	0	0	102	99	99	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	14	14	14	0	0	8	6	0	0	0	0	0	0	7
			EU.Italy	0	0	0	0	0	0	0	0	0	4	29	34	17	0	0	0	0	0	0	0	0	0	0	47	57
			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	95	0	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	**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	5
			EU.Portugal	5651	7528	4996	8297	4399	4544	1810	1302	2167	2958	4315	8504	4735	11158	8995	6057	1084	12974	4143	2794	4049	1712	1347	708	1785
			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	0	6970	16949	14246
			Gabon	1	11	51	26	0	59	76	21	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Ghana	20225	21258	18607	24205	26380	43612	54088	36517	57540	40194	34435	47746	54209	31934	35419	38648	43922	45505	44169	52627	44443	44250	57876	49045	55508
			Guatemala	0	0	0	0	0	0	0	0	0	0	2120	4808	6389	4959	5546	6319	4036	2951	2829	3631	4907	5811	7078	7386	9800
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1224	1224	1010	0	1	1	3	1	
			Guinée Rep.	0	0	975	6432	2408	0	0	0	0	0	0	0	0	0	0	0	0	1500	1473	7942	7363	5484	0	0	
			Japan	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	4	5	2	5	1	1
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	61	80	49	98	21	110
			Maroc	3652	3672	6886	2859	5532	4741	4176	4091	1737	1303	3403	3843	4666	4032	1592	1309	2580	2343	2151	2267	2045	1068	576	258	750
			Namibia	0	2	15	0	1	0	0	0	8	0	0	0	0	0	0	0	71	2	2	15	1	0	0	1	1
			Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	12	4	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	13027	12978	14853	5855	1300	572	1308	1559	281	342	0	7126	11490	13468	18821	8253	8518	9590	12509	10927	14558	14165	8372	11510	8815
			Russian Federation	540	1471	1450	381	1146	2086	1426	374	0	0	0	0	0	392	1130	313	260	0	20	0	0	2	1	1	110
			S. Tomé e Príncipe	212	190	180	187	178	169	181	179	179	179	179	117	166	143	0	229	235	241	247	254	260	266	360	380	346
			Senegal	95	59	18	163	455	1963	1631	1506	1271	1060	733	1395	4874	3534	2278	3661	4573	2447	4823	4339	4183	4091	5943	17082	25431
			South Africa	6	4	4	1	6	2	1	7	1	1	2	2	1	0	0	4	4	2	6	8	2	5	2	2	1
			St. Vincent and Grenadines	5731	2184	1847	1501	1191	1441	2127	1422	1435	524	42	0	0	1	0	0	0	0	0	0	0	0	0	0	8
			Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	36	0	0	0	15	17	0	0	0	

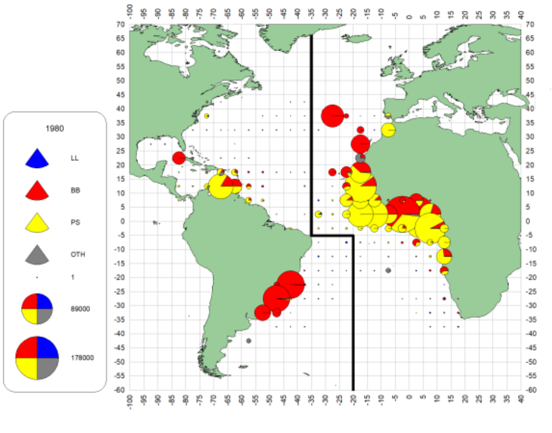
				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			UK.Sta Helena	65	55	115	86	294	298	13	64	205	63	63	63	63	88	110	45	15	25	371	29	7	26	6	127	9
			Vanuatu	10808	10896	8477	5992	1233	0	1192	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	35	2407	1197	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		NCC	Chinese Taipei	2	10	3	5	47	73	39	41	24	23	26	16	10	9	14	19	6	11	15	2	12	9	4	2	2
		NCO	Benin	2	2	2	2	7	3	2	2	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	10	7	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	7	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)	133	744	2803	0	27	0	0	0	760	148	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATW	CP	Barbados	6	6	6	5	5	10	3	3	0	0	0	0	0	0	0	0	0	0	1	2	0	1	1	1	2
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	164	**0**
			Brazil	17771	20588	16560	22528	26564	23789	23188	25164	24146	18338	20416	23037	26388	23270	24191	20846	23307	23456	30571	30863	32438	25195	18133	18231	20068
			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	45	40	35	30	30	30	30	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	100	123
			EU.España	397	0	0	0	0	0	1	1	0	0	0	0	0	0	5	11	0	0	0	0	0	0	0	641	223
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	10	0	0	0	0	25	224
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	9	0	0	23	0	0	0	0	0	
			EU.Portugal	0	0	0	0	0	0	0	4	1	0	3	3	5	21	11	0	6	0	8	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	85	35	84
			Grenada	25	11	12	11	15	23	23	23	15	14	16	21	22	15	26	20	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	11	86
			Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	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	1	0	2	3	6	51	13	54	71	75	9	7	10	7	8	9	7	9	8	5	5	7	10	6
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	543	410	161	185	
			St. Vincent and Grenadines	66	56	53	37	42	57	37	68	97	357	92	251	251	355	90	83	54	46	50	0	36	39	47	0	78
			Trinidad and Tobago	0	0	3	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.	367	99	82	85	84	106	152	44	70	88	79	103	30	61	66	67	119	54	87	112	117	76	78	134	99
			UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
			Venezuela	11172	6697	2387	3574	3834	4114	2981	2890	6870	2554	3247	3270	1093	2008	921	757	2250	2119	1473	1742	1002	1179	2019	2317	2222
		NCC	Chinese Taipei	9	7	2	10	1	2	1	0	1	16	14	27	28	29	2	8	0	2	1	11	1	2	21	17	34
			Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	552	0	0	0	**0**
		NCO	Argentina	50	1	0	1	0	2	0	1	0	0	0	30	0	0	0	0	3	12	0	0	0	0	0	0	
			Colombia	2074	789	1583	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	1017	1268	886	1000	1000	651	651	651	0	0	624	545	514	536	0	0	0	0	0	0	0	0	0	0	
			Dominica	24	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	143	257	146	146	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Jamaica	0	0	0	62	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	1	0
			Sta. Lucia	53	86	72	38	100	263	153	216	151	106	132	137	159	120	89	168	0	153	143	109	171	139	87	0	
Landings(FP)	ATE	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	395	368	179	636	301	0	0	
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	419	131	162	276	603	726	411	230	428	1362	0	0	
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	88	171	116	105	917	415	441	545	520	351	0	0	
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	562	544	202	0	0	
			EU.España	5959	4719	2899	453	1990	2562	3802	3700	0	0	1738	1907	713	437	366	1158	1994	1394	1842	983	998	1623	0	0	
			EU.France	8055	7573	5568	2447	3414	3647	4316	4740	1786	1601	3484	3096	918	346	206	287	1120	743	1480	1646	463	440	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	260	69	66	162	59	136	51	102	72	93	0	0	
			Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	387	0	330	118	359	614	1778	2379	1670	2146	0	0	
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	796	548	977	693	680	354	609	284	962	400	0	0	
		NCO	Mixed flags (EU tropical)	3858	3568	4543	1316	2345	1508	1119	2194	218	65	1547	2953	1708	1478	3003	2998	2624	3427	2372	0	0	0	10960	12785	11196
Discards	ATE	CP	Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	631	0	94
			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	
		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	



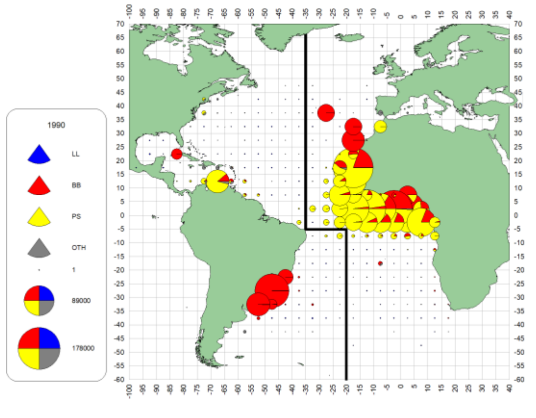
a. SKJ (1960-69)



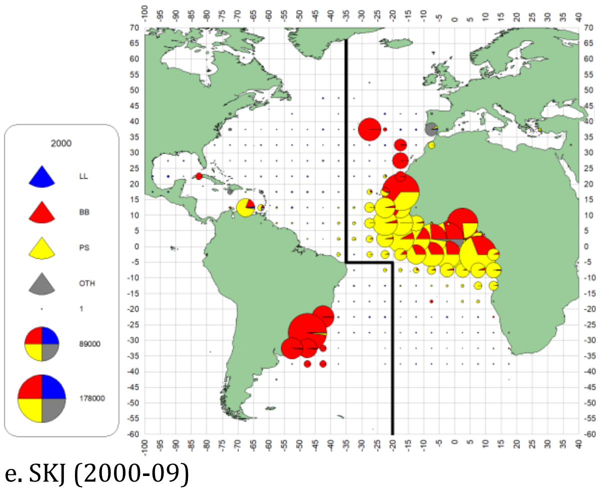
b. SKJ (1970-79)



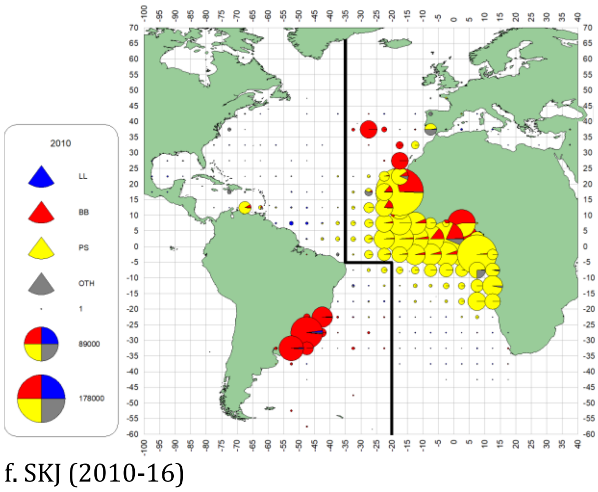
c. SKJ (1980-89)



d. SKJ (1990-99)

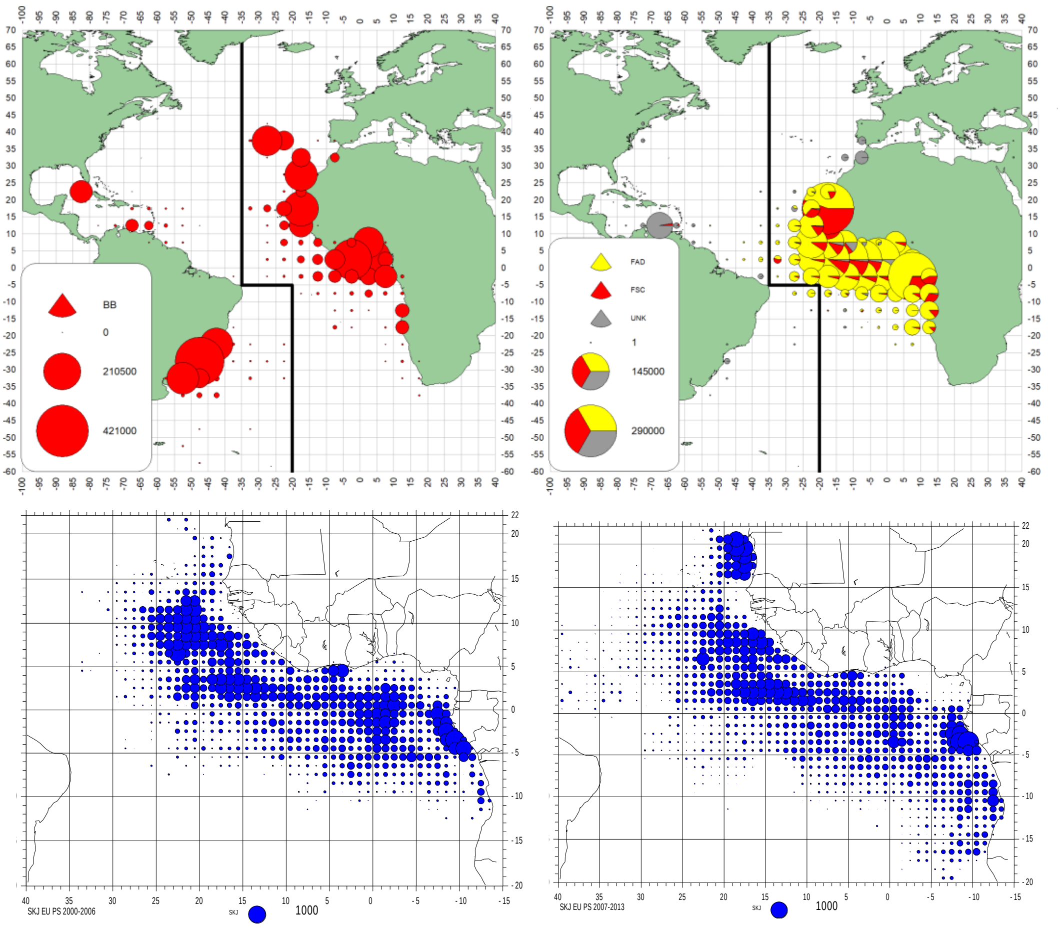


e. SKJ (2000-09)

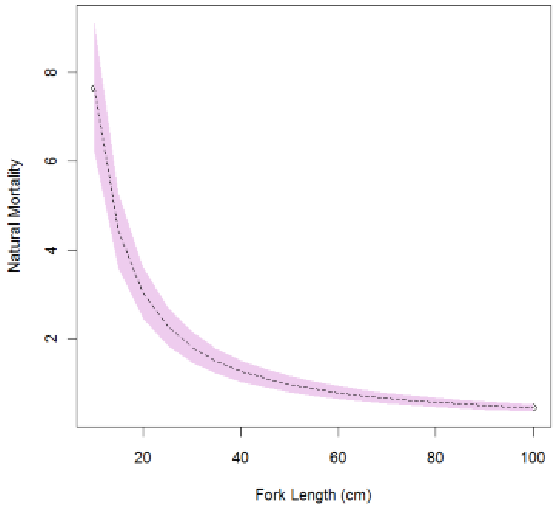


f. SKJ (2010-16)

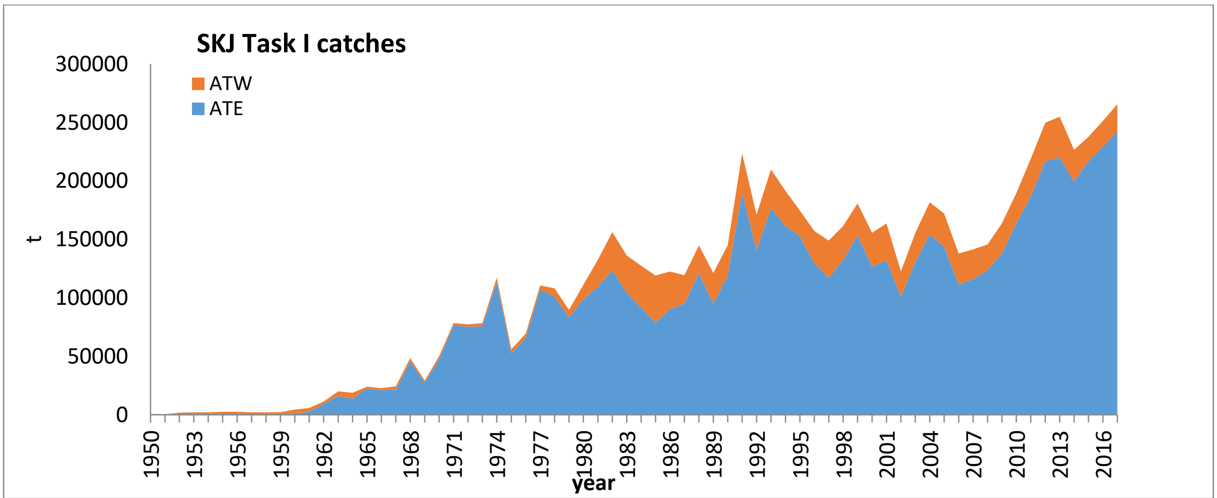
SKJ-Figure 1A [a-f]. Geographical distribution of the skipjack catch by major gears and decade. The maps are scaled to the maximum catch observed during 1960-2016 (last decade only covers 7 years).



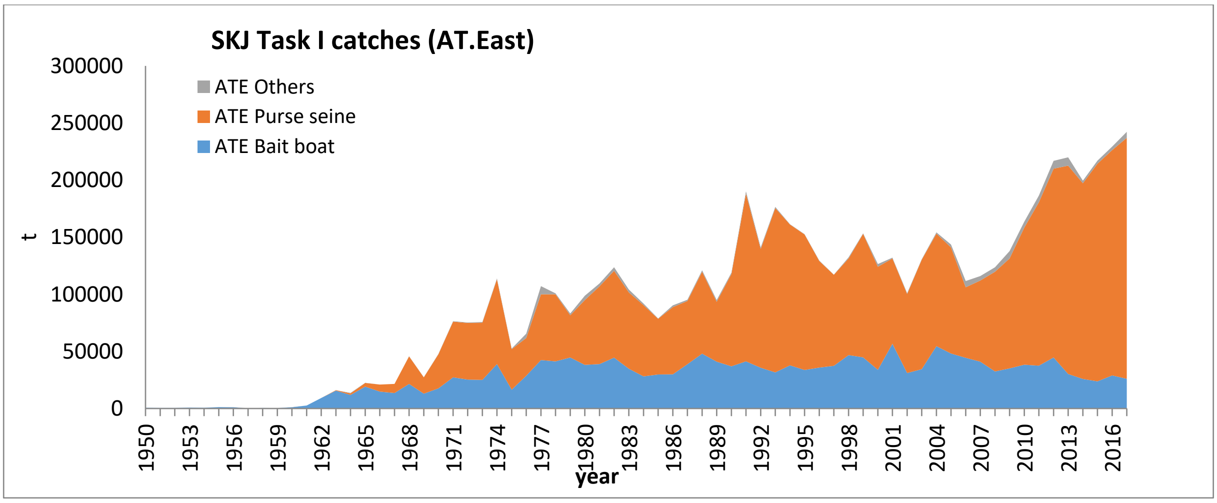
SKJ-Figure 1B. Distribution of skipjack catches in the Atlantic for baitboat (upper left panel) between 1950 and 2014 and for purse seiners (upper right panel) by fishing mode (free schools vs. FADs. UNK is considered to be mainly free schools in the Western and mainly FAD in the Eastern Atlantic) between 1991 and 2014. Skipjack catches made by European and other CPCs purse seiners (about 75% of the total catches) between 2000 and 2006 (lower left panel) and between 2007 and 2014 (lower right panel) showing the withdrawal from the Senegal fishing zone on free schools, due to non-renewal of the fishing agreements in 2006, and the appearance of a fishing area under FADs in 2012 North of 15ºN latitude.



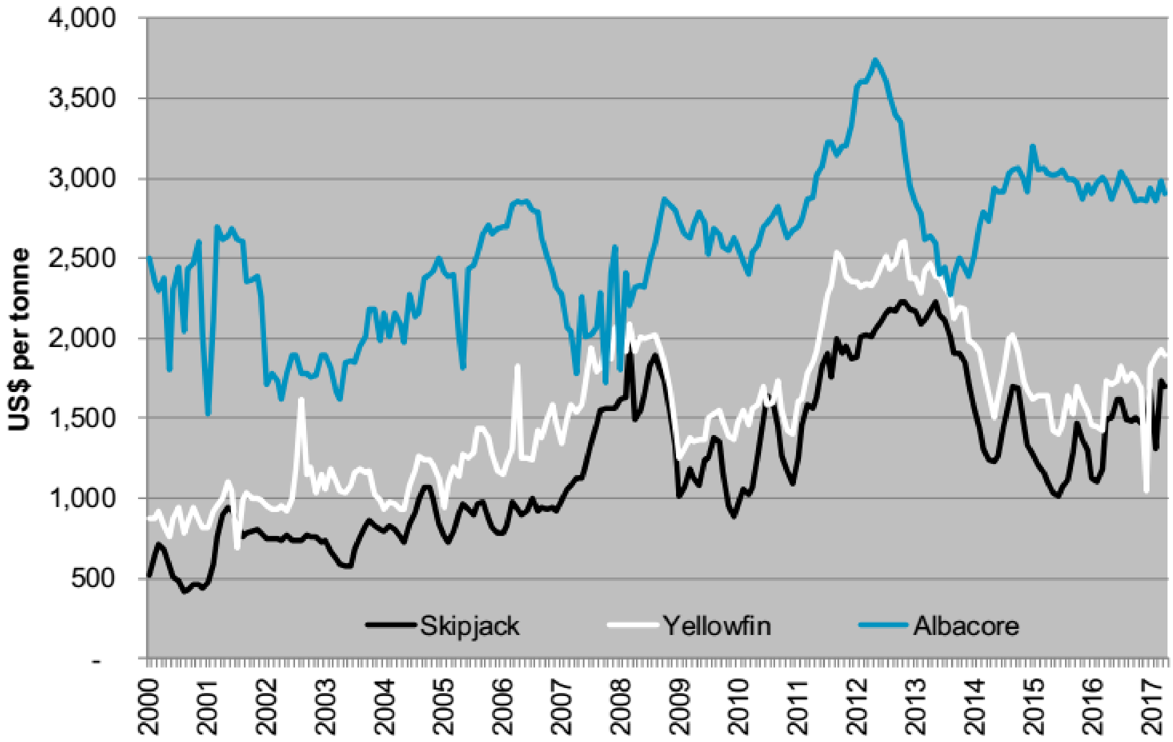
SKJ-Figure 2. Estimates of natural mortality by size of Atlantic skipjack calculated by empirical relationships between mortality and some biological parameters (which show different values from those traditionally used in the East).



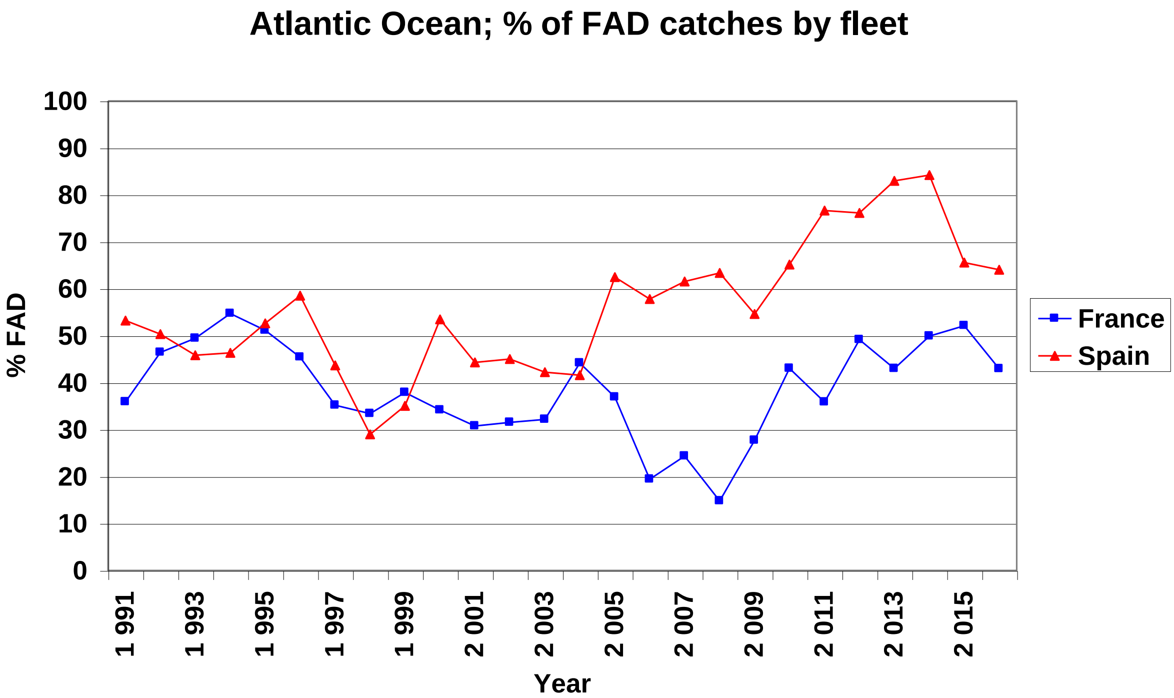
SKJ-Figure 3. Total skipjack catches (t) in the Atlantic and by stock (East and West) between 1950 and 2017. It is possible that skipjack catches taken in the eastern Atlantic in recent years were not reported or were under-estimated in the logbook correction of species composition based on multi-species sampling carried out at the ports. The 2017 figure is still preliminary.



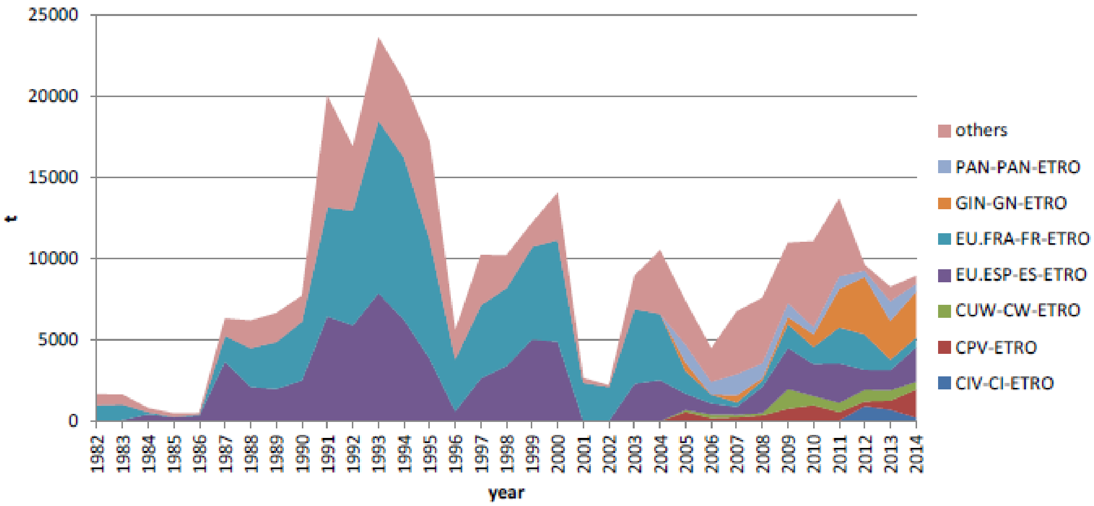
SKJ-Figure 4. Skipjack catches in the eastern Atlantic, by gear (1950-2017), after correction of Ghana's data by species (1996-2014).



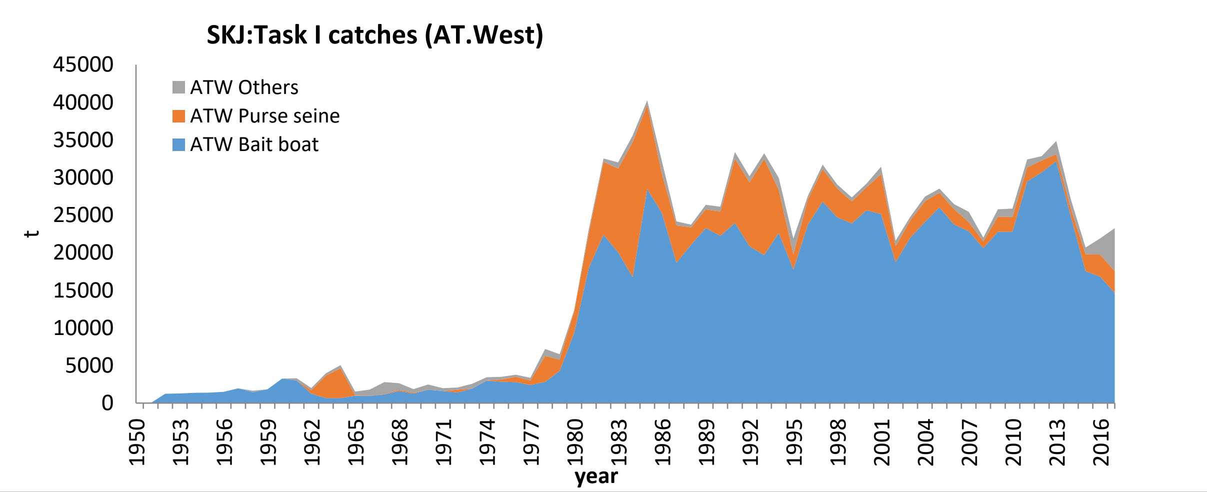
SKJ-Figure 5. Average prices of skipjack and yellowfin in U.S. dollars (adjusted for inflation and converted into the value of the 2015$US) in the Bangkok market.
(Source at 2017-09-14: https://www.ffa.int)



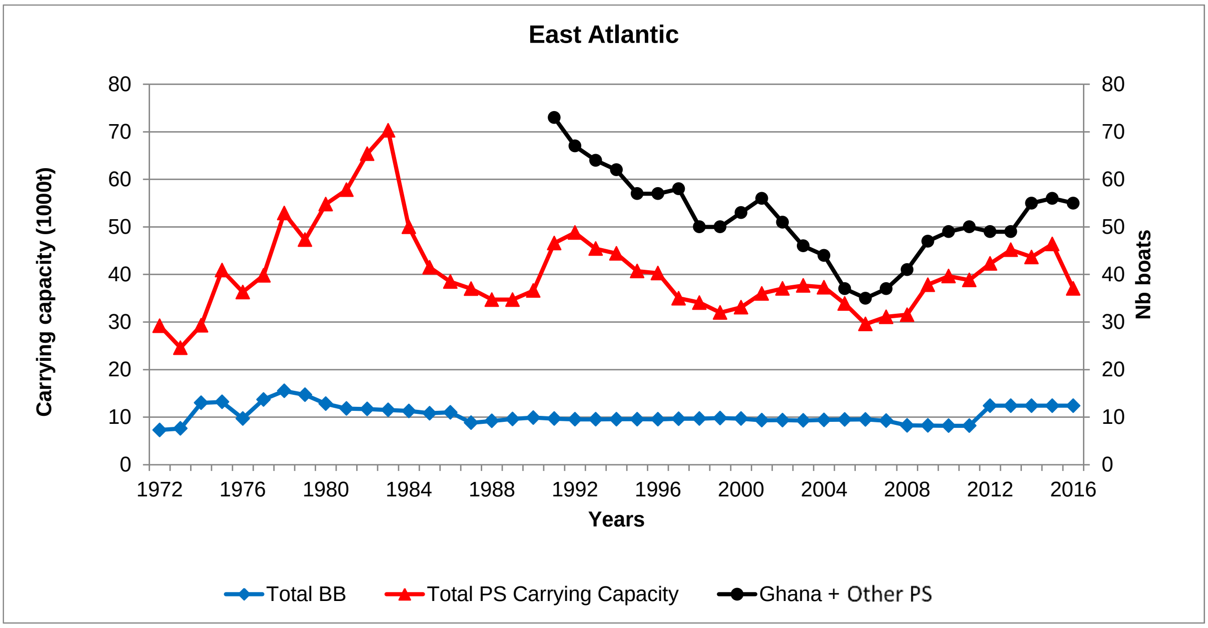
SKJ-Figure 6. Changes in the proportion of total catches under FADs made by French and Spanish purse seiners (1991-2016). The increase in the percentage of catches under FADs coincides with the shift from the Senegal area, known for its seasonal fishing on free schools (see **Figure 1**), and with the increase of skipjack prices.



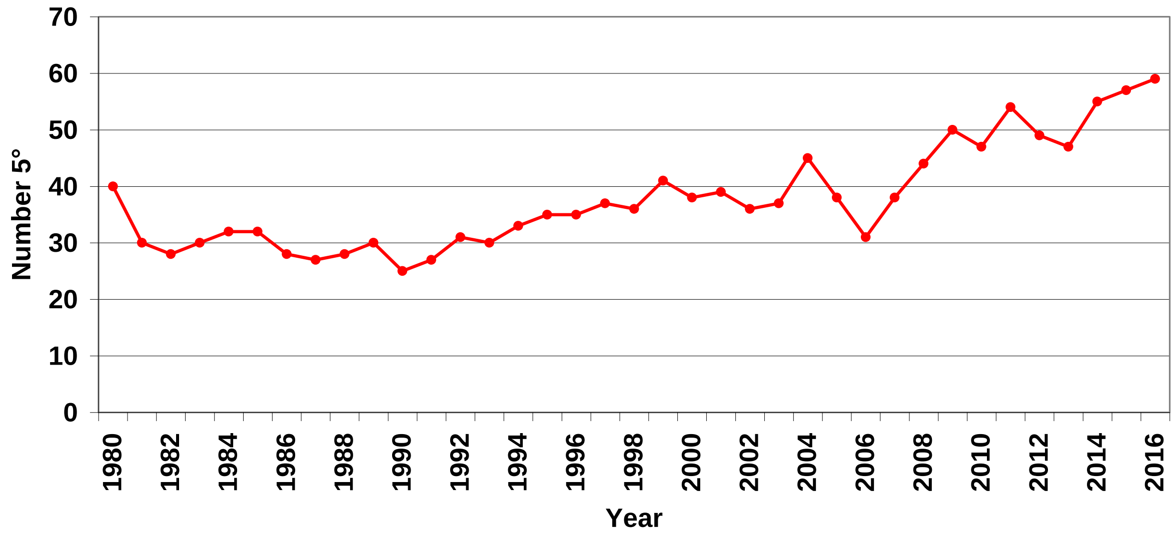
SKJ-Figure 7. Estimated landings of *faux poissons* (1981-2014) by purse seiners operating in the Eastern Atlantic for the three major species of tropical tunas in the local market of Abidjan (Côte d'Ivoire).



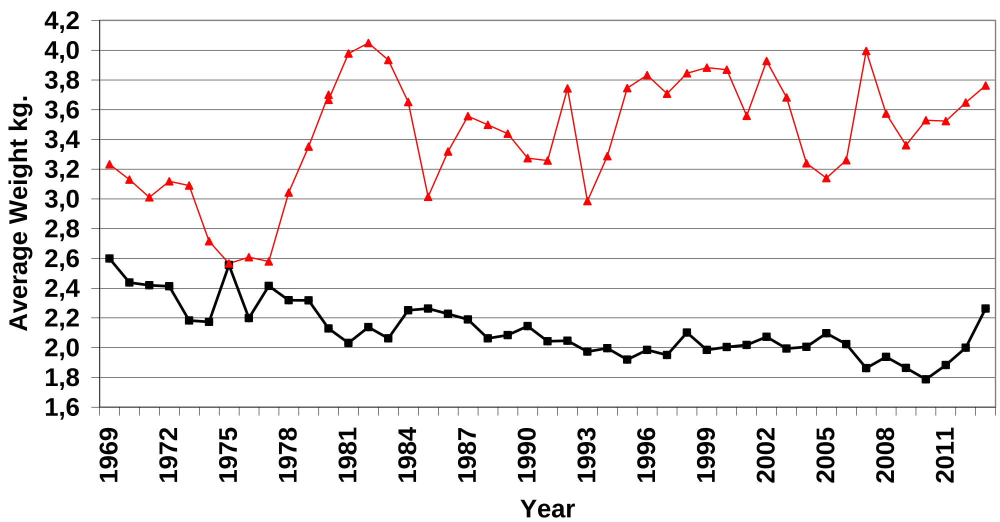
SKJ-Figure 8. Skipjack catches in the western Atlantic, by gear (1950-2017). The values for 2017 are preliminary.



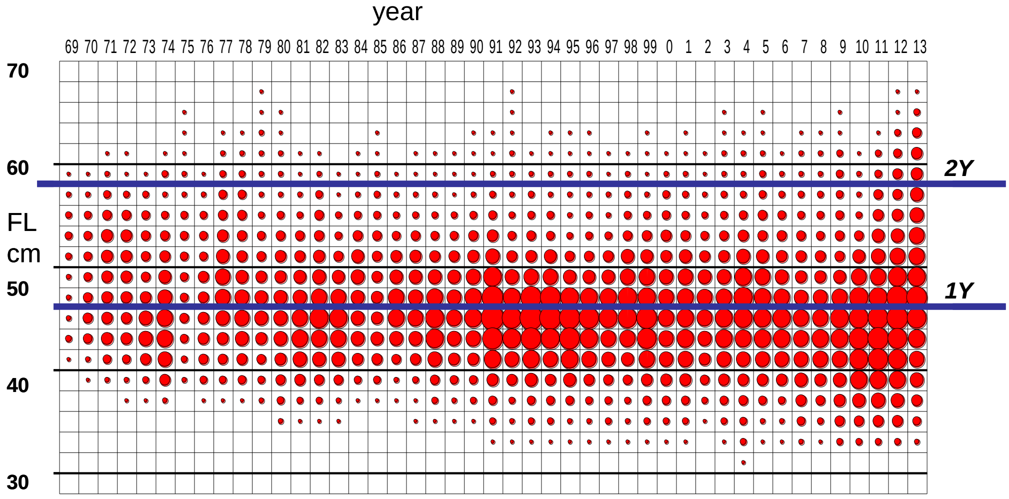
SKJ-Figure 9. Changes over time in the carrying capacity, corrected by the annual percentage of time at sea, (left axis) for the overall purse seiners (1971-2016) and baitboats (1971-2016) operating in the eastern Atlantic. The carrying capacity and number of vessels (right axis) include boats for the European purse seiners, Ghanaian fleets, and others CPCs. This figure does not reflect all the purse seine and baitboats operating in the Eastern Atlantic particularly for recent years.



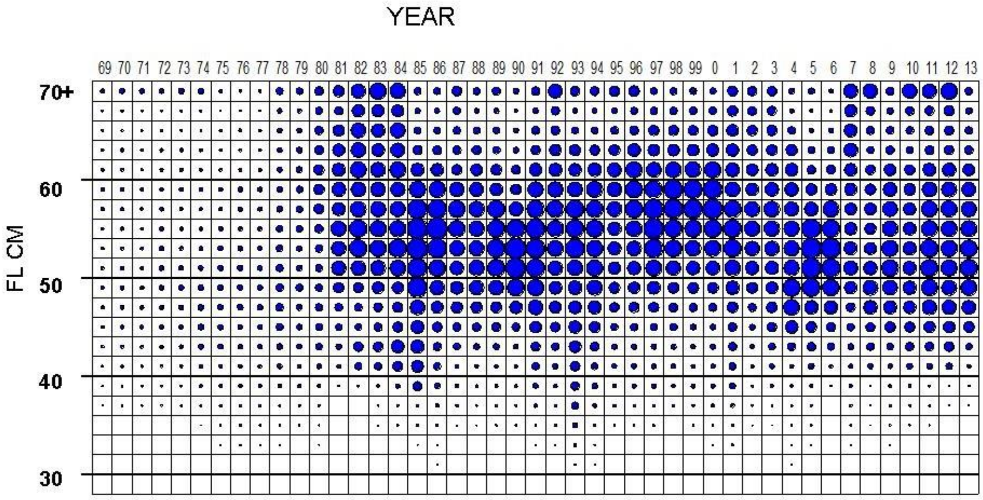
SKJ-Figure 10. Number of 5°x5° squares with annual skipjack catches above 10 t for the European and other CPCs purse seiners operating in the eastern Atlantic (1980-2016). The increase observed in 1991 could be due to a modification of the species composition correction procedure for the catches implemented at that date (skipjack catches could have been attributed to squares that did not have any until then). On the other hand, 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.



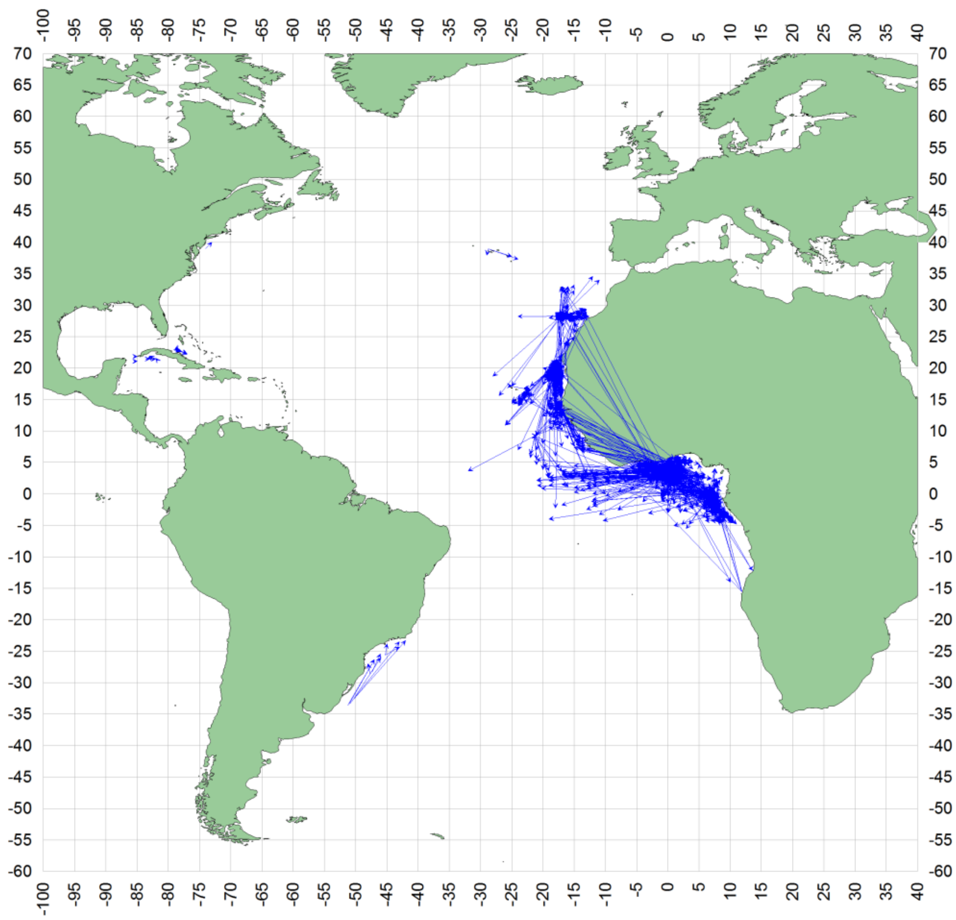
SKJ-Figure 11. Changes in the average weight of skipjack in the eastern (black) and western Atlantic (red).



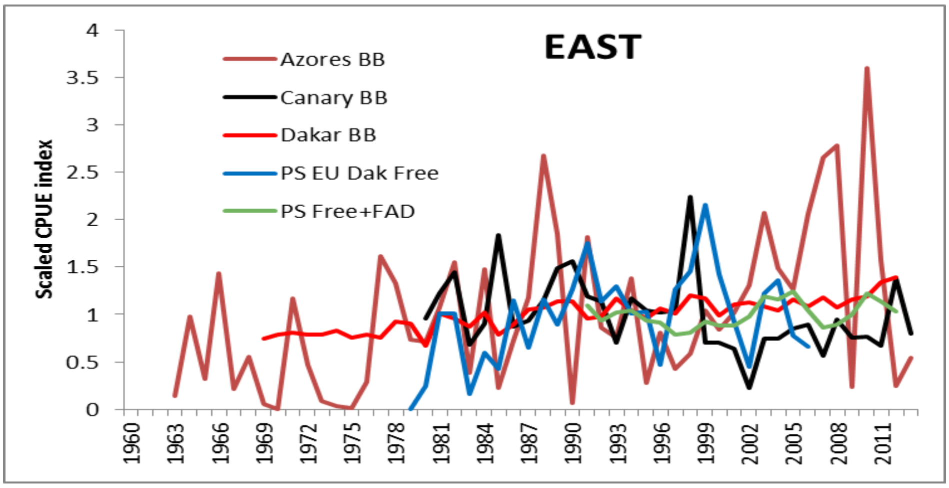
SKJ-Figure 12. Distribution of skipjack catch-at-size by size class (2 cm FL size bin) and year for the eastern Atlantic stock. Each bubble represents the proportion of catch weight stratified by size bin and year. The size limits of ages 1 and 2 are indicated by the horizontal lines (blue).



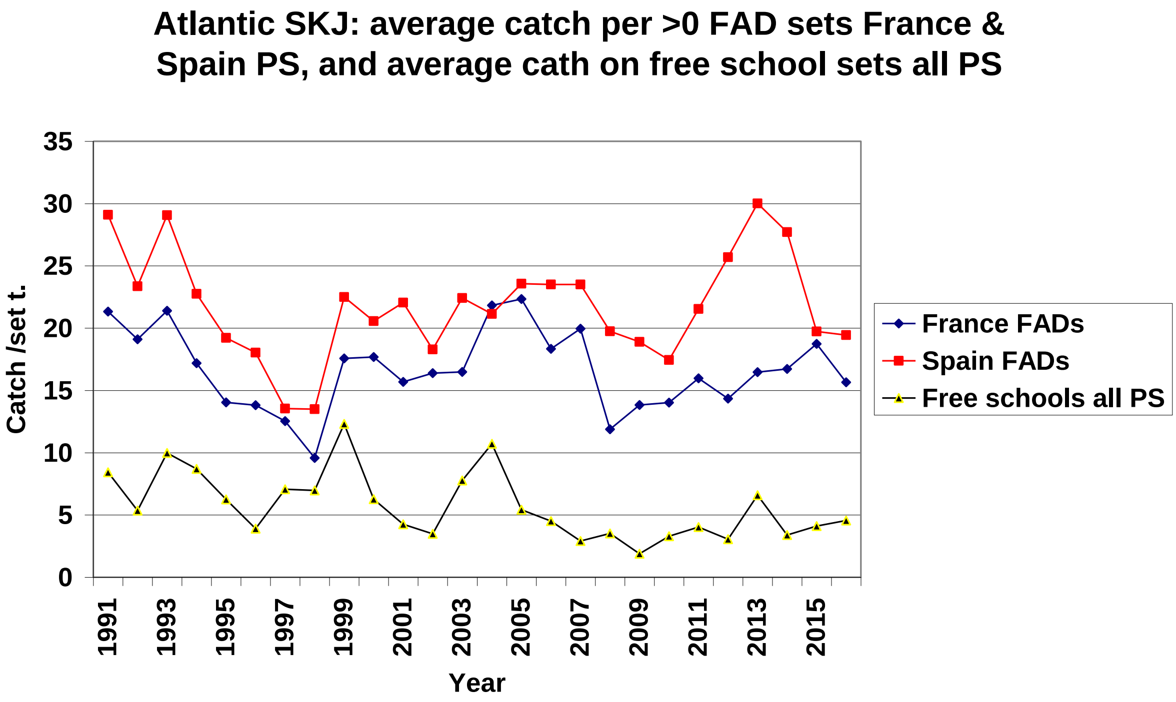
SKJ-Figure 13. Distribution of skipjack catch-at-size by size class (2 cm FL size bin) and year for the western Atlantic stock. Each bubble represents the proportion of catch weight stratified by size bin and year.



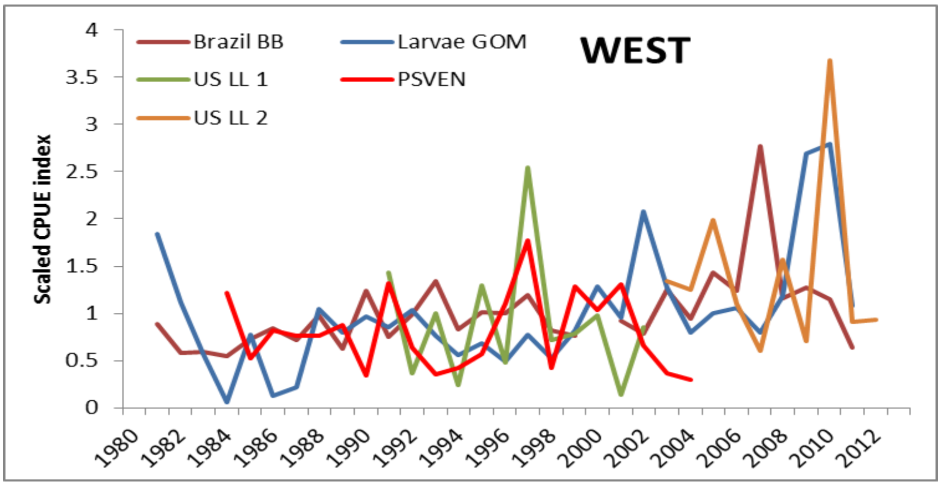
SKJ-Figure 14. Apparent movements (straight line distance between the tagging location and that of recovery) calculated from conventional tagging.



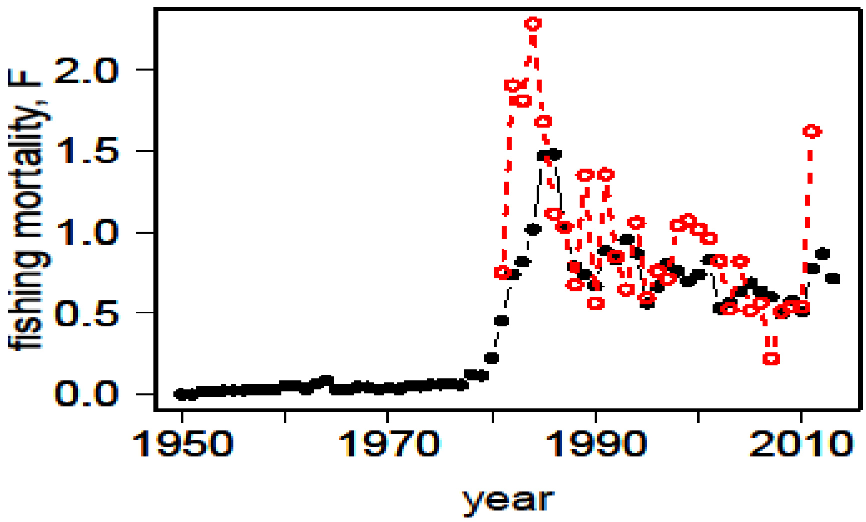
SKJ-Figure 15. Relative abundance indices for the eastern skipjack stock. Each index has been adjusted to its own average level given that to resolve problems regarding scaling, the indices for purse seine have been adjusted to the same level as the Azorean baitboat series.



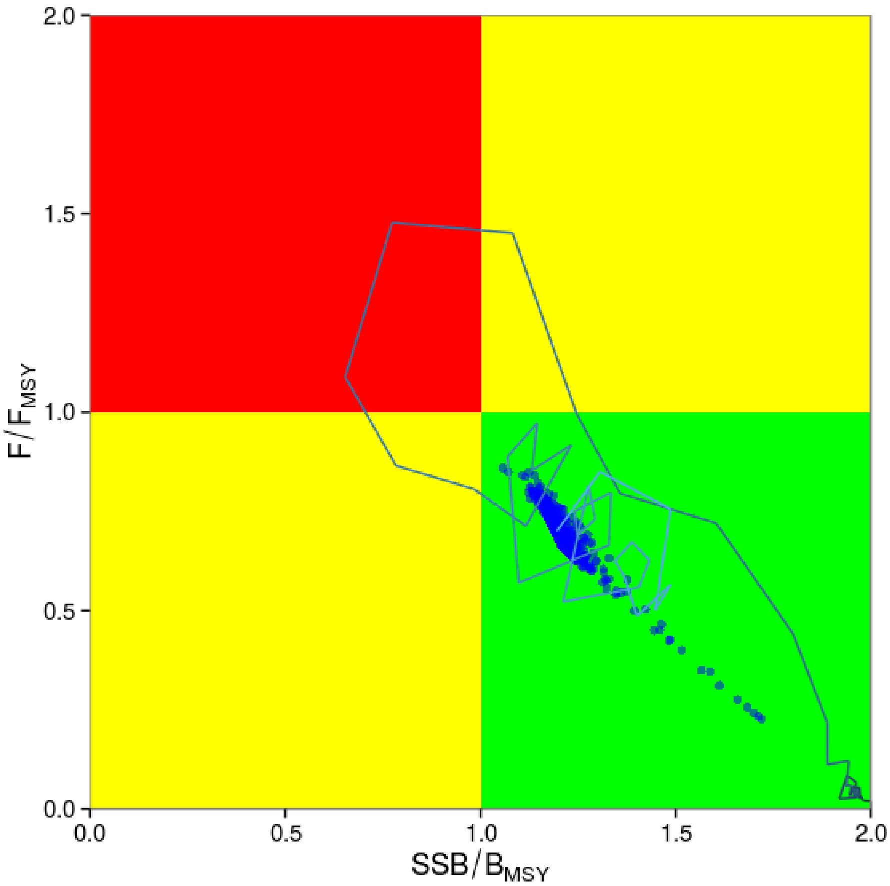
SKJ-Figure 16. Catches by set (t) of eastern Atlantic skipjack and on FADs (France and Spain + other CPCs fleets) and on free schools (all purse seiners).



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. 2017b).

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. 2017c).

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 tuna, 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 2017 was 28,310 t (above the TAC of 28,000 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 13,806 t, which is among the lowest values in the time series. 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 by-catch in tropical tuna-directed longline fisheries. Albacore is only caught as by-catch 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 by-catch 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 five 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 2017, the reported landings were 2,780 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 year 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, only two of the three indices (namely, the larval index and the Spanish longline index) were preliminarily updated. The larval index still showed a general decreasing trend in the last years, while the Spanish longline index 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) or the current TAC (28,000 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. 2017c).

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

In 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 also when $B_{CUR}>B_{LIM}$ and $B_{CUR}<B_{THR}$, and iv) the effect of 20% maximum TAC reduction and 25% maximum TAC increase when $B_{CUR}>B_{LIM}$ and $B_{CUR}<B_{THR}$. Results indicate that the HCR adopted in 17-04 and its new variants 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. The carry over effect was tested assuming that historical differences between catch and TAC (see **ALB-Figure 2A**) would remain in the future, and the Committee notes that the results of the analyses might differ under other assumptions. The three other scenarios (ii, iii, iv) led to more stability together with comparable yield and stock condition (**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 or TAC 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 in 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 are based on the same MSE framework and suggest that the Commission could adopt any of the variants (*a*, *b* or *c*) mentioned in paragraph 16 of Rec. 17-04, which would provide additional stability to the fisheries while meeting management objectives. However, the Committee noted that imposing the minimum TAC of 15,000 t 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. Finally, it should be noted that there is an extensive workplan to improve the MSE framework used in the evaluation of HCRs based on the recommendations of the external review.

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 (2017) Yield	28, 310 t	13,806 t	2,780 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.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				73086	71812	67517	60379	59585	59039	67063	70088	69919	60095	61467	53378	57728	67407	48794	42320	41663	40857	48796	53008	45594	42757	44197	48995	44896
	ATN			38135	35163	38377	28803	29023	25746	34551	33124	26253	22741	25567	25960	35318	36989	21991	20483	15375	19509	20039	25680	24633	26655	25443	30340	28310
	ATS			32813	35300	27552	28426	28022	30595	27656	31387	38796	31746	28002	22543	18882	24453	20283	18867	22265	19225	24129	25282	19457	13702	15199	14336	13806
	MED			2138	1349	1587	3150	2541	2698	4856	5577	4870	5608	7898	4874	3529	5965	6520	2970	4024	2124	4628	2047	1503	2400	3554	4319	2780
Landings	ATN		Bait boat	15646	11967	16411	11338	9821	7562	8780	11072	6103	6638	7840	8128	10458	14273	8496	7931	4994	6026	5530	8816	4975	7341	9265	14455	12196
			Longline	7093	7309	4859	4641	4051	4035	6710	7321	7372	6180	7699	6917	6911	5223	3237	2647	2619	3913	3666	3759	6514	3093	4458	5394	4952
			Other surf.	7279	7506	3555	3337	4378	6846	6817	5971	2828	420	551	697	624	625	525	274	427	324	412	352	596	163	28	96	48
			Purse seine	229	292	278	263	26	91	56	191	264	118	211	348	99	188	198	70	84	74	0	167	7	35	115	45	38
			Trawl	1779	2131	3049	2571	2877	1318	5343	3547	5374	5376	3846	2369	7001	6385	3429	4321	2811	2026	6852	6678	6558	9184	5771	6299	6611
			Troll	6109	5959	10226	6652	7870	5894	6845	5023	4312	4009	5419	7501	10224	10296	6105	5239	4440	7146	3578	5909	5891	6660	5597	3751	4164
	ATS		Bait boat	7379	9339	7091	6960	8110	10353	6709	6873	10355	9712	6973	7475	5084	5876	3375	4350	7926	3748	5938	6931	5211	4765	4965	2949	1846
			Longline	23947	24806	20040	21000	19547	19799	20640	24398	28039	21671	20626	14735	12977	17740	15087	13218	12113	13471	16445	17846	13888	8888	10104	11243	11656
			Other surf.	39	91	10	209	127	0	73	58	377	323	82	299	288	395	1762	1219	2066	1651	1538	66	266	7	0	108	114
			Purse seine	1448	1064	412	257	117	434	183	58	25	39	309	16	534	442	58	81	160	355	208	437	91	42	129	36	190
			Trawl	0	0	0	0	120	9	52	0	0	0	12	18	0	0	0	0	0	0	0	0	0	0	0	0	
	MED		Bait boat	231	81	163	205	0	33	96	88	77	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Longline	410	350	87	391	348	194	416	2796	2597	3704	4248	2335	1997	3026	4101	2694	2160	1719	2327	1959	1392	2343	3235	4258	2706
			Other surf.	879	766	1031	2435	1991	2426	4271	2693	2196	1757	46	87	169	134	182	246	634	404	1408	8	18	27	58	29	46
			Purse seine	559	23	0	0	0	0	0	0	0	1	3557	2452	1362	2803	2237	24	1230	0	869	68	86	14	247	7	26
			Trawl	0	0	0	0	0	0	0	0	0	0	48	0	0	0	0	5	0	0	0	0	0	5	4	9	0
			Troll	59	129	306	119	202	45	73	0	0	117	0	0	0	1	0	1	0	1	0	6	0	3	0	0	2
Discards	ATN		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	179	209	300	302
	ATS		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	0	25	6	7	8	10	16	
Landings	ATN	CP	Barbados	0	0	0	0	1	1	1	0	2	5	8	10	13	9	7	7	4	6	4	20	22	13	16	38	32
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	26	39	416	351	155	230	79	1	399	448
			Brazil	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Canada	9	32	12	24	31	23	38	122	51	113	56	27	52	27	25	33	11	14	28	34	32	47	32	20	17
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	**0**
			China PR	0	14	8	20	0	0	21	16	57	196	155	32	112	202	59	24	27	142	101	21	81	35	21	103	124
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	53	39	146	0	0	0	151	549
			EU.España	18380	16998	20197	16324	17295	13285	15363	16000	9177	8952	12530	15379	20447	24538	14582	12725	9617	12961	8357	13719	10502	11607	14126	17077	13964
			EU.France	6293	5934	5304	4694	4618	3711	6888	5718	6006	4345	3456	2448	7266	6585	3179	3009	1122	1298	3348	3361	4592	6716	3441	4224	4191
			EU.Ireland	1946	2534	918	874	1913	3750	4858	3464	2093	1100	755	175	306	521	596	1517	1997	788	3597	3575	2231	2485	2390	2337	2492
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	
			EU.Portugal	3385	974	6470	1634	395	91	324	278	1175	1953	553	513	556	119	184	614	108	202	1046	1231	567	2609	929	1111	2527
			EU.United Kingdom	499	613	196	49	33	117	343	15	0	0	0	0	6	19	30	50	67	118	57	50	133	136	31	0	0
			FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	4	0	7	2	0	3	0	0	0	0	0	0	0	0	0	**0**
			Grenada	0	0	2	1	6	7	6	12	21	23	46	25	29	19	20	15	18	18	18	0	0	0	0	0	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	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	485	505	386	466	414	446	425	688	1126	711	680	893	1336	781	288	402	288	525	336	400	1745	267	276	297	368
			Korea Rep.	8	0	2	2	1	0	0	0	0	0	0	0	59	45	12	59	82	110	60	200	184	64	5	13	8
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	
			Maroc	0	0	0	0	0	0	0	0	0	55	81	120	178	98	96	99	130	0	0	0	0	0	0	20	20
			Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	2	0
			Panama	60	117	73	11	5	0	0	0	0	0	0	0	0	96	298	113	45	154	103	0	246	126	103	200	
			Philippines	0	0	0	0	0	151	4	0	0	0	0	0	9	0	8	19	54	0	0	83	0	0	0	0	

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		Sierra Leone	0	0	0	0	0	0	0	0	91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		St. Vincent and Grenadines	2	0	0	0	0	0	1	704	1370	300	1555	89	802	76	263	130	135	177	329	305	286	328	305	291	297
		Trinidad and Tobago	0	0	0	0	2	1	1	2	11	9	12	12	9	12	18	32	17	17	23	47	67	71	95	71	48
		U.S.A.	509	741	545	472	577	829	315	406	322	480	444	646	488	400	532	257	189	315	422	418	599	458	247	252	237
		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	0	1	0	2	2	2	0	0	1	1	0	0	0	0	0	1	0	0	1	0	1	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	2	0	0	**0**
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	414	507	235	95	20	140	187	196	172	228	195	0	0	**0**
		Venezuela	246	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	6300	6409	3977	3905	3330	3098	5785	5299	4399	4330	4557	4278	2540	2357	1297	1107	863	1587	1367	1180	2394	947	2857	3134	2385
		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	0
		Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	249	216	0	0	0	**0**
	NCO	Cuba	0	0	0	0	0	0	0	0	0	1	322	435	424	527	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	3	1	1	
		Dominican Republic	0	0	0	0	323	121	73	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	13	10	8	11	3	8	12	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	1	0	1	1	0	0	0	1	3	2	10	0	2	2	2	2	0	130	2	3	2	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	168	0	5	0	0	**0**
		Belize	0	0	2	0	0	0	8	2	0	0	0	0	0	54	32	31	213	303	365	171	87	98	0	123	219
		Brazil	3613	1227	923	819	652	3418	1872	4411	6862	3228	2647	522	556	361	535	487	202	271	1269	2077	2016	462	490	658	497
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	8	46	24	0	5	0	5	0	0	0	0	0	**0**
		China PR	0	0	0	0	0	0	39	89	26	30	26	112	95	100	35	25	89	97	80	61	65	34	120	94	185
		Curaçao	0	0	0	0	9	192	0	2	0	0	0	0	0	0	0	0	21	4	4	24	0	0	1	14	10
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47	43	45	50	0	0	0	0	**0**
		EU.España	783	831	457	184	256	193	1027	288	573	836	376	81	285	367	758	933	1061	294	314	351	369	259	418	195	347
		EU.France	564	129	82	190	38	40	13	23	11	18	63	16	478	347	12	50	60	109	53	161	73	38	53	17	78
		EU.Portugal	483	1185	655	494	256	124	232	486	41	433	415	9	43	8	13	49	254	84	44	11	1	3	1	9	9
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
		Ghana	0	0	0	0	0	0	0	0	0	0	53	0	0	0	5	10	14	25	0	0	0	0	0	0	**0**
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	56	0	0	15	0	1	3	1
		Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	
		Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	74	0	0	0	0	
		Honduras	0	0	2	0	7	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	467	651	389	435	424	418	601	554	341	231	322	509	312	316	238	1370	921	973	1194	2903	3106	1131	1752	1096	1194
		Korea Rep.	20	3	3	18	4	7	14	18	1	0	5	37	42	66	56	88	374	130	70	89	33	2	4	48	86
		Maroc	68	24	24	0	5	4	0	0	0	14	0	0	7	0	0	0	0	0	0	0	0	0	0	0	**0**
		Namibia	0	1111	950	982	1199	1429	1162	2418	3419	2962	3152	3328	2344	5100	1196	1958	4936	1320	3791	2420	848	1057	1062	994	214
		Panama	318	458	228	380	53	60	14	0	0	0	0	0	17	0	87	5	6	1	0	12	3	0	6	5	13
		Philippines	0	0	0	0	0	5	4	0	0	0	0	0	52	0	13	79	45	95	96	203	415	18	0	0	
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	**0**
		South Africa	6881	6931	5214	5634	6708	8412	5101	3610	7236	6507	3469	4502	3198	3735	3797	3468	5043	4147	3380	3553	3510	3719	4030	2065	1762
		St. Vincent and Grenadines	0	29	30	41	0	23	0	2116	4303	44	0	0	0	65	160	71	51	31	94	92	97	110	100	107	101
		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	0	1	5	1	1	1	2	8	2	1	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	38	5	82	47	18	1	1	58	12	2	0	0	0	62	46	94	81	3	120	2	2	0	0	0	**0**
		Uruguay	28	16	49	75	56	110	90	90	135	111	108	120	32	93	34	53	97	24	37	12	209	0	0	0	**0**
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	684	1400	96	131	64	104	85	35	83	91	0	0	**0**
	NCC	Chinese Taipei	19400	22573	18351	18956	18165	16106	17377	17221	15833	17321	17351	13288	10730	12293	13146	9966	8678	10975	13032	12812	8519	6675	7157	8907	9090
	NCO	Argentina	0	2	0	0	120	9	52	0	0	0	12	18	0	0	0	0	0	130	43	0	0	0	0	0	
		Cambodia	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			NEI (ETRO)	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	146	123	102	169	47	42	38	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	0	2	7	12	20	30	11	7	2
			EU.Cyprus	0	0	0	0	0	0	0	6	0	12	30	255	425	507	712	209	223	206	222	315	350	377	495	542	568
			EU.España	298	218	475	429	380	126	284	152	200	209	1	138	189	382	516	238	204	277	343	389	244	283	53	51	206
			EU.France	64	23	3	0	5	5	0	0	0	1	0	0	0	0	2	1	0	1	2	0	0	1	1	0	
			EU.Greece	1	1	0	952	741	1152	2005	1786	1840	1352	950	773	623	402	448	191	116	125	126	126	165	287	541	1332	608
			EU.Italy	1275	1107	1109	1769	1414	1414	2561	3630	2826	4032	6913	3671	2248	4584	3970	2104	2727	1109	2501	1117	615	1353	1602	1490	1348
			EU.Malta	0	0	0	0	1	1	6	4	4	2	5	10	15	18	1	5	1	2	5	19	29	62	37	56	4
			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	0	2	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	0	750	800	
			Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120	0	0	0	0	0	0	0	**0**
			Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	14	0	0	0	1	1	0	0	0	
			Turkey	0	0	0	0	0	0	0	0	0	0	0	27	30	73	852	208	631	402	1396	62	71	0	53	25	44
		NCO	NEI (MED)	500	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	
			Venezuela	0	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	0	1	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	0	25	6	7	8	10	16	
			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 $B>B_{MSY}$

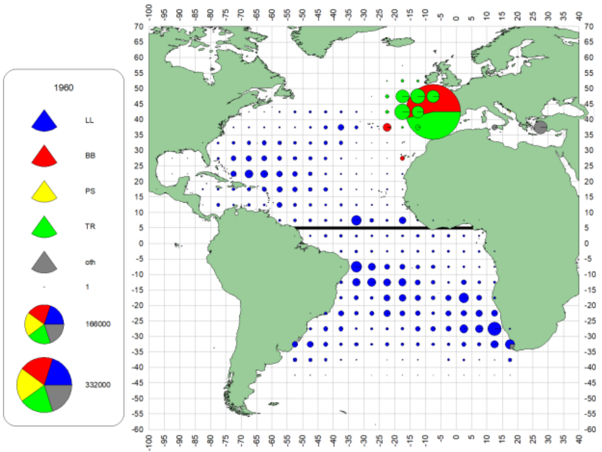
Catch (t)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
12,000	75	80	94	95	96	96	96	96	96	96	96	96	96
14,000	75	79	93	95	95	95	95	96	96	96	96	96	96
16,000	75	78	91	94	94	95	95	95	95	95	95	95	95
18,000	75	77	87	93	93	94	94	94	94	95	95	95	95
20,000	75	76	81	90	91	92	92	92	92	92	92	91	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

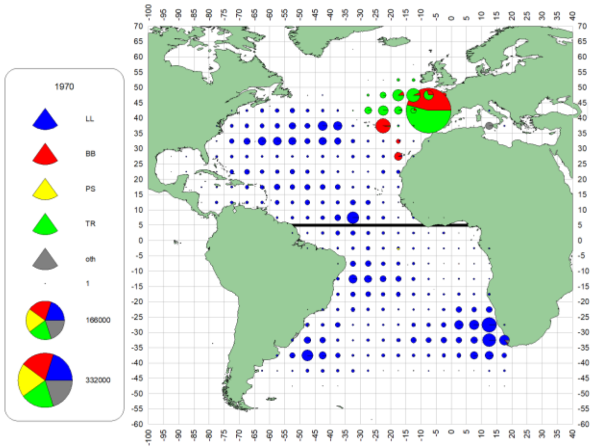
(c) Probability of green status ($B>B_{MSY}$ and $F<F_{MSY}$).

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

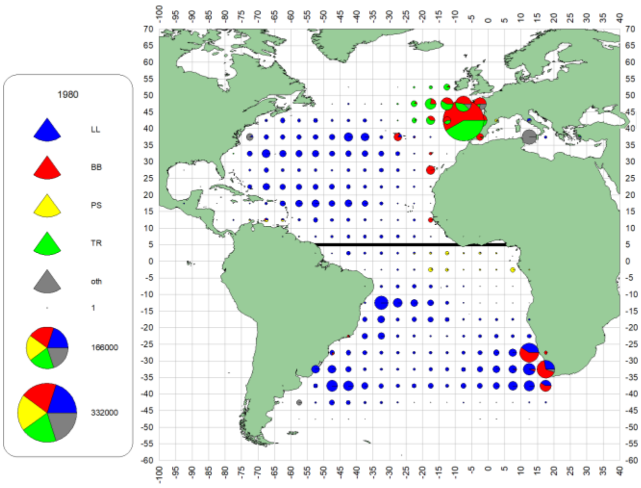
F	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
0.75*FMSY	75	76	89	90	90	91	91	92	92	92	92	92	92
0.80*FMSY	74	75	86	88	89	89	89	89	89	89	90	90	90
0.85*FMSY	72	73	81	85	86	86	86	86	86	86	86	86	86
0.90*FMSY	69	69	74	81	81	82	82	82	82	82	82	82	82
0.95*FMSY	64	64	65	73	75	75	77	77	77	77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



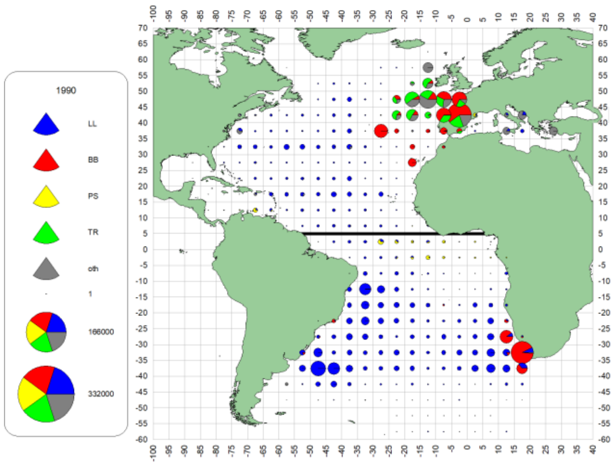
a. ALB (1960-69)



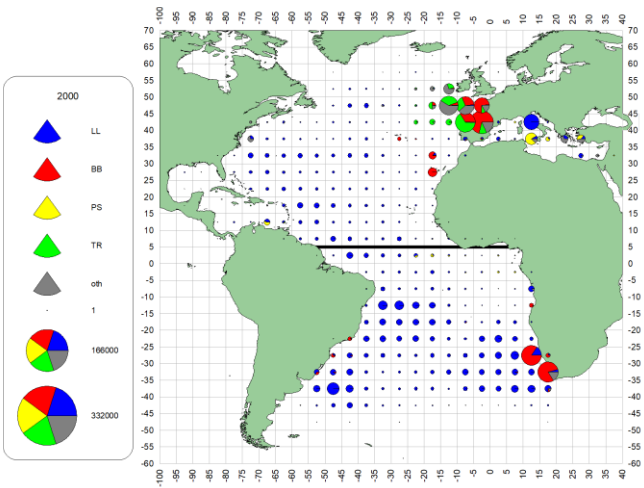
b. ALB (1970-79)



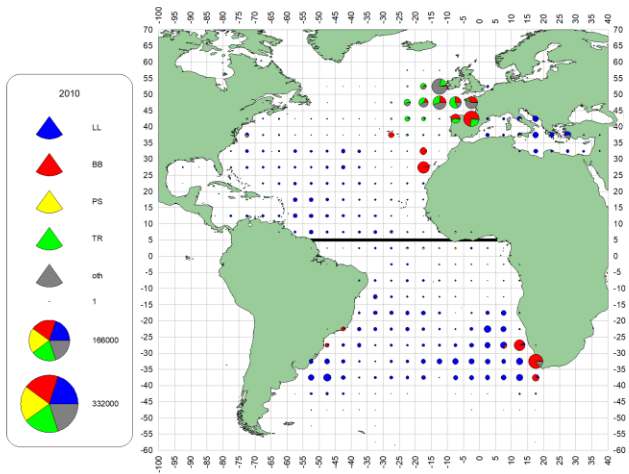
c. ALB (1980-89)



d. ALB (1990-99)



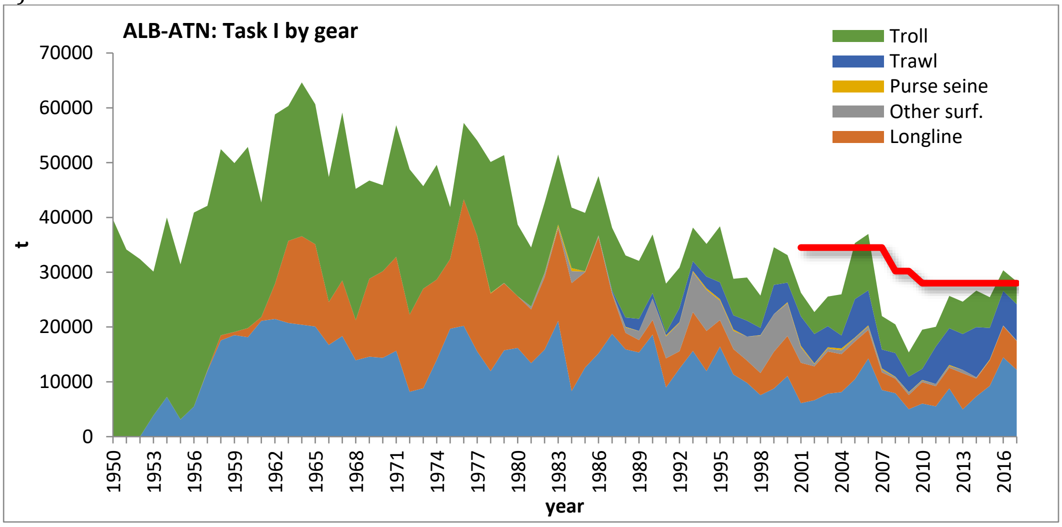
e. ALB (2000-09)



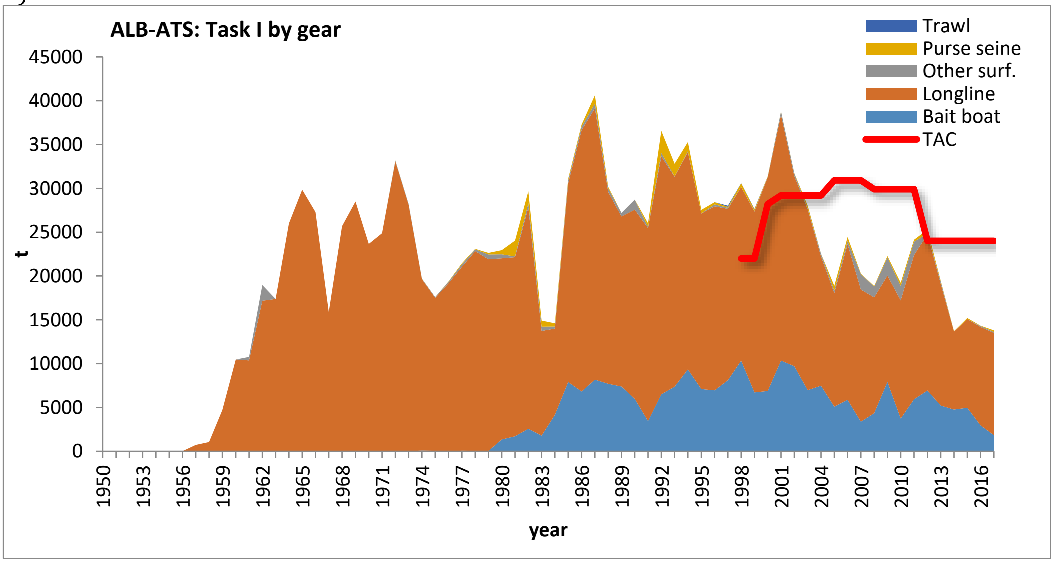
f. ALB (2010-16)

ALB-Figure 1. Geographic distribution of albacore accumulated catch by major gears and decade (1960-2016). 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 2016 (last decade only covers 7 years).

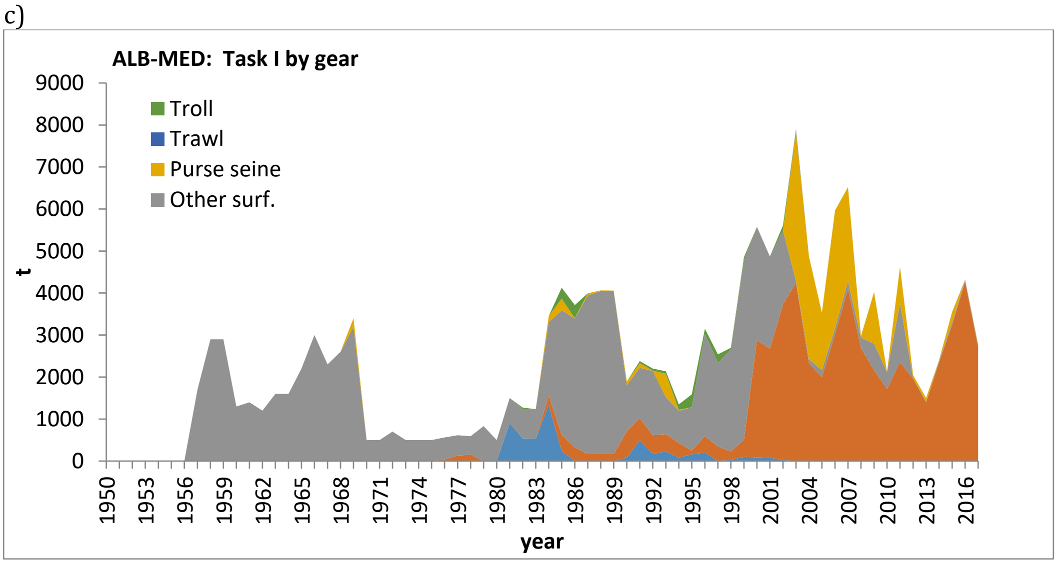
a)



b)

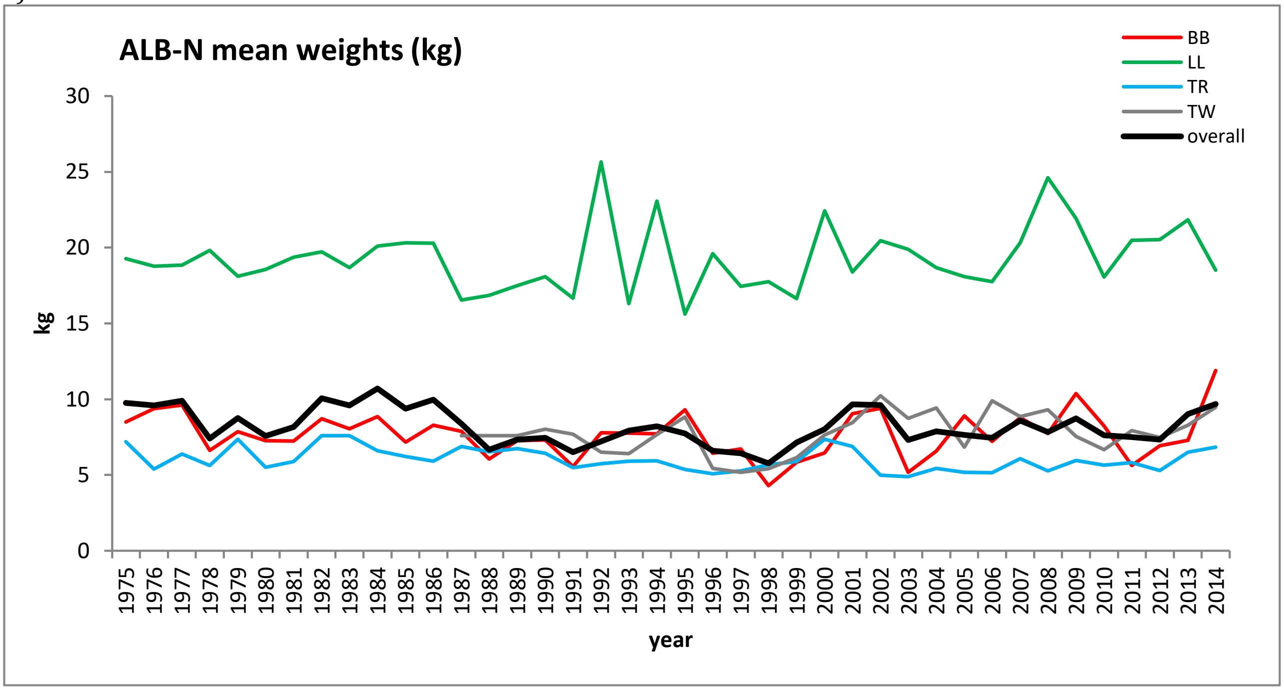


c)

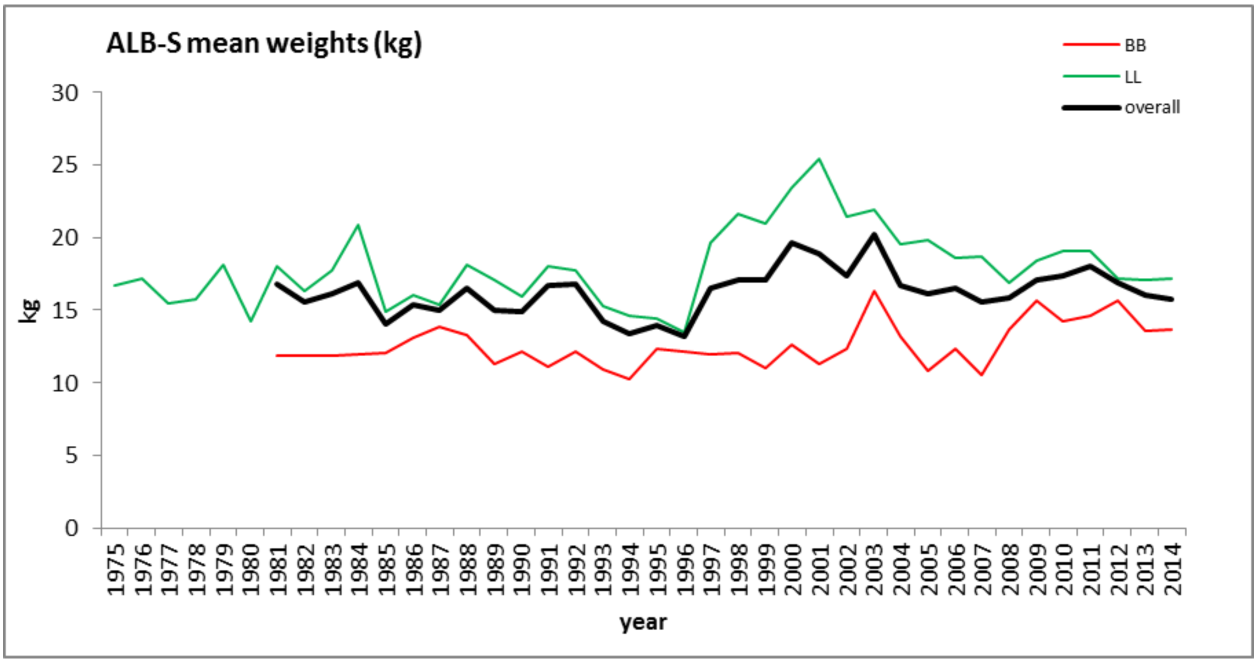


ALB-Figure 2a, b, c. Total albacore catches reported to ICCAT (Task I) by gear for the northern, southern Atlantic stocks including TAC, and the Mediterranean stock.

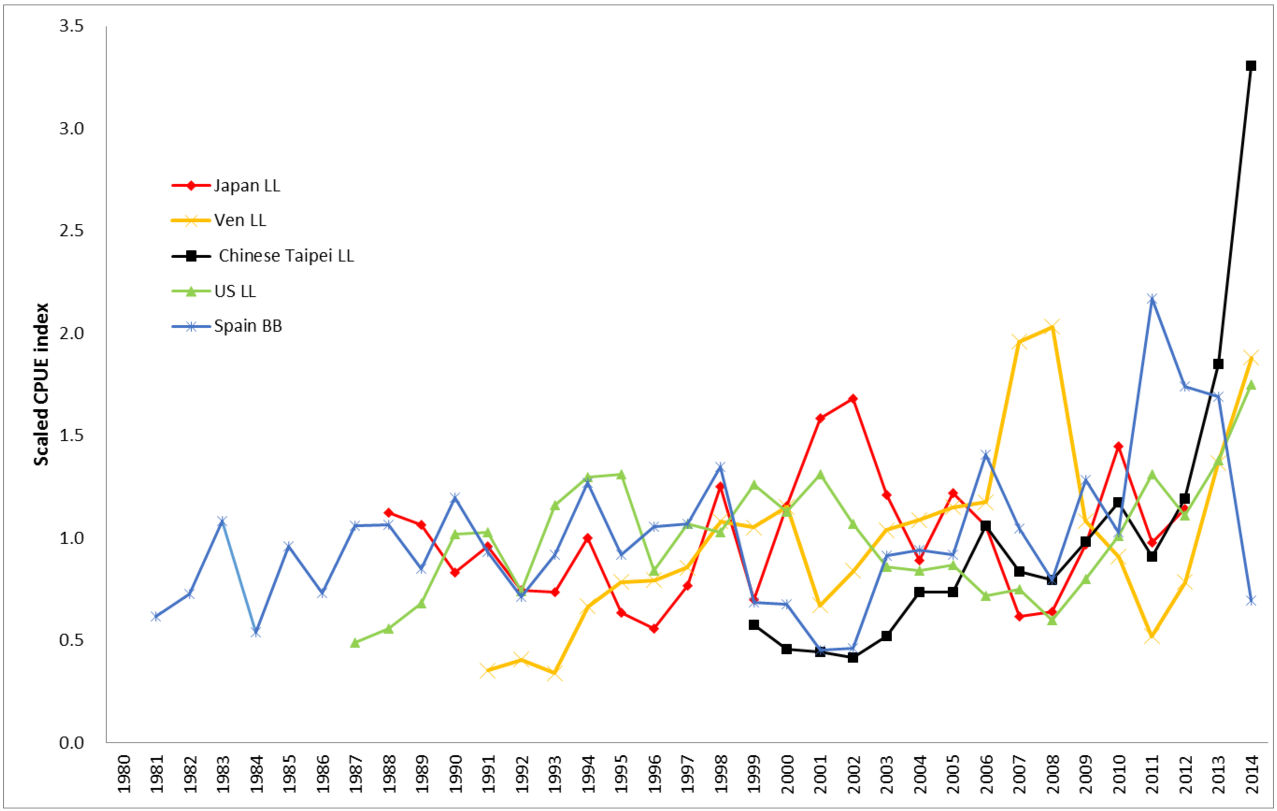
a)



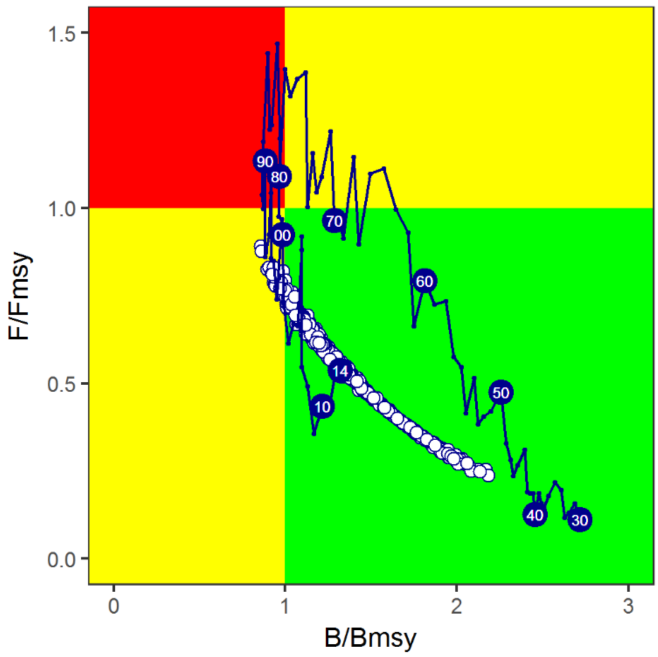
b)



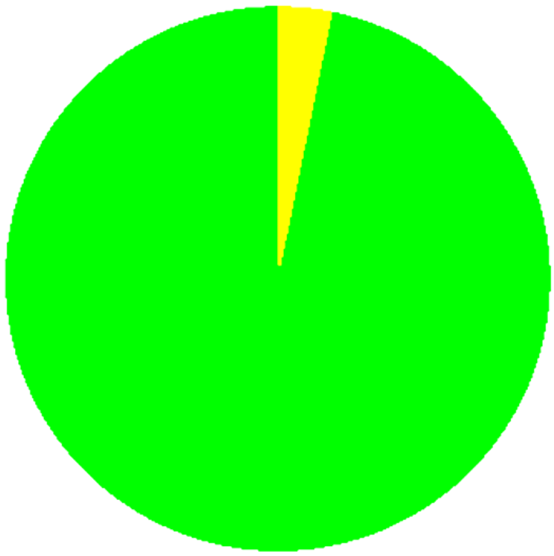
ALB-Figure 3a, b. Mean weight trend by surface and longline fisheries in North Atlantic (a) and South Atlantic (b) stocks. The baitboat fishery in the South Atlantic started in 1979 and mean weights are provided from 1980 onwards.



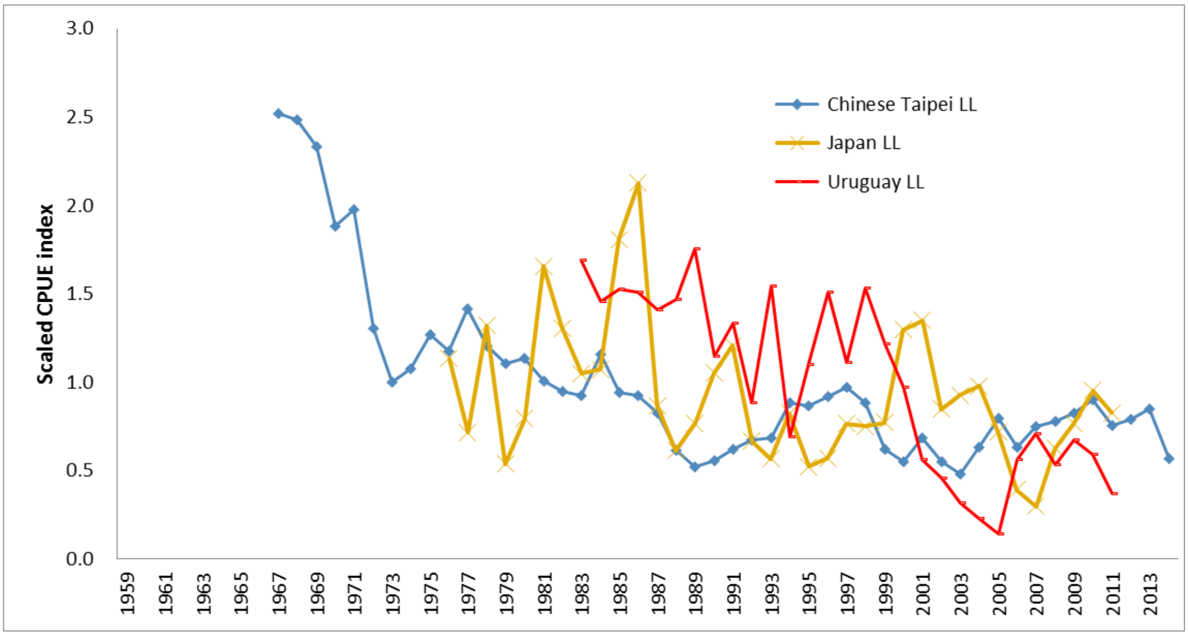
ALB-Figure 4. North Atlantic albacore. Standardized catch rate indices used in the 2016 stock assessment from the surface fisheries, which take mostly juvenile fish, and from the longline fisheries, which take mostly adult fish.



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.

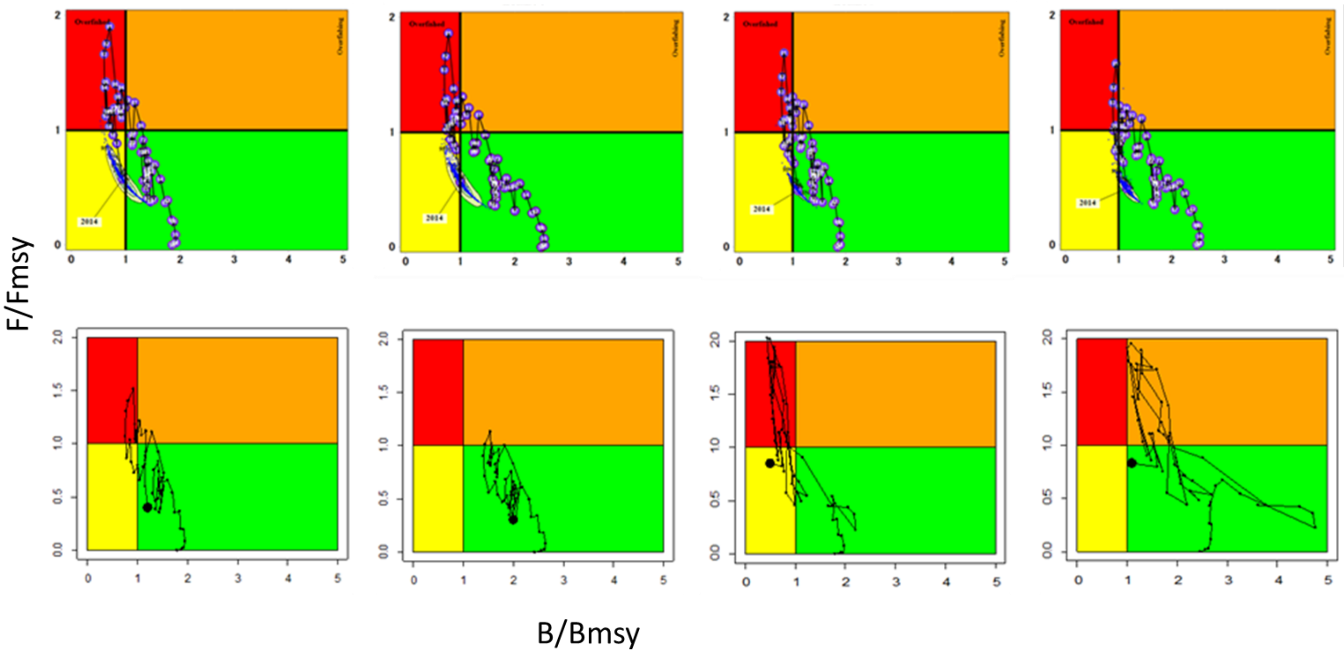


ALB-Figure 6. North Atlantic albacore probability of being overfished and overfishing (red, 0%), of being neither overfished nor overfishing (green, 96.8%), and of being overfished (yellow, 3.2%), according to the Base Case.

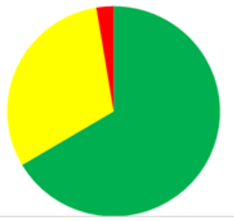


ALB-Figure 7. South Atlantic albacore. Standardized catch rates used in the 2016 stock assessment.

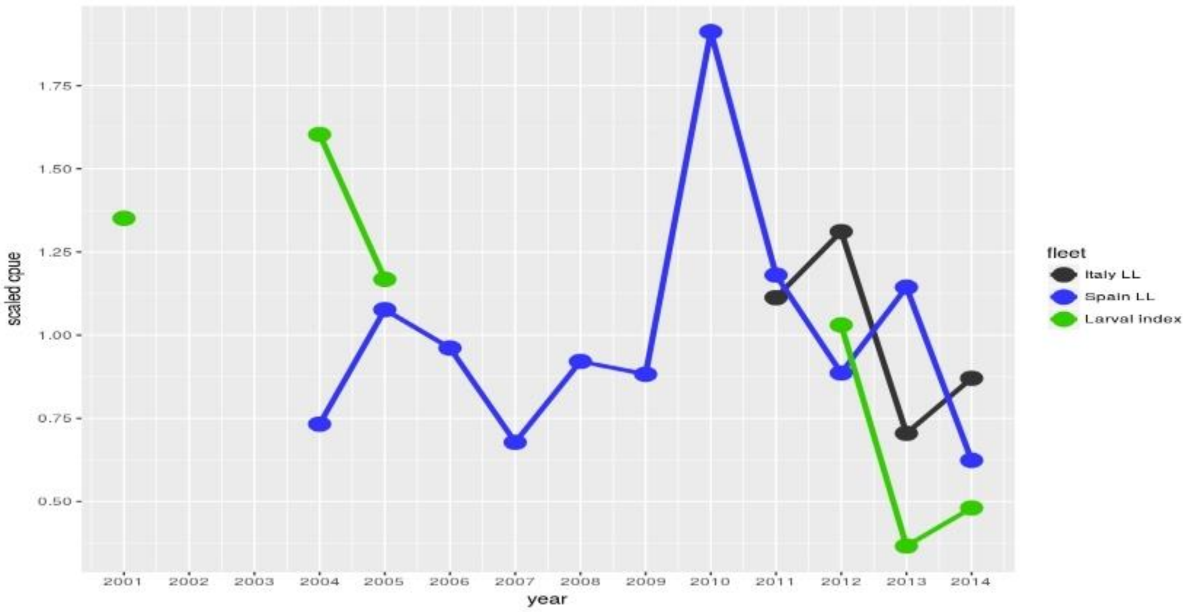
a)



b)

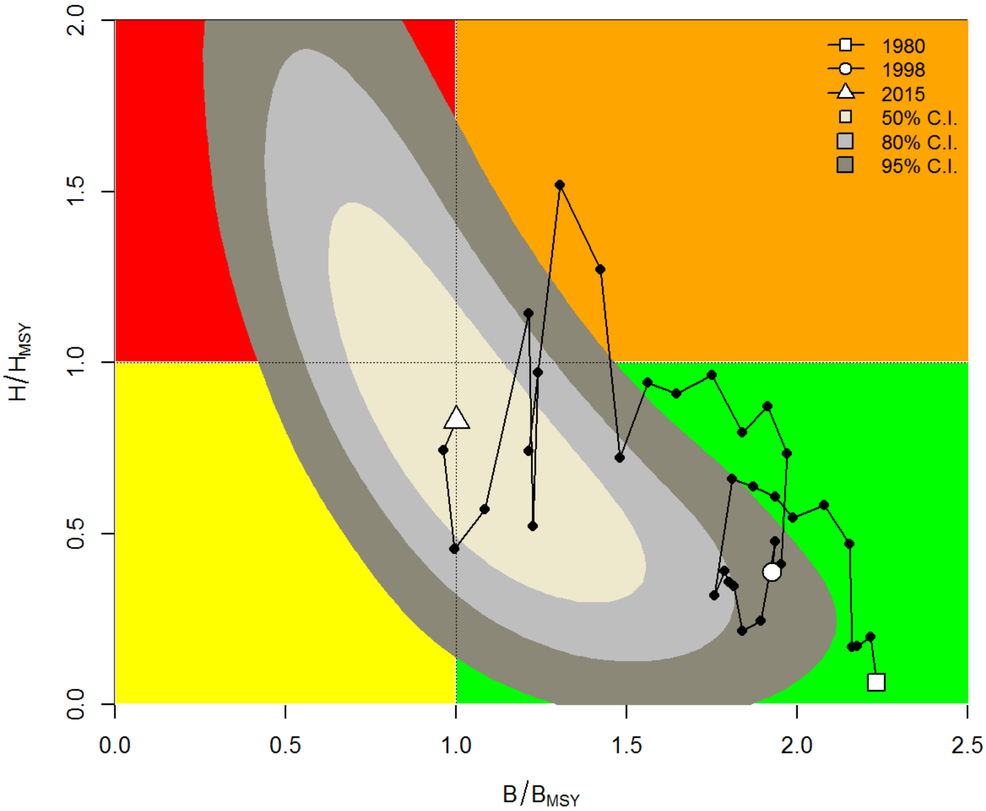


ALB-Figure 8. South Atlantic albacore. a) Stock status trajectories of B/B_{MSY} and F/F_{MSY}, as well as uncertainty around the current estimate (Kobe plots) for the base case ASPIC models (upper row) alongside those from the base case BSP runs (bottom row). From left to right, boxes indicate the following 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%).

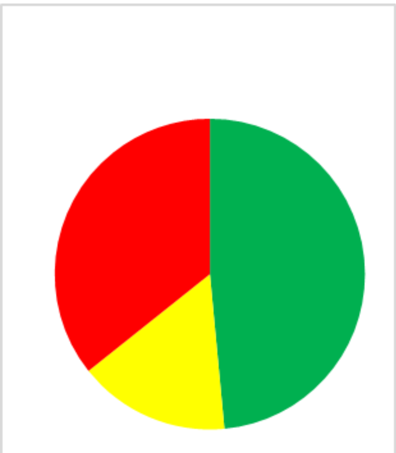


ALB-Figure 9. Set of abundance indices used in the 2017 assessment of the Mediterranean albacore stock.

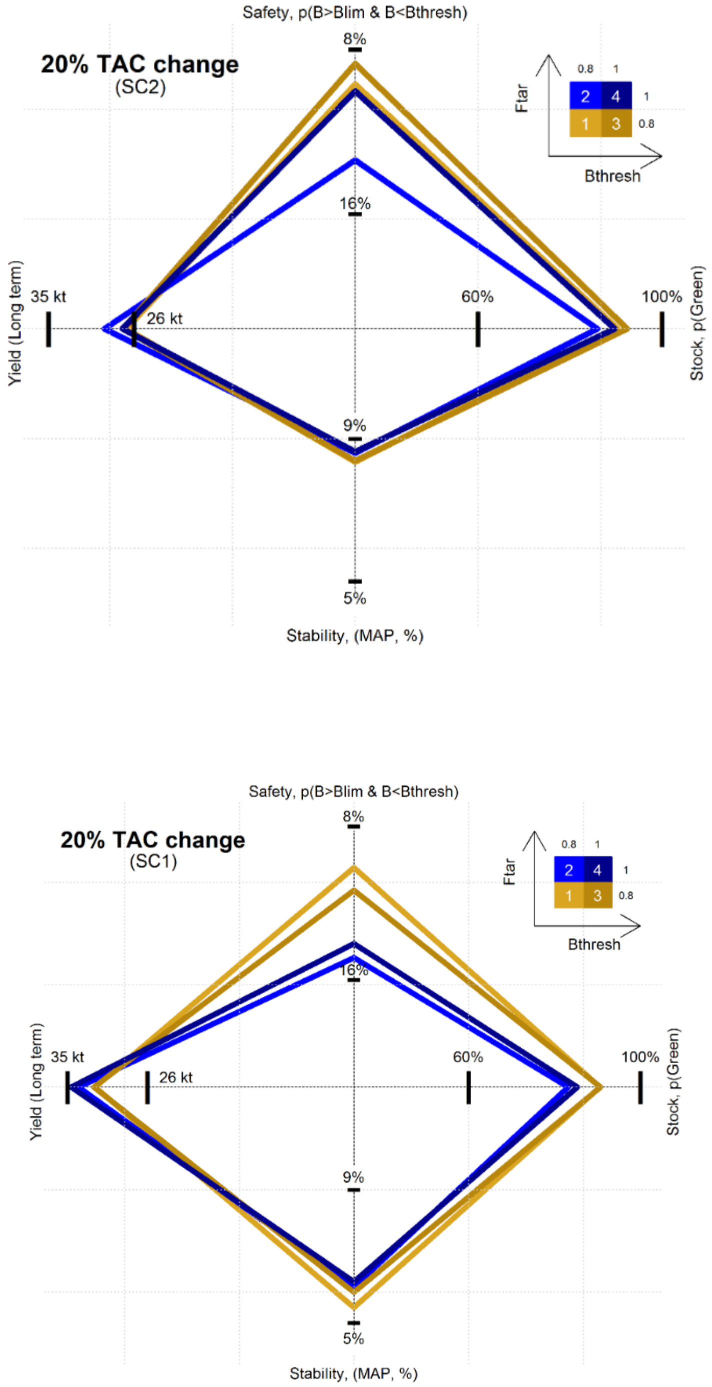
a)



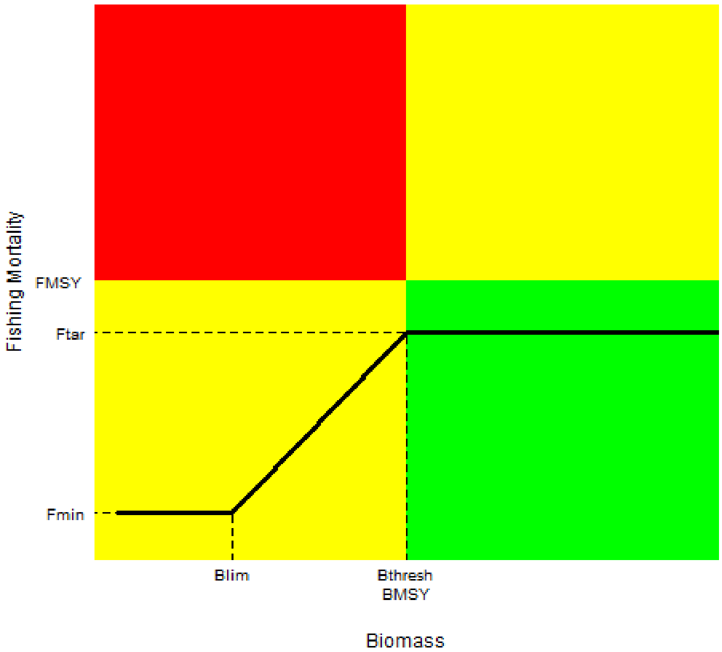
b)



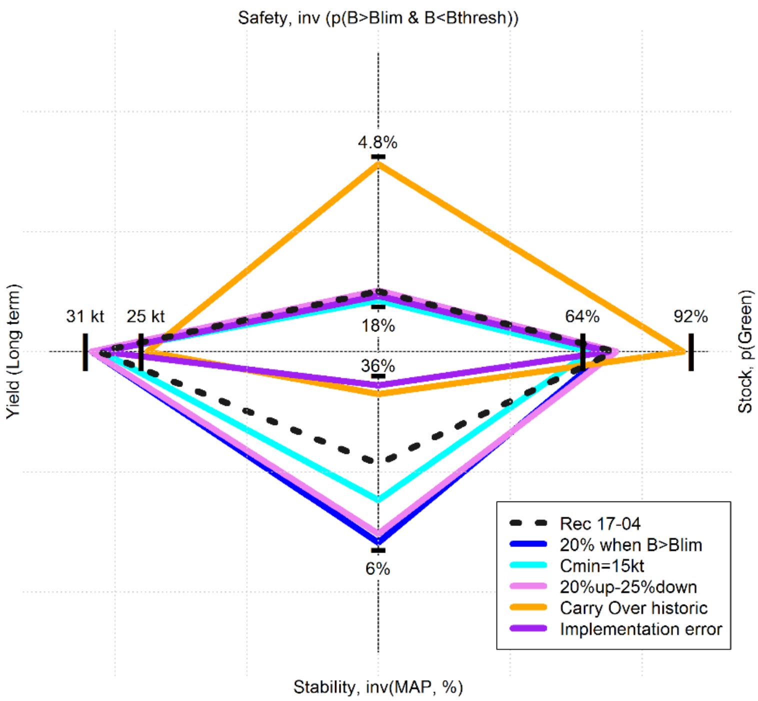
ALB-Figure 10. Mediterranean albacore. a) Stock status trajectories of B/B_{MSY} and F/F_{MSY}, as well as uncertainty around the current estimate (Kobe plots) for the base case JABBA model. (b) Probability of being overfished and overfishing (red, 36%), of being neither overfished nor overfishing (green (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<BTHRESHOLD. 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 (orange), the effect of setting a lower TAC limit of 15000 t (light blue), the effect of applying the 20% stability clause also when $B_{CUR}>B_{LIM}$ and $B_{CUR}<B_{THR}$ (dark blue), and the effect of 25% maximum TAC reduction and 20% maximum TAC increase when $B_{CUR}>B_{LIM}$ and $B_{CUR}<B_{THR}$ (pink). The purple scenario represents an extreme scenario of imperfect implementation of the TAC.

9.5 BFT – ATLANTIC BLUEFIN TUNA

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, 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, have been calibrated between readers from several institutions resulting in stock specific age length keys and a new growth model for the western population.

Currently, the SCRS 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 SCRS considered two spawning schedules; one identical to that used for the East and one with peak spawning at age 15. 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 at 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.

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.

The two stocks share several characteristics (e.g. biological, environmental) and the natural mortality rate have to be similar in magnitude and decline with age. Thus, the Committee revised the natural mortality assumptions and adopted a single new age specific natural mortality curve for both stocks.

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 2013 and 2017 were, 13,243 t, 13,261 t, 16,201 t, 19,131 t, and 23,616 t for the East Atlantic and Mediterranean, of which, 9,080 t, 9,343 t, 11,360 t, 13,163 t and 16,401 t was reported for the Mediterranean for those same years (**BFT-Table 1**).

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 likely was on 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 uses these estimates (1996-2007) rather than the declared catches.

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.

During the 2017 stock assessment meeting, 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 2017 (**BFTE-Figure 3**). The Committee anticipates that additional indices could be used for tracking the abundance of the stock (e.g. GBYP aerial survey).

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 4**). 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 4**). This result is 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 4**) 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.

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

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 5**). 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 5**).

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. It is too early since the associated TACs have been implemented to be able to evaluate the effect on the resource.

The Committee noted that reported catches are in line with recent TACs due to current monitoring and enforcement controls.

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 2017 advice included a recommendation to evaluate indices annually to advise on the continuation of the stepped increase. The indices which have been updated up to 2017 did not clearly indicate any change in the stock abundance. Consequently, the Committee is of the view that the stepped increase for 2019 from Rec 17-07 can be maintained.

Given the abundance increase reported in 2017 assessment, the Committee advises that the Commission should consider moving from the current rebuilding plan to a management plan, while not weakening the current monitoring and control measures. The indices that have been updated through 2017 provided no clear indication to deviate from this advice.

EAST ATLANTIC AND MEDITERRANEAN BLUEFIN TUNA SUMMARY	
Current reported yield (2017)	23,616 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. 17-07 TAC 2018-2020	28, 200 - 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 28 September 2018.

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

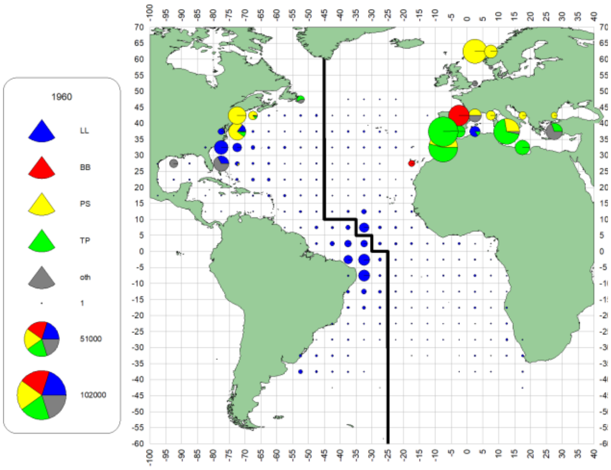
				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				36642	48881	49751	54009	53545	52657	52772	52775	52784	53319	52305	52125	51756	51812	62638	26460	21798	13195	11781	12688	14725	14887	18042	21032	25467
BFT-E				34258	46769	47303	51497	51211	50000	50000	50000	50000	50000	50000	50000	50000	50000	61000	24460	19818	11338	9774	10934	13243	13261	16201	19131	23616
	ATE			9317	7054	9780	12098	16379	11630	10247	10061	10086	10347	7396	7410	9039	7802	8441	8243	6684	4379	3984	3834	4163	3918	4841	5968	7216
	MED			24941	39715	37523	39399	34831	38370	39753	39939	39914	39653	42604	42590	40961	42198	52559	16217	13133	6959	5790	7100	9080	9343	11360	13163	16401
BFT-W	ATW			2384	2113	2448	2512	2334	2657	2772	2775	2784	3319	2305	2125	1756	1811	1638	2000	1980	1857	2007	1754	1482	1627	1842	1901	1851
Landings	ATE		Bait boat	3884	2284	3093	5369	7215	3139	1554	2032	2426	2635	1409	1902	2282	1263	2436	2393	1260	725	636	283	243	95	172	1085	1195
			Longline	2802	2311	4522	4212	4057	3789	3570	3736	3303	2896	2750	2072	2716	2306	1705	2491	1951	1194	1125	1139	1167	1194	1467	1829	2208
			Other surf.	976	590	555	273	60	387	404	509	558	631	521	290	424	831	502	181	297	124	35	49	141	210	193	261	295
			Purse seine	24	213	458	323	828	700	726	661	153	887	490	1078	1197	408	0	0	2	1	0	0	2	0	0	42	49
			Sport (HL+RR)	0	25	0	0	237	28	33	126	61	63	109	89	11	99	11	12	11	44	51	53	46	43	104	35	101
			Traps	1631	1630	1152	1921	3982	3586	3960	2996	3585	3235	2116	1978	2408	2895	3788	3166	3164	2292	2137	2311	2564	2376	2905	2716	3363
	MED		Bait boat	48	0	206	5	4	11	4	38	28	1	9	17	5	0	0	0	38	1	0	2	2	9	25	0	50
			Longline	2470	6993	8469	9856	7313	4117	3338	3424	4144	3234	3482	3028	3411	3135	3269	2376	1344	1242	962	587	605	588	776	1523	1184
			Other surf.	371	776	545	417	282	284	228	728	354	340	198	197	175	81	85	0	0	1	1	1	20	29	3	37	90
			Purse seine	20065	27948	23799	26021	24279	31792	33798	33237	33043	34044	37291	37869	36639	38363	48994	13540	11448	4986	4293	6172	7982	8184	9993	11315	14466
			Sport (HL+RR)	1238	2307	3562	2149	2340	1092	1533	1773	1167	1520	1404	1325	619	494	117	149	160	448	356	202	240	289	361	284	335
			Traps	749	1691	942	951	613	1074	852	739	1177	515	221	154	112	125	93	152	144	281	165	125	222	232	192	0	272
	ATW		Longline	712	539	491	545	382	764	915	858	610	729	186	644	425	565	420	606	366	529	743	478	470	498	553	562	559
			Other surf.	406	307	384	429	293	342	279	283	201	107	139	97	89	85	63	78	121	107	147	117	121	119	138	93	123
			Purse seine	295	301	249	245	250	249	248	275	196	208	265	32	178	4	28	0	11	0	0	2	29	38	34	0	
			Sport (HL+RR)	854	804	1114	1032	1181	1108	1125	1121	1650	2036	1399	1139	924	1005	1023	1134	1251	1009	888	917	692	810	1085	1204	1144
			Traps	29	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	39	26	17	11	20	6	10	13
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	5
	MED		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	
			Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	12	9	11	2	4	5
	ATW		Longline	88	83	138	167	155	123	160	222	105	211	232	181	131	149	100	159	207	174	202	224	145	139	19	29	11
			Other surf.	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1
			Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	4	5	0	
			Sport (HL+RR)	0	0	0	0	14	3	0	0	6	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	0	85	103	80	68	39	19	41	24	42	72	119	42	38	36	36	38	37	45	54	64
			EU.Denmark	37	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			EU.España	4962	3137	3819	6186	9519	4565	4429	3493	3633	4089	2172	2801	3102	2339	3680	3536	2409	1550	1483	1329	1553	1282	1655	1986	2509
			EU.France	1099	336	725	563	269	613	588	542	629	755	648	561	818	1218	629	253	366	228	135	148	223	212	254	343	350
			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	
			EU.Ireland	0	0	0	0	14	21	52	22	8	15	3	1	1	2	1	1	1	2	4	10	13	19	14	32	16
			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	2	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	91	363	169	199	712	323	411	441	404	186	61	27	82	104	29	36	53	58	180	223	235	243	263	327	429
			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	0	1	0	1	1	12	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	**0**
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
			Guinée Rep.	0	330	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	0	2	27	0	0	1	0	0	0	0	0	0	0	0	2	5	4	30	37	6	0
			Japan	2484	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	1155	1089	1093	1129	1134	1386	1578	1905
			Korea Rep.	0	4	205	92	203	0	0	6	1	0	0	3	0	1	0	0	0	0	0	0	0	0	0	161	181

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		Maroc	415	720	678	1035	2068	2341	1591	2228	2497	2565	1797	1961	2405	2196	2418	1947	1909	1348	1055	990	960	959	1176	1433	1703
		Norway	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	44	51
		Panama	0	1	19	550	255	0	13	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	0	6	0	0	0	**0**
		Sierra Leone	0	0	0	0	0	0	0	93	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	NCC	Chinese Taipei	6	20	4	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	0	0	0	0	0	0	**0**
	NCO	Faroe Islands	0	0	0	0	0	67	104	118	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	1	1	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)	223	68	189	71	208	66	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	2	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	0	50	0	0	0	9	34	40	47	56
		Algerie	1097	1560	156	638	829	1674	1760	2083	2098	2056	1504	1440	1500	1673	1489	1311	0	0	0	69	244	244	370	448	1038
		China PR	0	97	137	93	49	0	20	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	1058	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	834	619	389	371	369	384	385	456	515	630
		EU.Cyprus	14	10	10	10	10	21	31	61	85	91	79	105	149	110	1	132	2	3	10	18	17	18	22	59	110
		EU.España	2018	2741	4607	2588	2209	2000	2003	2772	2234	2215	2512	2353	2758	2689	2414	2465	1769	1056	942	1064	948	1164	1238	1467	1688
		EU.France	6995	11843	9604	9171	8235	7122	6156	6794	6167	5832	5859	6471	8638	7663	10200	2670	3087	1755	805	791	2191	2216	2565	3054	3661
		EU.Greece	439	886	1004	874	1217	286	248	622	361	438	422	389	318	255	285	350	373	224	172	176	178	161	195	218	235
		EU.Italy	5379	6901	7076	10200	9619	4441	3283	3847	4383	4628	4981	4697	4853	4708	4638	2247	2749	1061	1783	1788	1938	1946	2273	2488	3196
		EU.Malta	259	580	590	402	396	409	449	378	224	244	258	264	350	270	334	296	316	136	142	137	155	160	182	212	261
		EU.Portugal	164	306	313	274	37	54	76	61	64	0	2	0	0	11	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	64	77	77	155	99	124
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	**0**
		Japan	793	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18	0	0	0	0	0	0	0	**0**
		Korea Rep.	0	684	458	591	410	66	0	0	0	0	0	700	1145	26	276	335	102	0	0	77	80	81	0	0	**0**
		Libya	635	1422	1540	1388	1029	1331	1195	1549	1941	638	752	1300	1091	1327	1358	1318	1082	645	0	756	929	933	1153	1368	1631
		Maroc	79	1092	1035	586	535	687	636	695	511	421	760	819	92	190	641	531	369	205	182	223	309	310	322	350	439
		Panama	467	1499	1498	2850	236	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	0	50	41	0	34	0	0	0	0	40	47	57
		Tunisie	2132	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	2545	431	2679	1932	1042	852	1017	1057	1047	1248	1461	1755
		Turkey	3084	3466	4219	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	519	536	551	555	1091	1324	1515
	NCC	Chinese Taipei	328	709	494	411	278	106	27	169	329	508	445	51	267	5	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	0	4	3	1	0	1	1
		Israel	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	0	427	639	171	1058	761	78	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (combined)	0	773	211	0	101	1030	1995	109	571	508	610	709	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (inflated)	0	0	0	0	0	9471	16893	16458	15298	15880	18873	18376	14164	18343	28234	0	0	0	0	0	0	0	0	0	
		Serbia & Montenegro	0	0	2	4	0	0	0	4	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	
ATW	CP	Brazil	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**0**
		Canada	459	392	576	597	503	595	576	549	524	604	557	537	600	733	491	575	530	505	474	477	480	463	531	466	472
		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	
		FR.St Pierre et Miquelon	0	0	0	0	0	0	1	0	0	3	1	10	5	0	4	3	2	8	0	0	0	0	9	0	**0**
		Japan	581	427	387	436	322	691	365	492	506	575	57	470	265	376	277	492	162	353	578	289	317	302	347	345	346
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	1	52	0	0	0	0	0	0	0	0	0	0	**0**
		Mexico	17	4	23	19	2	8	14	29	10	12	22	9	10	14	7	7	10	14	14	51	23	51	53	55	34
		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	
		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**

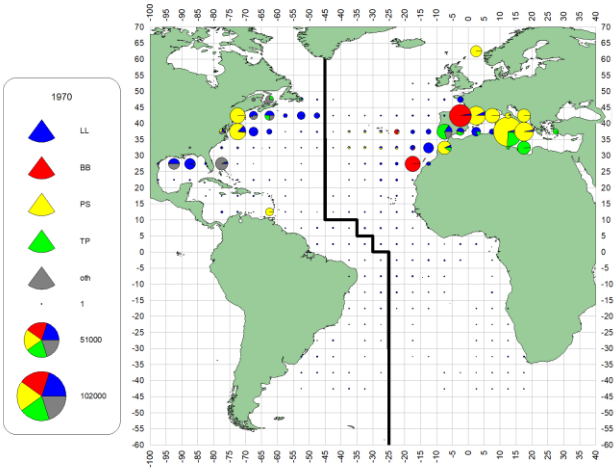
				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			U.S.A.	1237	1163	1311	1285	1334	1235	1213	1212	1583	1840	1426	899	717	468	758	764	1068	803	738	713	502	667	877	1002	986
			UK.Bermuda	0	0	0	1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	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	0	4	0	2	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	0	74	11	19	27	19	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	
			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	0	429	270	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	2	43	9	3	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	0	5
	MED	CP	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	0	4	5	5	2	2	4	5
			EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	
			Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	0	0	0	
			Tunisie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	
			Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	
	ATW	CP	Canada	0	0	0	0	6	16	11	46	13	37	14	15	0	2	0	1	3	25	36	17	0	0	3	8	1
			Japan	0	0	0	0	8	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	1	0	0	0	0	
			U.S.A.	88	83	138	171	155	110	149	176	98	174	218	167	131	147	100	158	204	150	166	206	159	143	22	24	11

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.

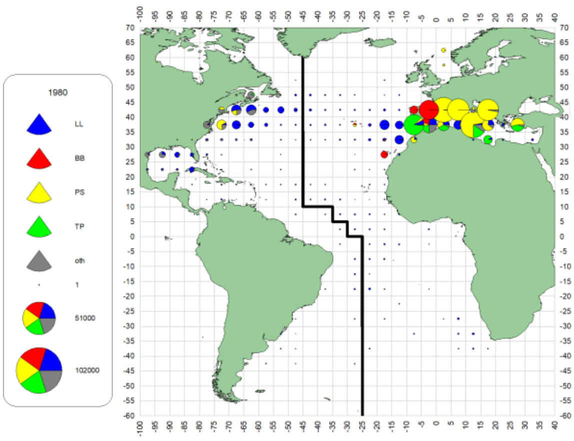
Catch (t)	2018	2019	2020	2021	2022
18,000	100	100	100	100	100
20,000	99	99	99	99	99
22,000	99	99	98	98	98
23,655	98	98	98	98	98
24,000	98	98	97	98	97
26,000	97	96	96	96	96
28,000	95	94	94	94	94
30,000	93	92	92	90	89
31,000	90	90	89	89	88
32,000	89	88	87	86	83
33,000	86	85	83	81	80
34,000	82	81	79	78	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



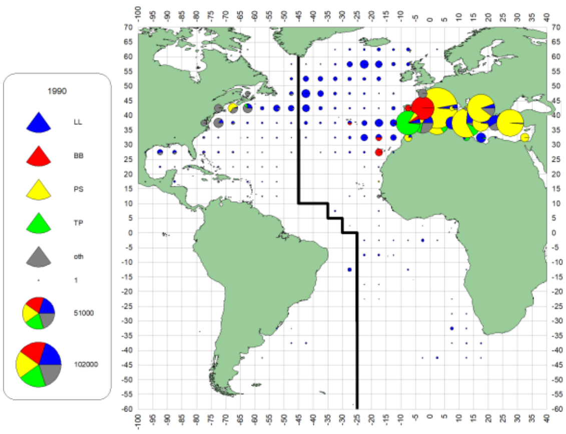
a. BFT (1960-69)



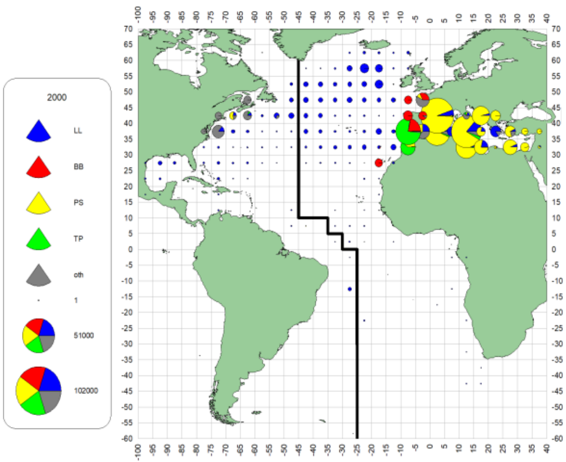
b. BFT (1970-79)



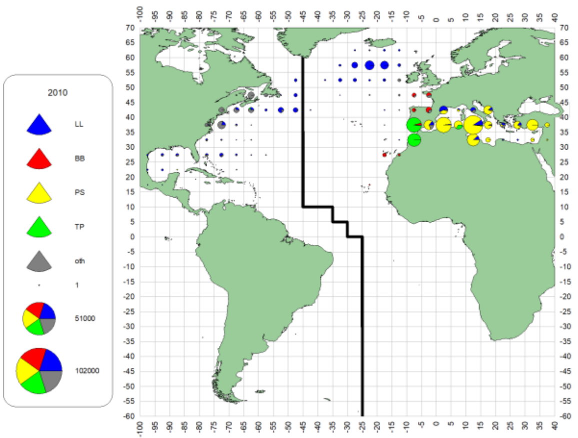
c. BFT (1980-89)



d. BFT (1990-99)

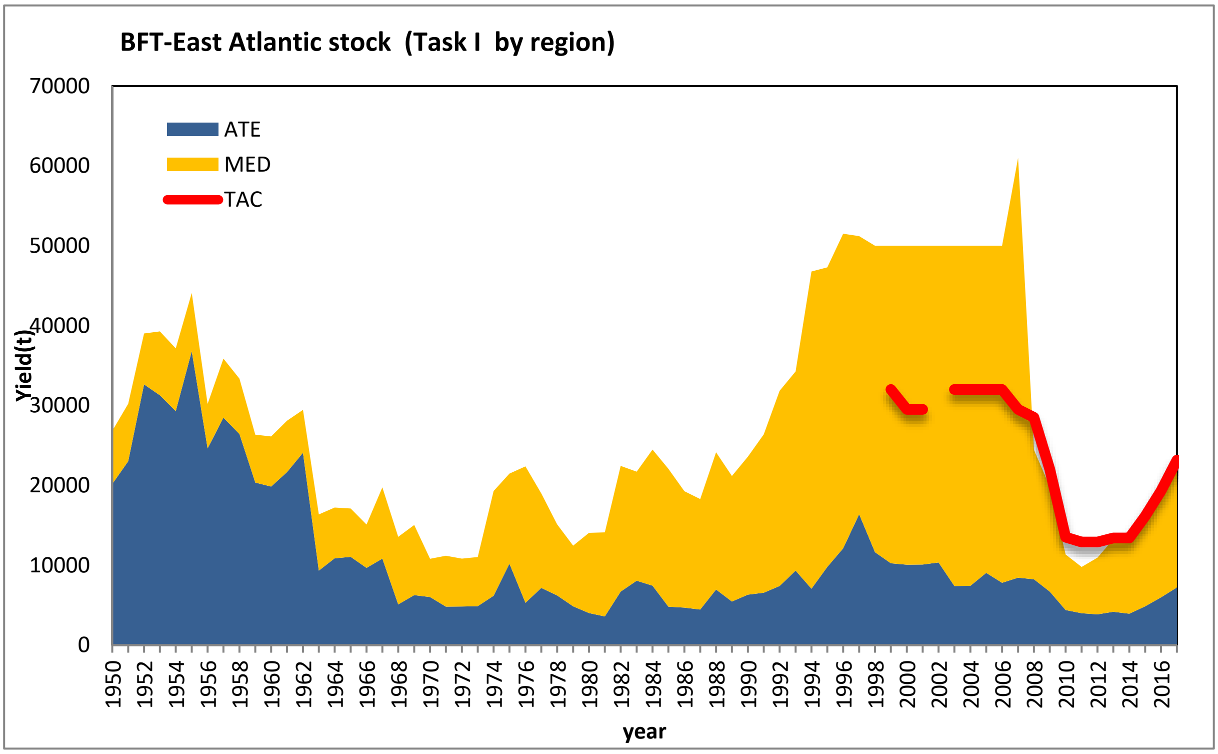


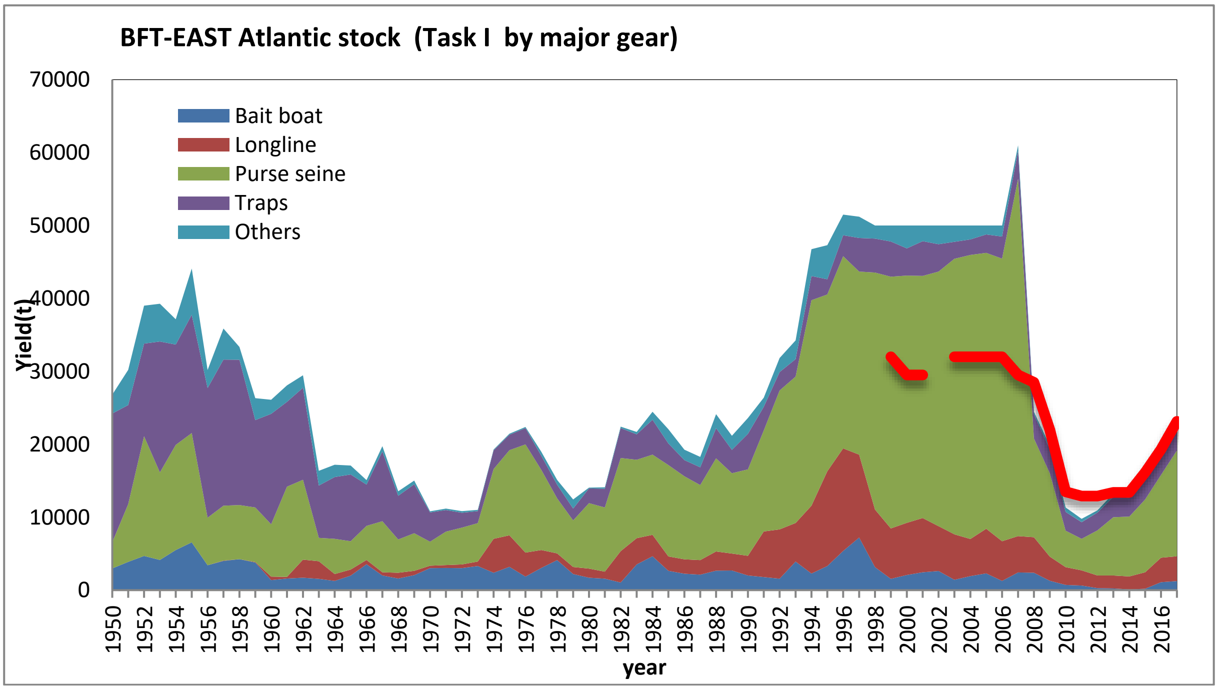
e. BFT (2000-09)



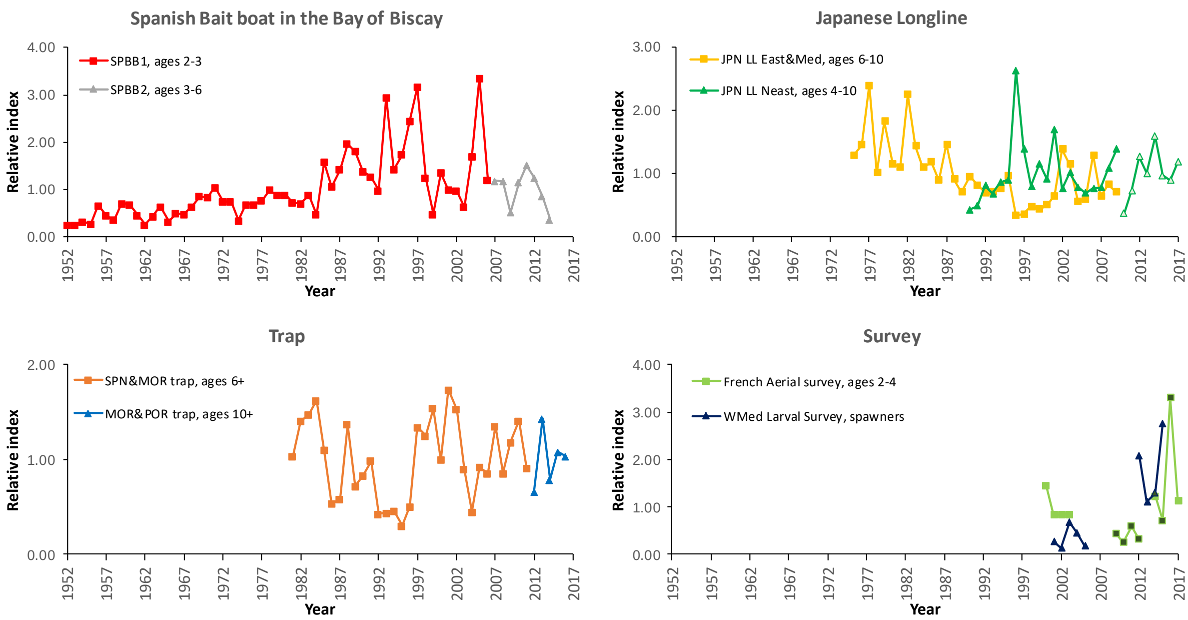
f. BFT (2010-16)

BFT-Figure 1. Geographic distribution of bluefin tuna catches per 5x5 degrees and per main gears from 1960 to 2016 (last decade only covers 7 years).

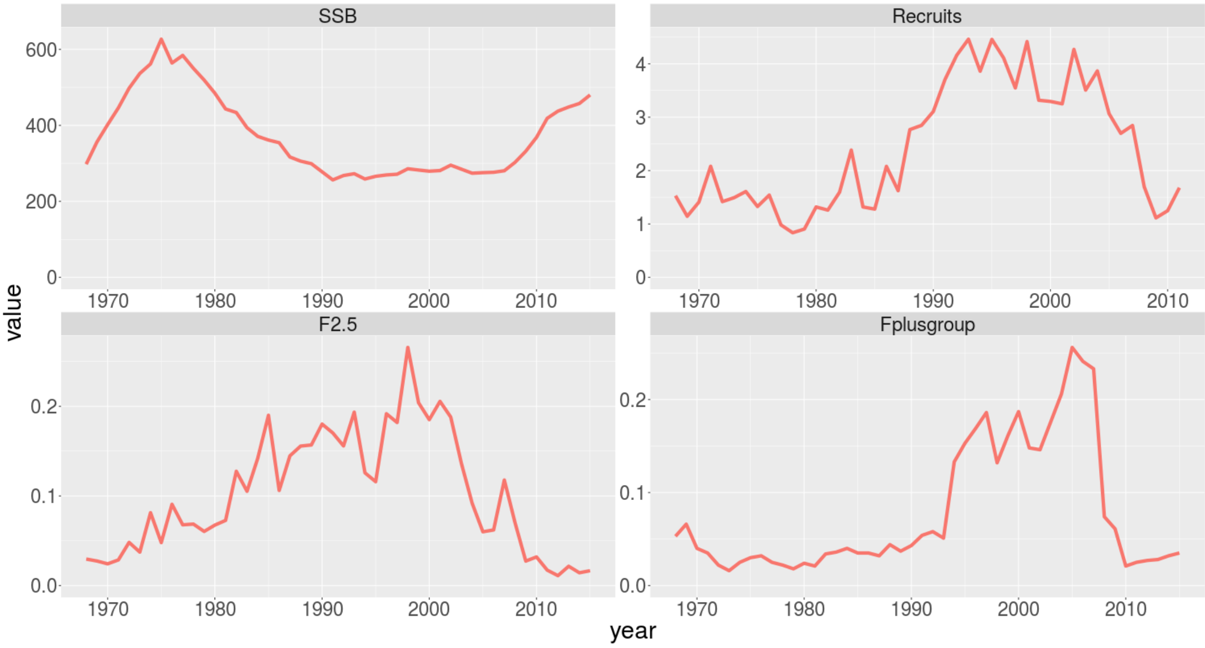




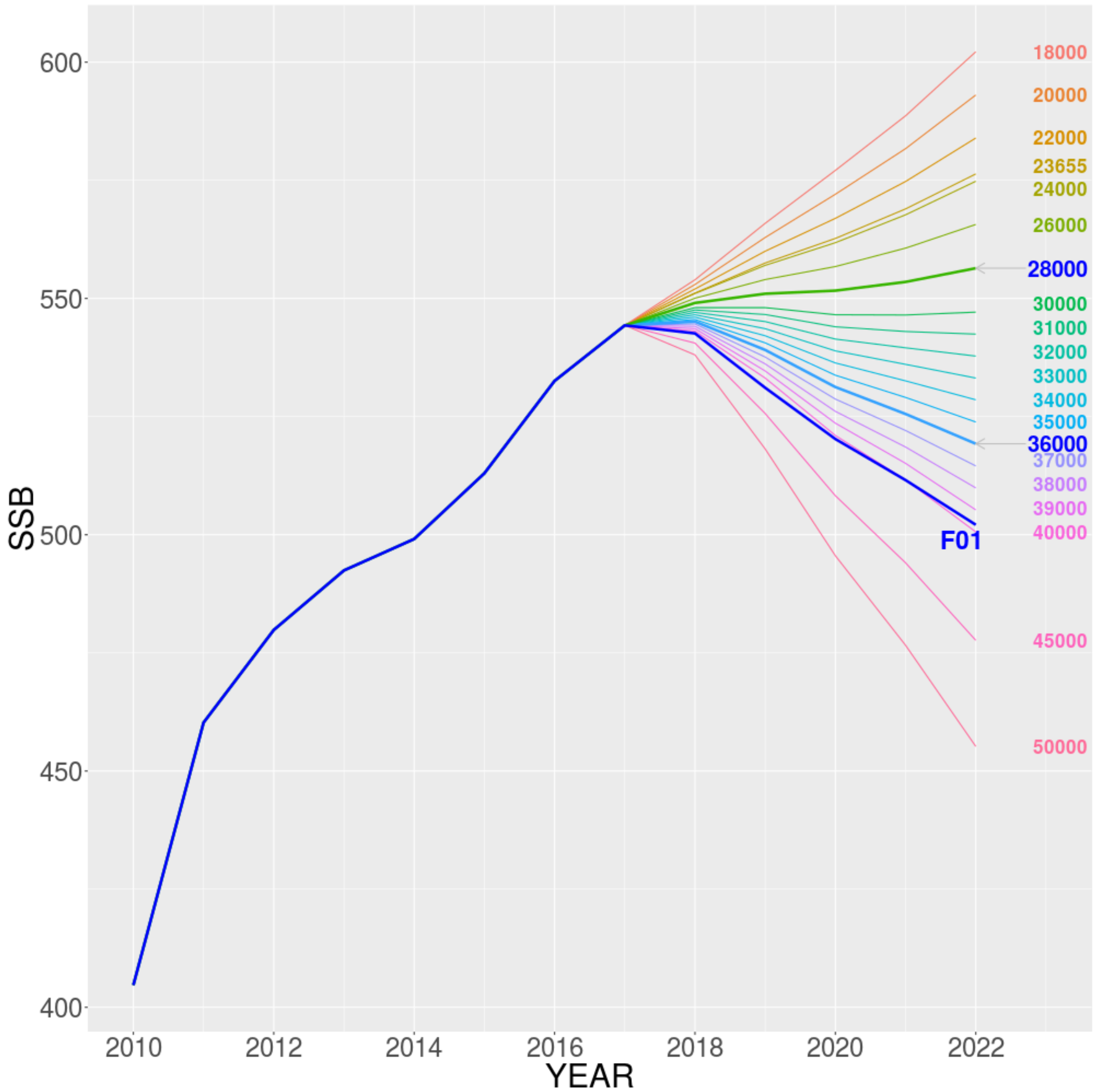
BFTE-Figure 2. Reported catch for the East Atlantic and Mediterranean from Task I data from 1950 to 2017 split by main geographic areas (top panel) and by gears (bottom panel) together with unreported catch estimated by the SCRS (using fishing capacity information and mean catch rates over the last decade) from 1998 to 2007 (the SCRS did not detect unreported catch using fishing capacity information since 2008) 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. 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 and French aerial survey has been updated until 2017, and it was split in 2009/2010. Due to uncertainty in the updated Morocco-Portugal combined index the working group did not consider it to be a reliable indicator of stock trends at this point and the previous index is retained in this figure.



BFTE-Figure 4. 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 5. 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 (**BFTW-Figure 1**). Catches dropped sharply thereafter to slightly above 3,000 t in 1969 with the collapse of the bluefin tuna by-catch longline fishery off Brazil in 1967 and declines in purse seine catches. Catches increased again to average 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 (**BFT-Table 1**). The catch in 2015 was 1,842 t, 1,901 in 2016 and 1,851 t in 2017 (**BFTW-Figure 1**).

The most recent (2017) stock assessment used 10 CPUE and two survey indices up to 2015 including the Gulf of St. Lawrence acoustic survey. The two traditional Canadian CPUE indices for the Gulf of St Lawrence and Southwest Nova Scotia were replaced with a combined index for the two areas in the 2017 assessment but only separate indices were updated in 2018 (**BFTW-Figure 2**). Updated indices are shown in **BFTW-Figure 2.**

BFTW-3. State of the stock

The SCRS cautions that conclusions from the latest assessment (2017), 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 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 3** and **BFTW 4**). 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 as well as national research programs 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 biomasses were considerably higher than current ones (**BFTW-Figure 4**).

As indicated above, 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 in **BFTW-Table 2** and **BFTW-Figure 5**. 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.

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**). The Committee notes that recent catches are below TACs.

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. As there are no signs in the fishery indicators that would indicate a reason to alter current management, the Committee is of the view that the current catch advice from Rec 17-06 can be maintained.

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 F reference points are shown in parentheses.

SUMMARY TABLE	
Current Catch including discards (2017)	1,851*
$F_{CURRENT}$ (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 28 September 2018.
[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.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				36642	48881	49751	54009	53545	52657	52772	52775	52784	53319	52305	52125	51756	51812	62638	26460	21798	13195	11781	12688	14725	14887	18042	21032	25467
BFT-E				34258	46769	47303	51497	51211	50000	50000	50000	50000	50000	50000	50000	50000	50000	61000	24460	19818	11338	9774	10934	13243	13261	16201	19131	23616
	ATE			9317	7054	9780	12098	16379	11630	10247	10061	10086	10347	7396	7410	9039	7802	8441	8243	6684	4379	3984	3834	4163	3918	4841	5968	7216
	MED			24941	39715	37523	39399	34831	38370	39753	39939	39914	39653	42604	42590	40961	42198	52559	16217	13133	6959	5790	7100	9080	9343	11360	13163	16401
BFT-W	ATW			2384	2113	2448	2512	2334	2657	2772	2775	2784	3319	2305	2125	1756	1811	1638	2000	1980	1857	2007	1754	1482	1627	1842	1901	1851
Landings	ATE		Bait boat	3884	2284	3093	5369	7215	3139	1554	2032	2426	2635	1409	1902	2282	1263	2436	2393	1260	725	636	283	243	95	172	1085	1195
			Longline	2802	2311	4522	4212	4057	3789	3570	3736	3303	2896	2750	2072	2716	2306	1705	2491	1951	1194	1125	1139	1167	1194	1467	1829	2208
			Other surf.	976	590	555	273	60	387	404	509	558	631	521	290	424	831	502	181	297	124	35	49	141	210	193	261	295
			Purse seine	24	213	458	323	828	700	726	661	153	887	490	1078	1197	408	0	0	2	1	0	0	2	0	0	42	49
			Sport (HL+RR)	0	25	0	0	237	28	33	126	61	63	109	89	11	99	11	12	11	44	51	53	46	43	104	35	101
			Traps	1631	1630	1152	1921	3982	3586	3960	2996	3585	3235	2116	1978	2408	2895	3788	3166	3164	2292	2137	2311	2564	2376	2905	2716	3363
	MED		Bait boat	48	0	206	5	4	11	4	38	28	1	9	17	5	0	0	0	38	1	0	2	2	9	25	0	50
			Longline	2470	6993	8469	9856	7313	4117	3338	3424	4144	3234	3482	3028	3411	3135	3269	2376	1344	1242	962	587	605	588	776	1523	1184
			Other surf.	371	776	545	417	282	284	228	728	354	340	198	197	175	81	85	0	0	1	1	1	20	29	3	37	90
			Purse seine	20065	27948	23799	26021	24279	31792	33798	33237	33043	34044	37291	37869	36639	38363	48994	13540	11448	4986	4293	6172	7982	8184	9993	11315	14466
			Sport (HL+RR)	1238	2307	3562	2149	2340	1092	1533	1773	1167	1520	1404	1325	619	494	117	149	160	448	356	202	240	289	361	284	335
			Traps	749	1691	942	951	613	1074	852	739	1177	515	221	154	112	125	93	152	144	281	165	125	222	232	192	0	272
	ATW		Longline	712	539	491	545	382	764	915	858	610	729	186	644	425	565	420	606	366	529	743	478	470	498	553	562	559
			Other surf.	406	307	384	429	293	342	279	283	201	107	139	97	89	85	63	78	121	107	147	117	121	119	138	93	123
			Purse seine	295	301	249	245	250	249	248	275	196	208	265	32	178	4	28	0	11	0	0	2	29	38	34	0	
			Sport (HL+RR)	854	804	1114	1032	1181	1108	1125	1121	1650	2036	1399	1139	924	1005	1023	1134	1251	1009	888	917	692	810	1085	1204	1144
			Traps	29	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	39	26	17	11	20	6	10	13
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	5
	MED		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	
			Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	12	9	11	2	4	5
	ATW		Longline	88	83	138	167	155	123	160	222	105	211	232	181	131	149	100	159	207	174	202	224	145	139	19	29	11
			Other surf.	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1
			Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	4	5	0	
			Sport (HL+RR)	0	0	0	0	14	3	0	0	6	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	0	85	103	80	68	39	19	41	24	42	72	119	42	38	36	36	38	37	45	54	64
			EU.Denmark	37	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			EU.España	4962	3137	3819	6186	9519	4565	4429	3493	3633	4089	2172	2801	3102	2339	3680	3536	2409	1550	1483	1329	1553	1282	1655	1986	2509
			EU.France	1099	336	725	563	269	613	588	542	629	755	648	561	818	1218	629	253	366	228	135	148	223	212	254	343	350
			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	
			EU.Ireland	0	0	0	0	14	21	52	22	8	15	3	1	1	2	1	1	1	2	4	10	13	19	14	32	16
			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	2	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	91	363	169	199	712	323	411	441	404	186	61	27	82	104	29	36	53	58	180	223	235	243	263	327	429
			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	0	1	0	1	1	12	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	**0**
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
			Guinée Rep.	0	330	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	0	2	27	0	0	1	0	0	0	0	0	0	0	0	2	5	4	30	37	6	0
			Japan	2484	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	1155	1089	1093	1129	1134	1386	1578	1905
			Korea Rep.	0	4	205	92	203	0	0	6	1	0	0	3	0	1	0	0	0	0	0	0	0	0	0	161	181

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		Maroc	415	720	678	1035	2068	2341	1591	2228	2497	2565	1797	1961	2405	2196	2418	1947	1909	1348	1055	990	960	959	1176	1433	1703
		Norway	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	44	51
		Panama	0	1	19	550	255	0	13	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	0	6	0	0	0	**0**
		Sierra Leone	0	0	0	0	0	0	0	93	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	NCC	Chinese Taipei	6	20	4	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	0	0	0	0	0	0	**0**
	NCO	Faroe Islands	0	0	0	0	0	67	104	118	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	1	1	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)	223	68	189	71	208	66	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	2	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	0	50	0	0	0	9	34	40	47	56
		Algerie	1097	1560	156	638	829	1674	1760	2083	2098	2056	1504	1440	1500	1673	1489	1311	0	0	0	69	244	244	370	448	1038
		China PR	0	97	137	93	49	0	20	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	1058	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	834	619	389	371	369	384	385	456	515	630
		EU.Cyprus	14	10	10	10	10	21	31	61	85	91	79	105	149	110	1	132	2	3	10	18	17	18	22	59	110
		EU.España	2018	2741	4607	2588	2209	2000	2003	2772	2234	2215	2512	2353	2758	2689	2414	2465	1769	1056	942	1064	948	1164	1238	1467	1688
		EU.France	6995	11843	9604	9171	8235	7122	6156	6794	6167	5832	5859	6471	8638	7663	10200	2670	3087	1755	805	791	2191	2216	2565	3054	3661
		EU.Greece	439	886	1004	874	1217	286	248	622	361	438	422	389	318	255	285	350	373	224	172	176	178	161	195	218	235
		EU.Italy	5379	6901	7076	10200	9619	4441	3283	3847	4383	4628	4981	4697	4853	4708	4638	2247	2749	1061	1783	1788	1938	1946	2273	2488	3196
		EU.Malta	259	580	590	402	396	409	449	378	224	244	258	264	350	270	334	296	316	136	142	137	155	160	182	212	261
		EU.Portugal	164	306	313	274	37	54	76	61	64	0	2	0	0	11	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	64	77	77	155	99	124
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	**0**
		Japan	793	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18	0	0	0	0	0	0	0	**0**
		Korea Rep.	0	684	458	591	410	66	0	0	0	0	0	700	1145	26	276	335	102	0	0	77	80	81	0	0	**0**
		Libya	635	1422	1540	1388	1029	1331	1195	1549	1941	638	752	1300	1091	1327	1358	1318	1082	645	0	756	929	933	1153	1368	1631
		Maroc	79	1092	1035	586	535	687	636	695	511	421	760	819	92	190	641	531	369	205	182	223	309	310	322	350	439
		Panama	467	1499	1498	2850	236	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	0	50	41	0	34	0	0	0	0	40	47	57
		Tunisie	2132	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	2545	431	2679	1932	1042	852	1017	1057	1047	1248	1461	1755
		Turkey	3084	3466	4219	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	519	536	551	555	1091	1324	1515
	NCC	Chinese Taipei	328	709	494	411	278	106	27	169	329	508	445	51	267	5	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	0	4	3	1	0	1	1
		Israel	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	0	427	639	171	1058	761	78	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (combined)	0	773	211	0	101	1030	1995	109	571	508	610	709	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (inflated)	0	0	0	0	0	9471	16893	16458	15298	15880	18873	18376	14164	18343	28234	0	0	0	0	0	0	0	0	0	
		Serbia & Montenegro	0	0	2	4	0	0	0	4	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	
ATW	CP	Brazil	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**0**
		Canada	459	392	576	597	503	595	576	549	524	604	557	537	600	733	491	575	530	505	474	477	480	463	531	466	472
		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	
		FR.St Pierre et Miquelon	0	0	0	0	0	0	1	0	0	3	1	10	5	0	4	3	2	8	0	0	0	0	9	0	**0**
		Japan	581	427	387	436	322	691	365	492	506	575	57	470	265	376	277	492	162	353	578	289	317	302	347	345	346
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	1	52	0	0	0	0	0	0	0	0	0	0	**0**
		Mexico	17	4	23	19	2	8	14	29	10	12	22	9	10	14	7	7	10	14	14	51	23	51	53	55	34
		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	
		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**

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			U.S.A.	1237	1163	1311	1285	1334	1235	1213	1212	1583	1840	1426	899	717	468	758	764	1068	803	738	713	502	667	877	1002	986
			UK.Bermuda	0	0	0	1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	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	0	4	0	2	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	0	74	11	19	27	19	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	
			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	0	429	270	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	2	43	9	3	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	0	5
	MED	CP	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	0	4	5	5	2	2	4	5
			EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	
			Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	0	0	0	
			Tunisie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	
			Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	
	ATW	CP	Canada	0	0	0	0	6	16	11	46	13	37	14	15	0	2	0	1	3	25	36	17	0	0	3	8	1
			Japan	0	0	0	0	8	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	1	0	0	0	0	
			U.S.A.	88	83	138	171	155	110	149	176	98	174	218	167	131	147	100	158	204	150	166	206	159	143	22	24	11

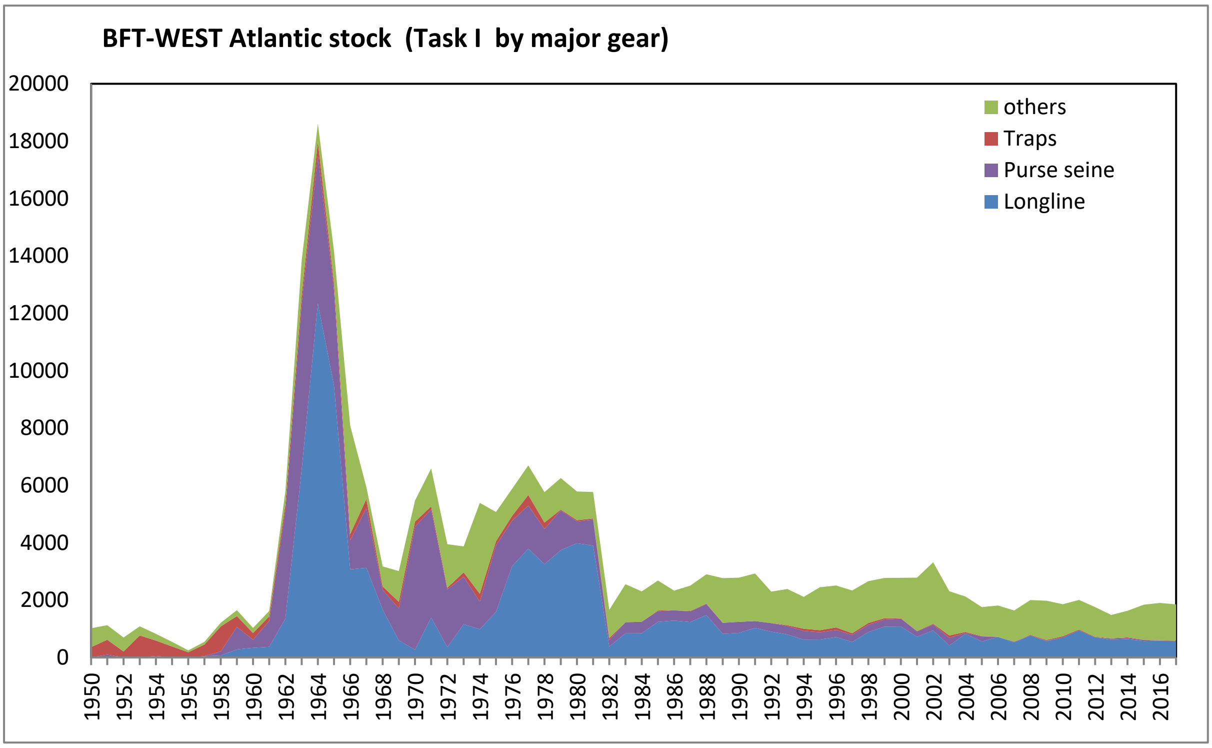
BFTW-Table 1. Kobe II matrix giving the probability that the fishing mortality rate (F) will be less than the F reference point ($F \leq F_{0.1}$, overfishing not occurring) over the next 3 years for alternative constant catches, based on results from the 2017 VPA and SS combined.

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%

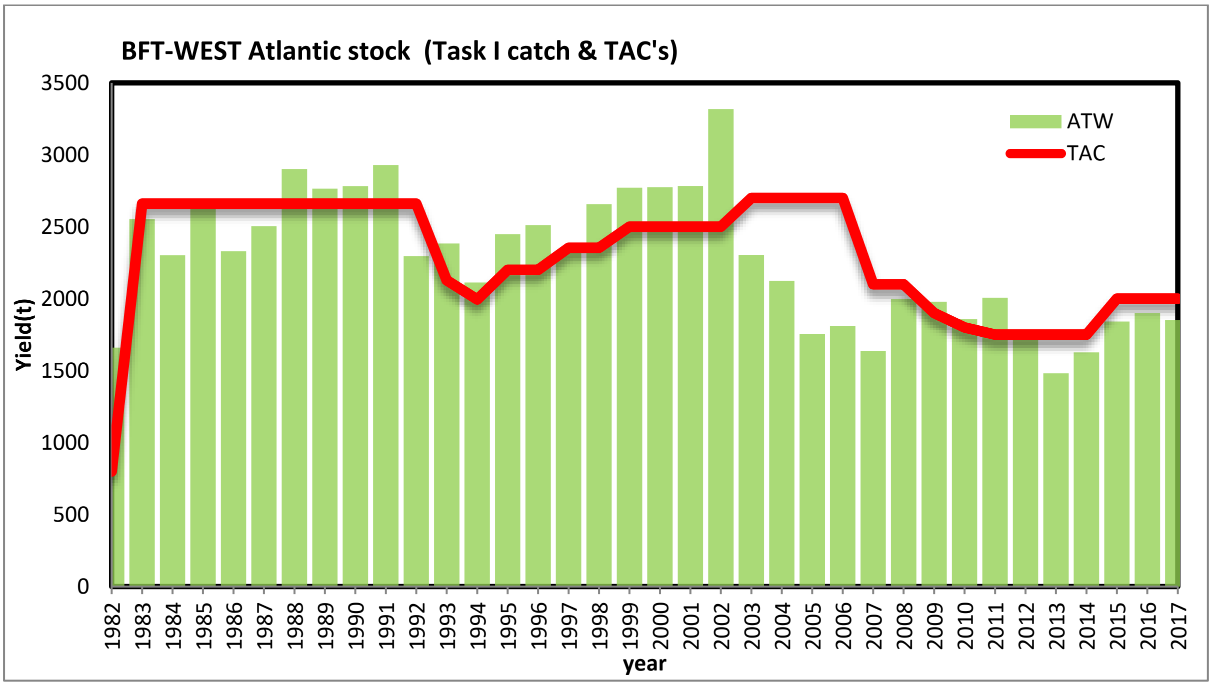
BFTW-Table 2. Relative change in total stock biomass relative to 2017 under alternative constant catch scenarios from the 2017 assessment.

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%

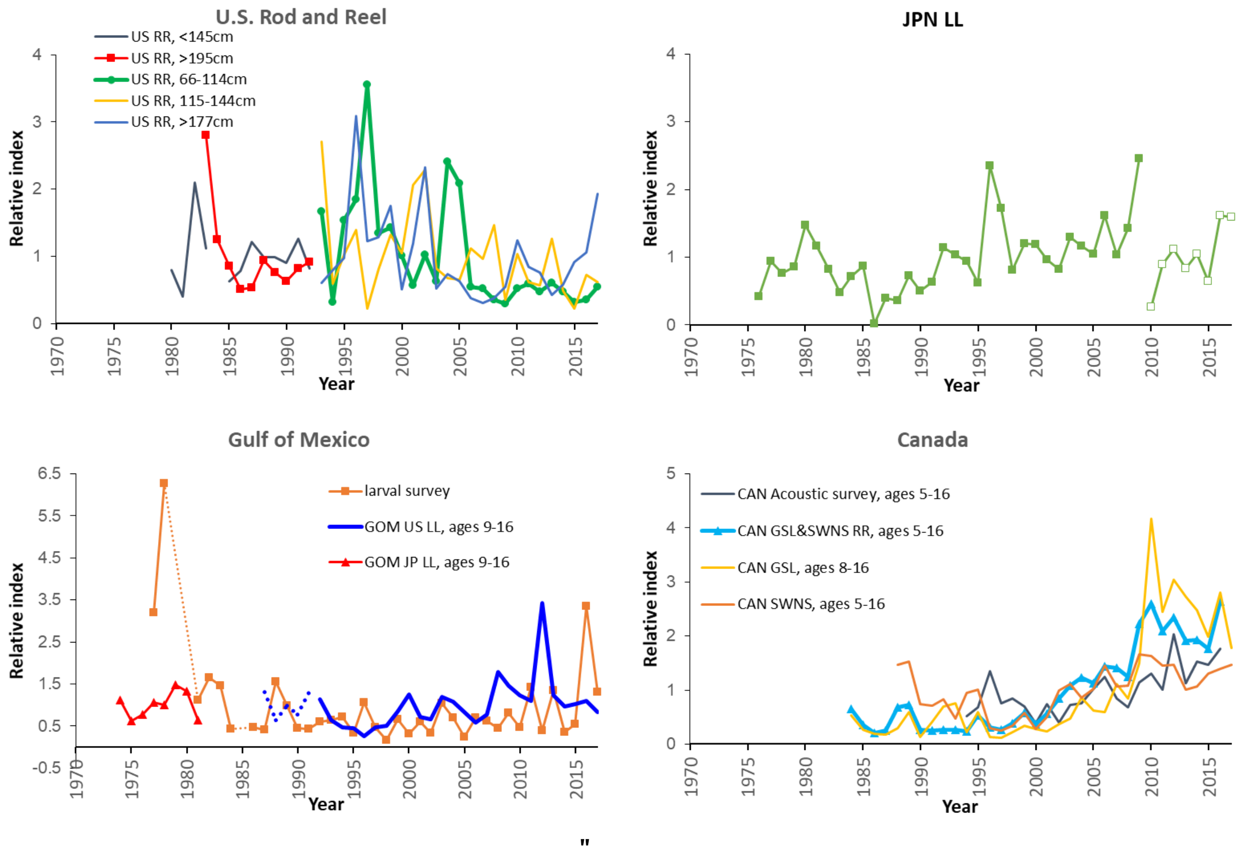
(a)



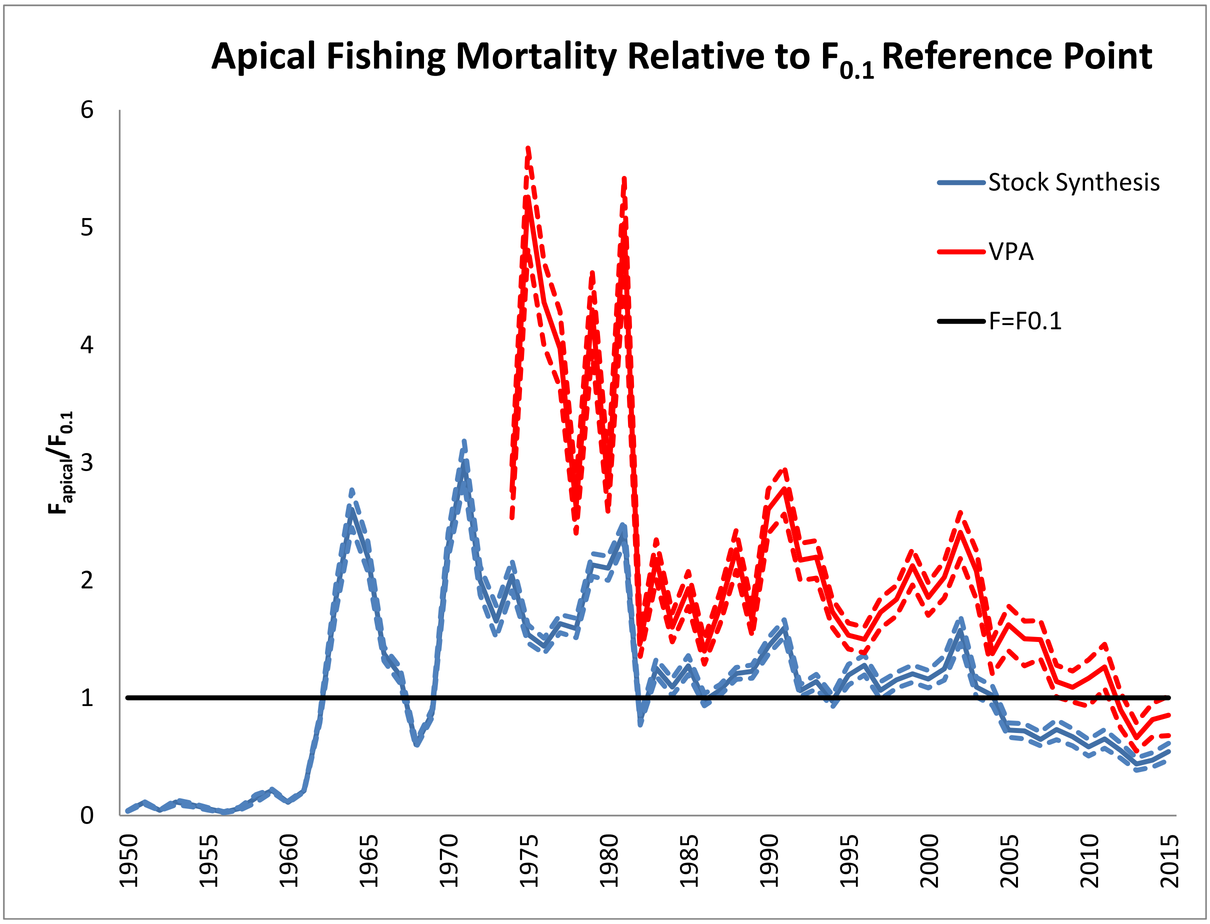
(b)



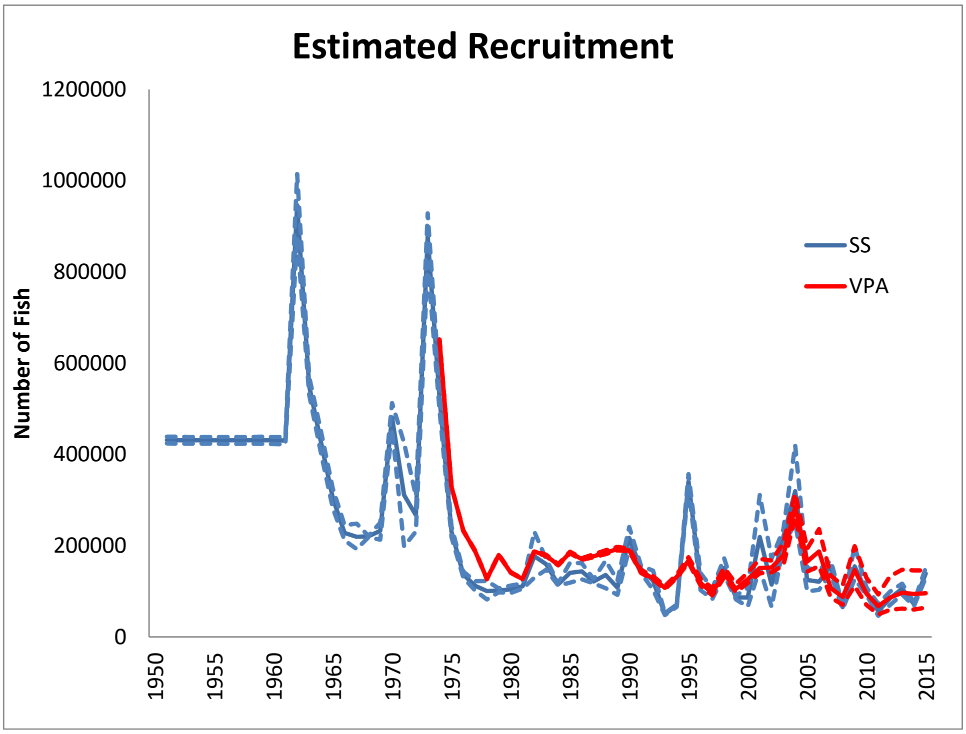
BFTW-Figure 1. Historical catches of western bluefin tuna: (a) by gear type and (b) in comparison to TAC levels agreed by the Commission.

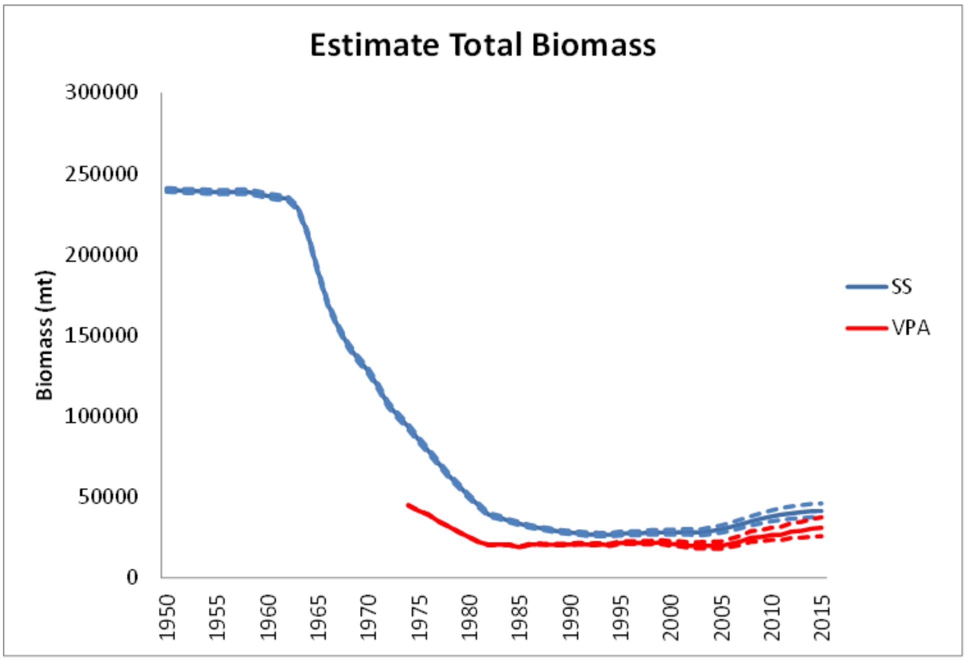


BFTW-Figure 2. Indices of relative abundance for western bluefin tuna. Canada combined GSL and SWNS index was not updated, instead the updated individual SWNS and GSL indices are shown for reference.



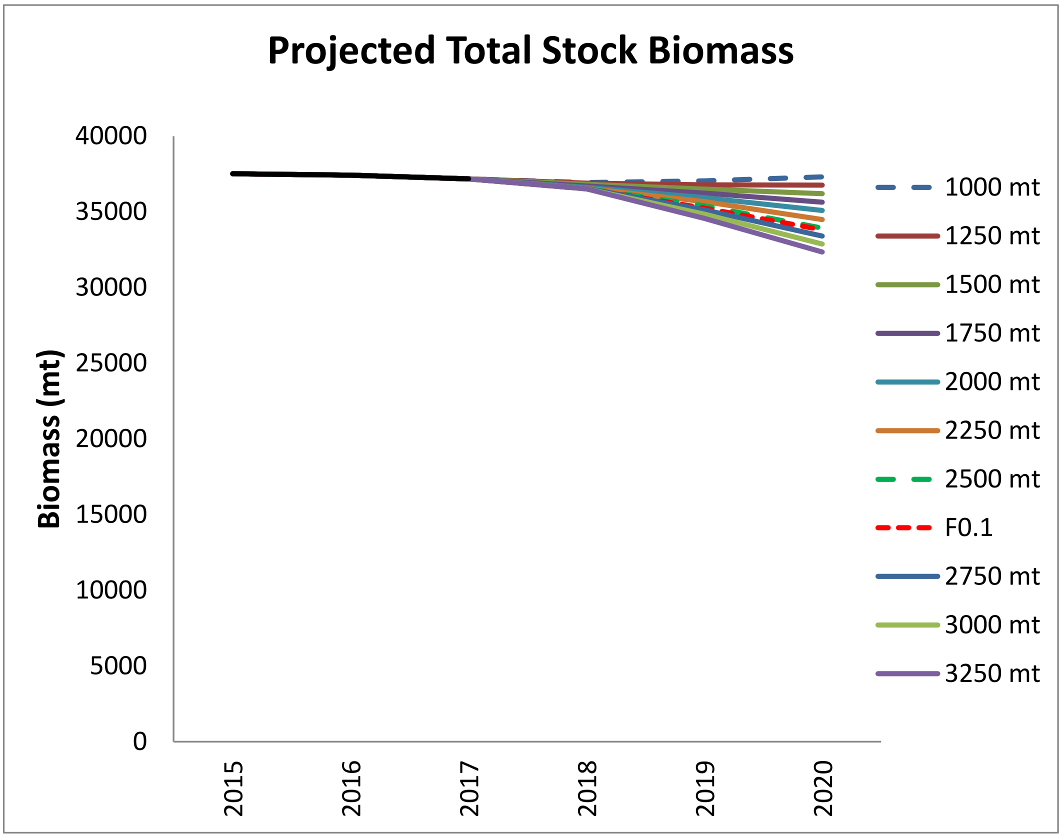
BFTW-Figure 3. Estimated fishing mortality relative to the $F_{0.1}$ reference point estimated by VPA (red) and SS (blue) from the 2017 assessment. The 80% confidence intervals are indicated with dashed lines.



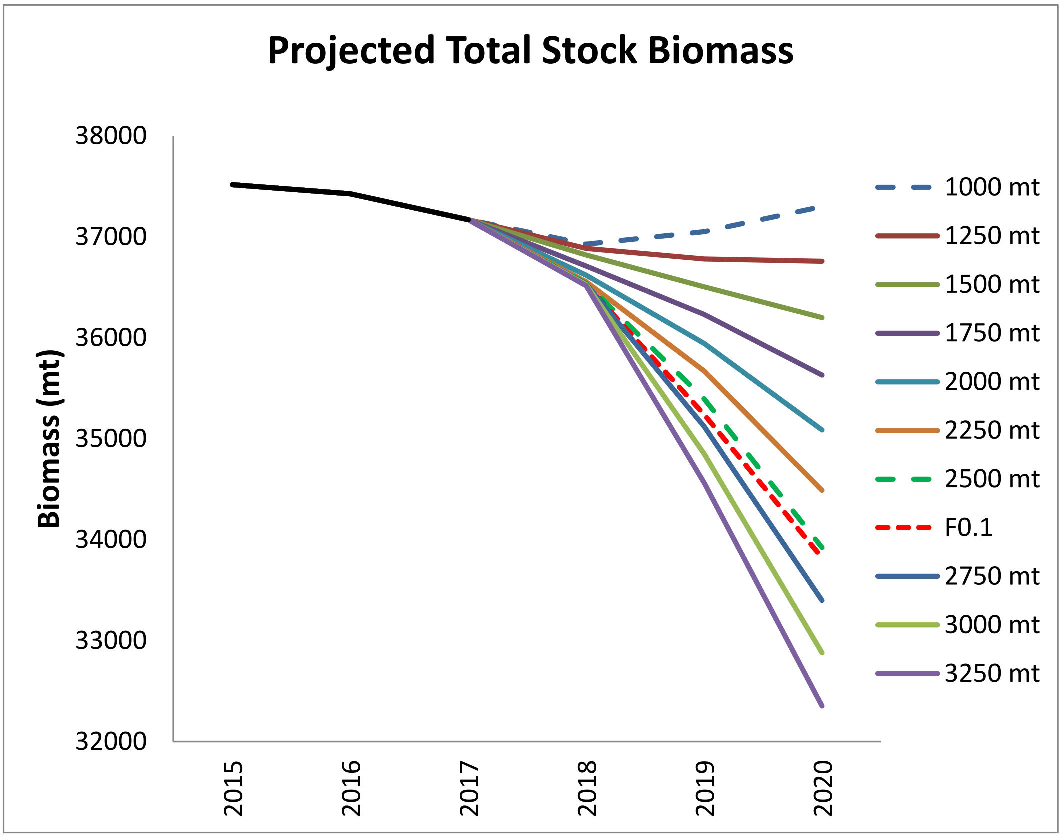


BFTW-Figure 4. Median estimates of recruitment and total stock biomass for the base VPA (red) and SS (blue) models from the 2017 assessment. The 80% confidence intervals are indicated with dashed lines. The recruitment estimates for the last three years of the VPA are considered unreliable and have been replaced by the average estimates from 2007 to 2012 and the replaced values are shown in the figure for reference.

a)



b)



BFTW-Figure 5. 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 TAC is 2350 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. 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 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 2016 and 2017 were 2,019 t and 1,987 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 (2017) Yield	1,987 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]. Reduce the total harvest to 2,000 t in 2016, 2017, and 2018.

[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] 2017 yield should be considered provisional.

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

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL	A+M		3175	4258	4228	5418	5735	5696	5390	5481	4471	3906	4418	3208	3577	3174	4296	3776	3345	3052	2901	2855	2161	2689	1925	2019	1987
Landings		Longline	2167	2966	2934	3786	4218	4151	3632	3658	2498	1743	2001	1666	1906	1677	2289	2100	1859	1773	1294	1198	1005	1534	1153	1229	1372
		Other surf.	588	870	869	1118	950	1033	1237	1302	1400	1459	1650	884	1126	888	1327	787	775	739	855	903	744	900	550	507	468
		Sport (HL+RR)	293	311	272	318	428	460	437	462	548	655	747	623	520	571	637	851	650	521	696	680	354	198	111	217	48
Discards		Longline	127	111	153	197	139	51	83	60	22	37	19	34	24	38	42	37	40	19	56	70	55	54	106	52	72
		Other surf.	0	0	0	0	0	1	0	0	2	11	0	1	1	0	0	1	20	1	0	2	4	3	5	13	27
Landings	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	**0**
		Barbados	21	19	31	25	30	25	19	19	18	11	11	0	0	25	0	0	0	9	13	14	11	12	34	11	24
		Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	3	3	7	47	19	8	5	13	1
		Brazil	147	81	180	331	193	486	509	467	780	387	577	195	612	298	262	182	150	130	63	48	114	105	89	79	64
		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	0	62	73	62	78	120	201	23	92	88	89	58	96	99	65	13	77	100	99	61	45	40	44	50	40
		Curaçao	40	40	40	40	40	40	40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44
		Côte d'Ivoire	104	151	134	113	157	66	189	288	208	111	171	115	21	8	132	66	72	54	17	48	48	87	15	72	44
		EU.España	44	55	40	158	122	195	125	140	94	28	12	51	24	91	38	55	160	257	131	190	147	209	287	225	321
		EU.France	179	191	197	252	299	333	370	397	428	443	443	450	470	470	461	585	498	344	461	395	212	276	149	157	187
		EU.Portugal	15	11	10	7	3	47	8	22	18	8	32	27	48	105	135	158	106	140	54	53	25	23	46	50	57
		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	1	2	0	304	5	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Ghana	236	441	471	422	491	447	624	639	795	999	415	470	759	405	683	191	140	116	332	234	163	236	88	44	162
		Grenada	33	52	50	26	47	60	100	87	104	69	72	45	42	33	49	54	32	69	53	32	63	63	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	23
		Japan	926	1523	1409	1679	1349	1185	790	883	335	267	442	540	442	490	920	1028	822	731	402	430	189	280	288	296	428
		Korea Rep.	13	56	56	144	56	2	3	1	1	0	0	1	6	33	64	91	36	85	57	34	24	10	3	26	25
		Liberia	0	0	87	148	148	701	420	712	235	158	115	188	304	162	274	76	56	46	133	94	178	293	35	127	
		Maroc	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	4	7	82
		Mexico	3	13	13	13	13	27	35	68	37	50	70	90	86	64	91	81	93	89	68	106	86	67	72	66	60
		Namibia	0	0	0	0	0	0	0	0	0	3	0	5	9	57	0	50	2	23	10	0	8	36	8	32	57
		Panama	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
		Philippines	0	0	0	0	0	7	71	38	0	0	0	0	0	0	0	8	0	3	4	1	2	2	0	0	
		Russian Federation	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**
		S. Tomé e Príncipe	25	28	33	36	35	33	30	32	32	32	32	9	21	26	0	68	70	72	74	76	78	81	11	10	13
		Senegal	0	9	0	2	5	0	0	0	11	24	32	11	1	5	91	114	61	41	64	164	45	72	10	82	39
		South Africa	0	0	0	0	0	0	0	0	1	4	0	0	0	0	2	0	0	1	0	0	0	1	1	0	
		St. Vincent and Grenadines	2	2	2	0	1	0	0	0	0	20	0	0	0	0	1	3	2	1	0	0	2	0	0	0	2
		Trinidad and Tobago	2	16	28	14	49	15	20	51	17	16	9	11	7	14	16	34	26	22	25	46	48	48	35	19	**0**
		U.S.A.	80	88	43	43	46	50	37	24	16	17	19	26	16	17	9	13	6	4	6	14	9	1	9	19	13
		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	11	15	15	15	3	5	1	2	2	2	2	2	2	2	2	2	0	1	2	2	3	3	3	2	1
		UK.British Virgin Islands	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**
		UK.Sta Helena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	12	2	1	1	0	0
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	**0**
		Uruguay	0	3	1	1	26	23	0	0	0	1	5	3	2	8	5	0	6	1	0	0	0	0	0	0	**0**
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	7	8	6	3	2	0	0	**0**
		Venezuela	86	122	117	148	142	226	240	125	84	88	120	101	160	172	222	130	120	151	116	143	111	139	150	185	97
	NCC	Chinese Taipei	685	663	467	660	1478	578	486	485	240	294	319	315	151	99	233	148	195	153	199	133	78	62	61	75	73
	NCO	Benin	6	5	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	69	39	85	43	53	12	38	55	56	34	3	4	7	7	0	0	0	0	0	0	0	0	0	0	
		Dominica	0	0	0	0	0	0	0	0	64	69	75	36	44	55	58	106	76	76	60	0	0	85	62	49	
		Dominican Republic	0	0	0	0	41	71	29	23	23	115	207	142	30	38	47	67	60	65	100	98	99	96	73	170	
		Jamaica	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Mixed flags (FR+ES)	146	133	126	96	82	80	83	147	151	131	148	171	150	136	135	139	164	178	186	181	191	173	176	0	
		NEI (BIL)	0	0	0	0	0	0	0	53	184	258	167	89	7	160	209	205	177	0	34	0	0	0	0	0	
		NEI (ETRO)	174	326	362	435	548	803	761	492	274	17	14	0	0	0	0	0	0	0	0	0	0	0	0	0	

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		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	2	2	8
		Sta. Lucia	0	0	0	0	4	1	0	10	5	9	18	17	21	53	46	70	72	58	64	119	99	111	53	88	
		Togo	0	0	0	0	23	0	73	53	141	103	775	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	0	2	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	0	4
		EU.España	0	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	0	6	11
		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	2
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	1	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	0	2
		U.S.A.	127	111	153	197	139	52	83	60	25	49	19	35	25	36	42	38	42	19	50	39	55	53	81	25	46
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0	24	27	26

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 $F<F_{MSY}$

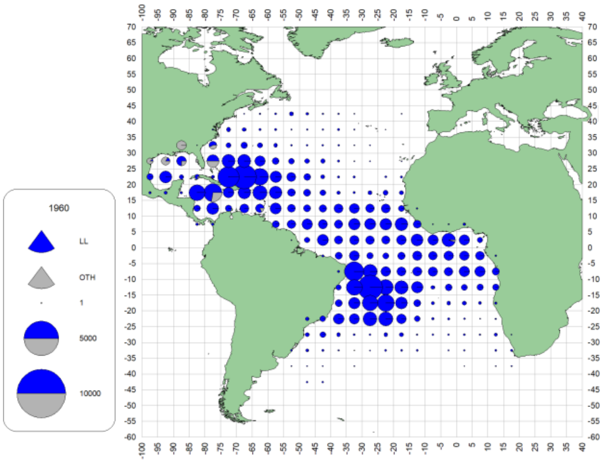
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
0	100	100	100	100	100	100	100	100	100	100
1000	98	98	98	98	98	98	98	98	98	98
1250	92	93	93	93	93	94	94	94	94	94
1500	84	85	85	86	87	87	87	88	88	89
1750	73	74	76	77	78	79	80	80	80	81
2000	60	62	64	66	67	69	70	71	72	73
2250	45	48	51	53	55	57	58	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 $B>B_{MSY}$

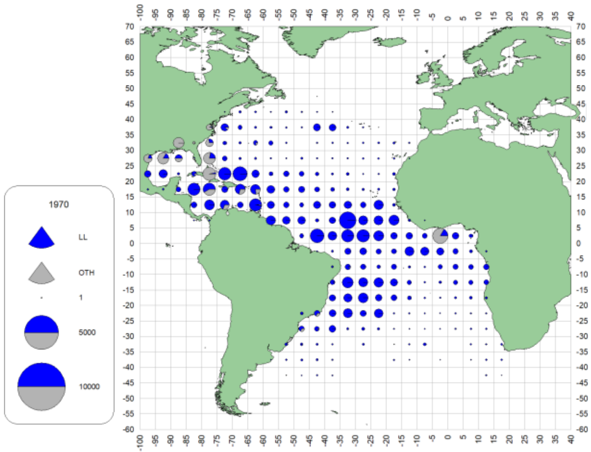
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
0	11	21	34	47	59	68	75	80	84	86
1000	11	18	26	35	43	51	57	63	68	71
1250	11	16	24	31	39	46	52	57	61	66
1500	11	16	22	28	34	40	46	51	56	60
1750	11	15	20	26	31	36	41	46	49	53
2000	11	14	19	24	28	32	36	40	43	46
2250	11	14	17	21	24	27	31	34	37	39
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 $B>B_{MSY}$

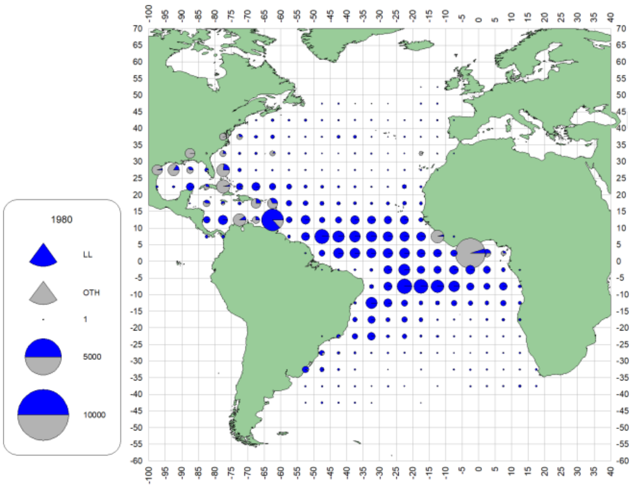
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
0	11	21	34	47	59	68	75	80	84	86
1000	11	18	26	35	43	51	57	63	68	71
1250	11	16	24	31	39	46	52	57	61	66
1500	11	16	22	28	34	40	46	51	56	60
1750	11	15	20	26	31	36	41	46	49	53
2000	11	14	19	24	28	32	36	40	43	46
2250	11	14	17	20	24	27	31	34	36	39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



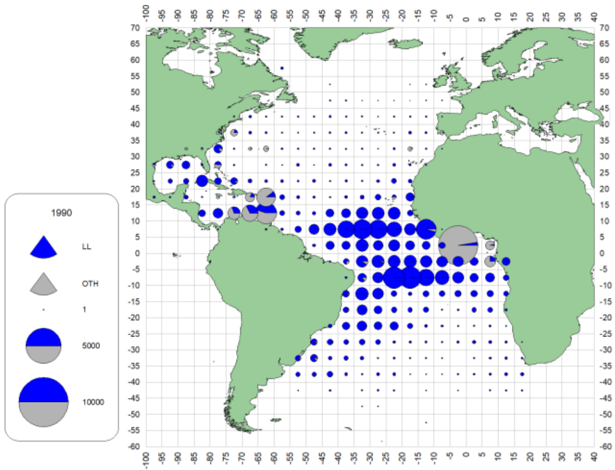
a. BUM (1960-69)



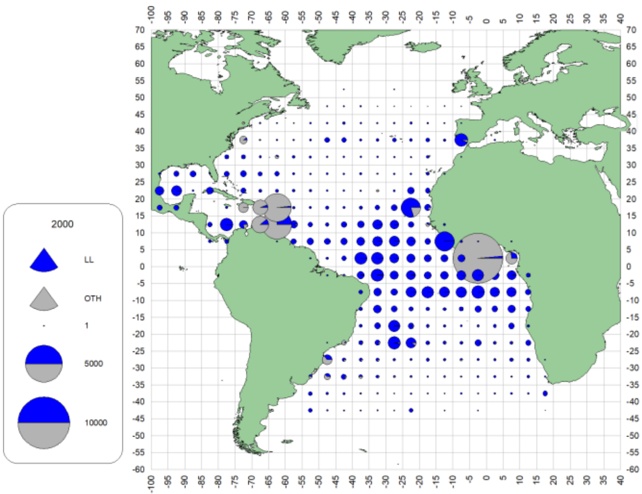
b. BUM (1970-79)



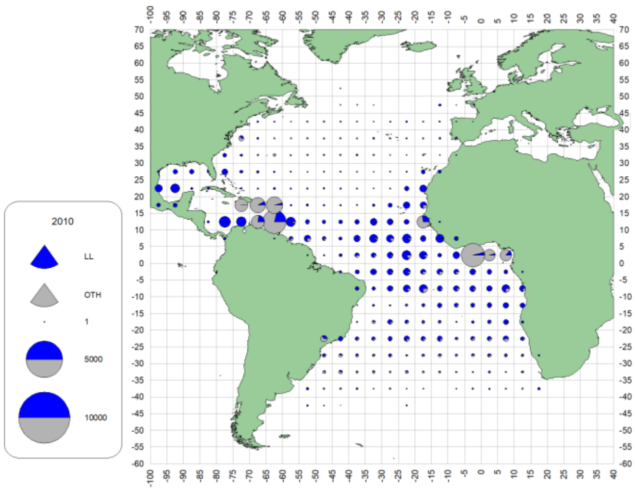
c. BUM (1980-89)



d. BUM (1990-99)

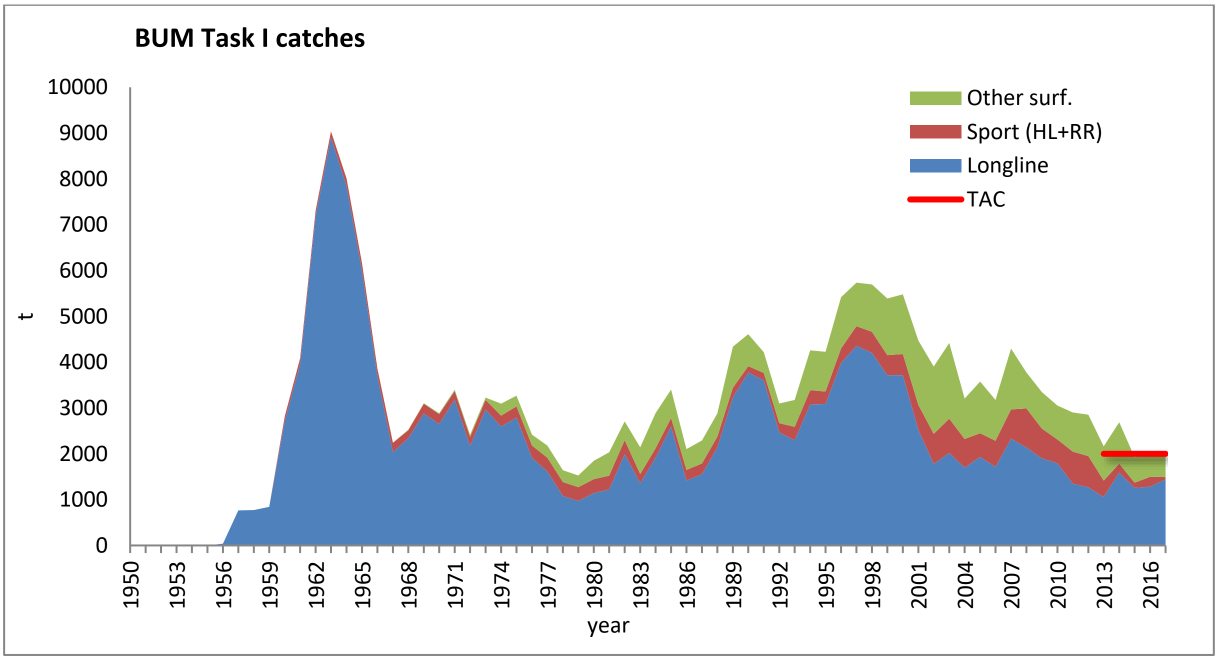


e. BUM (2000-09)

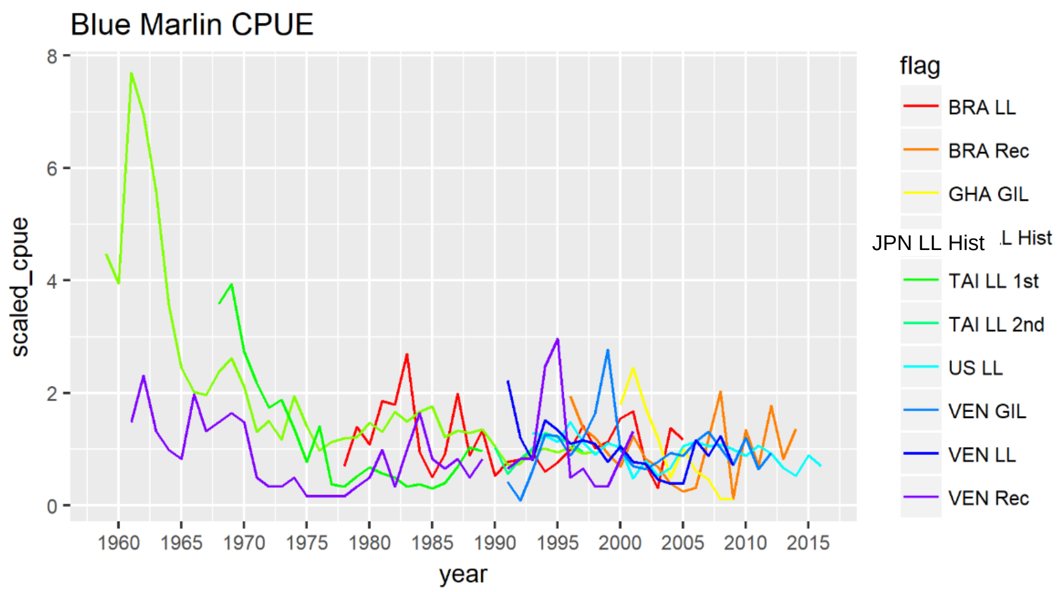


f. BUM (2010-16)

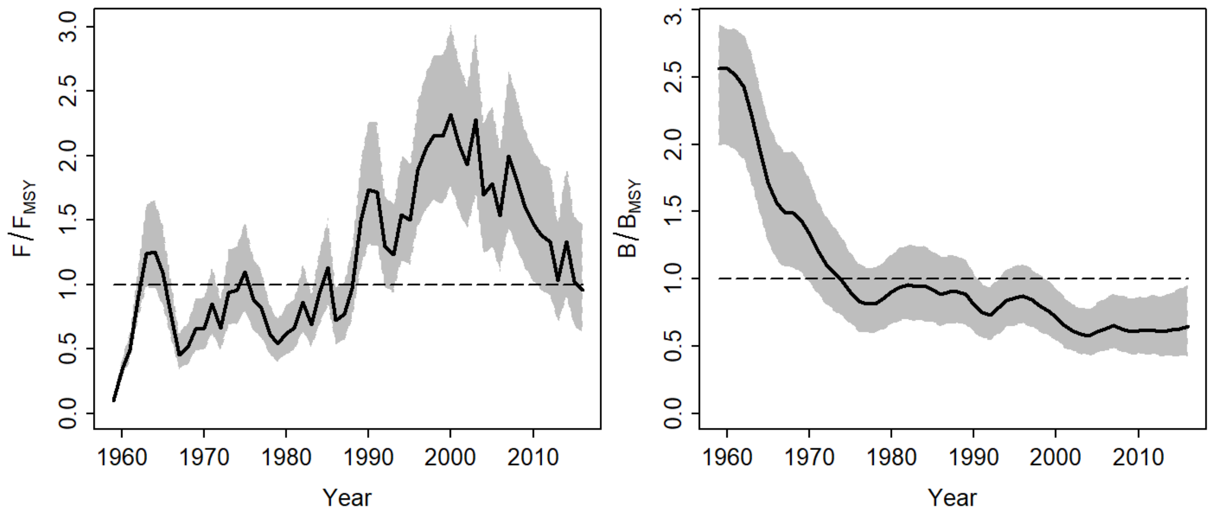
BUM-Figure 1. Geographic distribution of blue marlin total catches by decade (last decade only covers 7 years).



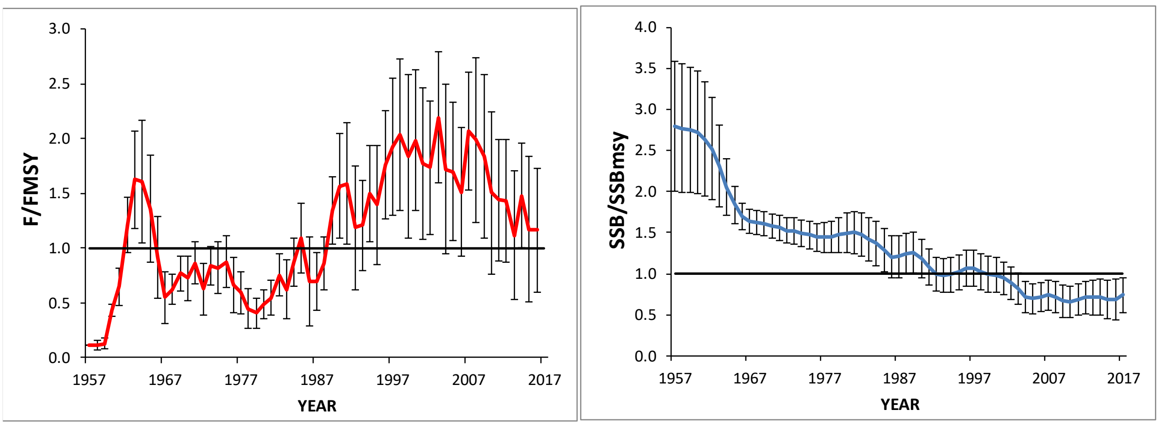
BUM-Figure 2. Atlantic blue marlin (*Makaira nigricans*) Task I catches (landings + dead discards) (t) by gear type between 1950 and 2017.



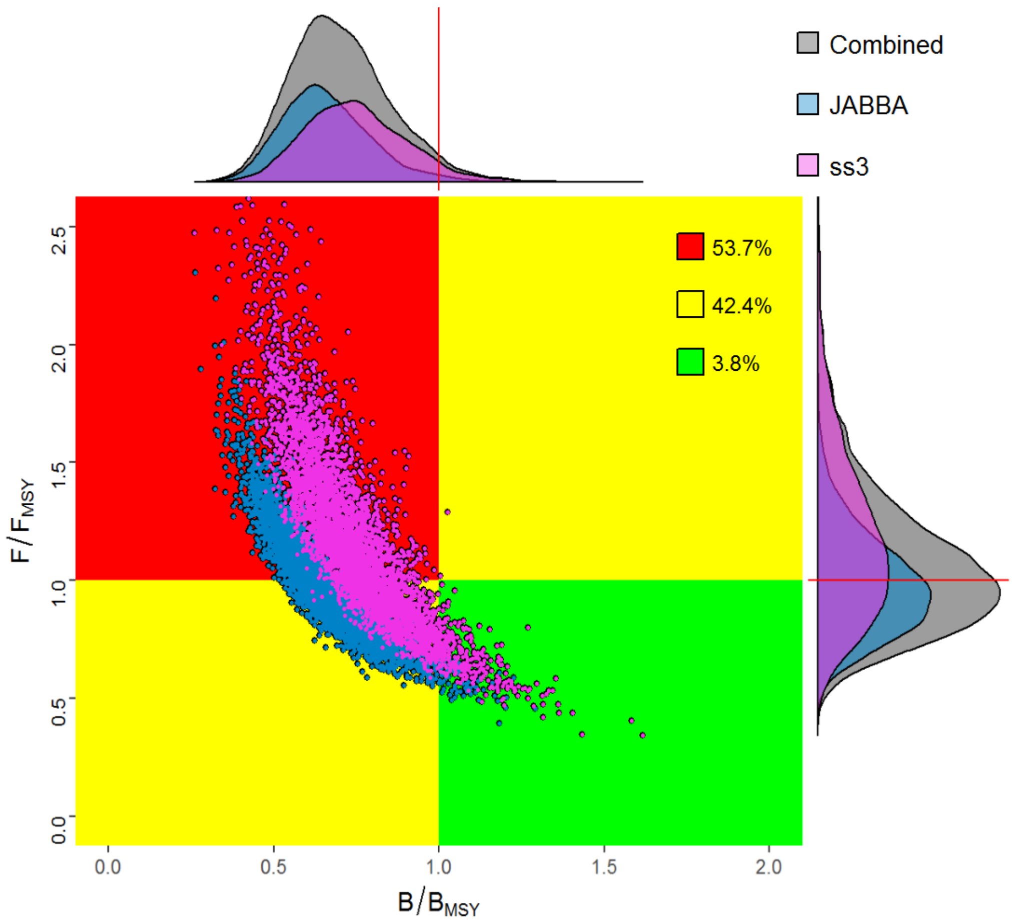
BUM-Figure 3. Plot of the indices of abundance used in the blue marlin stock assessment, 2018.



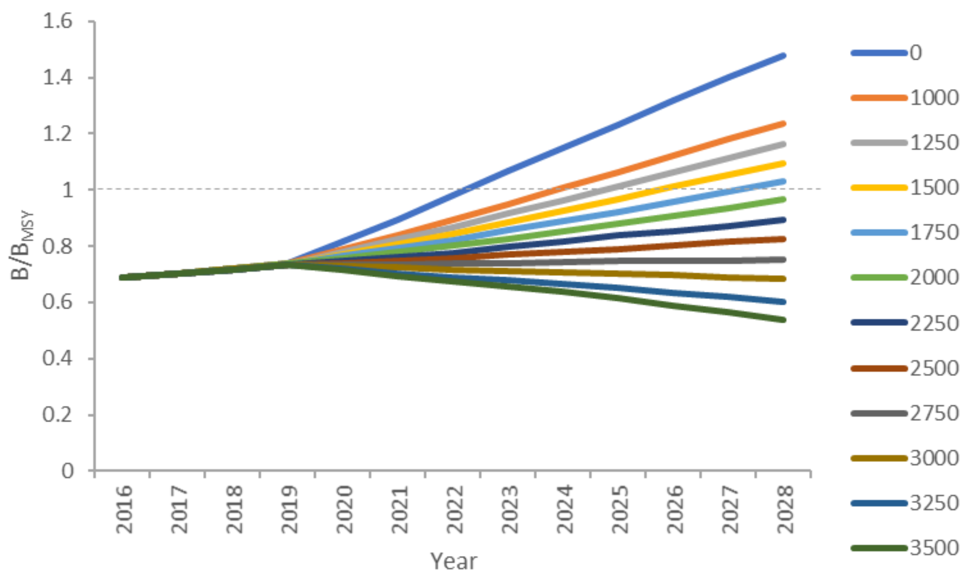
BUM-Figure 4.1. Trends in harvest rate relative to F_{MSY} and biomass relative to B_{MSY} for the Bayesian surplus production model (JABBA) fits to Atlantic blue marlin. Shaded grey area indicates 95% C.I.



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 2012 through a process that included a data preparatory meeting in April 2011 (Anon. 2012) and an assessment meeting held in May 2012 (Anon. 2013). The last year of fishery data used in the assessment was 2010.

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.

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 1990-2010 were obtained during the 2012 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.

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 (**WHM-Table 1**) in 2017 were 401 t, compared to 521 t reported for 2016. Landings for 2017 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 2011 and 2012 meetings. Following the guidelines developed by the SCRS Working Group on Stock Assessment Methods (WGSAM), seven CPUE series were selected for their inclusion in the assessment models. In general, the indices showed no discerning trend during the latter part of the time series examined (**WHM-Figure 3**). During the 2012 assessment, an estimated standardized combined CPUE index for white marlin showed a sharp decline during the period 1960-1991, and a relatively stable trend thereafter (**WHM-Figure 3**).

WHM-3. State of the stock

Unlike the partial assessment conducted in 2006, the Committee conducted a full assessment in 2012, which included estimations of management benchmarks. Two models were used to estimate the status of the stock, a production model (ASPIC), and a fully integrated model (SS3). The methods used for the fully integrated model followed very closely those used in the 2011 blue marlin assessment. 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 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 landings data. There remains uncertainty not only in the species composition but also the magnitude of the catch. This is especially a problem with the landings data starting in 2002 when CPCs were mandated to release 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 results of the 2012 assessment indicated that the stock remained overfished but most likely was not undergoing overfishing (**WHM-Figure 4, Figure 5**). Relative fishing mortality had been declining over the last ten years and was most likely to be below F_{MSY} (**WHM-Figure 6**). Relative biomass has probably stopped declining over the last ten years, but still remains well below B_{MSY} (**WHM-Figure 6**). There is considerable uncertainty in these results. The two assessment models provide different estimates about the productivity of the stock, with the integrated model suggesting that white marlin is a stock that can rebuild relatively fast whereas the surplus production model suggests the stock will rebuild very slowly. The results from both approaches are considered to be equally plausible. These results are conditional on the reported catch being a true reflection of the fishing mortality experienced by white marlin. Sensitivity analyses suggest that if recent fishing mortality has been greater than reported, because discards are not reported by many fleets, estimates of stock status would be more pessimistic and current relative biomass would be lower and overfishing would continue. The presence of unknown quantities of roundscale spearfish in the reported catches and data used to estimate relative abundance of white marlin increases the uncertainty for the stock status and outlook for this species.

WHM-4. Outlook

In 2012 the outlook for this stock remained uncertain because of the possibility that reported catches underestimate fishing mortality and the lack of certainty in the productivity of the stock. As a result, forecasts of how the stock would respond to different levels of catch were uncertain (**WHM-Table 2**). At catch levels of about 400 t the stock would likely increase in size, but was very unlikely to rebuild to B_{MSY} in the ten-year projection period (**WHM-Table 2**). Fishing mortality was highly likely to remain below F_{MSY}. The speed at which the stock biomass would have increase and the time necessary to rebuild the stock to B_{MSY} remains highly uncertain. This will depend on whether reported catches were true estimates of fishing mortality, and on the true productivity of the white marlin stock.

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, and 2018 the annual limit of 400 t for white marlin/spearfish (Rec. 15-05). In 2016 reported catch was 521 t, while preliminary catch in 2017 was 401 t.

The Committee is concerned with the significant increase in the contribution from non-industrial fisheries to the total white marlin harvest and that 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 precludes any analysis of the current regulations. In addition the Committee expressed concern of 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 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.

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

In 2012, the Commission implemented Rec. 12-04, intended to reduce the total harvest to 400 t in 2013, 2014, and 2015 to allow the rebuilding of the white marlin stock from the overfished condition. In 2015, the Commission extended the 400 t annual catch limit to 2016, 2017, and 2018 (Rec. 15-05). The Committee expressed its concern on the effectiveness of such measure in light of the misidentification of spearfishes in the white marlin catches, which causes uncertainty in stock assessment results and enforcement related problems. The Committee notes that if catches continue to exceed the TAC, as was the case for 2015 and 2016, the rebuilding of the stock will proceed more slowly.

ATLANTIC WHITE MARLIN SUMMARY

MSY	874 t[1] - 1604 t[2]
Current (2017) Yield	401 t [3]
Relative Biomass:	
B_{2010}/B_{MSY}	0.50 (0.42-0.60)[4]
SSB_{2010}/SSB_{MSY}	0.322 (0.23-0.41)[5]
Relative Fishing Mortality:	
F_{2010}/F_{MSY}	0.99 (0.75-1.27)[4] 0.72 (0.51-0.93)[5]
Stock Status (2010)	Overfished: Yes Overfishing: Not likely[6]
Conservation and Management Measure in Effect:	Recommendation [Rec. 15-05] Reduce the total harvest to 400 t in 2016, 2017, and 2018

[1] ASPIC estimates.
[2] SS3 estimates.
[3] 2017 yield should be considered provisional.
[4] ASPIC estimates with 10 and 90 percentiles.
[5] SS3 estimates with approximate 95% confidence intervals.
[6] Overfishing could be occurring if catches are under reported.

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

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL	A+M		1679	2202	1876	1679	1517	1912	1736	1521	1088	1010	844	823	751	610	680	670	714	493	563	460	637	433	464	521	401
Landings		Longline	1499	2039	1674	1520	1371	1684	1588	1389	981	832	756	739	672	526	606	559	602	413	437	369	455	356	433	396	364
		Other surf.	85	90	79	71	62	189	85	89	85	140	71	55	60	71	46	99	95	65	85	62	56	59	19	115	26
		Sport (HL+RR)	30	30	22	24	14	6	6	2	4	6	1	1	1	2	1	2	2	6	4	6	116	7	3	4	5
Discards		Longline	66	42	100	65	70	32	57	41	17	29	17	27	17	11	26	10	13	10	38	22	10	11	10	5	7
		Other surf.	0	0	0	0	0	1	0	0	1	4	0	0	0	0	0	0	2	0	0	1	0	0	0	0	
Landings	CP	Barbados	29	26	43	15	41	33	25	25	24	15	15	0	0	33	0	0	0	6	3	5	6	6	10	14	17
		Belize	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Brazil	301	91	105	75	105	217	158	106	172	407	266	80	244	90	52	55	53	35	75	71	352	102	121	67	47
		Canada	0	4	4	8	8	8	5	5	3	2	1	2	5	3	2	2	1	2	1	2	3	5	3	1	2
		China PR	0	9	11	9	11	15	30	2	20	23	8	6	9	6	10	5	9	8	3	4	2	0	0	0	3
		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	1
		Côte d'Ivoire	0	0	0	1	2	1	5	1	2	2	3	1	1	1	1	3	2	0	1	0	1	1	1	1	1
		EU.España	26	26	36	151	93	101	119	186	61	6	22	64	58	51	46	32	16	111	4	34	37	93	113	89	110
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1
		EU.Portugal	0	0	0	0	0	0	0	0	0	1	5	19	30	22	2	35	40	11	18	25	10	9	7	11	13
		Gabon	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Ghana	22	1	2	1	3	7	6	8	21	2	1	1	1	0	0	4	4	0	1	1	1	0	0	0	0
		Grenada	0	0	0	0	0	0	0	1	15	8	14	33	10	12	11	17	14	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	82	92	57	112	58	56	40	83	56	16	33	36	34	39	21	34	43	41	31	42	24	6	8	9	10
		Korea Rep.	8	43	23	59	23	0	0	0	0	0	11	40	7	0	113	96	78	43	43	0	0	0	0	0	0
		Liberia	0	0	0	1	1	3	8	4	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0	98	
		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
		Mexico	2	8	8	3	5	6	11	18	44	15	15	28	25	16	13	14	19	20	28	36	30	20	26	20	12
		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	0	1	12	0	0	0	0	0	0	0	0	1	0	2	2	0	0	0	0	0	
		S. Tomé e Príncipe	17	21	21	30	45	40	36	37	37	37	37	21	33	29	0	36	37	38	39	40	41	42	17	15	13
		South Africa	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		St. Vincent and Grenadines	1	0	0	0	0	0	0	0	0	0	44	0	0	0	0	0	0	0	0	0	0	0	0	0	8
		Trinidad and Tobago	1	11	18	8	32	10	13	4	2	5	12	6	6	5	12	10	11	15	14	39	33	38	32	20	**0**
		U.S.A.	19	13	7	12	8	5	5	1	3	6	1	1	1	1	0	2	2	2	26	1	4	2	2	1	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	**0**
		UK.Bermuda	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	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	1	0	0	0	0	0	0	0	0	0	0	**0**
		Uruguay	0	3	0	1	24	22	0	0	0	1	9	2	5	9	3	0	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	362	236	286	270	177	310	228	178	182	215	168	136	156	190	131	63	128	116	160	121	75	89	104	158	150
	NCC	Chinese Taipei	616	1350	907	566	441	506	465	437	152	178	104	172	56	44	54	38	28	20	28	15	7	7	10	10	5
		Costa Rica	0	0	0	0	0	0	3	14	0	0	1	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	0	1	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	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Mixed flags (FR+ES)	12	11	9	7	7	9	8	12	13	12	13	13	11	10	9	10	12	12	37	0	0	0	0	0	
		NEI (BIL)	0	0	0	0	0	0	0	34	77	4	30	134	42	37	170	204	199	0	11	0	0	0	0	0	
		NEI (ETRO)	114	214	237	285	359	526	498	322	180	11	9	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	2	1	1	1	0	

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		Togo	0	0	0	0	0	0	1	1	2	0	2	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	0	2	19	1	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
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	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	
		U.S.A.	66	42	100	65	70	33	58	41	18	33	17	27	17	10	8	10	14	8	36	21	10	11	8	3	5
		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	0	2	0	0	2	2	2

WHM-Table 2. Kobe II Strategy Matrix (K2SM) of the combined models (ASPIC and SS3). Percent values indicate the probability of achieving the goal of $F<F_{MSY}$, $B>B_{MSY}$, and $B > B_{MSY}$ and $F< F_{MSY}$ for each year under different constant catch scenarios (TAC tons).

$F<F_{MSY}$

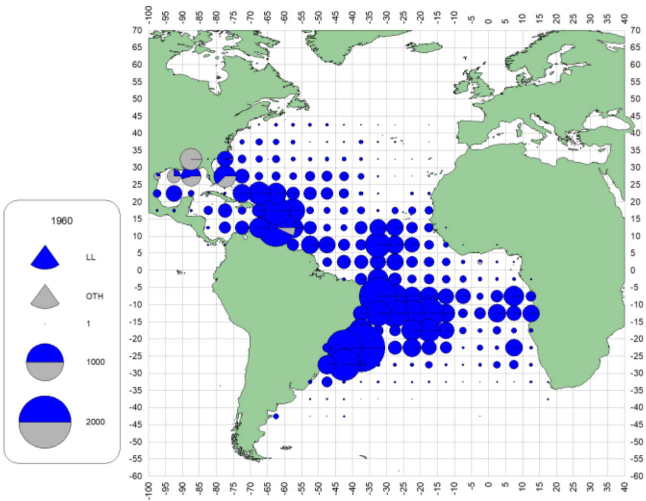
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
0	100	100	100	100	100	100	100	100	100	100
200	100	100	100	100	100	100	100	100	100	100
400	73	74	75	77	79	79	81	82	84	85
600	9	11	12	12	13	14	16	16	17	19
800	0	0	0	0	1	1	1	1	1	1
1000	0	0	0	0	0	0	0	0	0	0
1200	0	0	0	0	0	0	0	0	0	0
1400	0	0	0	0	0	0	0	0	0	0
1600	0	0	0	0	0	0	0	0	0	0

$B>B_{MSY}$

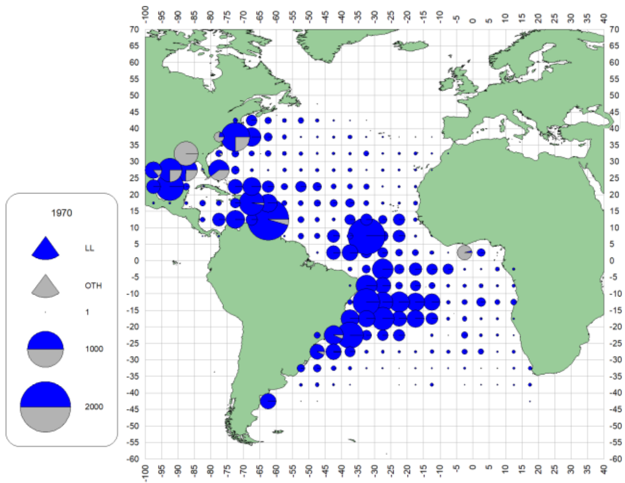
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
0	0	0	0	0	0	0	0	1	1	2
200	0	0	0	0	0	0	0	0	1	1
400	0	0	0	0	0	0	0	0	0	0
600	0	0	0	0	0	0	0	0	0	0
800	0	0	0	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0	0	0	0
1200	0	0	0	0	0	0	0	0	0	0
1400	0	0	0	0	0	0	0	0	0	0
1600	0	0	0	0	0	0	0	0	0	0

$F<F_{MSY}$ and $B>B_{MSY}$

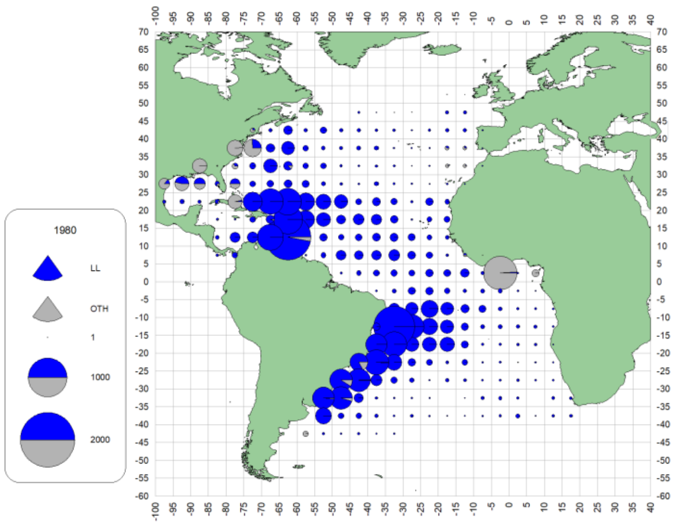
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
0	0	0	0	0	0	0	0	1	1	2
200	0	0	0	0	0	0	0	0	1	1
400	0	0	0	0	0	0	0	0	0	0
600	0	0	0	0	0	0	0	0	0	0
800	0	0	0	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0	0	0	0
1200	0	0	0	0	0	0	0	0	0	0
1400	0	0	0	0	0	0	0	0	0	0
1600	0	0	0	0	0	0	0	0	0	0



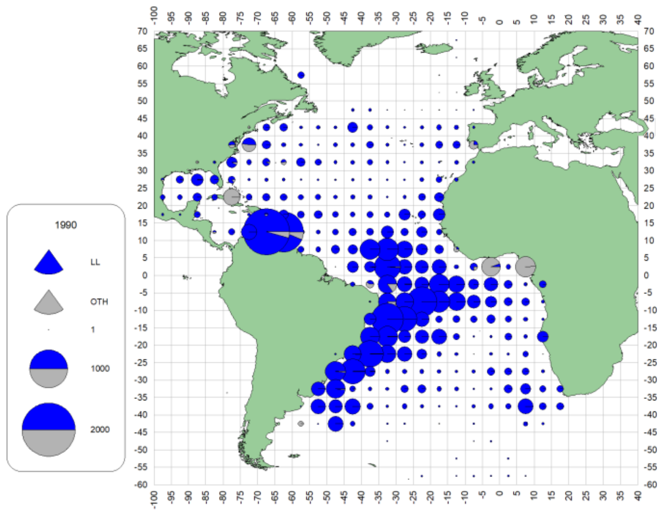
a. WHM (1960-69)



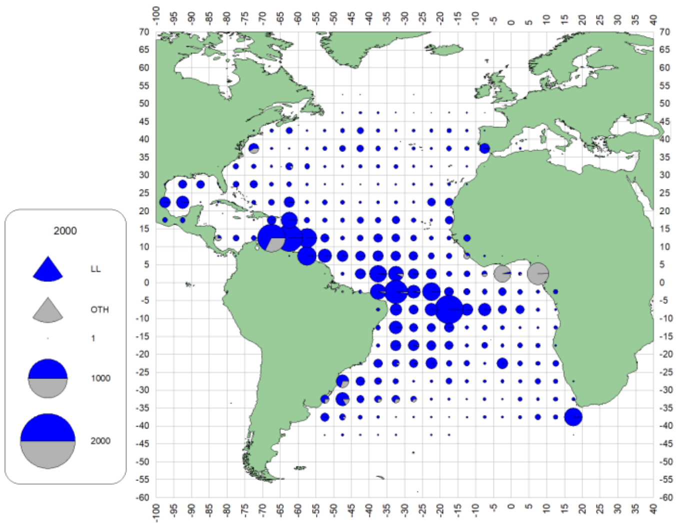
b. WHM (1970-79)



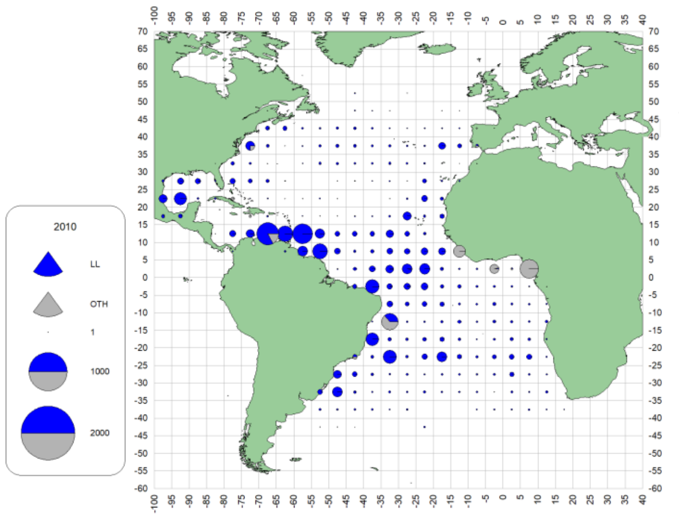
c. WHM (1980-89)



d. WHM (1990-99)

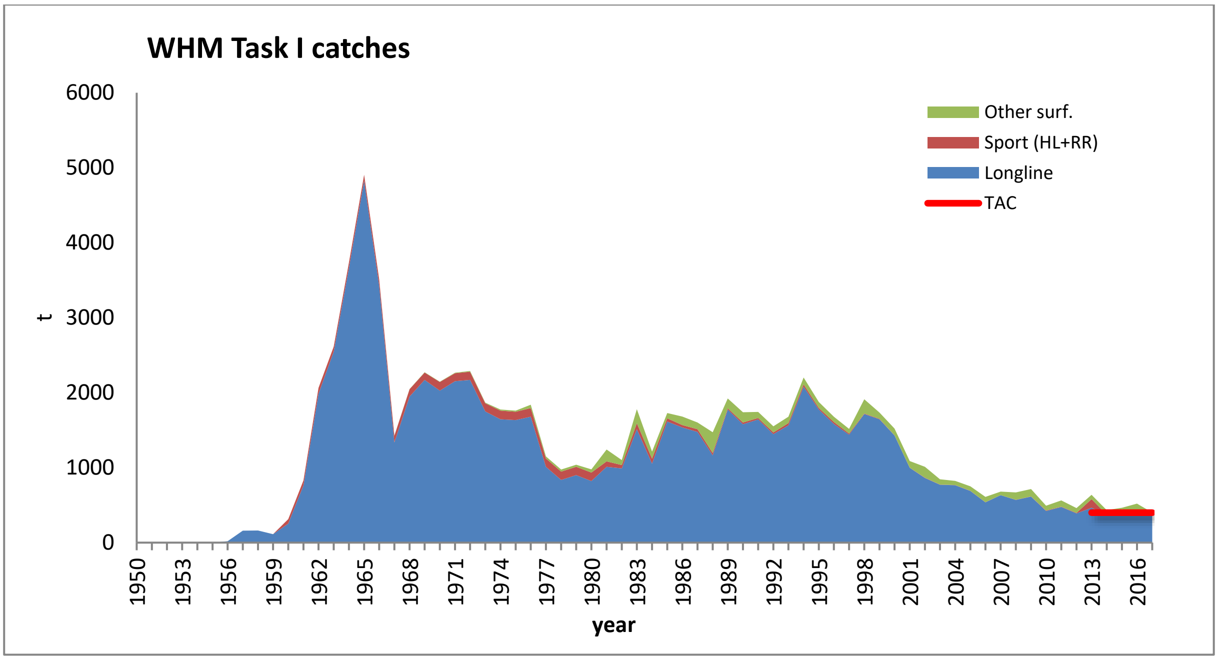


e. WHM (2000-09)

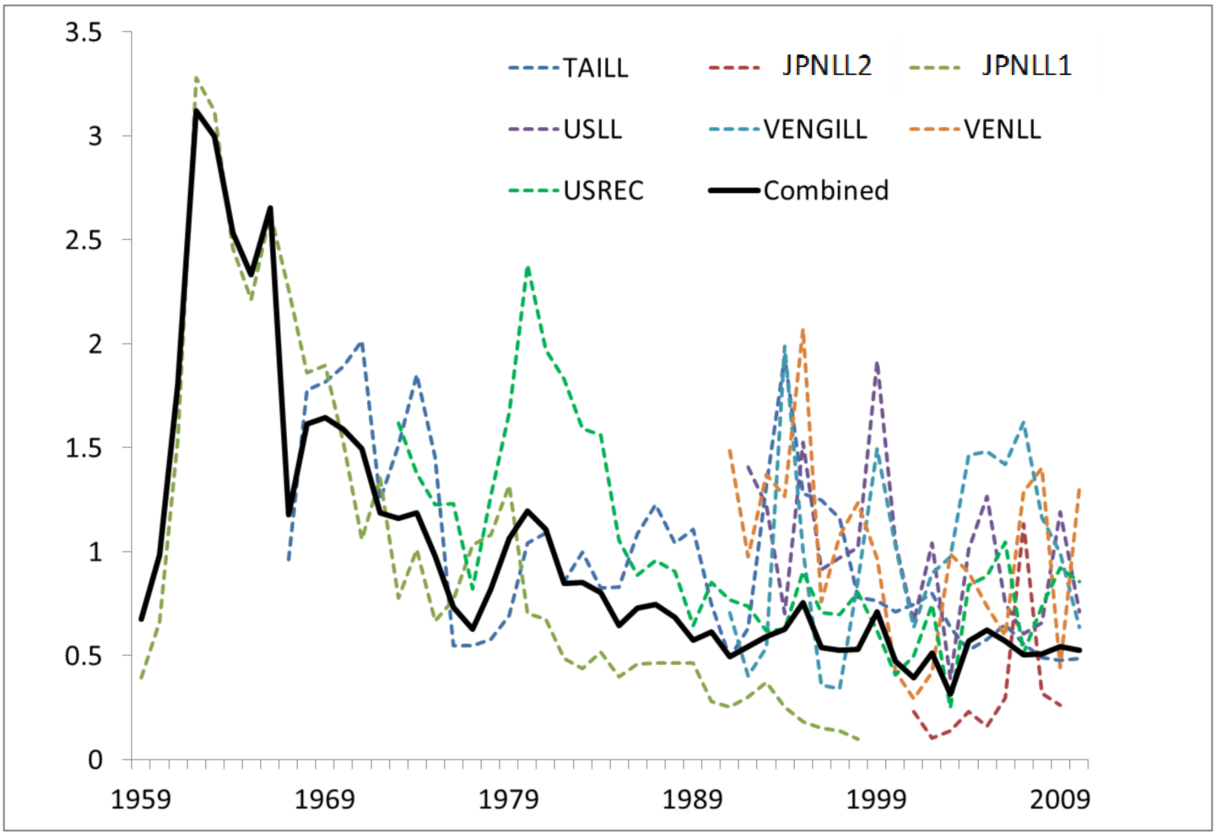


f. WHM (2010-16)

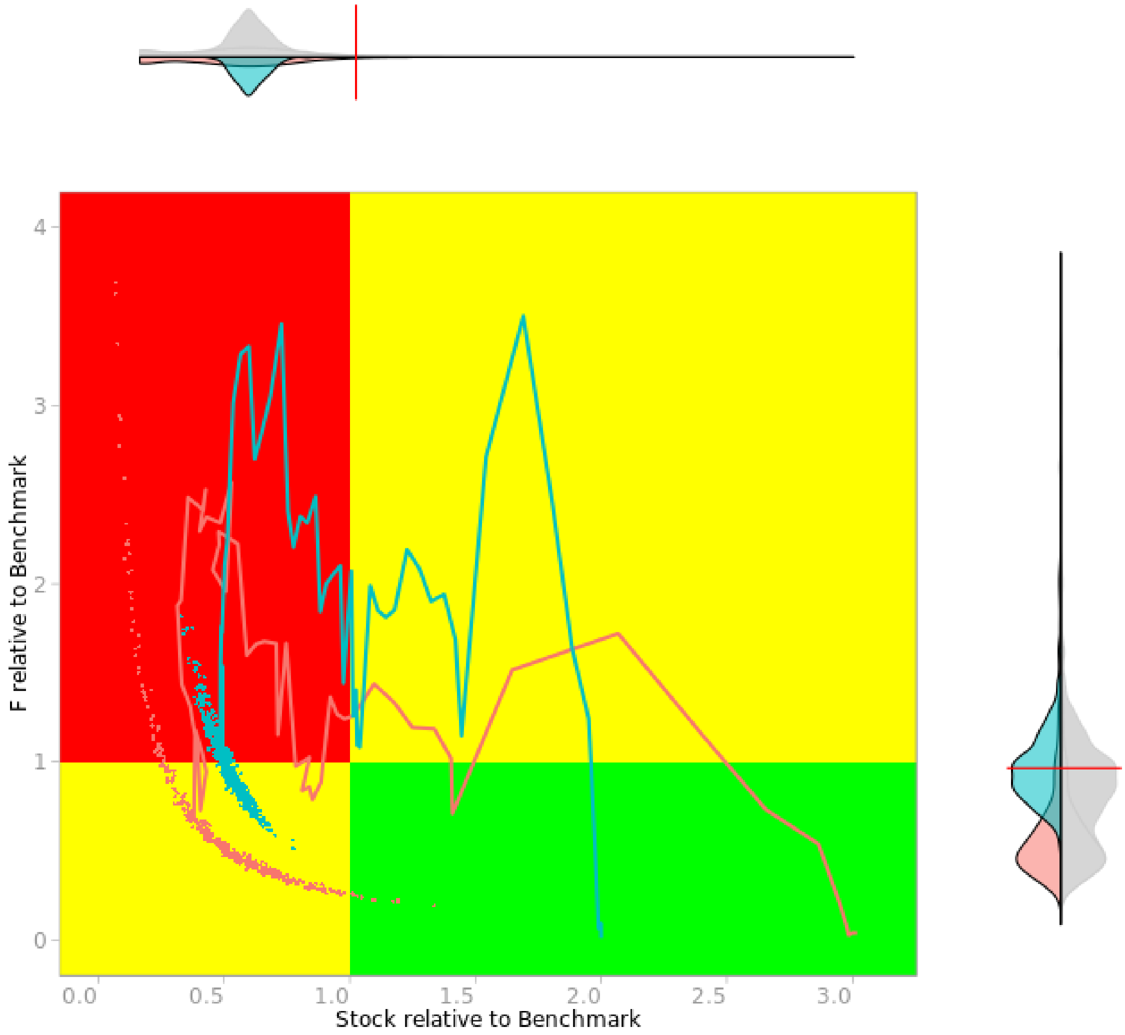
WHM-Figure 1. Geographic distribution of white marlin total catches by decade (last decade only covers 7 years).



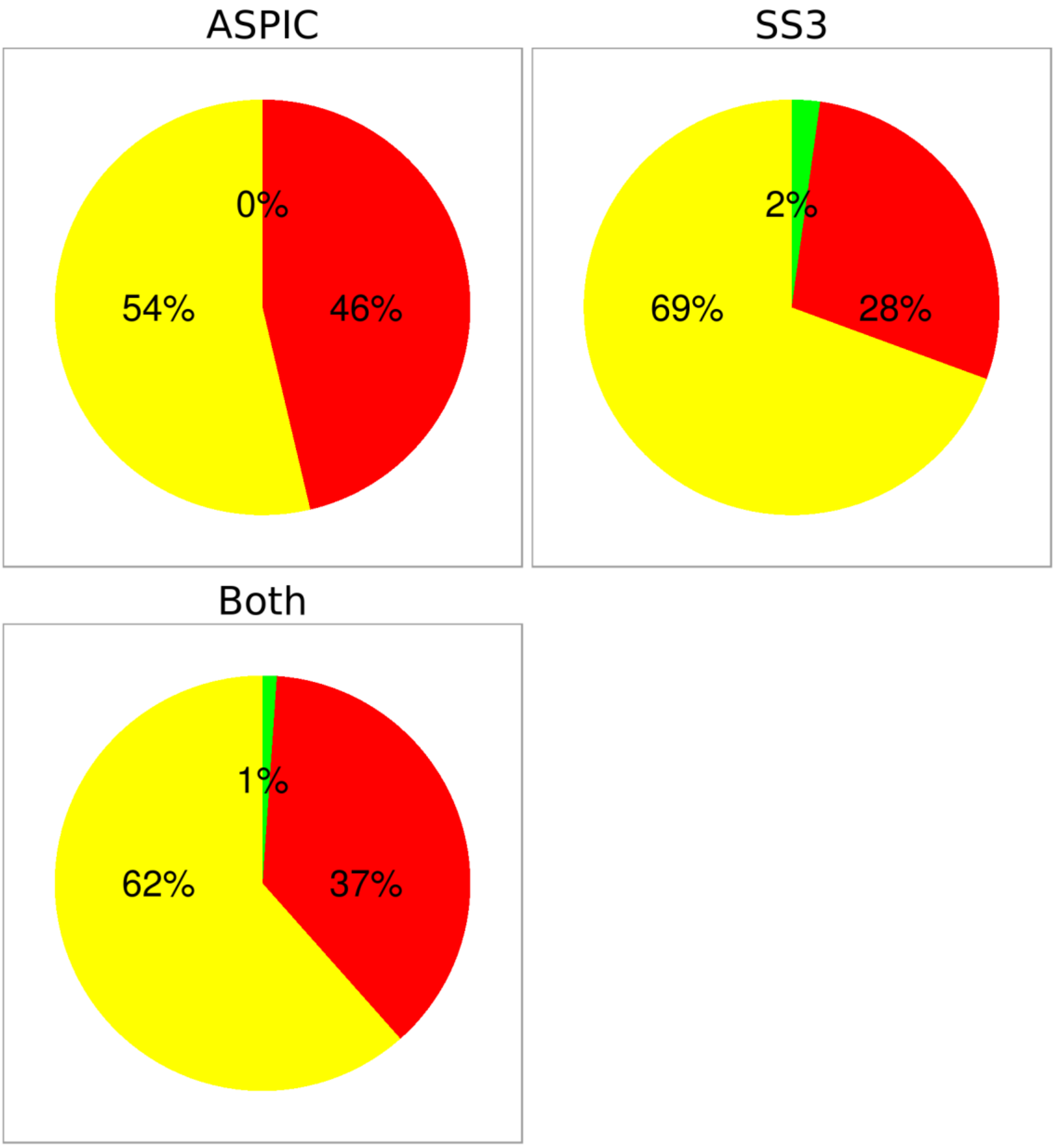
WHM-Figure 2. Total catch of white marlin reported in Task I for the period 1956-2017.



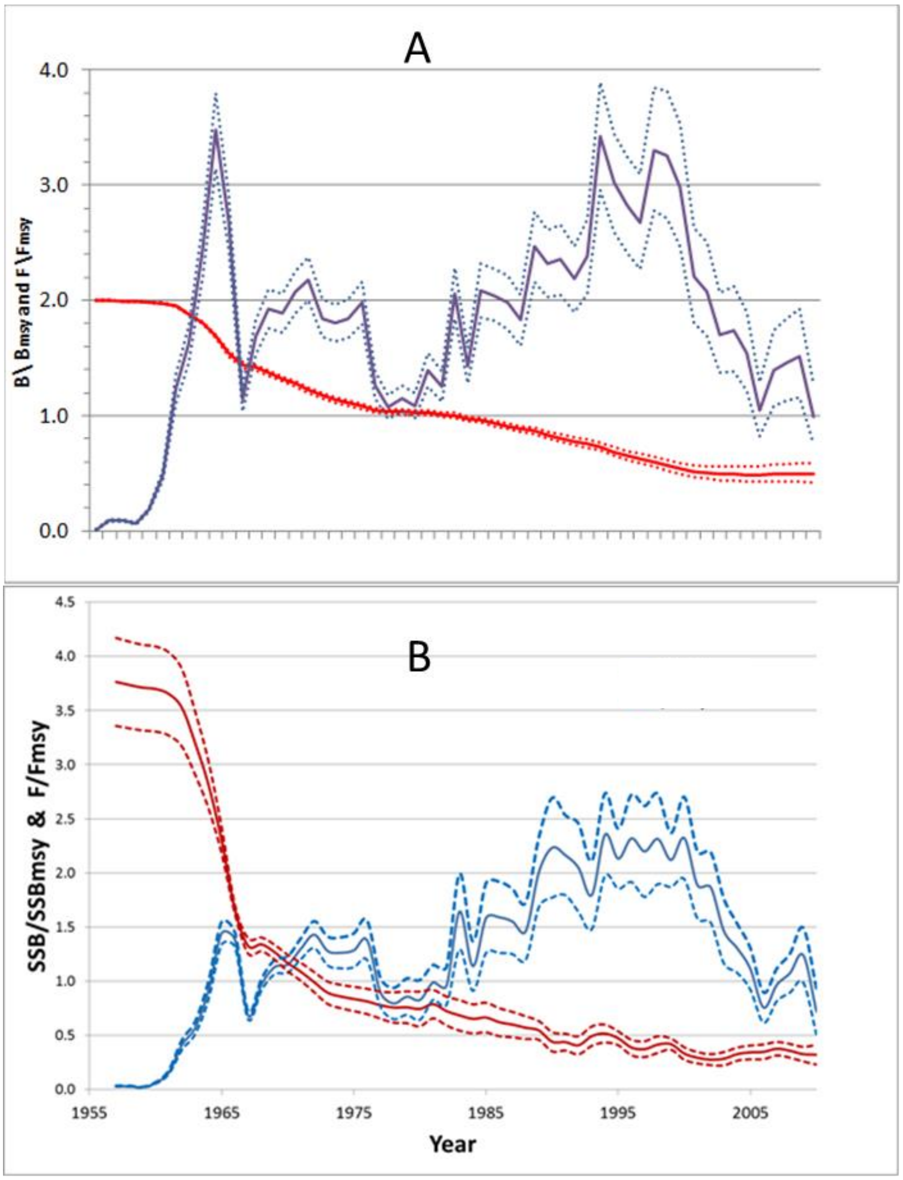
WHM-Figure 3. White marlin indices of abundance presented and selected during the meeting. For graphing purposes, the indices were scaled to their respective mean value for the period 1990-2010.



WHM-Figure 4. Kobe phase plot panel showing the estimated trajectories for stock (B) relative to B_{MSY} and harvest rate (F) relative to F_{MSY} (line) along with the bootstrap estimates for 2012. 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 red line represents the stock synthesis model, and the blue line represents the Surplus production model (large panel). 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 surplus production model and stock synthesis, and the lower part (blue and pink) are individual probabilities of surplus production model and stock synthesis overlaid. The red lines represent the benchmark levels (ratios equal to 1.0).



WHM-Figure 5. Pie chart showing the proportion of assessment results for 2012 that are within the green quadrant of the Kobe plot chart (not overfished, no overfishing), the yellow quadrant (overfishing), and the red quadrant (overfished and overfishing).



WHM-Figure 6. Historical surplus production model (A) and stock synthesis model (B) estimates of biomass over biomass at MSY ratio (red) and fishing mortality over fishing mortality at MSY ratios (blue) for 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 2017 were 1,591 t, compared to 1,422t reported for 2016 (**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 2017 were 1,076 t, compared to 1,213 t reported for 2016 (**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 that the total catch harvested must be no more than 1271 t (67% of the average estimate of the Maximum Sustainable Yield), however, the current catch level exceeds this level.

West Atlantic

It was established that the total catch harvested must be no more than 1,030 t (67% of the average estimate of the Maximum Sustainable Yield), however, the current catch level exceeds this level.

If the catch limit is exceeded in any stock, the Commission shall review the implementation and effectiveness of the current regulation.

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.

Based on the assessment results, and considering the associated uncertainties, the Commission recommended at a minimum that catches should not exceed 1,271 t [Rec. 16-11]. Considering the increase in catch levels during 2016 and 2017, the Commission may consider alternative management measures to prevent further increases in catch levels.

West Atlantic

The Stock Synthesis models for the western Atlantic sailfish stock estimates MSY between 1,438-1,636 t. Although current catches are well below this level, the results of the assessment were highly uncertain, and therefore the Committee recommends that the western Atlantic sailfish catches should not exceed current levels

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 (2017)	1,076 t[4]	1,591 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]	0.33-2.85 [3]
	0.63 (0.42 – 2.02)[2]	
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] 2017 yield should be considered provisional.

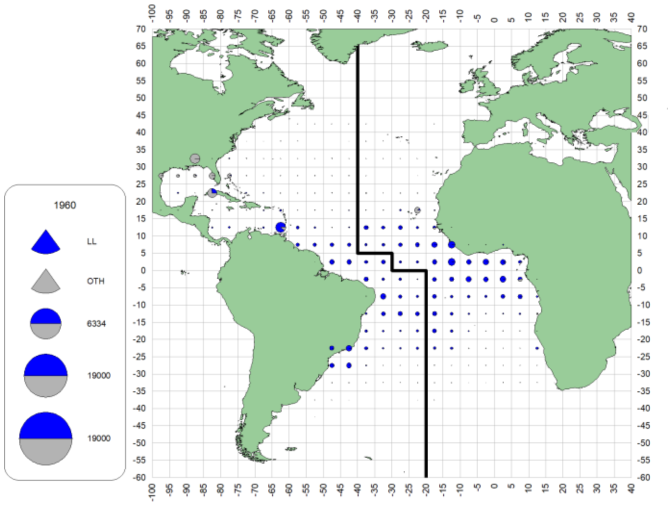
SAI-Table 1. Estimated catches (t) of Atlantic sailfish (*Istiophorus albicans*) by area, gear and flag.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				3228	2292	2445	3023	2604	2975	2922	3976	4603	4411	4137	4339	4059	3854	4137	3962	3753	3082	2887	2859	2324	2020	2144	2634	2666
	ATE			1815	1172	1234	1881	1347	1362	1342	1980	2806	2351	2639	2612	2220	1916	2577	2229	2129	1853	1553	1591	1339	1163	1246	1422	1591
	ATW			1413	1120	1211	1142	1257	1613	1580	1996	1797	2060	1498	1727	1839	1939	1561	1733	1624	1229	1334	1267	985	856	898	1213	1076
Landings	ATE		Longline	256	151	189	196	216	275	273	198	314	391	335	282	319	580	590	628	622	514	546	543	457	423	435	338	375
			Other surf.	1111	954	910	1504	644	859	883	1231	1725	1862	2022	2110	1758	1289	1798	1488	932	900	870	985	765	730	749	1082	1115
			Sport (HL+RR)	448	67	135	182	488	228	186	551	767	98	282	219	143	46	189	113	575	439	136	58	117	10	56	0	94
	ATW		Longline	865	558	544	416	500	917	879	1436	1510	1344	1053	1077	1467	1490	1096	1213	1153	1131	1213	1074	880	727	884	1184	1052
			Other surf.	252	317	291	426	350	402	467	438	216	603	440	642	368	442	452	502	457	92	101	154	86	107	1	6	6
			Sport (HL+RR)	233	217	348	230	350	267	163	76	60	106	0	0	0	2	6	7	4	2	10	19	7	12	5	15	11
Discards	ATE		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	6	1	4
			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	3
	ATW		Longline	63	28	29	69	57	27	72	45	11	7	5	7	3	5	8	9	10	4	10	20	12	11	7	7	7
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	0	24	0	0	0	0	0	0	19
			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	3	3	3	3	5	9	4	5	11	4	4	8	16	8	1	4	5	2	4	1	1	2	2	4
			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	1
			Côte d'Ivoire	40	54	66	91	65	35	80	45	47	65	121	73	93	78	52	448	74	24	108	192	80	99	55	38	405
			EU.España	42	8	13	42	48	15	20	8	195	245	197	169	202	214	227	239	318	206	197	257	229	302	333	225	236
			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	7	11
			EU.Portugal	2	1	2	1	2	27	53	13	4	10	13	19	31	137	43	49	131	170	121	72	109	33	41	30	27
			EU.United Kingdom	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**
			Gabon	3	3	110	218	2	0	0	0	0	0	4	4	1	0	0	0	0	0	0	0	0	4	0	0	5
			Ghana	693	450	353	303	196	351	305	275	568	592	566	521	542	282	420	342	358	417	299	201	220	191	99	238	267
			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	11	1	3	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	27	45	52	47	19	58	16	26	6	20	22	70	50	62	144	199	94	115	143	157	71	59	36	52	45
			Korea Rep.	2	5	5	11	4	0	0	0	0	0	0	0	0	0	0	0	1	0	10	1	6	10	2	6	15
			Liberia	0	0	33	85	43	136	122	154	56	133	127	106	122	118	115	0	0	0	0	0	0	0	0	0	
			Maroc	0	0	0	0	0	0	0	0	0	0	0	0	15	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	1
			Russian Federation	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**
			S. Tomé e Príncipe	81	88	92	96	139	141	141	136	136	136	136	515	346	292	384	114	119	121	124	127	131	134	312	212	219
			Senegal	462	162	167	240	560	260	238	786	953	240	673	567	463	256	737	446	630	484	174	247	165	37	60	586	301
			Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	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	
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	4	0	0	0	1	5	0	0	0	0	0	0	0	0	0	2
			U.S.A.	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**
			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	157	38	58	24	56	44	66	45	50	62	49	15	25	36	109	121	80	21	52	54	42	17	21	23	26
		NCO	Benin	20	20	20	19	6	4	5	5	12	2	2	5	3	3	4	0	0	0	0	0	0	0	0	0	
			Cuba	77	83	72	533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Mixed flags (FR+ES)	182	160	128	97	110	138	131	353	400	365	413	336	264	274	205	251	308	265	275	275	275	275	275	0	
			NEI (BIL)	0	0	0	0	0	0	0	28	269	408	213	55	1	105	43	20	11	0	44	0	0	0	0	0	
			NEI (ETRO)	27	51	57	69	86	127	120	77	43	3	2	16	7	8	10	0	0	0	0	0	0	0	0	0	
			Togo	0	0	0	0	9	22	36	23	62	55	95	135	47	31	71	0	0	0	0	0	0	0	0	0	
	ATW	CP	Barbados	50	46	74	25	71	58	44	44	42	26	27	26	42	58	42	0	0	18	36	36	39	44	54	56	42

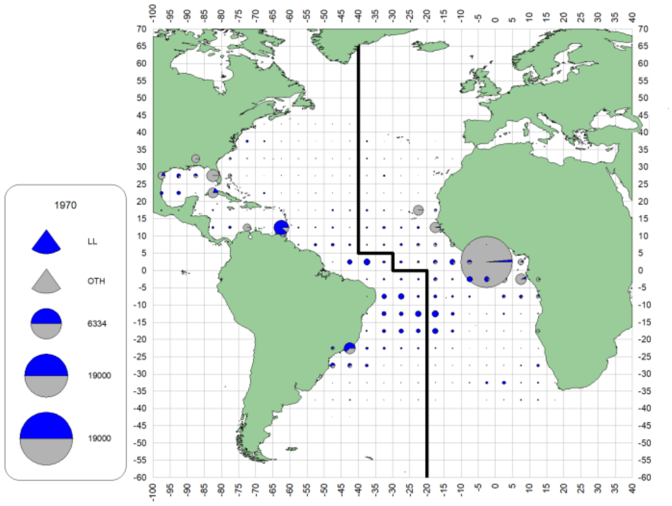
				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	5	0	12	0	0	52	8	0	4	0	0	11	**0**
			Brazil	243	129	245	310	137	184	356	598	412	547	585	534	416	139	123	268	433	71	137	108	76	57	72	59	39
			China PR	0	3	3	3	3	3	9	4	3	1	0	1	0	0	0	1	2	1	1	1	0	1	1	3	6
			Curaçao	15	15	15	15	15	15	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	13	19	36	5	20	42	7	14	309	414	183	160	89	134	214	361	412	275	190	184	203	244	311	207	454
			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	4	0	0	12	12	110	18	53	101	20	19	9	2	0	0	0	0	1
			Grenada	246	151	119	56	83	151	148	164	187	151	171	112	147	159	174	216	183	191	191	191	191	191	191	0	
			Japan	1	8	2	4	17	3	10	12	3	3	10	5	22	4	1	33	43	36	12	16	7	11	12	13	7
			Korea Rep.	3	4	4	12	4	0	0	0	0	0	0	0	0	0	0	0	1	0	40	3	1	1	0	0	**0**
			Mexico	2	19	19	10	9	65	40	118	36	34	45	51	55	41	46	45	48	34	32	51	63	42	35	47	51
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	415	
			St. Vincent and Grenadines	4	4	2	1	3	0	1	0	2	164	3	86	73	59	18	13	8	7	4	4	3	4	1	85	8
			Trinidad and Tobago	1	2	1	4	10	25	37	3	7	6	8	10	9	17	13	32	16	16	38	72	34	29	51	53	63
			U.S.A.	202	179	345	231	349	267	163	76	58	103	0	0	0	0	0	3	3	0	0	7	3	2	2	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	341	223	180	255	279	515	367	261	249	277	327	509	607	1042	549	382	416	498	590	543	341	210	152	246	387
		NCC	Chinese Taipei	112	117	19	19	2	65	17	11	33	31	13	8	21	5	14	10	11	6	8	26	6	3	6	5	5
		NCO	Aruba	10	10	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	42	46	37	37	40	28	196	208	68	32	18	50	72	47	56	0	0	0	0	0	0	0	0	0	
			Dominica	0	0	0	0	0	0	0	0	5	3	0	1	0	3	3	4	2	0	2	0	0	5	3	3	
			Dominican Republic	50	90	40	40	101	89	27	67	81	260	91	144	165	133	147	0	0	0	0	0	0	0	0	0	
			NEI (BIL)	0	0	0	0	0	0	0	297	268	0	0	0	0	68	81	252	17	0	21	0	0	0	0	0	
			NEI (ETRO)	15	27	30	36	46	67	64	41	23	1	1	9	4	4	6	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
			Seychelles	0	0	0	0	0	0	0	3	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	4	0	2	2	3	2	3	1	0	
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	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
			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
			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	0
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	6	1	4
	ATW	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0
			U.S.A.	63	28	29	69	57	27	72	45	11	7	5	7	4	5	7	10	10	4	10	19	11	11	6	7	6
		NCC	Chinese Taipei	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

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

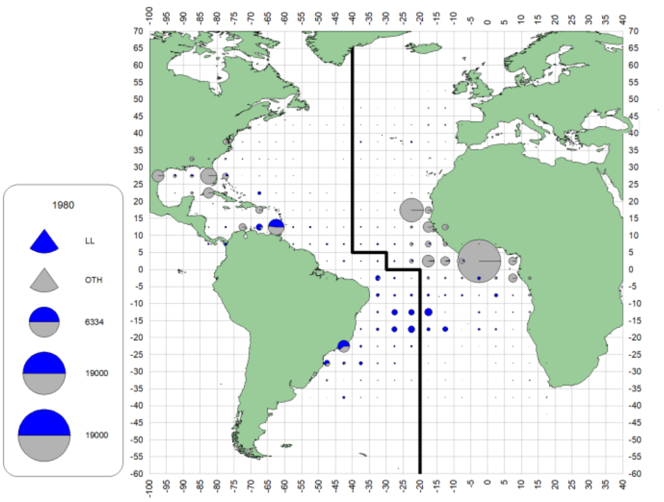
				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				540	320	240	165	201	266	306	278	188	179	133	188	169	340	167	166	140	245	153	229	447	52	80	76	350
	ATE			419	198	207	128	194	192	257	181	81	84	54	51	68	84	66	60	78	128	73	170	95	16	18	15	29
	ATW			120	122	33	37	7	74	50	97	107	95	79	137	101	256	102	106	62	117	80	58	352	36	62	62	321
Landings	ATE		Longline	307	100	129	69	126	106	176	121	81	84	54	51	68	84	66	60	78	128	73	170	95	16	18	14	29
			Other surf.	112	98	78	59	68	86	81	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATW		Longline	120	122	26	34	7	74	50	97	107	95	79	137	101	256	102	106	62	117	80	58	337	30	59	61	320
			Other surf.	0	0	0	2	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	0	15	6	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	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	
	ATW		Longline	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
Landings	ATE	CP	China PR	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			EU.España	12	0	5	1	1	9	31	17	9	6	5	0	3	3	0	2	7	32	12	10	9	13	17	10	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	
			EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	24	8	2	6	25	9	20	0	0	0	0	1
			Japan	31	36	26	25	30	22	33	29	20	16	25	36	40	21	36	53	59	49	39	134	85	3	0	4	2
			Korea Rep.	1	1	1	3	1	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	6	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	0	10
		NCC	Chinese Taipei	263	63	97	41	94	73	112	75	52	62	25	15	25	37	22	2	6	16	9	6	0	0	1	0	1
		NCO	Mixed flags (FR+ES)	112	98	78	59	68	86	81	60	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	0	4	0	0	0	0	0	
	ATW	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	3	0	0	0	0	0	**0**
			Brazil	0	0	0	0	0	0	0	27	56	39	3	0	0	5	4	0	0	0	24	4	325	6	6	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	0	1	0
			EU.España	5	0	1	0	0	0	22	47	20	5	21	0	5	14	0	2	5	0	10	10	9	11	19	14	259
			EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	26	15	44	10	10	0	1	0	0	0	0	**0**
			Japan	1	2	3	4	1	8	11	11	3	12	40	41	58	54	25	45	26	57	12	13	3	1	0	0	**0**
			Korea Rep.	2	4	4	10	4	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	82	0	135	23	13	7	8	5	4	3	3	1	7	52
			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	0	2	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	1	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	111	116	19	18	2	64	16	11	24	39	12	11	20	17	20	0	0	5	12	3	1	3	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	0	1	
			NEI (BIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	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	
		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
	ATW	CP	U.S.A.	0	0	6	1	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	2	0	1



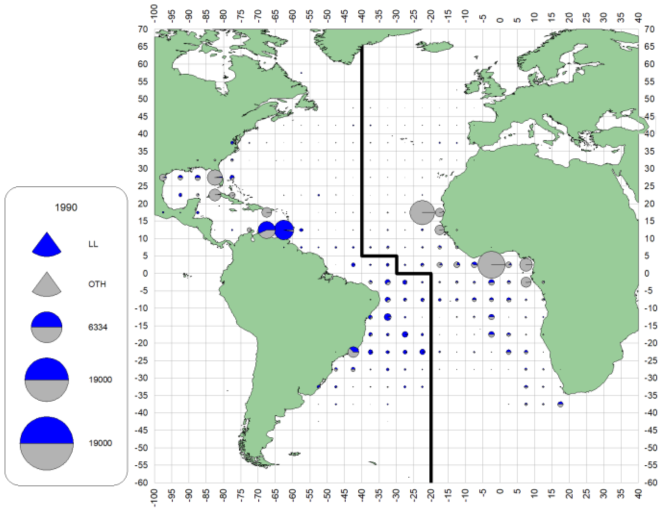
a. SAI (1960-69)



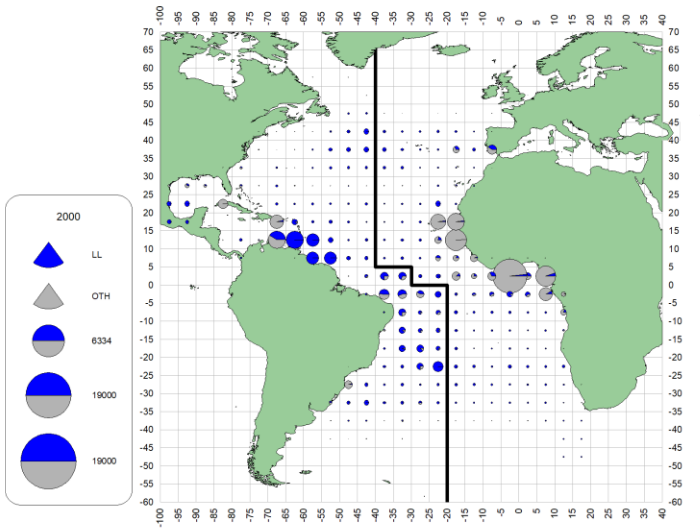
b. SAI (1970-79)



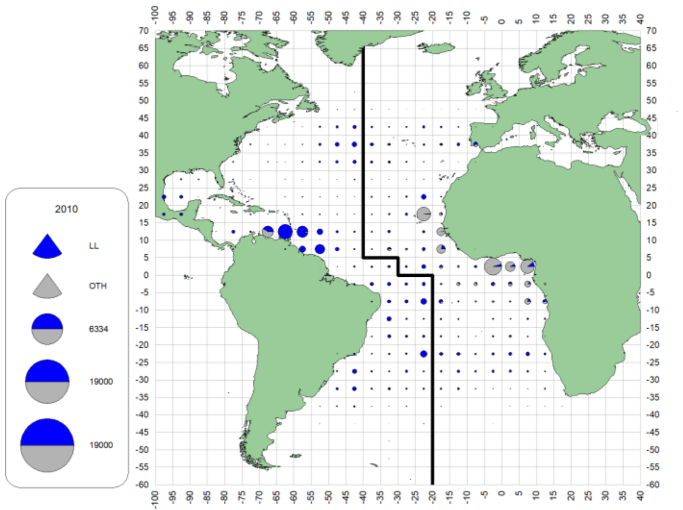
c. SAI (1980-89)



d. SAI (1990-99)

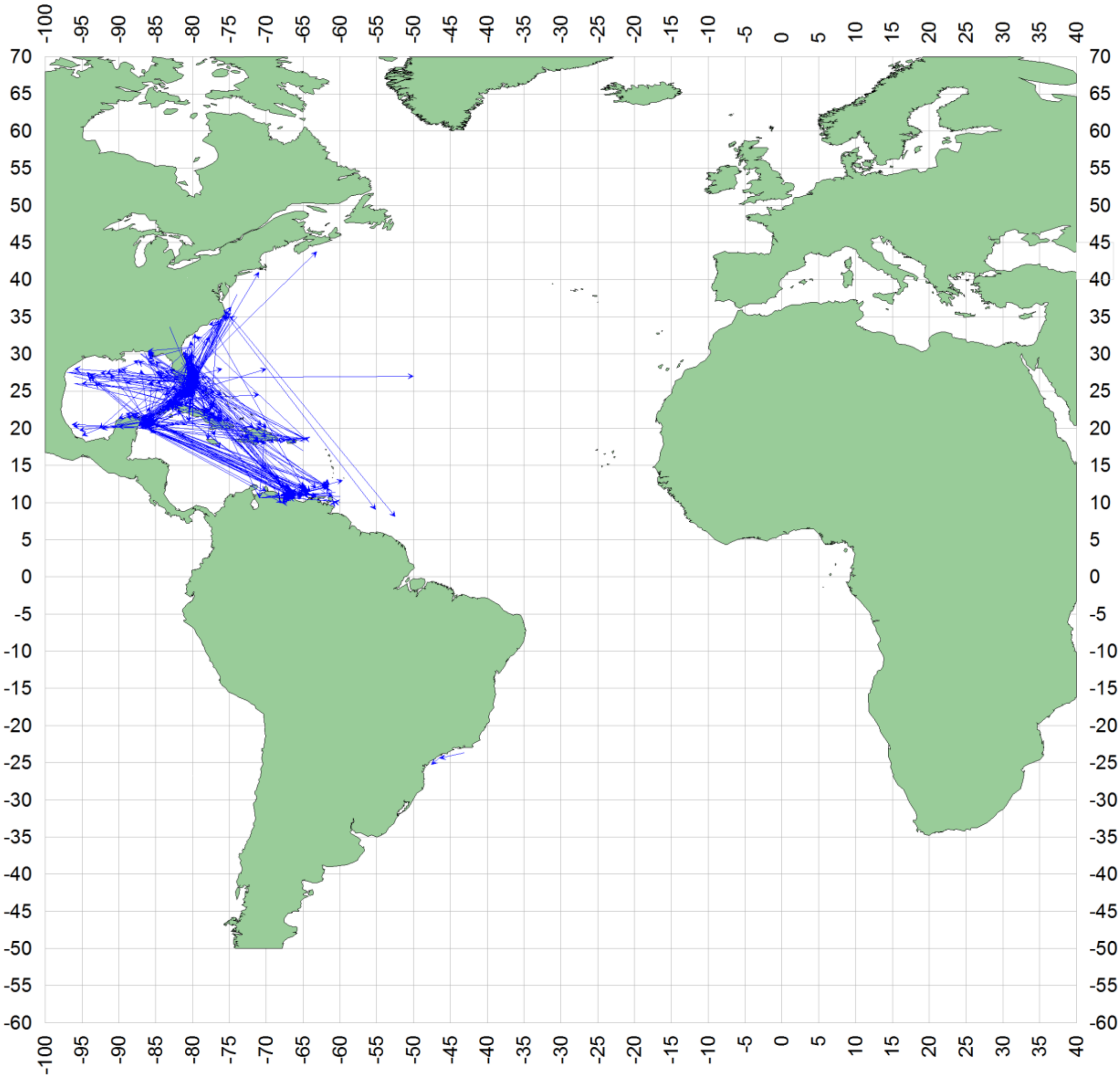


e. SAI (2000-09)

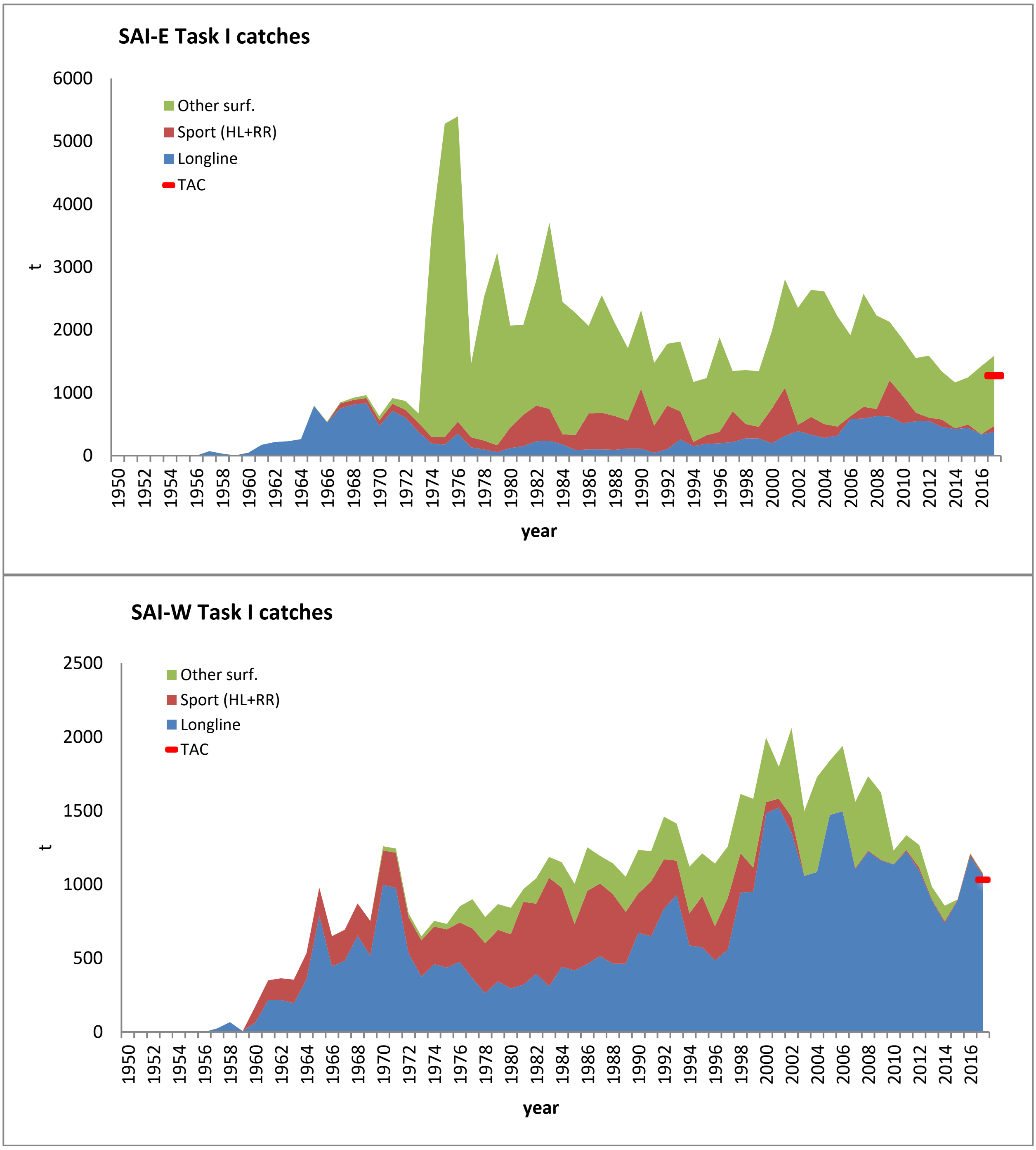


f. SAI (2010-16)

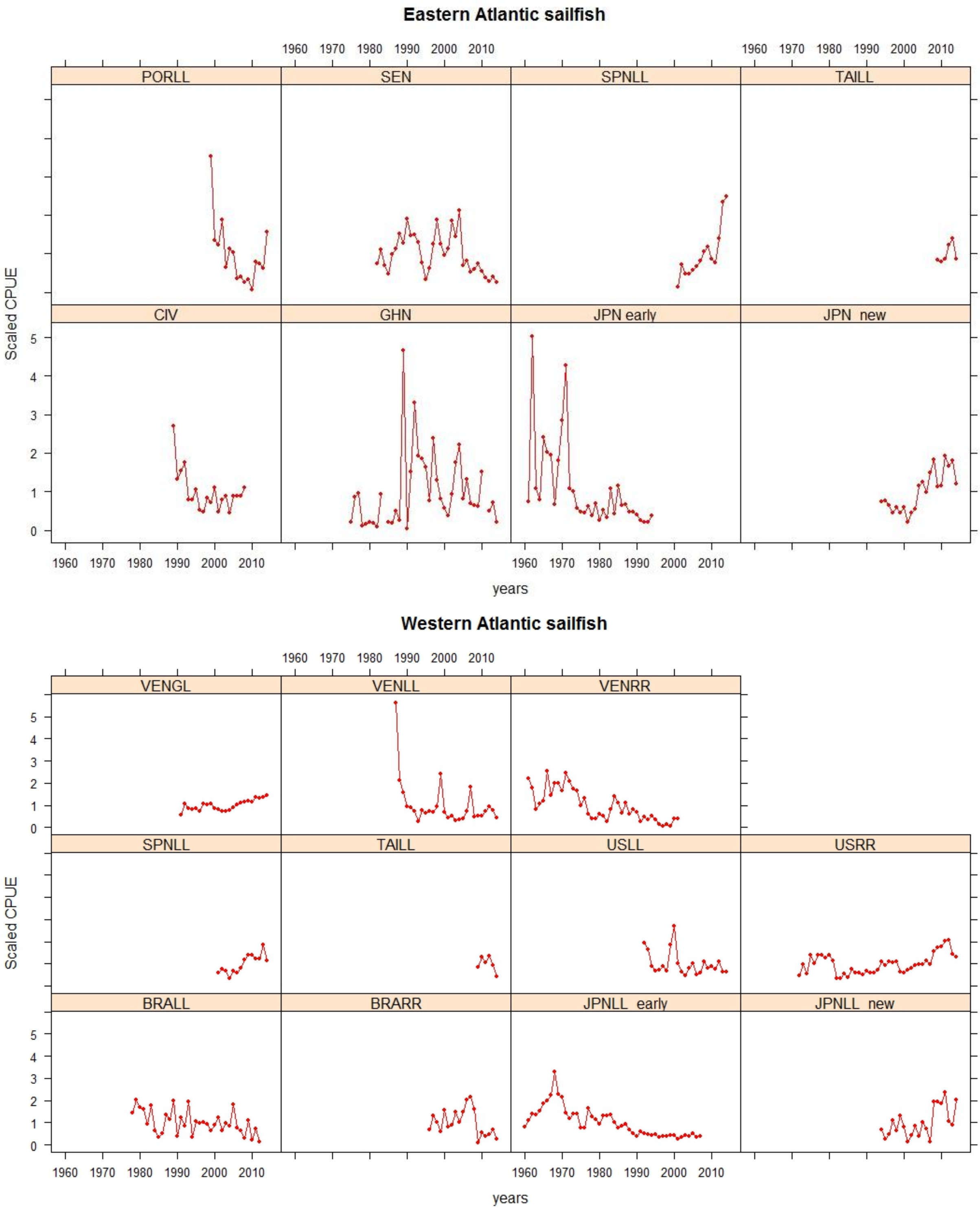
SAI-Figure 1. Geographic distribution of sailfish total catches by decade (last decade only covers 7 years). The dark line denotes the separation between stocks.



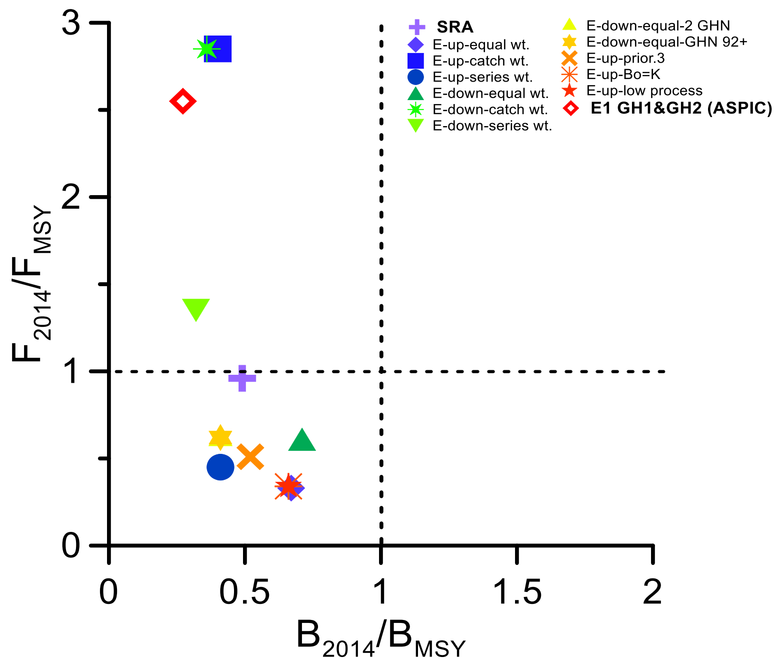
SAI-Figure 2. Conventional tag returns for Atlantic sailfish. Lines join the locations of release and recapture.



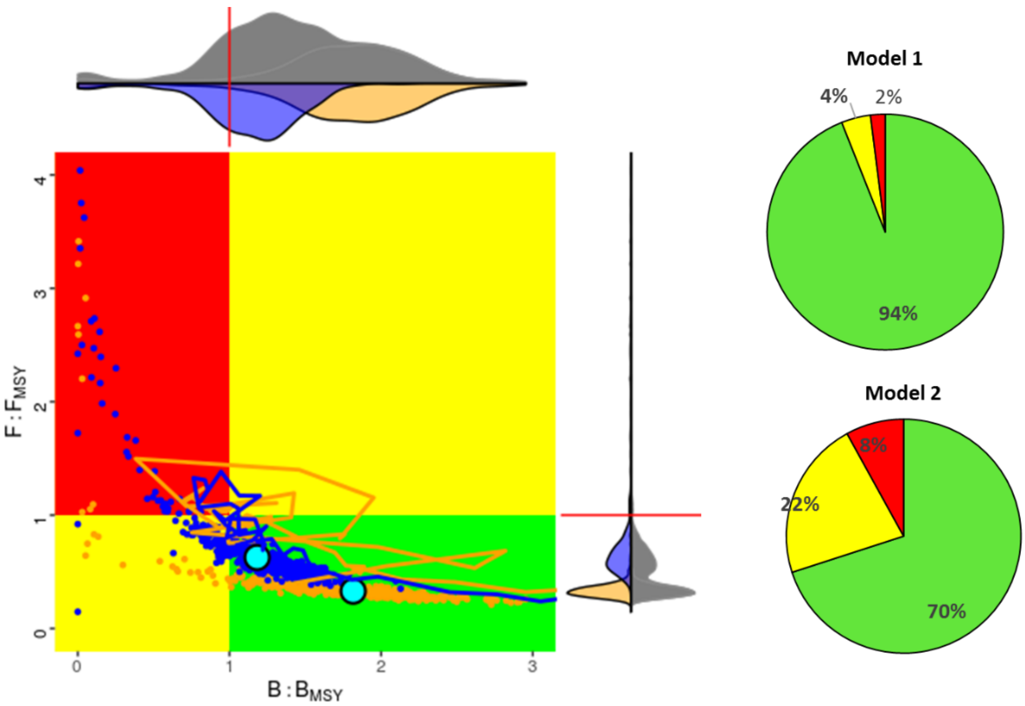
SAI-Figure 3. Task I catches of sailfish for each of the two Atlantic stocks, East and West. In 2016 a TAC of 1271 t and 1030 t was implemented Rec. 16-11 for East and West stocks, respectively.



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 9** to this SCRS Report, and recommendations pertinent to Atlantic swordfish are presented in Item 19.

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 by-catch 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 2017 (20,559 t) was 2.6% lower than the reported catch of 2016 (21,111 t). As a small number of countries have not yet reported their 2017 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 12,000 t per year (**SWO-ATL-Table 1**). The catch in 2017 (10,046 t) represents a 50.4% 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 2017, the 10,512 t of reported catch was about 52% 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**). The volume of Atlantic-wide reported discards by these fleets has ranged from a minimum of 157 t in 2009 to a maximum of 1,139 t in 2000, with 146 t reported for 2017. 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

In 2017, the Committee provided information on the effectiveness of existing minimum size 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 then averaged 11,472 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 13,674 t, and did not exceed the TAC in any year. In 2010, the TAC was reduced to 15,000 t and in 2018 it was reduced to 14,000. The reported catch since 2010 averaged 10, 837 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.

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 estimated biomass is close to B_{MSY}.

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 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 (2017) Yield[3]	10,046 t	10,512 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 Overfishing: NO	Overfished: YES Overfishing: NO
Management Measures in Effect	TAC (2018): 13,200 t [Rec. 17-02] 125/119 cm LJFL minimum size	TAC (2018): 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.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				32868	34459	38803	33511	31567	26251	27123	27180	25139	23758	24075	25146	25536	25715	27932	23596	24930	24251	23978	24554	21238	20634	21010	21111	20559
	ATN			16738	15501	16872	15222	13025	12223	11622	11453	10011	9654	11442	12068	12373	11470	12302	11050	12081	11553	12523	13868	12069	10678	10673	10376	10046
	ATS			16130	18958	21930	18289	18542	14027	15502	15728	15128	14104	12633	13079	13163	14245	15630	12546	12848	12698	11455	10686	9169	9956	10337	10735	10512
Landings	ATN		Longline	15670	14365	15850	13819	12203	10961	10715	9921	8676	8799	10333	11407	11528	10838	11475	10341	11439	10964	11610	12955	11344	10059	10121	9514	9211
			Other surf.	660	428	496	815	371	778	377	394	433	240	486	341	512	409	546	465	485	437	511	512	526	463	386	758	689
	ATS		Longline	15739	17839	21584	17859	18299	13748	14823	15448	14302	13576	11712	12485	12915	13723	14967	11761	12106	11920	10833	10255	8958	9736	10045	10518	10264
			Other surf.	391	1119	346	429	222	269	672	278	825	527	920	593	248	522	572	779	743	630	548	291	210	175	248	216	137
Discards	ATN		Longline	408	708	526	562	439	476	525	1137	896	607	618	313	323	215	273	235	151	148	392	391	199	156	167	105	146
			Other surf.	0	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	0	1	21	10	6	1	0	0	0	1	0	0	91	6	0	147	74	140	0	46	43	2	111
			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	33	16	16	12	13	19	10	21	25	44	39	27	39	20	13	23	21	16	21	29	20	21
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	112	106	184	141	142	76	1	3	59
			Brazil	0	0	0	0	0	0	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Canada	2234	1676	1610	739	1089	1115	1119	968	1079	959	1285	1203	1558	1404	1348	1334	1300	1346	1551	1489	1505	1604	1579	1548	1188
			China PR	73	86	104	132	40	337	304	22	102	90	316	56	108	72	85	92	92	73	75	59	96	60	141	135	81
			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	25	30	0	0	0	0	0	27	21
			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	6598	6185	6953	5547	5140	4079	3996	4595	3968	3957	4586	5376	5521	5448	5564	4366	4949	4147	4889	5622	4084	3750	4013	3916	3588
			EU.France	95	46	84	97	164	110	104	122	0	74	169	102	178	92	46	14	15	35	16	94	44	28	66	90	79
			EU.Ireland	7	0	0	15	15	132	81	35	17	5	12	1	1	3	2	2	1	1	2	5	2	3	15	15	10
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	1961	1599	1617	1703	903	773	777	732	735	766	1032	1320	900	949	778	747	898	1054	1203	882	1438	1241	1420	1460	1871
			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	2	3	1	5	11	0	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
			FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	10	3	36	48	0	82	48	17	90	1	0	18	3	0	0	**0**
			Grenada	13	0	1	4	15	15	42	84	0	54	88	73	56	30	26	43	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	0	13	0	0	0	
			Iceland	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Japan	1126	933	1043	1494	1218	1391	1089	161	0	0	0	575	705	656	889	935	778	1062	523	639	300	545	430	379	455
			Korea Rep.	19	16	16	19	15	0	0	0	0	0	0	0	51	65	175	157	3	0	0	0	64	35	0	9	19
			Liberia	14	26	28	28	28	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	
			Maroc	39	36	79	462	267	191	119	114	523	223	329	335	334	341	237	430	724	963	782	770	1062	1062	850	900	900
			Mexico	6	14	0	22	14	28	24	37	27	34	32	44	41	31	35	34	32	35	38	40	33	32	31	36	64
			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	17	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	1	4	44	5	0	8	0	22	28	0	17	36	9	14	0	0	
			Russian Federation	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**
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	28	11	1	44	43	49	78	52	51
			Sierra Leone	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			St. Vincent and Grenadines	23	0	4	3	1	0	1	0	22	22	7	7	7	0	51	7	34	13	11	8	4	40	102	33	46
			Trinidad and Tobago	11	180	150	158	110	130	138	41	75	92	78	83	91	19	29	48	30	21	16	14	16	26	17	13	36
			U.S.A.	3783	3366	4026	3559	2987	3058	2908	2863	2217	2384	2513	2380	2160	1873	2463	2387	2730	2274	2551	3393	2824	1809	1581	1408	1270
			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	1	1	5	5	3	3	2	0	0	1	1	0	3	4	3	3	3	1	1	1	1	2	**0**
			UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	4	4	7	0	3	0	0	4	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	13	17	0	0	**0**
			Vanuatu	0	0	0	0	0	0	0	0	0	0	0	35	29	14	0	0	0	10	23	15	2	4	7	0	**0**
			Venezuela	73	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	127	507	489	521	509	286	285	347	299	310	257	30	140	172	103	82	89	88	192	166	115	78	115	148	78
			Guyana	0	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	16	50	86	7	7	7	7	0	0	10	3	3	2	2	0	0	0	0	0	0	0	0	0	0	
			Dominica	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
			Faroe Islands	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			NEI (ETRO)	111	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	0
			Seychelles	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	0	1	0	0	0	0	0	0	0	0	0	2	3	0	0	2	0	0	0	0	0	0	0	0	
	ATS	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	18	0	0	13
			Belize	0	0	1	0	0	0	17	8	0	0	0	0	0	0	120	32	111	121	207	197	136	45	111	176	166
			Brazil	2013	1571	1975	1892	4100	3847	4721	4579	4082	2910	2920	2998	3785	4430	4153	3407	3386	2926	3033	2833	2384	2892	2599	2935	2406
			China PR	0	0	0	0	0	29	534	344	200	423	353	278	91	300	473	470	291	296	248	316	196	206	328	222	302
			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	14	20	19	26	18	25	26	20	19	19	43	29	31	39	17	159	267	156	145	88	110	55	42	25	17
			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	6974	7937	11290	9622	8461	5832	5758	6388	5789	5741	4527	5483	5402	5300	5283	4073	5183	5801	4700	4852	4184	4113	5059	4992	4654
			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.Lithuania	0	794	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	380	389	441	384	381	392	393	380	354	345	493	440	428	271	367	232	263	184	125	252	236	250	466
			EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	49	0	0	3	0	0	0	0	0	0	0	
			Gabon	0	0	0	0	0	0	0	0	0	0	9	2	1	0	0	0	2	0	0	0	0	0	0	0	
			Ghana	121	51	103	140	44	106	121	117	531	372	734	343	55	32	65	177	132	116	60	54	37	26	56	36	55
			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	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Honduras	0	0	6	4	5	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Japan	5256	4699	3619	2197	1494	1186	775	790	685	833	924	686	480	1090	2155	1600	1340	1314	1233	1162	684	976	657	637	902
			Korea Rep.	198	164	164	7	18	7	5	10	0	2	24	70	36	94	176	223	10	0	0	42	47	53	5	19	11
			Namibia	0	22	0	0	0	0	730	469	751	504	191	549	832	1118	1038	518	25	417	414	85	129	395	225	466	600
			Nigeria	0	0	0	9	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	29	105	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	6	1	8	1	1	4	58	41	49	14	35	15	35	58	0	0	
			S. Tomé e Príncipe	202	190	178	166	148	135	129	120	120	120	120	126	147	138	138	183	188	193	60	84	60	94	145	154	65
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	138	195	180	264	162	178	143	97	173	160
			Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	**0**
			South Africa	4	1	4	1	1	240	143	328	547	649	293	295	199	186	207	142	170	145	97	50	171	152	218	164	159
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	7	16	4	3	2	2	19	0	5	9
			U.S.A.	0	0	0	171	396	160	179	142	43	200	21	15	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	0	0	0	0	0	0	0	0	20	4	0	0	0	0	0	0	0	0	0	0	5	6	2	0	**0**
			Uruguay	260	165	499	644	760	889	650	713	789	768	850	1105	843	620	464	370	501	222	179	40	103	0	0	0	**0**
			Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	11	26	6	3	0	3	1	3	0	1	1	0	**0**
		NCC	Chinese Taipei	846	2829	2876	2873	2562	1147	1168	1303	1149	1164	1254	745	744	377	671	727	612	410	424	379	582	406	511	478	416
		NCO	Argentina	14	24	0	0	0	0	38	0	5	10	8	0	0	0	0	0	0	1	0	0	0	0	0	0	
			Benin	28	25	24	24	10	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cambodia	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	192	452	778	60	60	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	0	4	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	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Togo	8	14	14	64	0	0	0	0	0	0	0	9	10	2	0	0	0	0	0	0	0	0	0	0	
Discards	ATN	CP	Canada	0	0	0	0	5	52	35	50	26	33	79	45	106	38	61	39	9	15	8	111	59	12	8	11	21
			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	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	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	0	1	0	0	0	0	0	0
			U.S.A.	408	708	526	588	446	433	494	490	308	263	282	275	227	185	220	205	148	138	223	217	120	137	137	90	107
			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	0	27	0	7	18	4	18
	ATS	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	6	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	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	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	0	4	117	0	45	43	2	111

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.

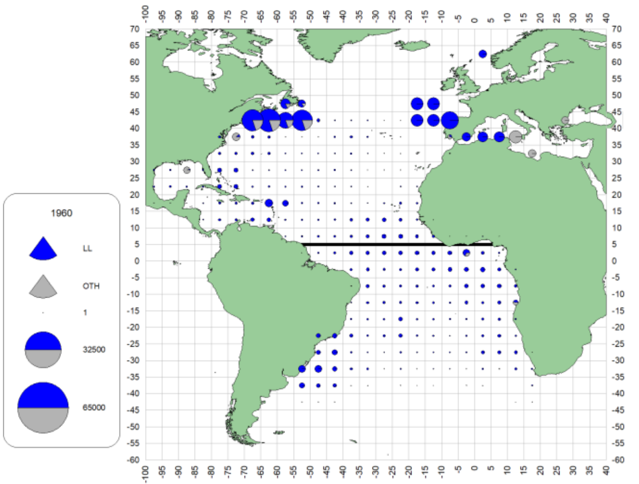
Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
10000	86	90	92	94	95	96	96	97	97	97	97
10500	83	87	90	91	93	94	94	95	95	96	96
11000	78	83	86	88	90	91	92	93	93	93	94
11500	73	78	81	84	86	87	88	89	90	91	92
12000	68	73	76	79	81	83	84	86	86	87	88
12500	62	66	70	73	75	77	78	79	80	81	82
13000	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.

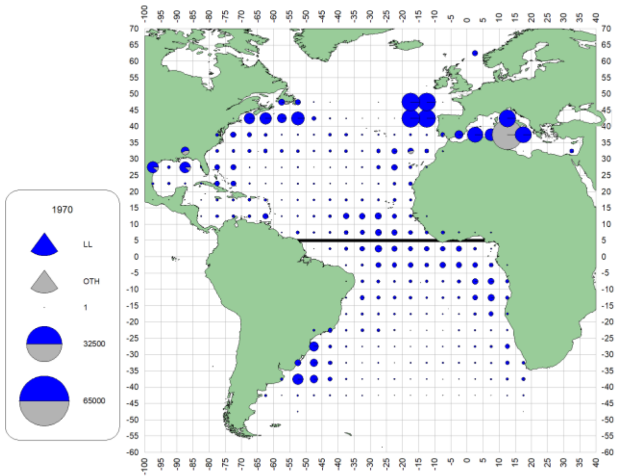
Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
10000	35	51	65	75	81	85	88	90	92	93	95
10500	35	51	63	72	78	82	86	88	90	91	92
11000	35	49	59	67	74	79	82	85	87	88	90
11500	36	47	57	64	70	75	78	81	83	85	86
12000	36	46	54	60	66	70	74	77	79	81	83
12500	36	44	51	56	60	65	68	71	73	75	76
13000	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.

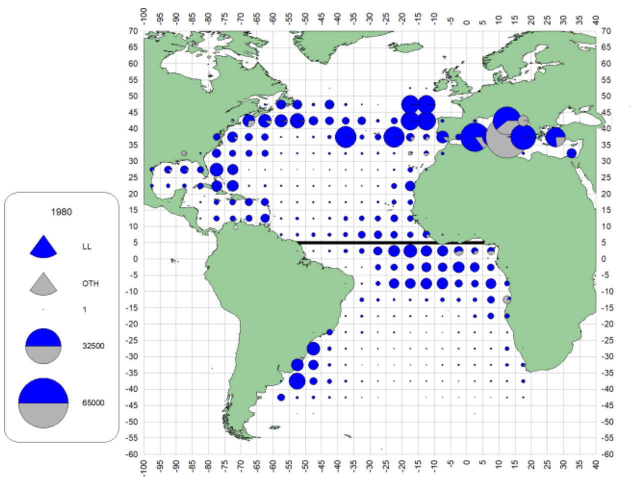
Catch	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
10000	35	51	65	75	81	85	88	90	92	93	95
10500	35	51	63	72	78	82	86	88	90	91	92
11000	35	49	59	67	74	79	82	85	87	88	90
11500	36	47	57	64	70	75	78	81	83	85	86
12000	36	46	54	60	66	70	74	77	79	81	83
12500	36	44	51	56	60	65	68	71	73	75	76
13000	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



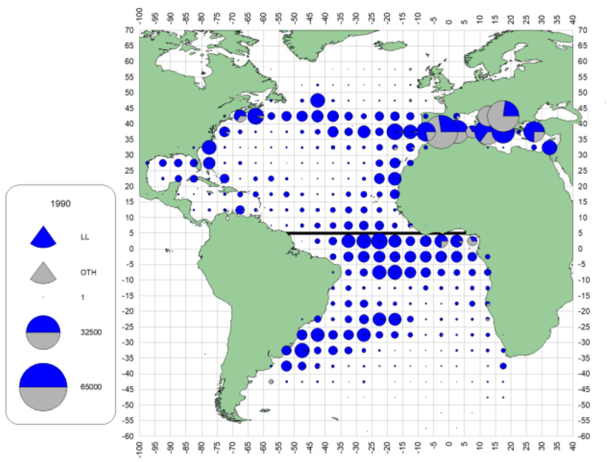
a. SWO (1960-69)



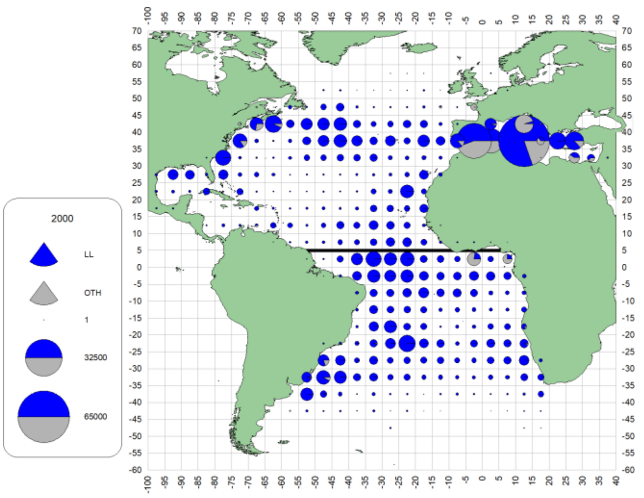
b. SWO (1970-79)



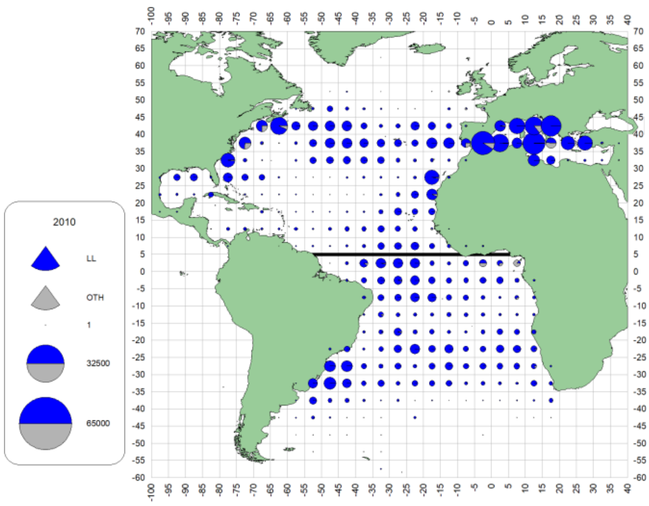
c. SWO (1980-89)



d. SWO (1990-99)

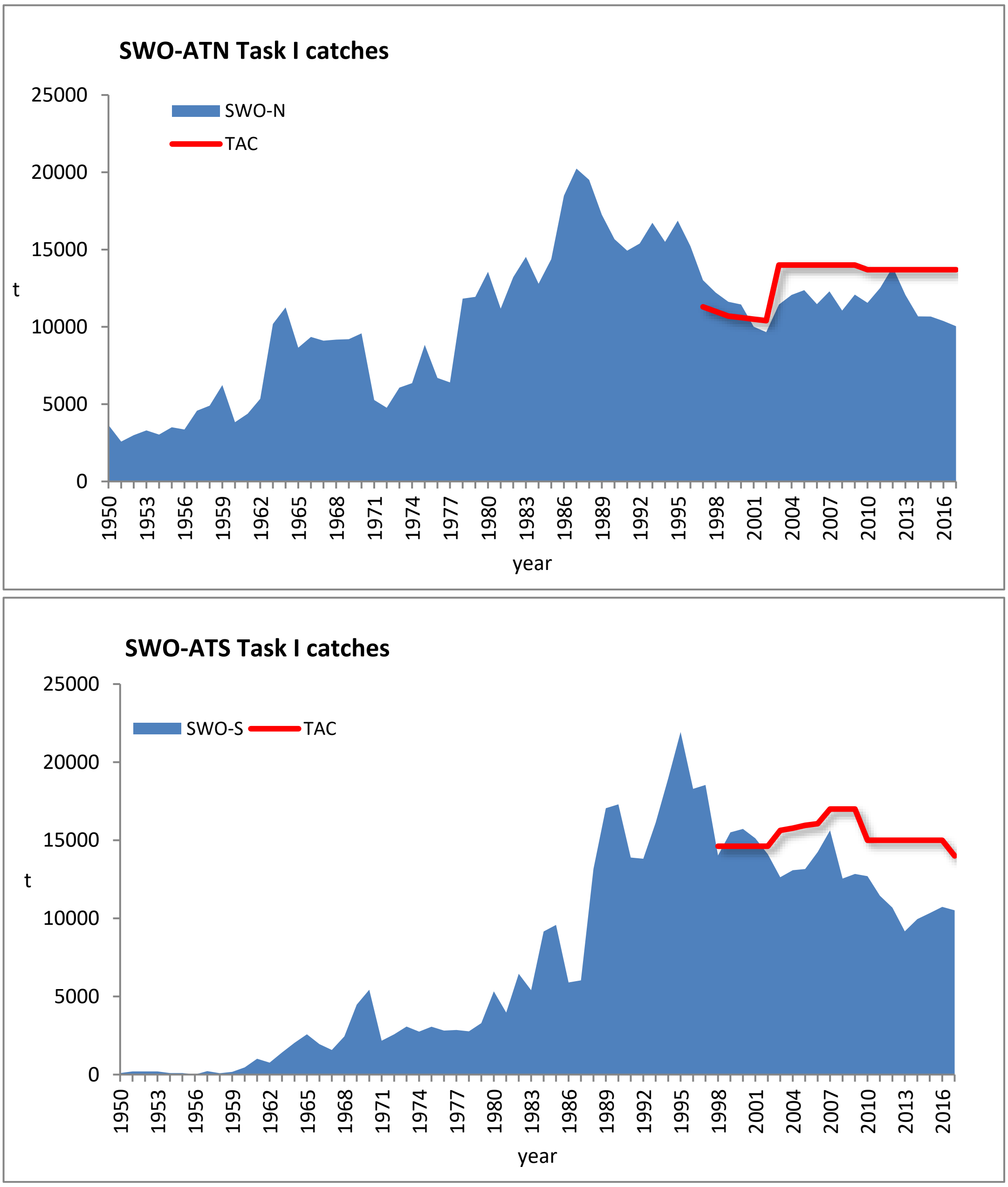


e. SWO (2000-09)

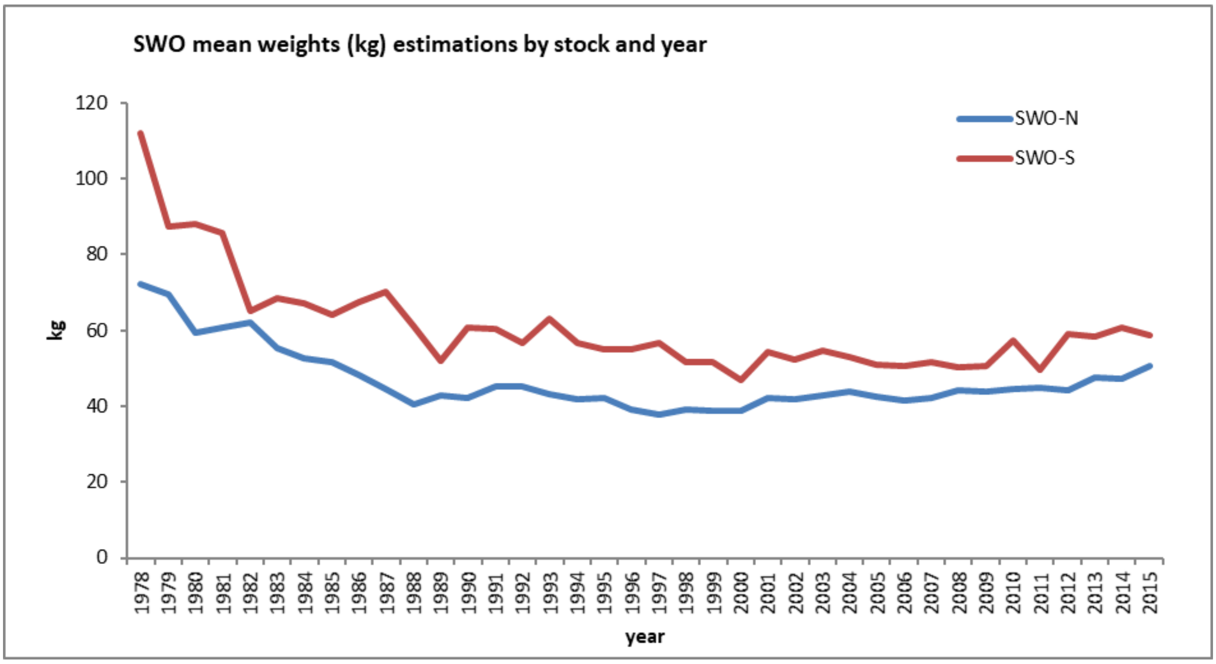


f. SWO (2010-16)

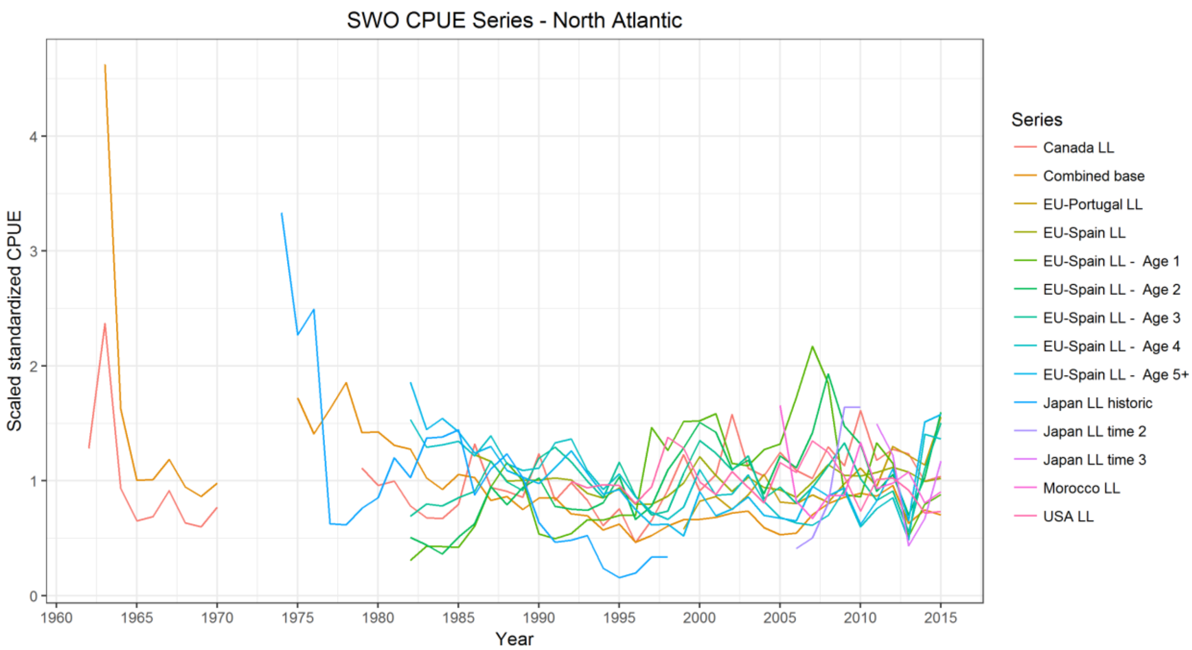
SWO-ATL-Figure 1. Geographic distribution of swordfish cumulative catch (t) by gear, in the Convention area, shown on a decadal scale. The maps are scaled to the maximum catch observed during 1960-2016 (the last decade only covers 7 years).



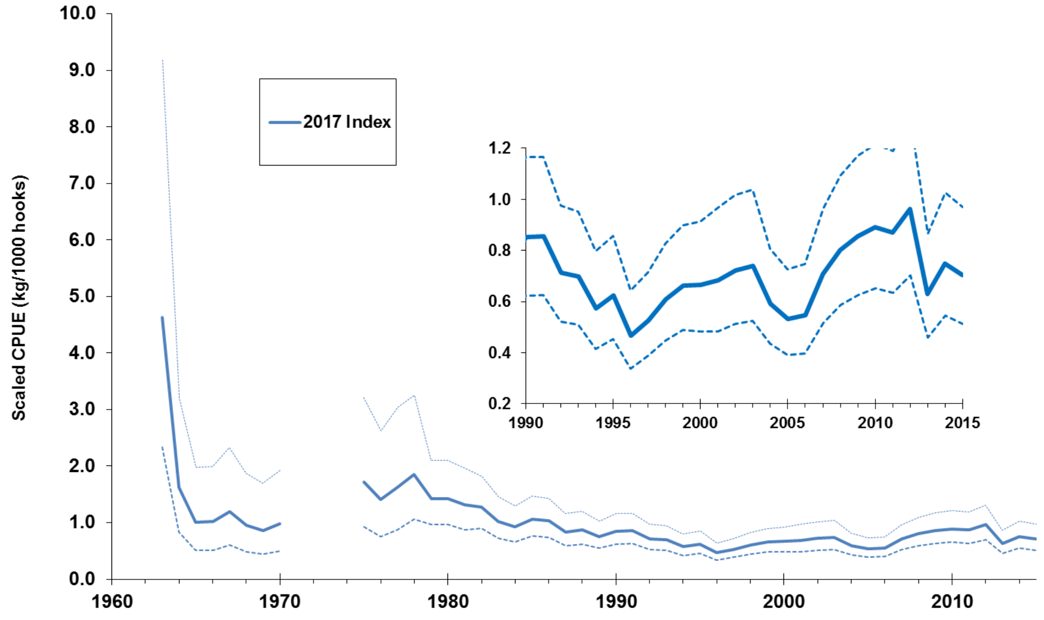
SWO-ATL-Figure 2. North and South Atlantic swordfish catches and TAC (t), for the period 1950-2017.



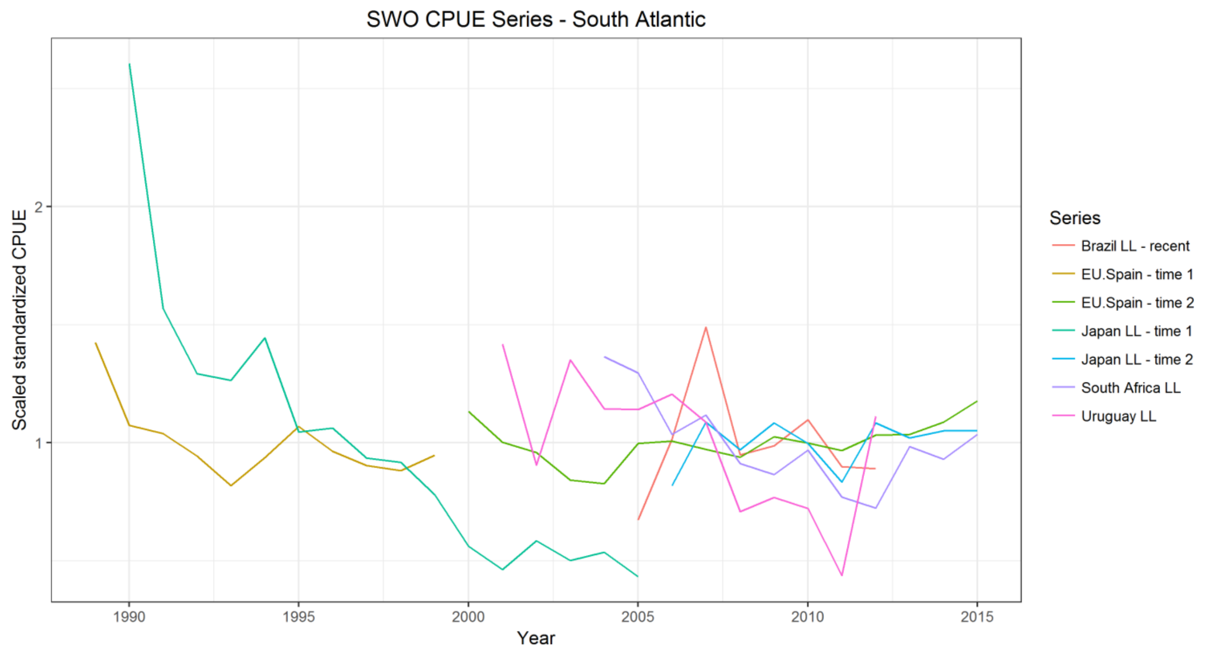
SWO-ATL-Figure 3. Trends in mean weight (kg) for the North and South Atlantic swordfish stocks.



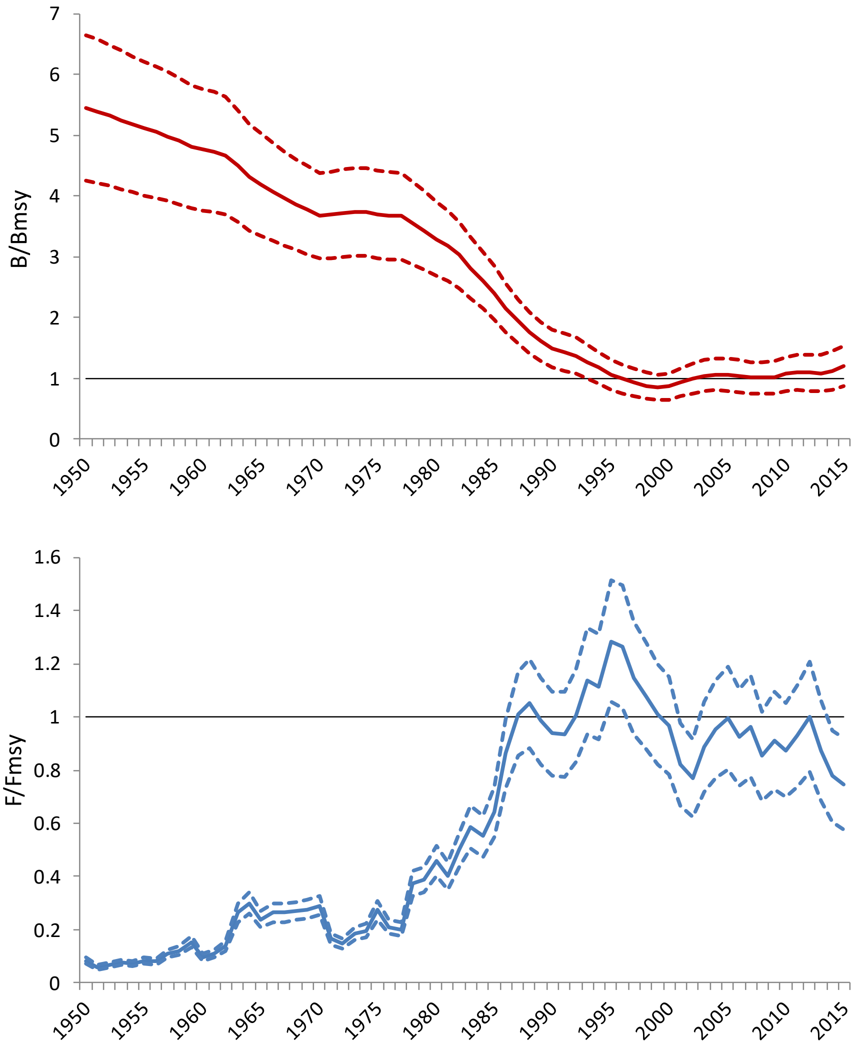
SWO-ATL-Figure 4. Standardized CPUEs series provided by CPCs for the North Atlantic swordfish and the combined index for the base continuity production model. The CPUE series were scaled to their mean for comparison purposes.



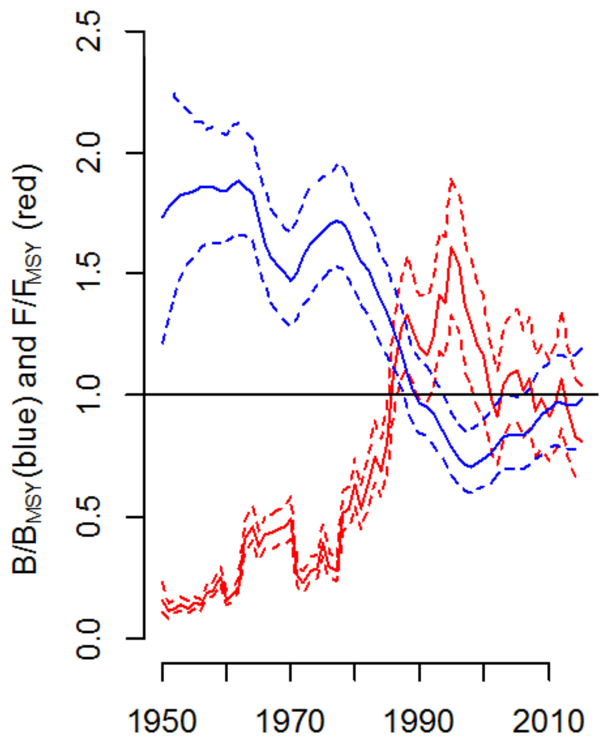
SWO-ATL-Figure 5. Standardized combined biomass CPUE index for North Atlantic and 95% confidence intervals, used as the continuity run for the Surplus Production model. The inset plot shows the detail of the index trend since 1990.



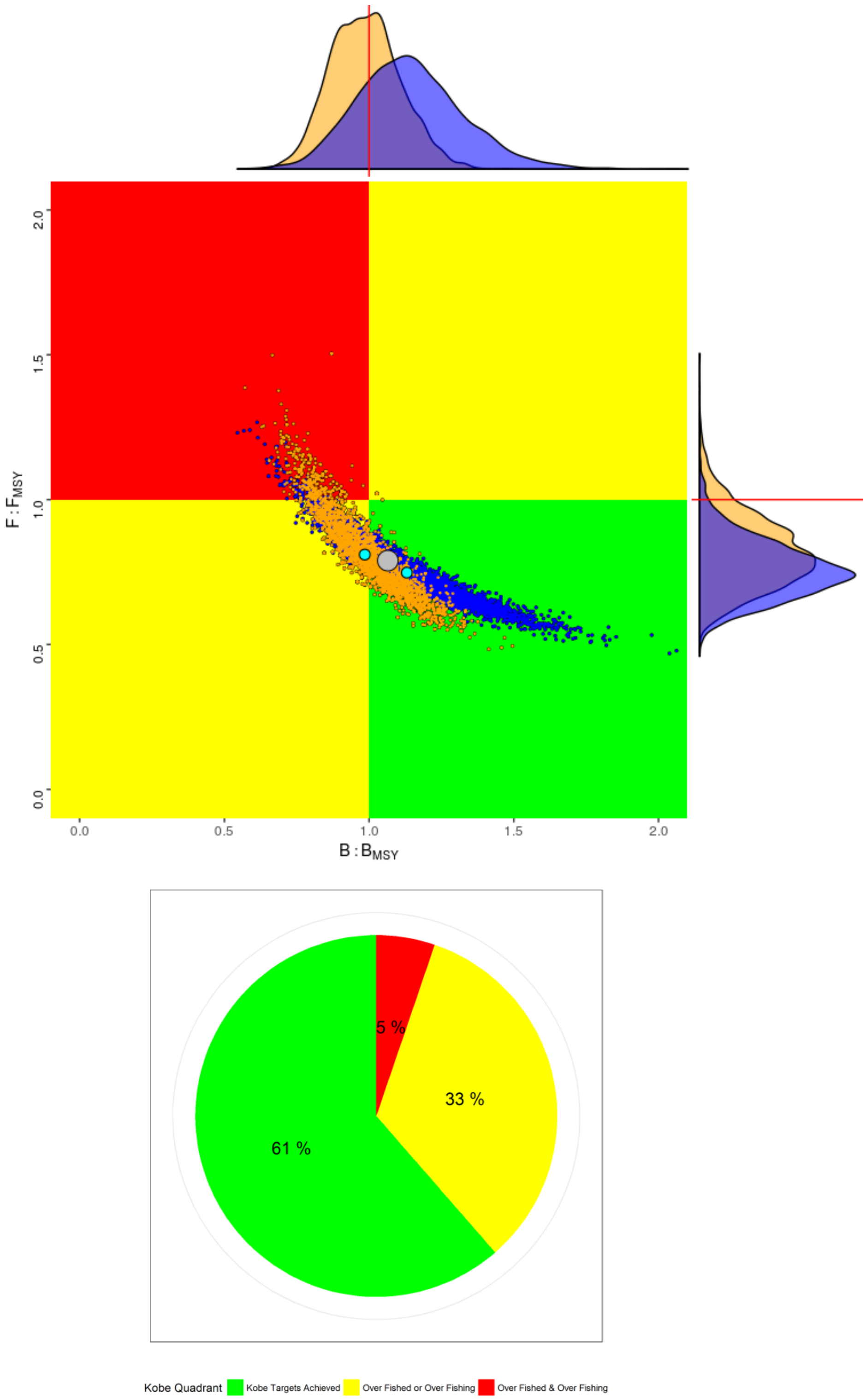
SWO-ATL-Figure 6. Standardized CPUEs series provided by CPCs for South Atlantic swordfish. The CPUE series were scaled to their mean for comparison purposes.



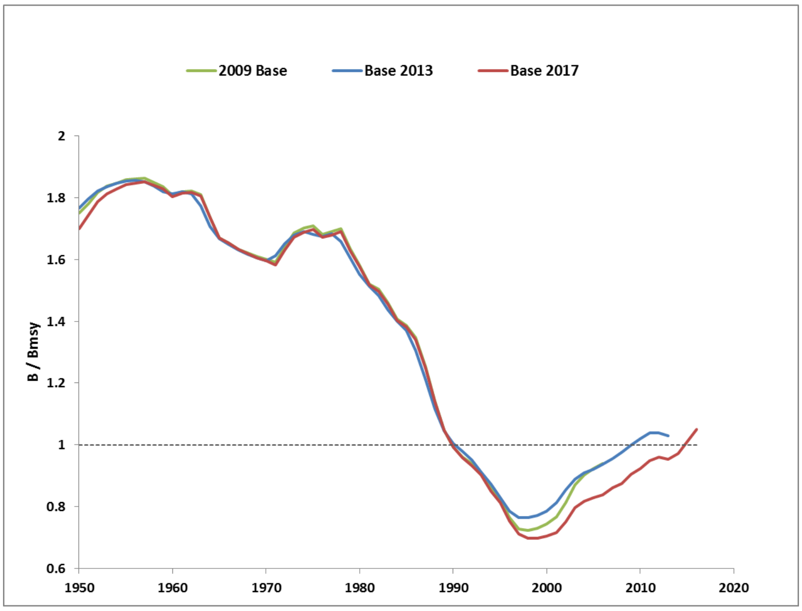
SWO-ATL-Figure 7. Results from the North Atlantic swordfish base case Age Structured Model: trends in relative biomass (top) and fishing mortality (bottom). Dashed lines represent lower and upper 95% CIs.



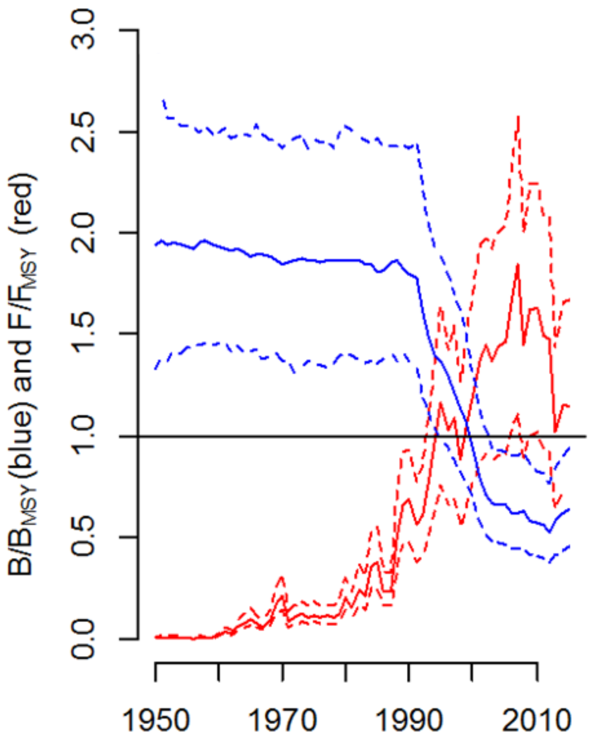
SWO-ATL-Figure 8. Results from the North Atlantic swordfish base case Bayesian Surplus Production Model: trends in relative biomass and fishing mortality. Dashed lines represent lower and upper 90% CIs.



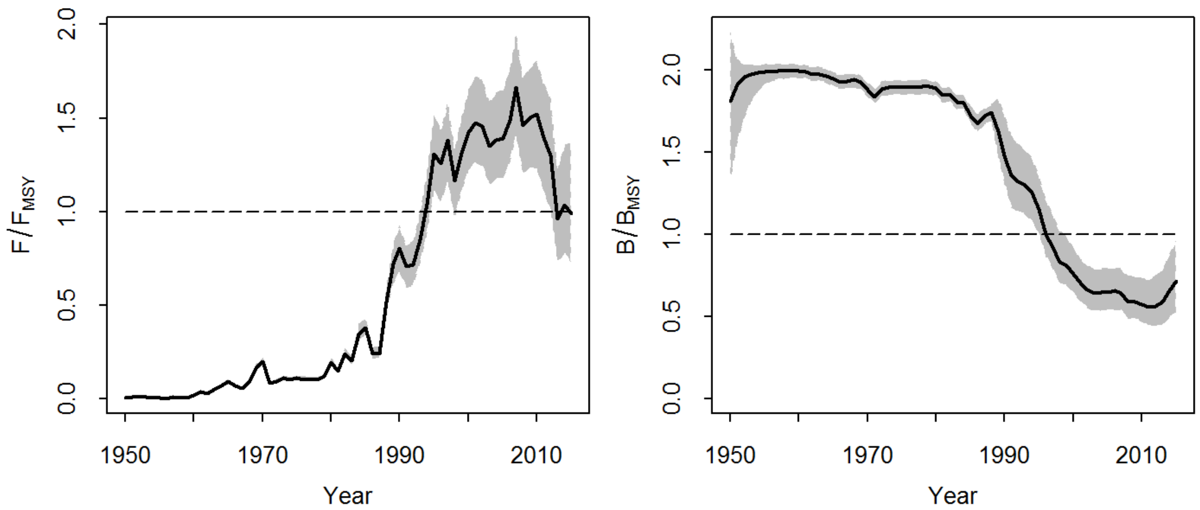
SWO-ATL-Figure 9. North Atlantic swordfish stock status terminal points (2015) from the final base Age Structured and Bayesian Surplus Production Models. The solid light blue circle is the estimated median point with the respective uncertainties from each model (Bayesian Surplus Production Model in orange 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%).



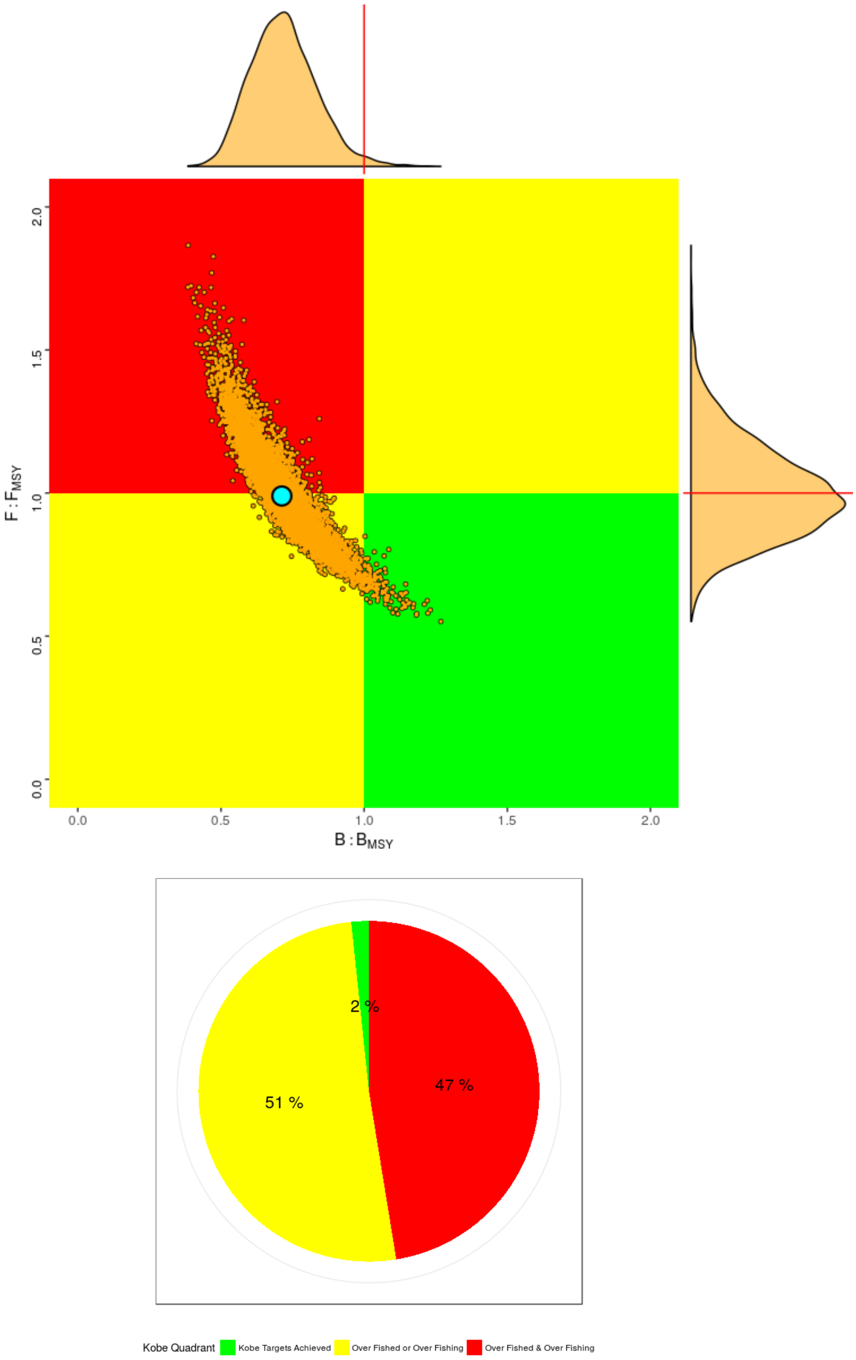
SWO-ATL-Figure 10. Comparison of relative biomass trends estimated by the Surplus Production base case model for the 2009, 2013 and 2017 North Atlantic swordfish stock assessments.



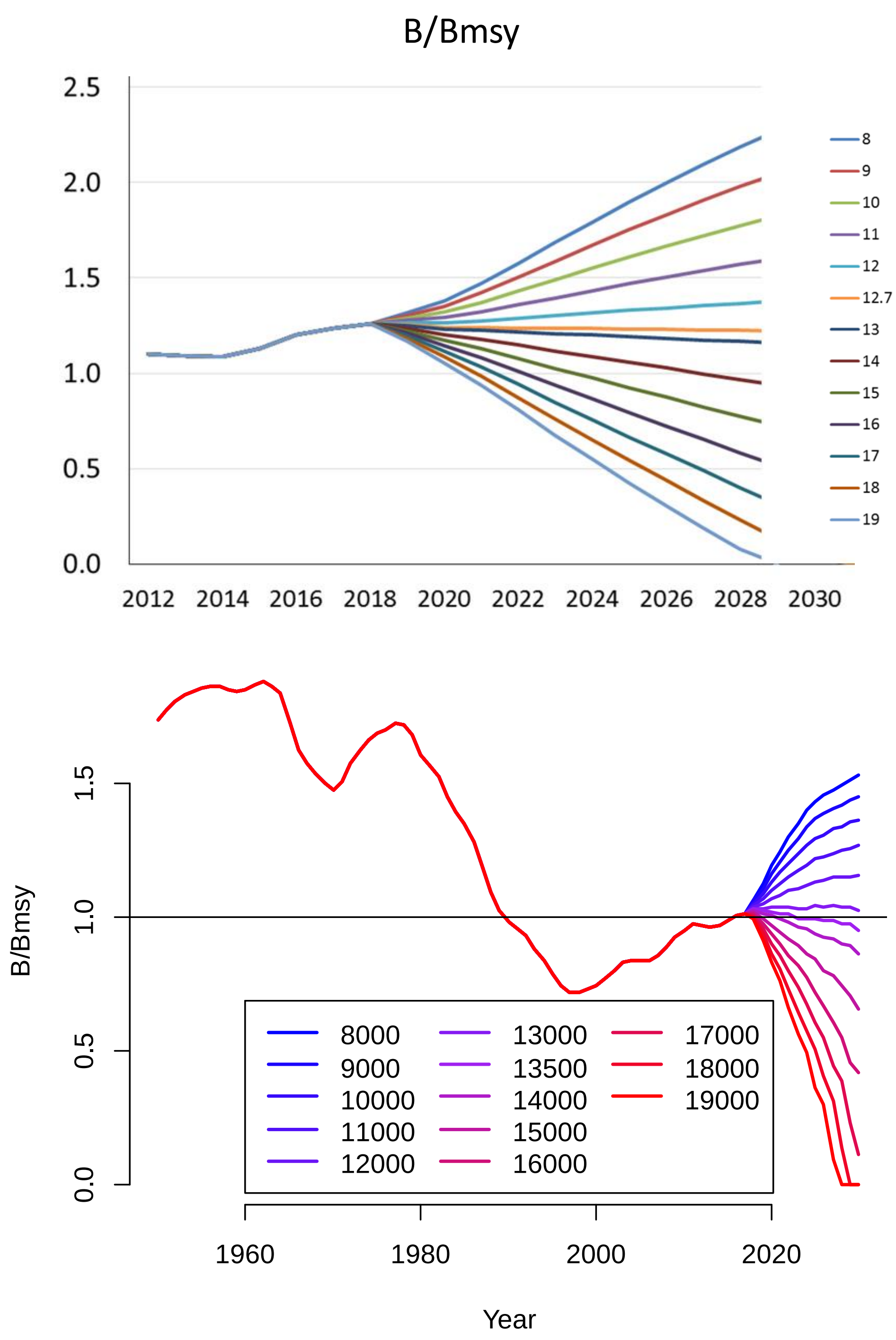
SWO-ATL-Figure 11. South Atlantic swordfish biomass and fishing mortality rates relative to MSY levels, from a Bayesian Surplus Production model (BSP2). Dashed lines represent lower and upper 90% CIs.



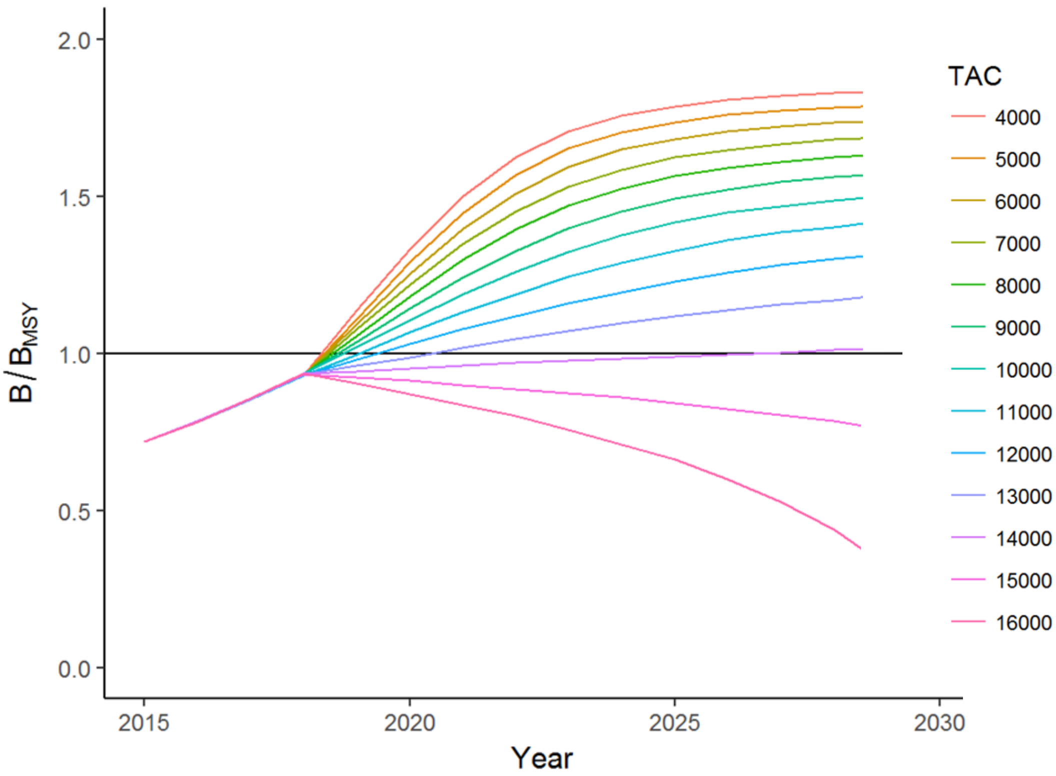
SWO-ATL-Figure 12. South Atlantic swordfish biomass and fishing mortality rates relative to MSY levels, from the Bayesian Surplus Production base case model (JABBA). Grey areas represent lower and upper 95% CIs.



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 2017 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% 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. 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.

Preliminary 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 six years (2012-2017), 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 8-10,000 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 (2003-2015) are EU-Italy (45%), EU-Spain (13%), EU-Greece (10%), Morocco (14%), 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 (2003-2017), 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] 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 2012-2017 among the lower of the last three decades. In addition, reported catches of juvenile swordfish of less than 90 cm have also decreased more than 50%, compared with the levels of the decade of 2000s. As the additional measures foreseen under Rec. 16-05 have only recently been adopted, their effects cannot be 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 (2017) Yield	8,402 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].

[1] Estimates based on the age structured model and equilibrium analyses (see text for details).
[2] Estimates for 2017 are considered preliminary.

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

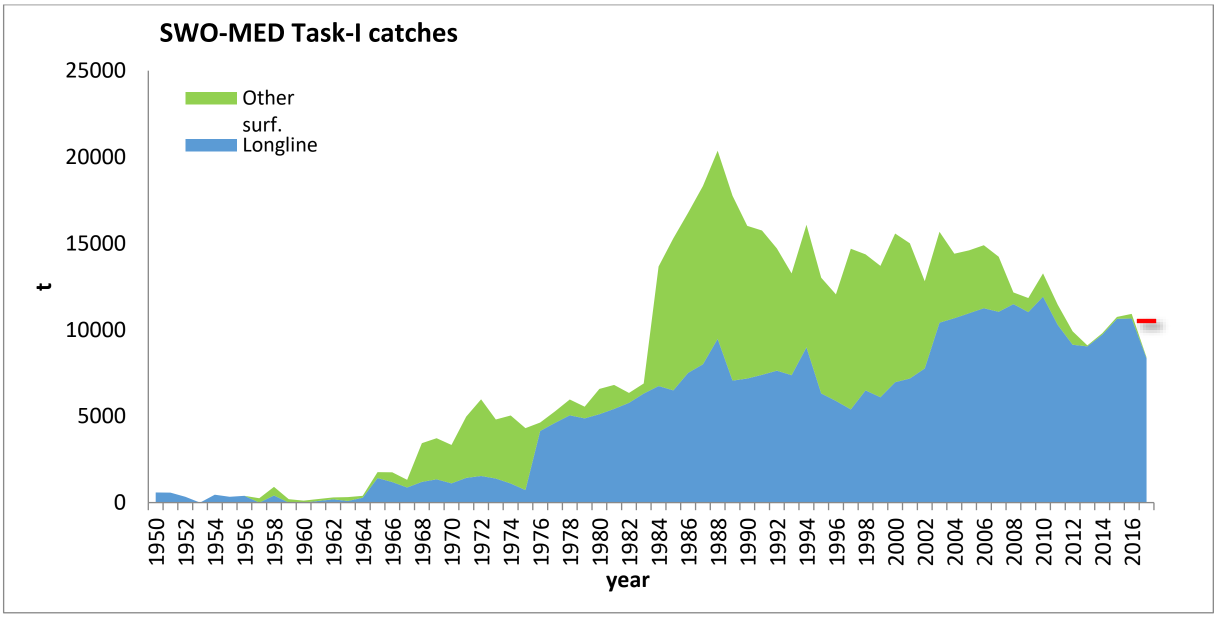
			1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
TOTAL	MED		13265	16082	13015	12053	14693	14369	13699	15569	15006	12814	15674	14405	14600	14895	14227	12164	11840	13265	11450	9913	9096	9801	10751	10921	8402
Landings		Longline	7377	8985	6319	5884	5389	6496	6097	6963	7180	7767	10415	10667	10848	11230	11028	11465	11020	11918	10288	9131	9047	9718	10631	10658	8345
		Other surf.	5888	7097	6696	6169	9304	7873	7602	8606	7826	5047	5259	3729	3639	3649	3179	672	819	1347	1162	782	49	83	113	263	57
Discards		Longline	0	0	0	0	0	0	0	0	0	0	0	9	113	16	19	27	0	0	0	0	0	0	7	0	
Landings	CP	Albania	0	0	0	13	13	13	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Algerie	562	600	807	807	807	825	709	816	1081	814	665	564	635	702	601	802	468	459	216	387	403	557	568	671	550
		EU.Croatia	0	0	0	0	0	10	20	0	0	0	0	0	0	0	0	4	3	6	6	4	10	16	10	25	20
		EU.Cyprus	116	159	89	40	51	61	92	82	135	104	47	49	53	43	67	67	38	31	35	35	51	59	45	43	50
		EU.España	1358	1503	1379	1186	1264	1443	906	1436	1484	1498	1226	951	910	1462	1697	2095	2000	1792	1744	1591	1607	2073	2283	1733	1487
		EU.France	0	0	0	0	0	0	0	0	12	27	0	19	0	0	14	14	16	78	81	12	66	127	182	179	113
		EU.Greece	1568	2520	974	1237	750	1650	1520	1960	1730	1680	1230	1120	1311	1358	1887	962	1132	1494	1306	877	1731	1344	761	761	392
		EU.Italy	6330	7765	7310	5286	6104	6104	6312	7515	6388	3539	8395	6942	7460	7626	6518	4549	5016	6022	5274	4574	2862	3393	4272	3946	2987
		EU.Malta	91	47	72	72	100	153	187	175	102	257	163	195	362	239	213	260	266	423	532	503	460	376	489	410	330
		EU.Portugal	0	0	0	0	0	0	0	13	115	8	1	120	14	16	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	0	1	0	0	0	**0**
		Japan	4	2	4	5	5	7	4	2	1	1	0	2	4	0	3	1	1	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	1	0	0	0	0	0	0	0	**0**
		Libya	0	0	0	0	0	11	0	8	6	0	10	2	0	16	0	0	0	0	0	0	0	0	585	960	30
		Maroc	2589	2654	1696	2734	4900	3228	3238	2708	3026	3379	3300	3253	2523	2058	1722	1957	1587	1610	1027	802	770	770	480	1110	1000
		Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	28	0	0	0	9	4	0	0	0	
		Tunisie	354	298	378	352	346	414	468	483	567	1138	288	791	791	949	1024	1011	1012	1016	1040	1038	1036	1030	1034	1007	1003
		Turkey	292	533	306	320	350	450	230	370	360	370	350	386	425	410	423	386	301	334	190	80	97	56	35	77	441
	NCC	Chinese Taipei	1	1	0	1	3	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	0	7	0	
		EU.Greece	0	0	0	0	0	0	0	0	0	0	0	9	113	16	19	27	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).

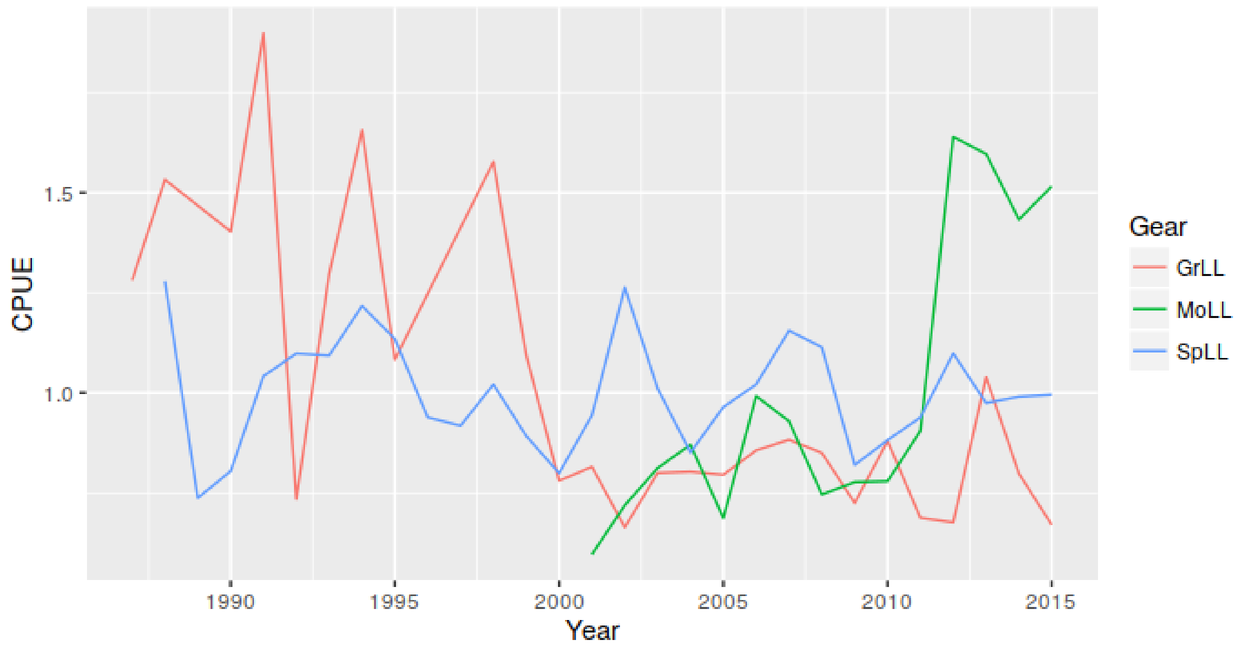
F multiplier		*F/Fsq*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*
0	F_{MSY}	0	0	0	0	0	100	100	100	100	100	100
0.25	F_{MSY}	0.14	0	0	0	0	7	100	100	100	100	100
0.5	F_{MSY}	0.29	0	0	0	0	0	10	69	96	98	100
0.75	F_{MSY}	0.43	0	0	0	0	0	1	3	20	53	72
1	F_{MSY}	0.57	0	0	0	0	0	0	0	2	4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

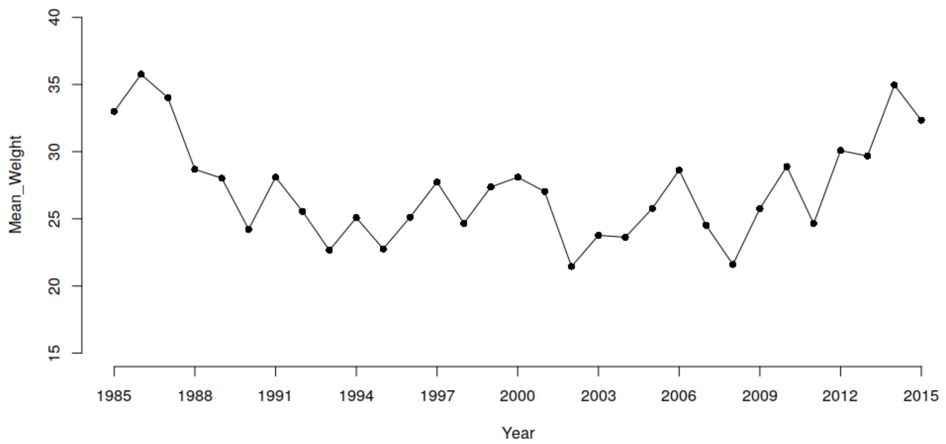
F multiplier		*F/Fsq*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*
0	F_{MSY}	0	0	0	0	0	0	0	0	0	0	0
0.25	F_{MSY}	0.14	1684	2306	3011	3843	4723	5666	6550	7409	8217	8865
0.5	F_{MSY}	0.29	3278	4275	5374	6640	7937	9299	10597	11752	12860	13771
0.75	F_{MSY}	0.43	4786	5949	7203	8639	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



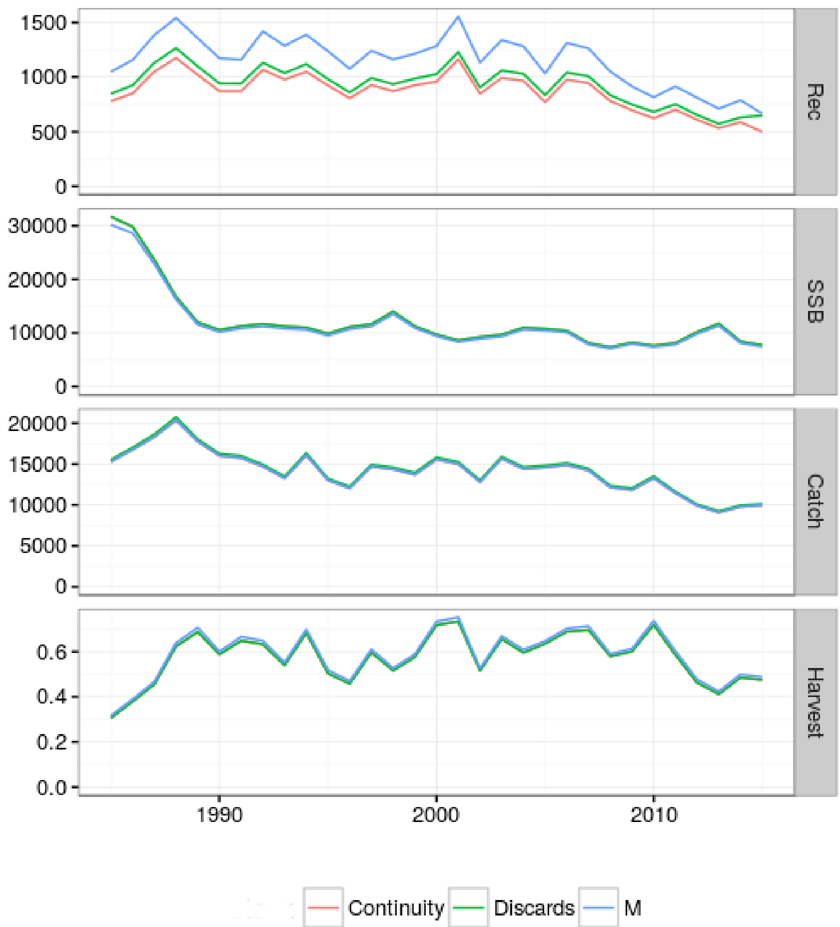
SWO-MED-Figure 1. Estimates of Task I swordfish catches (t) in the Mediterranean by major gear types, for the period 1950-2017. Misreporting may occur in the earlier period (up to the middle 1980s).



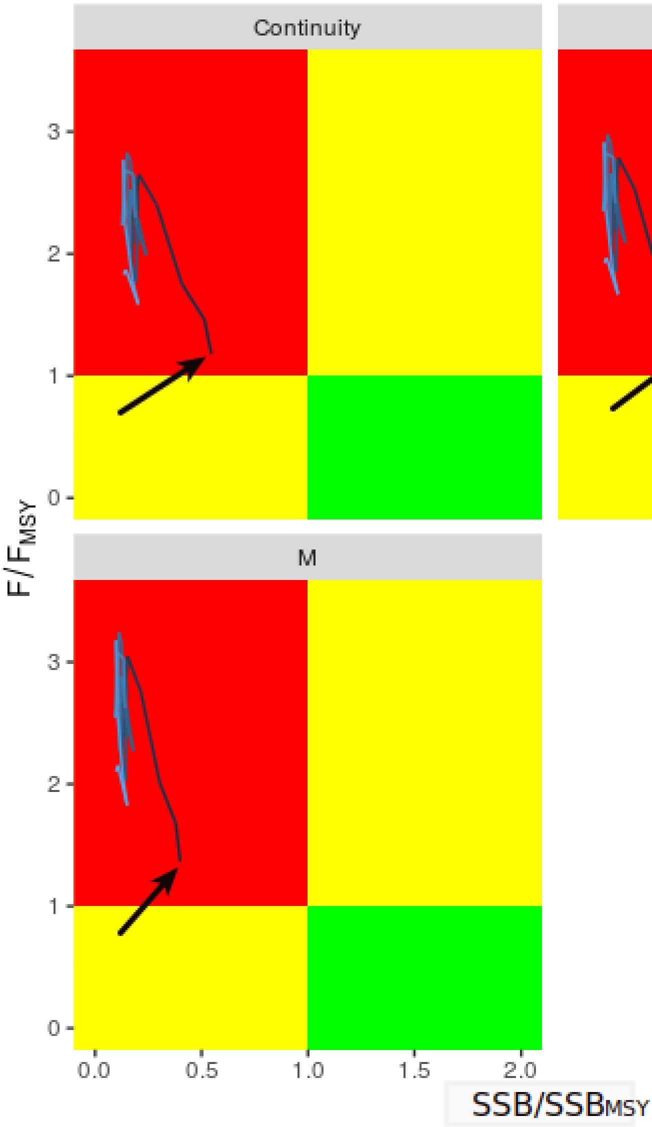
SWO-MED-Figure 2. Relative abundance indices used in the assessment of the Mediterranean swordfish. All indices are scaled to their individual means to facilitate comparison of trends and relative degree of variability. GrLL=Greek longlines, SpLL=Spanish longlines, MoLL=Moroccan longlines.



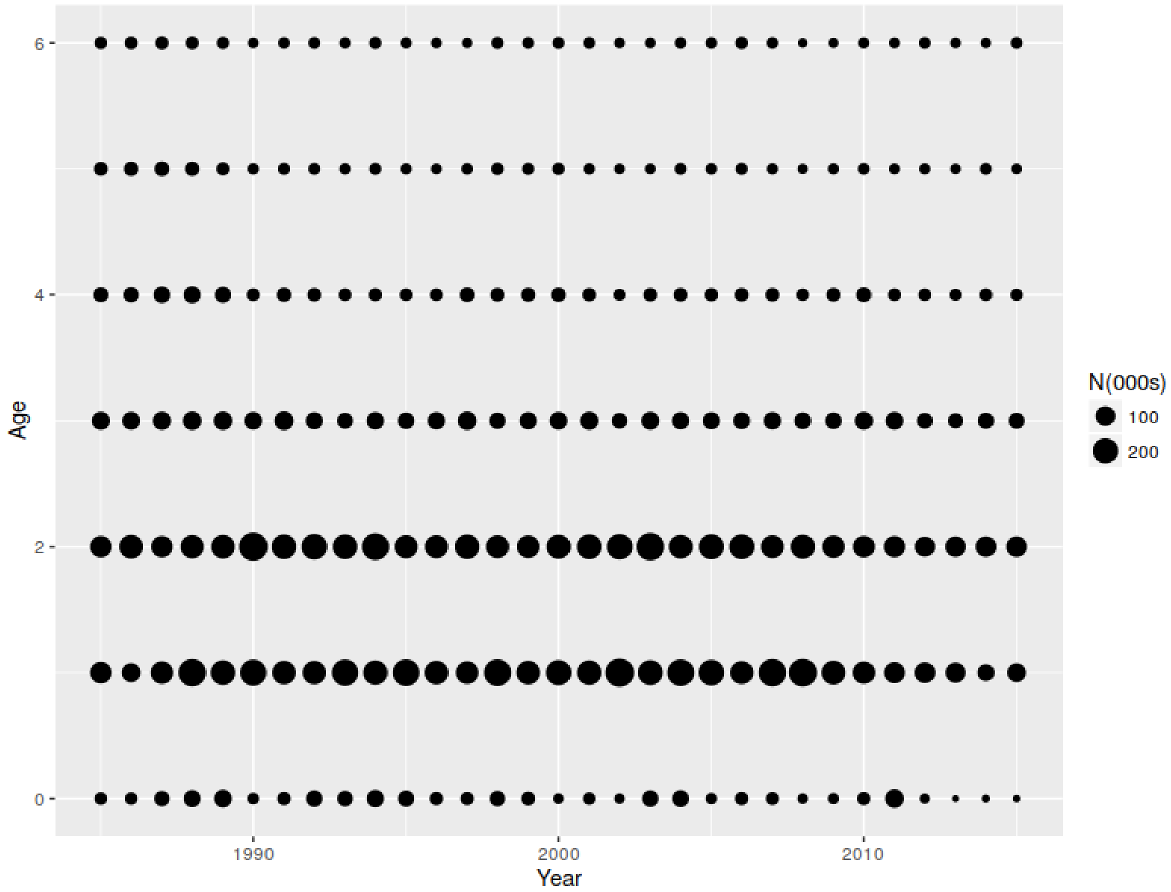
SWO-MED-Figure 3. Time series of mean fish weight (kg) in the catches.



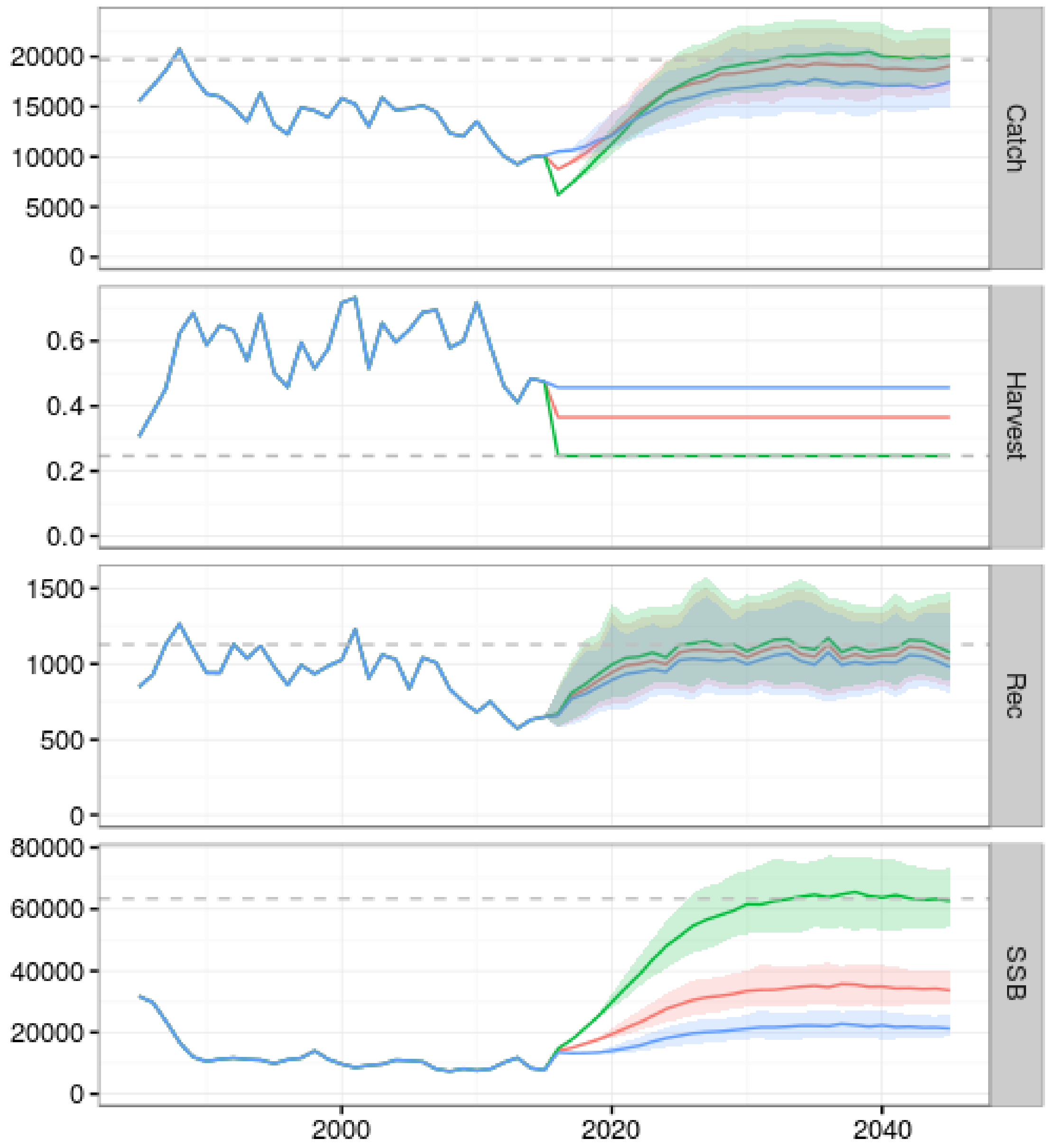
SWO-MED-Figure 4. Estimates of historic time series of recruitment (thousands of fish), SSB (t), catch (t) and average fishing mortality (harvest) of ages 2-4 from the three age structured model runs (Continuity=constant natural mortality, Discards=assuming discard rate of 4 zero-age fish/t, M=natural 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. A recent document on the feeding habit of dolphin fish off the Brazilian coast showed that these species also feed on crustaceans, mollusks and cephalopods. 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 more recent study based on the histological analysis and the gonado-somatic index of female gonads found that the spawning season of the West African Spanish mackerel extends from April to July in the Gulf of Guinea. The results from preliminary studies conducted on Atlantic bonito in the northwestern coasts of Africa showed that this species reaches its first sexual maturity between 38 and 49 cm FL and the spawning period extends from May to July. For blackfin tuna, a new study revealed that the first size of maturity of this species was estimated at 45 cm FL and that this species spawns from March to August.

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. 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. This study revealed also the presence of few individuals caught in Strait of Gibraltar genetically identified as *Auxis thazard*. A recent preliminary genetic study of blackfin tuna in the western Atlantic Ocean using microsatellite markers, concluded that there were very weak levels of divergence among different geographic areas sampled.

The bullet tuna caught in the Spanish Mediterranean coast showed a positive allometric growth with no effect of sex on growth. Another recent study showed that the bullet tuna (age class 3+) caught in the same area had a better physical condition during years with positive North Atlantic Oscillation (NAO) phase. These results could be explained by the environmental conditions during positive NAO phase that would enhance the migration process.

A study conducted recently 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.

Within the Atlantic Ocean Tropical tuna Tagging Programme (ICCAT AOTTP), so far 4,556 little tunny and 131 wahoo have been tagged and released at sea in 2 years since the project began. Of these, 393 tagged little tunny have been recovered (9%) and only one wahoo has been recaptured at the St Peter and St Paul Islands off Brazil. This fish was at liberty for 210 days but a distance of only 8 nautical miles was recorded between release and recapture. 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, the open database provided in the 2016 intersessional meeting of the Small Tunas Species Group (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, Lmax, 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 Poor 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 1989 to 2016 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 92% of Task I nominal catches between 1950 and 2016. These are: BON (34%), LTA (14%), FRI (13%), KGM and SSM (both with 11%), and, BRS and BLT (5% each). In 1980, there was a marked increase in reported landings compared to previous years, reaching a peak of about 145,560 t in 1988 (**SMT-Figure 1**). The annual trend in the total catches by species are shown in **SMT-Figure 2**. Reported landings for the 1989-1995 period decreased to approximately 95,491 t, and then an oscillation in the values in the following years, with a minimum of 68,279 t in 2008 and a maximum of 148,588 t in 2016. 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 2017 is 89,451 t. The Committee pointed out the relative importance of small tuna fisheries in the Mediterranean and the Black Sea, which account for about 30% of the total reported catches (1950 to 2017) 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 catch, 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

There is little information available to determine the stock structure of many small tuna species. The Committee suggests that countries be requested to submit all available data to ICCAT as soon as possible, in order to be used in future meetings of the Committee.

Generally, current information does not allow the Committee to carry out quantitative assessments of stock status of the majority of the species. Nevertheless, few regional assessments have been carried out.

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 Atlantic region are plotted in **SMT-Figures 3a, b**. 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 based on Task II data 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-Figures 4a and b** 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 coloured 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 2017, the Ecological Risk Analysis (ERA) was updated 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* (**SMT-Table 3**). The update indicated that BRS was no longer designated at high risk and has been listed as at moderate risk. Also, in 2017, the Group suggested that different data-limited approaches should be evaluated in order to provide scientific information on the status of SMT.

In 2018, preliminary results on the implementation of data-limited approaches for small tunas using simulation testing were provided. Different catch-based and length-based assessment methods and scenarios were compared in order to give some recommendations for future analysis. The selection of data limited methods is dependent on data availability and quality, and the Group noted that it is still necessary to assess data quality before applying any assessment method and discussed which data should be used to implement some data-poor approaches.

Catch data have been improved but they are still incomplete for some species, regions and fleets. 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.

The Group recommends that length-based methods could be applied, in a near future, to estimate stock status for stocks given as priority. Comparison between length-based and catch models should be considered when data improved.

SMT-5. Outlook

In the absence of any quantitative assessment, 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 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.

As part of its 2019 workplan, the Committee will identify potential management procedures and management performance measures for high-priority small tuna stocks in preparation for the start of the development of management strategy evaluation for these species.

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. 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, the Committee has not been able to conduct any quantitative stock assessment for any of the small tunas stocks, but the Group has improved in identifying spatial visualization of current status and data gaps in the life history parameters of SMT species. The Committee has applied some Data Poor models, however, their robustness still need 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 Poor 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.

					1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
BLF	TOTAL	A+M			3535	2719	4051	4488	3258	3395	3203	2483	4034	4756	1303	1926	1031	1937	1927	1669	1442	1548	1533	1529	1226	913	1172	1455	922
	Landings			All gears	3535	2719	4051	4488	3258	3395	3203	2483	4034	4756	1303	1926	1031	1937	1927	1669	1442	1548	1533	1529	1226	913	1172	1455	922
	Discards				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	22	38	153	649	418	55	55	38	149	1669	1	118	91	242	233	266	10	9	46	124	110	299	325	228	192
				Curaçao	65	60	50	45	45	45	45	45	45	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				EU.España	46	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	1140	1330	1370	1040	1040	1040	1040	1040	1040	1040	0	0	0	0	0	0	0	32	19	26	0	14	12	14	14
				Grenada	253	189	123	164	126	233	94	164	223	255	335	268	306	371	291	290	291	291	291	291	291	0	0	0	
				Mexico	0	0	0	0	0	0	0	0	12	0	10	9	10	10	12	6	7	6	9	5	4	4	4	5	4
				St. Vincent and Grenadines	53	19	20	18	22	17	15	23	24	24	0	0	0	0	0	0	0	0	0	0	11	0	0	0	5
				Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	5	5	5	5	5	5	5	5	5	5	5	5	0	5	5
				U.S.A.	508	492	582	447	547	707	617	326	474	334	414	675	225	831	422	649	619	622	417	599	418	346	627	955	653
				UK.Bermuda	5	7	4	5	4	6	6	5	4	5	9	4	5	8	7	6	7	9	8	11	11	15	20	17	17
				UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	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	1224	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	54	223	156	287	287	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Dominica	15	19	30	0	0	0	79	83	54	78	42	20	38	47	29	37	45	41	37	39	37	39	24	34	
				Dominican Republic	133	239	892	892	231	158	18	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Jamaica	0	0	0	148	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	
				Sta. Lucia	16	82	47	35	40	100	41	45	108	96	169	96	126	182	151	179	165	203	229	192	147	104	80	0	
	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			3420	5300	4301	5909	3070	2309	2646	3912	5796	6041	3794	6223	4231	4090	5459	6825	5557	7952	9484	6234	7653	3916	5571	4003	3228
	Landings			All gears	3420	5300	4301	5909	3070	2309	2646	3912	5796	6041	3794	6223	4231	4090	5459	6825	5557	7952	9484	6234	7653	3916	5566	4003	3218
	Discards				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	9
	Landings		CP	Algerie	348	306	230	237	179	299	173	225	230	481	0	391	547	586	477	1134	806	970	1119	1236	577	1025	1984	1592	231
				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	0	94	406	0	133	131	34
				Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	222	0	1
				EU.Croatia	52	22	28	26	26	26	26	0	0	0	0	0	0	0	0	0	0	8	13	9	10	12	15	15	25
				EU.España	648	1124	1472	2296	604	487	669	1024	861	493	495	1009	845	1101	3083	3389	726	3812	3227	1620	2654	749	1241	1081	2175
				EU.France	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
				EU.Greece	1400	1400	1400	1426	1426	0	0	196	125	120	246	226	180	274	157	620	506	169	129	118	155	108	311	207	181
				EU.Italy	379	531	531	229	229	229	462	462	462	2452	1463	1819	866	0	0	342	732	574	653	613	892	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	1	0	0	
				EU.Malta	9	1	2	3	6	1	3	1	1	0	2	8	4	11	14	12	7	11	23	3	85	14	14	11	9
				EU.Portugal	0	0	0	0	0	28	263	494	208	166	231	299	580	867	602	311	436	654	387	55	38	0	0	0	**0**
				Maroc	170	1726	621	1673	562	1140	682	763	256	621	246	326	50	199	35	83	336	525	237	194	237	171	811	200	**0**
				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	
				Russian Federation	70	100	0	0	0	0	0	408	1028	460	122	102	139	22	0	23	48	67	119	366	703	352	345	336	62
				Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	75	87	81	84	83	83	0	0	0	
				Tunisie	20	13	14	13	32	93	45	15	2300	932	989	1760	0	0	0	0	0	0	940	935	938	920	13	23	26
				Turkey	324	77	0	0	0	0	316	316	316	316	0	284	1020	1031	993	836	1873	1081	2552	907	863	562	476	407	474
				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	0	11	0	0	0	**0**
			NCO	Serbia & Montenegro	0	0	2	6	6	6	7	8	8	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	0	5	0	9
BON	TOTAL				30528	21719	21219	25134	24417	45253	37312	27151	27637	23925	14424	15832	78767	41398	15018	16814	23710	28921	36660	48232	24823	27972	15659	54874	21040
		ATL			4531	6037	6030	7939	10340	15523	9143	5179	5400	8208	3307	4584	4391	9648	6381	6772	13691	16337	22219	8911	6458	4620	6665	10936	9242

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	MED			25997	15682	15189	17195	14078	29730	28170	21972	22237	15717	11117	11248	74376	31751	8637	10042	10019	12584	14442	39321	18365	23352	8993	43938	11798
Landings	ATL		All gears	4531	6037	6030	7939	10340	15523	9143	5179	5400	8208	3307	4584	4391	9648	6381	6772	13691	16337	22219	8911	6458	4620	6665	10936	9242
	MED			25997	15682	15189	17195	14078	29730	28170	21972	22237	15717	11117	11248	74376	31751	8637	10042	10019	12584	14442	39321	18365	23352	8993	43938	11798
Discards	ATL			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			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	49	20	9	39	32	0	2	118	118	118	0	0	138	0	931	0	1962	1997	131	267	1134	2	3	3	2
			Barbados	0	0	0	0	0	0	0	0	1	2	2	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	0	2	0
			Brazil	142	142	137	0	0	0	0	0	0	0	0	0	90	0	0	0	0	0	171	0	38	0	1	2	1
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	539	539	539	539	0	0	0	**0**
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	3	13	755	3	0	26	3	16	6	3510
			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	5	3	2	2	1	0	12	12	10	5	23	9	2	15	14	13	36	45	57	7	44	28	10	43	18
			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	
			EU.France	1052	990	990	610	610	610	24	32	0	18	0	0	0	0	122	59	25	208	241	102	245	288	333	422	290
			EU.Germany	0	0	0	714	0	0	0	0	0	38	0	0	0	0	0	0	0	0	0	0	0	6	0	4	
			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	0	48	0	0	0	0	56	125	91	108	100	0	0	0	**0**
			EU.Latvia	0	3	19	301	887	318	0	416	396	639	0	0	0	0	0	0	0	1019	2231	34	48	29	0	0	
			EU.Lithuania	0	0	0	0	0	0	0	0	0	793	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	344	539	539	0	2047	104	1075	54	11	124	79
			EU.Poland	0	0	0	225	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.Portugal	145	56	78	83	49	98	98	162	47	61	40	50	38	318	439	212	124	476	461	321	184	22	25	570	368
			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	0	287	0	0	0	0	0	0	0	0	0	35	0	0	30	71	113	4	0	0	0	0	0
			Gabon	0	0	0	0	0	0	0	0	0	58	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	0	24	6	14	16	7	10	10	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	4	0	59	32	
			Maroc	1246	584	699	894	1259	1557	1390	2163	1700	2019	928	989	1411	1655	1053	1419	2523	109	145	235	89	90	174	850	1417
			Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	1303	839	1850	2384	6890	9463	3193	514	1052	2543	4951	
			Mexico	779	674	1144	1312	1312	1632	1861	1293	1113	1032	1238	1066	654	1303	1188	1113	1063	1046	1080	1447	1534	1115	1110	1188	1361
			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	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Russian Federation	0	0	0	0	0	4960	0	0	574	1441	461	16	79	316	259	52	368	1042	2293	848	125	416	308	850	666
			S. Tomé e Príncipe	0	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	171	814	732	1012	1289	2213	2558	286	545	621	195	183	484	2304	1020	1380	4029	1677	2876	1453	514	1217	1711	1581	1226
			Sierra Leone	0	0	0	0	0	0	0	11	245	44	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	
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	15	18	0	16	23	27	15	6	20	0	0	0	0	0	
			Trinidad and Tobago	17	703	169	266	220	30	117	117	56	452	188	280	81	7	16	38	68	68	14	9	16	16	0	16	16
			U.S.A.	171	128	116	156	182	76	83	142	120	139	44	70	68	40	97	47	50	46	66	46	50	80	50	56	61
			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	0	2	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	5	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	0	18	29	40	20	12
		NCO	Argentina	434	4	138	108	130	12	68	19	235	1	129	269	110	0	0	0	220	59	6	33	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	0	230	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	6	16	16	9	4	0	0	0	0	1	2	7	
			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	0	8	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	4

					1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
				Sta. Lucia	4	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
				Togo	311	254	145	197	197	197	197	0	0	0	0	1583	1215	2298	0	0	0	0	0	0	0	0	0	0	
				Ukraine	0	0	0	342	2786	1918	1114	399	231	656	30	0	0	0	0	0	0	0	0	0	0	0	0	0	
		MED	CP	Albania	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Algerie	471	418	506	277	357	511	475	405	350	597	0	609	575	684	910	1042	976	1009	355	353	614	504	716	452	593
				EU.Bulgaria	8	0	25	33	16	51	20	35	35	35	0	0	0	0	0	0	0	16	8	96	6	5	8	68	13
				EU.Croatia	6	70	0	0	0	25	120	0	0	0	0	0	0	0	0	0	0	59	41	31	56	56	34	20	22
				EU.Cyprus	0	0	0	0	0	0	0	14	0	10	10	6	4	3	0	0	0	0	0	0	0	0	0	0	**0**
				EU.España	200	344	632	690	628	333	433	342	349	461	544	272	215	429	531	458	247	518	574	442	881	585	519	358	314
				EU.France	6	0	0	0	0	0	0	0	0	27	0	0	0	0	15	34	20	23	13	12	30	25	103	60	217
				EU.Greece	2690	1581	2116	1752	1559	945	2135	1914	1550	1420	1538	1321	1390	845	1123	587	476	531	798	733	960	678	691	700	399
				EU.Italy	1238	1828	1512	2233	2233	2233	4159	4159	4159	4579	2091	2009	1356	0	0	1323	1131	964	1197	472	1245	1053	750	697	540
				EU.Malta	0	0	0	2	7	2	2	1	0	1	0	1	1	11	7	7	3	6	1	3	2	0	2	3	0
				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	
				Egypt	640	648	697	985	725	724	1442	1442	1128	1128	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Libya	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	705	780	82
				Maroc	25	93	37	67	45	39	120	115	5	61	85	78	38	89	87	142	131	57	12	1	0	8	26	50	46
				Tunisie	792	305	413	560	611	855	1350	1528	1183	1112	848	1251	0	0	0	0	0	0	1425	1415	1413	1407	867	1290	1993
				Turkey	19548	10093	8944	10284	7810	24000	17900	12000	13460	6286	6000	5701	70797	29690	5965	6448	7036	9401	10019	35764	13158	19032	4573	39460	7578
				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	300	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Serbia & Montenegro	3	2	6	10	12	12	14	17	17	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	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**
		MED		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**
BRS	TOTAL	A+M			8049	7161	7006	8435	8004	7923	5754	4785	4553	7750	5137	3410	3712	3587	2253	3305	2681	1590	1055	613	853	698	389	1124	1032
	Landings		CP	Brazil	842	1149	1308	3047	2125	1516	1516	988	251	3071	2881	814	471	1432	563	1521	1042	0	3	0	6	2	1	1	1
				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**
				Grenada	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Trinidad and Tobago	2130	2130	1816	1568	1699	2130	1328	1722	2207	2472	1867	2103	2720	1778	1414	1472	1498	1498	936	489	695	695	0	695	695
				Venezuela	5077	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	0	2	1	1	29	29
				Guyana	0	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			174	334	334	307	295	363	349	234	303	347	564	2632	2772	1295	4753	1042	5381	4798	7187	3647	5005	5381	5915	4229	6035
	Landings			All gears	174	334	334	307	295	363	349	234	303	347	564	2632	2772	1295	4753	1042	5381	4798	7187	3394	4779	5201	5908	4229	6026
	Discards				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	253	226	181	7	0	9
	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	0	185
				Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	11
				Brazil	0	0	0	0	0	0	0	0	0	0	2	2159	2311	761	4270	472	4400	2899	4379	641	775	762	1218	1461	1996
				Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	7	26
				Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	199	34	24	1482
				EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	73	73	0	85	166	113	102	161	64	71
				EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	372	819	1737	1360	1474	1473	1566	2	452
				EU.Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	700	525	1133	971	484
				EU.Malta	174	334	334	307	295	363	349	234	303	347	507	473	447	517	274	399	395	530	349	181	385	208	334	238	243
				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	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	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	0	1	0	1
				Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	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	0	250	0	2	6
				St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	56	118	72	96	84	86	48	0	6	105
				Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1	24	21	8
				Tunisie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	426	482
				U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	479	503	578	366	668	551	705	362

					1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
				UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	4	3	4
				Venezuela	0	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	0	343	307	245	0	0	**0**
				Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	515	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	0	278	295	186	
				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	27	63	64
				Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	407	505	0	
	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.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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	9
				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**
			NCC	Chinese Taipei	0	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			16797	13332	11816	13871	13968	14332	10589	8680	10151	5738	5936	8832	6154	8429	9789	7861	12384	14215	15471	18284	17597	17030	19426	23631	15422
	Landings			All gears	3004	5300	5617	6631	8992	9531	4992	3054	4505	3889	2935	5086	2933	5918	6019	5296	8237	8633	10515	9732	11829	10821	11534	14847	11112
	Landings(FP)				13793	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				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	0	78
	Landings		CP	Angola	4	6	21	29	12	31	2	38	38	38	0	0	0	0	95	0	63	19	59	39	22	47	2	1	**0**
				Belize	0	0	0	0	0	33	0	115	87	0	0	0	0	0	0	0	0	0	0	0	0	36	266	824	586
				Brazil	608	906	558	527	215	162	166	106	98	1117	860	414	532	603	202	149	313	204	347	259	227	293	308	271	445
				Cape Verde	115	86	13	6	22	191	154	81	171	278	264	344	300	318	378	574	1312	711	853	1811	2461	5418	3556	2324	1795
				Curaçao	0	0	0	590	1157	1030	1159	1134	1006	713	507	497	0	150	106	485	364	0	235	238	481	1456	1151	1124	1576
				Côte d'Ivoire	0	0	0	0	0	3	0	1	821	2	31	1356	4	354	541	14	813	161	297	38	2837	261	141	311	81
				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	362	297	386	947	581	570	23	17	722	438	635	34	166	73	278	631	1094	950	877	1708	1234	1200	1682	2537	1608
				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	
				EU.France	63	105	126	161	147	146	0	91	127	91	0	168	47	6	98	24	24	91	147	246	233	147	258	1201	773
				EU.Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	169	528	
				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	
				EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	150	90	0	164	5	85	0	6	90	45
				EU.Portugal	0	0	0	0	1	31	5	9	28	5	4	7	212	3	250	13	0	0	0	0	0	0	1	2	3
				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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	26	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	435	793	993
				Ghana	0	0	0	0	0	33	221	118	39	31	0	3	0	2577	2134	1496	2786	3604	2295	2469	2382	0	0	0	**0**
				Grenada	0	0	0	0	1	0	0	0	1	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	98	74	81	78	48	63	0	26	0	71	63
				Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	
				Guinée Rep.	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	96	94	332	503	236	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	306	190	707	716	2717	2315	764	629	486	591	236	696	227	52	135	179	9	19	862	554	55	21	90	125	200
				Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	269	169	377	492	1420	1953	661	101	211	806	996	
				Panama	118	341	328	240	91	0	0	0	0	0	0	394	975	970	1349	411	439	425	339	463	504	905	292	1356	1572
				Russian Federation	150	405	456	46	500	2433	477	12	25	308	56	56	63	6	6	12	113	270	912	113	217	139	249	545	389
				S. Tomé e Príncipe	33	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	342	319	309	0	101	0	7	0	4	0	13	288	151	83	119	383	15	217	201	341	16	22	1407	1133	391
				St. Vincent and Grenadines	0	0	0	0	17	65	0	0	208	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Trinidad and Tobago	17	0	56	199	368	127	138	245	0	0	0	414	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	0	1
				Venezuela	886	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	0	5	7	14	8	11
			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	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			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	0	36	48	0	43	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	0	100	154	71	86	78	107	0	0	
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	144	84	200	189	188	428	130	271	256	268	0	0	
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	29	55	29	36	225	233	139	214	149	224	0	0	
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	177	81	236	0	0	
			EU.España	8426	3990	3903	4495	3449	3154	3762	3385	3580	1074	1942	2450	1327	1423	2585	1685	2636	3117	3023	5770	2792	3289	2396	2391	
			EU.France	5367	4041	2297	2745	1527	1648	1836	2242	2066	775	1059	1296	1138	644	612	222	684	1214	815	1183	1466	1486	1342	1277	
			Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	142	75	69	99	53	105	25	150	42	65	0	0	
			Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	168	0	24	37	0	174	518	542	672	441	0	0	
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	274	230	251	297	261	157	230	158	234	92	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	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	0	141	0	78
KGM	TOTAL	A+M	All gears	16331	14777	14930	17782	19815	16394	17717	16205	15408	17258	15863	12830	11766	8185	17936	7344	12533	9742	10868	12766	12132	4432	3642	3942	3926
	Landings	CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	914	0	0	**0**
			Brazil	1380	1365	1328	2890	2398	3595	3595	2344	1251	2316	3311	247	202	316	33	0	0	1	1	0	0	0	0	0	**0**
			Grenada	0	0	0	2	4	28	14	9	4	5	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	2
			Mexico	3289	3097	3214	4661	4661	3583	4121	3688	4200	4453	4369	4564	3447	4201	3526	3113	3186	3040	3130	3090	3335	3019	3281	3130	3233
			St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	9	0	0	0	0	0	0	
			Trinidad and Tobago	1192	0	471	1029	875	746	447	432	410	1457	802	578	747	661	567	1043	1001	1001	720	393	495	496	1	494	494
			U.S.A.	9616	7831	7360	7058	8720	7373	6453	6780	6603	6061	6991	7129	7123	2837	13482	3013	8247	5630	6939	9187	8062	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**
			UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	**0**
			Venezuela	801	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	0	4	2	2	2	4	5
			Guyana	0	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	1	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	0	36	35	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Dominican Republic	52	0	0	0	589	288	230	226	226	226	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Jamaica	0	0	0	0	155	0	0	44	48	48	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	0	1	4	0	0	9	1	1	0	1	1	1	2	0	1	3	4	1	1	0	0	0	
LTA	TOTAL		All gears	13130	14399	12276	11569	14405	15719	12281	15319	16943	16723	16997	16357	11915	9925	18159	14213	16266	22428	24673	19574	20501	12817	24025	31106	30584
		ATL		11872	13202	10381	9453	12804	12804	9405	11830	13955	14080	16313	14918	10873	8320	16472	11954	14166	20258	21005	15389	15868	9212	17451	21318	15437
		MED		1258	1197	1894	2116	1601	2914	2876	3489	2988	2643	684	1439	1042	1605	1687	2259	2100	2170	3668	4186	4633	3605	6574	9788	15147
	Landings	ATL		10321	10906	9655	8779	11910	11732	8670	10258	11566	13476	14947	13352	10172	7417	13962	10137	12133	16781	16837	11770	12117	6560	8757	10898	8793
		MED		1258	1197	1894	2116	1601	2914	2876	3489	2988	2643	684	1439	1042	1605	1687	2259	2100	2170	3668	4186	4633	3605	6574	9788	15147
	Landings(FP)	ATL		1551	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		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	204	0	107
		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	
	Landings	ATL CP	Angola	175	121	117	235	75	406	118	132	132	132	0	0	2	0	4365	0	128	1759	3455	1905	1085	10	6	1	4
			Brazil	985	1225	1059	834	507	920	930	615	615	615	0	320	280	0	0	0	0	0	22	581	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**
			Cape Verde	17	23	72	63	86	110	776	491	178	262	143	137	81	123	292	250	357	185	102	131	131	131	131	218	113
			Curaçao	0	0	0	0	0	0	0	0	0	5	9	0	0	0	0	0	0	38	38	76	57	0	0	0	**0**
			Côte d'Ivoire	339	251	253	250	155	136	9	123	1	0	0	153	287	427	2159	1791	1446	1631	50	1062	1433	152	102	111	1881
			EU.España	0	0	10	55	27	110	6	2	22	8	1	489	50	16	0	38	35	136	168	71	52	112	381	477	185
			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	
			EU.France	8	54	59	22	215	21	696	631	610	613	0	10	27	12	0	1	50	35	5	30	27	6	29	217	359
			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	
			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	
			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	
			EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	69	8	0	18	1	9	0	0	0	0

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			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	45	72	72	218	320	171	14	50	0	2	16	19	21	24	43	10	6	5	14	4	18	0	0	7	31
			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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	15	23	38	0	0	0	0	**0**
			Gabon	0	0	0	182	0	18	159	301	213	57	173	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Ghana	359	994	513	113	2025	359	306	707	730	4768	8541	7060	5738	783	1335	745	1692	1465	1001	1274	1138	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	120	15
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	
			Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	673	256	176	101	78	151	212
			Maroc	52	43	230	588	195	189	67	101	87	308	76	91	33	0	40	2	63	5	57	10	11	3	0	11	12
			Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	670	423	943	1222	3549	4878	1634	252	529	1287	2478	
			Panama	64	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	265	189	96	49	0	88	0	0	0	74	13	0	0	0	0	0	0	268	11	208	399	255	136	547	433
			S. Tomé e Príncipe	41	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	4724	4536	3613	1972	4174	4715	1607	3546	5176	2866	4394	3508	2699	3826	3885	5108	5683	6371	4910	2769	5912	3774	5065	4855	3841
			South Africa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			St. Vincent and Grenadines	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	15
			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.	1286	1142	1312	2230	2015	1546	1623	1209	1451	1366	1492	1382	765	1351	1401	963	1244	1120	1201	1507	1191	1253	1337	1526	1393
			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	5	6	6	7	6	5	4	2	1	5	4	5	7	5	5	4	3	4	5	6	3	3	4	2	1
			Venezuela	1889	2115	2115	1840	1840	2815	2247	2247	2247	2254	50	0	0	0	0	30	0	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	0	12	12	16	54	48
		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	53	60	58	58	196	83	69	69	69	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	13	15	27	23	23	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	1	1	1	
			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)	0	20	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta. Lucia	0	0	0	0	2	2	2	0	1	10	1	0	0	1	0	0	0	0	0	0	1	0	2	0	
	MED	CP	Algerie	495	459	552	554	448	384	562	494	407	148	0	158	116	187	96	142	119	131	98	6	157	341	204	268	444
			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	2	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	28	25	44	37	43	31	19
			EU.Cyprus	11	23	10	19	19	19	16	19	19	19	0	0	0	0	6	5	4	0	0	0	0	0	0	0	**0**
			EU.España	0	0	15	18	9	15	0	8	82	32	0	41	262	116	202	212	86	299	488	441	235	300	456	384	486
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	42	0	0	0	1	0	**0**
			EU.Greece	0	0	0	0	0	0	0	195	125	132	0	0	112	69	72	183	148	165	301	276	363	289	271	501	299
			EU.Italy	0	0	0	0	0	0	0	0	0	16	24	38	34	0	0	486	243	365	304	669	557	442	0	992	930
			EU.Malta	0	0	0	0	0	0	0	0	0	1	1	1	1	3	2	5	3	7	5	21	9	4	7	1	6
			Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	849	712	0	0	**0**
			Libya	0	0	0	0	45	52	0	5	4	4	0	0	0	0	0	0	0	0	0	0	0	0	102	1100	48
			Maroc	0	0	1	0	1	14	8	0	0	3	1	0	9	0	331	19	24	1	0	0	0	0	0	3	0
			Syria	161	156	155	270	350	417	390	370	370	330	0	0	0	0	193	133	163	148	155	304	229	0	0	0	
			Tunisie	242	204	696	824	333	1113	752	1453	1036	960	657	633	0	0	0	0	0	0	810	800	803	798	5165	6323	12434
			Turkey	0	0	0	0	0	500	750	750	750	750	0	568	507	1230	785	1074	1309	1046	1437	1645	1386	682	326	184	480
		NCO	Israel	119	119	215	119	119	119	119	119	119	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (MED)	200	200	200	200	200	200	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Palestine	0	0	0	90	59	61	60	60	60	129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Serbia & Montenegro	28	21	35	22	18	20	18	16	16	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	0	18	223	51	238	144	133	0	0	
			Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	45	76	265	214	189	262	266	179	438	178	0	0	
			Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	39	42	50	160	185	167	209	284	284	0	0	
			Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	162	56	12	0	0	
			EU.España	707	1127	454	284	353	295	194	751	1197	209	656	508	206	213	1253	944	1181	1320	2067	1105	732	1182	2095	2065	

					1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
				EU.France	844	1169	272	391	540	777	541	821	1192	396	710	1058	367	205	262	122	241	901	1061	675	693	565	673	1169	
				Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	35	178	92	118	17	121	43	126	145	64	0	0	
				Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	15	0	21	2	0	358	260	666	1186	202	0	0	
				Panama	0	0	0	0	0	0	0	0	0	0	0	0	35	191	577	368	228	106	250	259	72	30	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	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	0	204	0	107
		MED		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**
MAW	TOTAL	A+M		All gears	1723	1278	1953	2910	1415	1496	909	1219	828	1345	565	352	480	571	847	616	684	2384	1333	1128	3016	1460	1242	3206	1086
	Landings		CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	1650	249	221	1247	0	3	1	2
				Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	2	0	66	0	0	1	0	0	0	90	35	47	76	122
				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	
				EU.Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	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	1717	
				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	298	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	0	1	1	0	10	0	0	0	0	0	
				Gabon	0	140	145	79	0	85	0	0	0	0	0	67	37	87	93	17	22	30	34	46	42	13	37	21	56
				Ghana	466	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	0	207	319	176	203	275	193	152	110	434	493	524	
				Russian Federation	19	0	0	0	0	14	0	0	0	0	15	0	0	1	0	0	0	0	0	0	0	4	0	0	**0**
				S. Tomé e Príncipe	5	6	6	8	7	8	5	6	6	6	6	21	12	13	0	91	93	96	98	100	102	105	13	11	37
				Senegal	1019	938	1614	2635	1046	878	700	987	617	794	532	262	431	196	435	329	278	331	749	610	1426	870	649	856	870
				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	214	194	188	188	362	511	205	205	205	205	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	0	21	0	42	12	0	0	0	0	0	0	0	0	0	0	0	0	0	
SSM	TOTAL	A+M		All gears	16317	14490	13697	16571	15403	8877	9837	8220	8383	9414	9793	8119	10470	6282	6102	5900	6197	5974	5931	5185	5459	3858	4079	3829	3712
	Landings		CP	Belize	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**
				EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	1	0	0	2	**0**
				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**
				Gabon	0	0	0	0	0	0	0	0	0	265	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
				Grenada	1	2	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Mexico	10066	8300	7673	11050	11050	5483	6431	4168	3701	4350	5242	3641	5723	3856	3955	4155	4251	4128	4026	3321	3581	3857	4077	3820	3701
				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.	5143	4380	3363	2866	3509	2968	3282	3893	4524	4613	4552	4477	4747	2425	2147	1746	1946	1846	1896	1864	1877	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	1	1	5	11
			NCO	Colombia	58	69	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				Cuba	310	409	548	613	613	236	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	739	1330	2042	2042	231	191	125	158	158	158	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	0	0	0	0	0	0	1	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
WAH	TOTAL	A+M		All gears	2671	2143	2408	2515	3085	2488	2957	2020	2296	2202	2049	2596	2456	1809	2568	2158	2354	2086	2500	3716	5396	2979	2157	16361	1850
	Landings				2671	2143	2408	2515	3085	2488	2957	2020	2296	2202	2049	2596	2099	1630	2283	1586	1883	1816	2023	3527	5289	2893	2151	16361	1836
	Landings(FP)				0	0	0	0	0	0	0	0	0	0	0	0	357	179	285	572	471	269	477	85	0	0	0	0	
	Discards				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	104	108	86	6	0	14
	Landings		CP	Barbados	91	82	42	35	52	52	41	41	0	0	34	45	26	41	36	27	17	30	29	22	21	17	10	11	10
				Belize	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
				Brazil	33	26	1	16	58	41	0	0	0	0	405	519	449	111	75	76	70	19	357	213	477	153	312	404	322
				Cape Verde	326	361	408	503	603	429	587	487	578	500	343	458	449	555	524	351	472	470	470	445	445	445	445	490	228
				Curaçao	270	250	230	230	230	230	230	230	230	230	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	16	3	1	11	0	5	5	12	9	95	1	25	1	1
				EU.España	22	20	15	25	25	29	28	32	38	46	48	305	237	110	66	38	73	53	87	35	50	41	50	59	51
				EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	46	45	38	159
				EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	4	3	9	8	10	2	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

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		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	
		Grenada	96	46	49	56	56	59	82	51	71	59	44	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	1	0	0	0	0	14	21	9	
		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	2
		Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	0	0	0	0	0	0	**0**
		Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	263	48	1591	46	122	13678	
		Mexico	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	16	12	18	15
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	91	240	120	86	111	99	210	373	228	0	109	
		S. Tomé e Príncipe	36	39	46	80	52	56	62	52	52	52	52	94	88	76	0	131	235	241	247	254	260	266	100	70	172
		Senegal	64	0	0	1	0	0	5	0	0	0	5	0	1	1	0	0	2	6	0	11	24	0	3	7	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	41	28	16	23	10	65	52	46	311	17	40	60	0	241	29	24	31	40	31	5	32	24	9	11	126
		Trinidad and Tobago	0	0	0	0	1	1	1	2	1	9	7	6	6	7	6	6	5	5	7	9	9	9	9	10	8
		U.S.A.	827	391	764	608	750	614	858	640	633	846	789	712	558	89	1123	495	522	358	240	399	207	480	757	1253	564
		UK.Bermuda	58	50	93	99	105	108	104	61	56	91	87	88	83	86	124	117	101	81	100	88	75	76	86	95	92
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	0	4	1	1	0	**0**
		UK.Sta Helena	35	26	25	23	0	0	0	0	0	0	0	0	0	0	0	0	29	19	31	12	16	16	10	15	16
		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	514	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	0	1132	1012	810	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	0	1
		Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	588	415	0	0	0	**0**
	NCO	Antigua and Barbuda	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Aruba	50	125	40	50	50	50	50	50	50	50	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	59	58	58	58	58	50	46	11	37	10	6	8	15	14	16	10	13	13	0	0	20	10	10	
		Dominican Republic	7	0	0	0	325	112	31	35	35	35	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	7	6	7	0	0	0	0	0	0	0	0	0	6	9	14
		Sta. Lucia	141	98	80	221	223	223	310	243	213	217	169	238	169	187	0	171	195	199	0	0	148	155	87	0	
Landings(FP)	CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	40	0	0	0	0	0	
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	92	9	55	60	22	29	25	4	0	0	0	0	
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	13	7	31	57	23	78	9	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	3	0	0	0	0	0	
		EU.España	0	0	0	0	0	0	0	0	0	0	0	0	92	63	44	224	262	136	240	56	0	0	0	0	
		EU.France	0	0	0	0	0	0	0	0	0	0	0	0	28	10	3	16	26	26	17	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	68	11	21	28	7	0	8	0	0	0	0	0	
		Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	10	0	8	15	7	0	0	0	0	0	0	0	
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	39	44	104	102	65	13	66	15	0	0	0	0	
	NCO	Mixed flags (EU tropical)	0	0	0	0	0	0	0	0	0	0	0	0	28	30	44	97	26	39	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	0	6	0	14
		Korea Rep.	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	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	**0**
	NCC	Chinese Taipei	0	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. Number of studies per species and ICCAT Region with values for each Life History parameter: L_{MAX} - maximum size (FL, cm), L_{INF} – asymptotic length (FL, cm), k - Von Bertalanffy growth rate parameter (1/year), to - hypothetical age that fish would have at zero length (years), T_{MAX} - empirical longevity (years), Lm_{50}- length at 50% maturity (FL, cm), Tm_{50}- age at 50% maturity (years), $F_{MEANBATCH}$ - average batch fecundity (average number of oocytes per batch), WL_a - intercept of the length-weight relationship, WL_b - regression slope of the length-weight relationship.

Mediterranean

Sc_name	Code	Lmax	Linf	k	t0	Tmax	Lm50	Tm50	Fmeanbatch	WL_a	WL_b
Auxis rochei	BLT	16	10	10	10	7	3	3	2	12	12
Auxis thazard	FRI	0	0	0	0	0	0	0	0	0	0
Euthynnus alletteratus	LTA	20	10	9	9	10	7	3	1	18	18
Orcynopsis unicolor	BOP	4	2	2	2	2	3	3	0	4	4
Sarda sarda	BON	39	12	12	12	12	5	1	2	33	33
Total		**79**	**34**	**33**	**33**	**31**	**18**	**10**	**5**	**67**	**67**

Northeast

Sc_name	Code	Lmax	Linf	k	t0	Tmax	Lm50	Tm50	Fmeanbatch	WL_a	WL_b
Acanthocybium solandri	WAH	1	0	0	0	0	0	0	0	1	1
Auxis rochei	BLT	4	1	1	1	2	0	0	0	5	5
Auxis thazard	FRI	1	0	0	0	0	0	0	0	1	1
Euthynnus alletteratus	LTA	10	4	4	1	5	3	0	0	4	4
Orcynopsis unicolor	BOP	3	0	0	0	0	0	0	0	0	0
Sarda sarda	BON	3	2	2	2	0	0	0	0	4	4
Scomberomorus tritor	STR	5	2	2	0	1	6	0	0	3	3
Thunnus atlanticus	BLF	0	1	1	1	0	0	0	0	0	0
Total		**27**	**10**	**10**	**5**	**8**	**9**	**0**	**0**	**18**	**18**

Southeast

Sc_name	Code	Lmax	Linf	k	t0	Tmax	Lm50	Tm50	Fmeanbatch	WL_a	WL_b
Acanthocybium solandri	WAH	0	0	0	0	0	0	0	0	0	0
Auxis rochei	BLT	1	1	1	1	1	3	0	1	0	0
Auxis thazard	FRI	1	1	1	1	1	0	0	0	0	0
Coryphaena hyppurus	DOL	0	0	0	0	0	0	0	0	0	0
Euthynnus alletteratus	LTA	0	0	0	0	0	0	0	0	0	0
Sarda sarda	BON	0	0	0	0	0	0	0	0	0	0
Scomberomorus tritor	MAW	1	0	0	0	0	0	0	0	0	0
Total		**3**	**2**	**2**	**2**	**2**	**3**	**0**	**1**	**0**	**0**

SMT-Table 2. (continued).

Northwest

Sc_name	Code	Lmax	Linf	k	t0	Tmax	Lm50	Tm50	Fmeanbatch	WL_a	WL_b
Acanthocybium solandri	WAH	23	12	12	6	6	5	2	2	8	8
Auxis rochei	BLT	0	0	0	0	0	0	0	0	0	0
Auxis thazard	FRI	0	0	0	0	0	0	0	0	0	0
Euthynnus alletteratus	LTA	8	1	1	1	0	1	0	0	5	5
Sarda sarda	BON					0		0	0		
Scomberomorus brasiliensis	BRS	8	4	4	3	3	0	0	0	1	1
Scomberomorus cavalla	KGM	36	45	45	43	45	8	4	1	14	14
Scomberomorus maculatus	SSM	29	14	14	14	16	6	0	1	18	18
Scomberomorus regalis	SCE	10	0	0	0	0	6	0	0	2	2
Thunnus atlanticus	BLF	28	11	11	11	8	3	0	0	17	17
Total		**142**	**87**	**87**	**78**	**78**	**29**	**6**	**4**	**65**	**65**

Southwest

Sc_name	Code	Lmax	Linf	k	t0	Tmax	Lm50	Tm50	Fmeanbatch	WL_a	WL_b
Acanthocybium solandri	WAH	2	0	0	0	0	1	0	1	1	1
Auxis rochei	BLT	0	0	0	0	0	0	0	0	0	0
Auxis thazard	FRI	1	0	0	0	0	0	0	0	1	1
Euthynnus alletteratus	LTA	0	0	0	0	0	0	0	0	0	0
Sarda sarda	BON	4	3	3	3	0	0	0	0	1	1
Scomberomorus brasiliensis	BRS	19	12	12	11	10	7	1	1	5	5
Scomberomorus cavalla	KGM	15	11	11	11	13	2	0	0	2	2
Thunnus atlanticus	BLF	13	2	2	1	0	4	0	1	11	11
Total		**54**	**28**	**28**	**26**	**23**	**14**	**1**	**3**	**21**	**21**

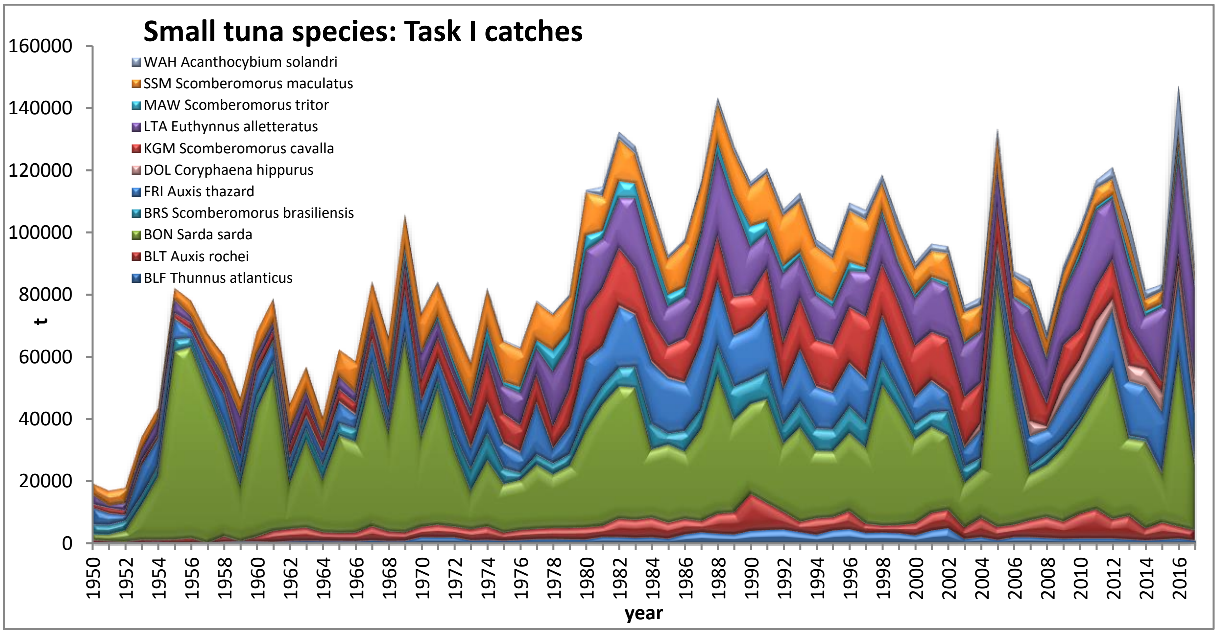
SMT-Table 3. Risk of the small tunas species caught by tuna purse-seine (a) and longline (b) fisheries in the Atlantic Ocean.

(a) Purse seine Fishery

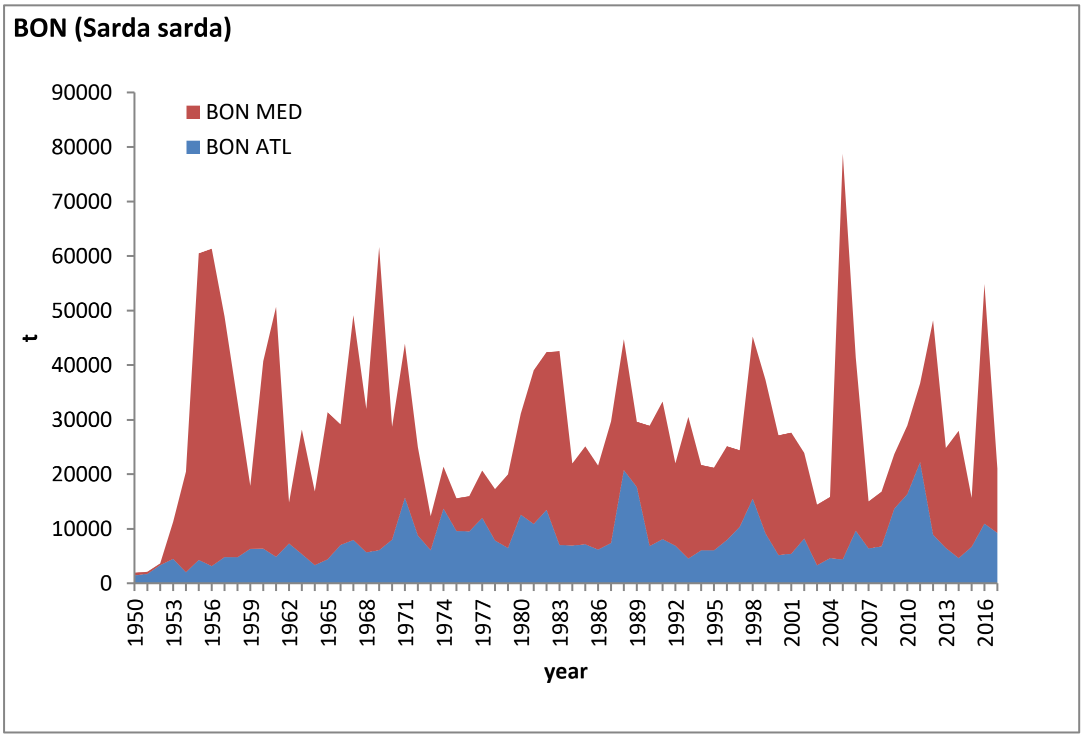
Stock	Rank	Productivity	Susceptibility	Vulnerability
LTA	1	1.35	2.29	2.09
KGM	2	1.35	1.67	1.78
SSM	3	1.60	1.67	1.55
BON	4	2.18	2.29	1.53
BRS	5	1.71	1.67	1.46
WAH	6	1.94	1.60	1.22
FRI	7	2.33	2.00	1.20
BLF	8	2.06	1.40	1.02
CER	9	2.27	1.67	0.99
BLT	10	2.35	1.60	0.88

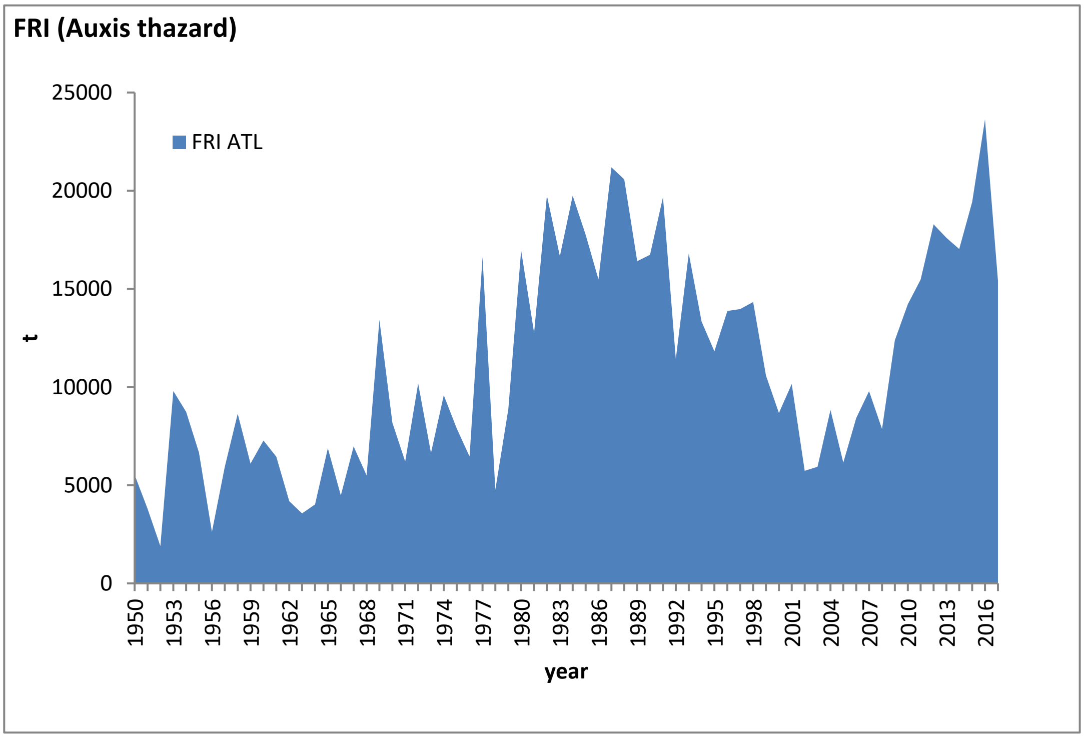
(b) Long Line Fishery

Stock	Rank	Productivity	Susceptibility	Vulnerability
WAH	1	1.94	2.57	1.89
KGM	2	1.35	1.33	1.68
LTA	3	1.35	1.29	1.67
SSM	4	1.60	1.67	1.55
BRS	5	1.71	1.67	1.46
BLF	6	2.06	1.86	1.27
BON	7	2.18	1.86	1.19
BLT	8	2.35	1.80	1.03
CER	9	2.27	1.67	0.99
FRI	10	2.33	1.40	0.78

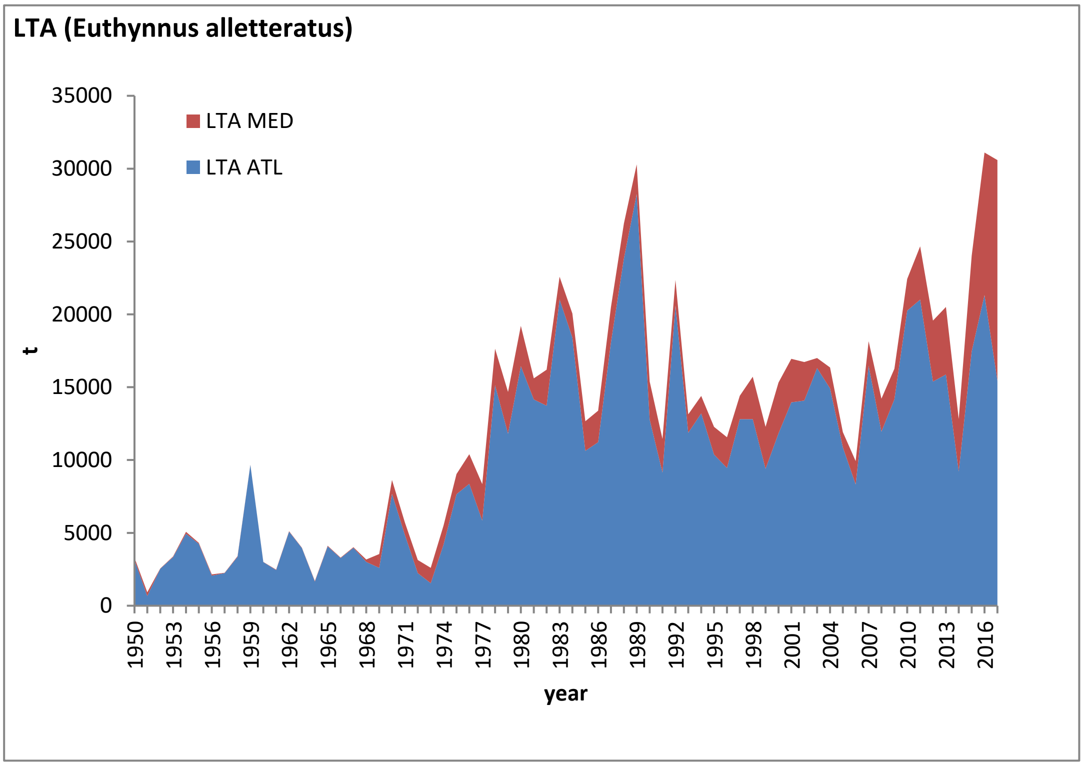


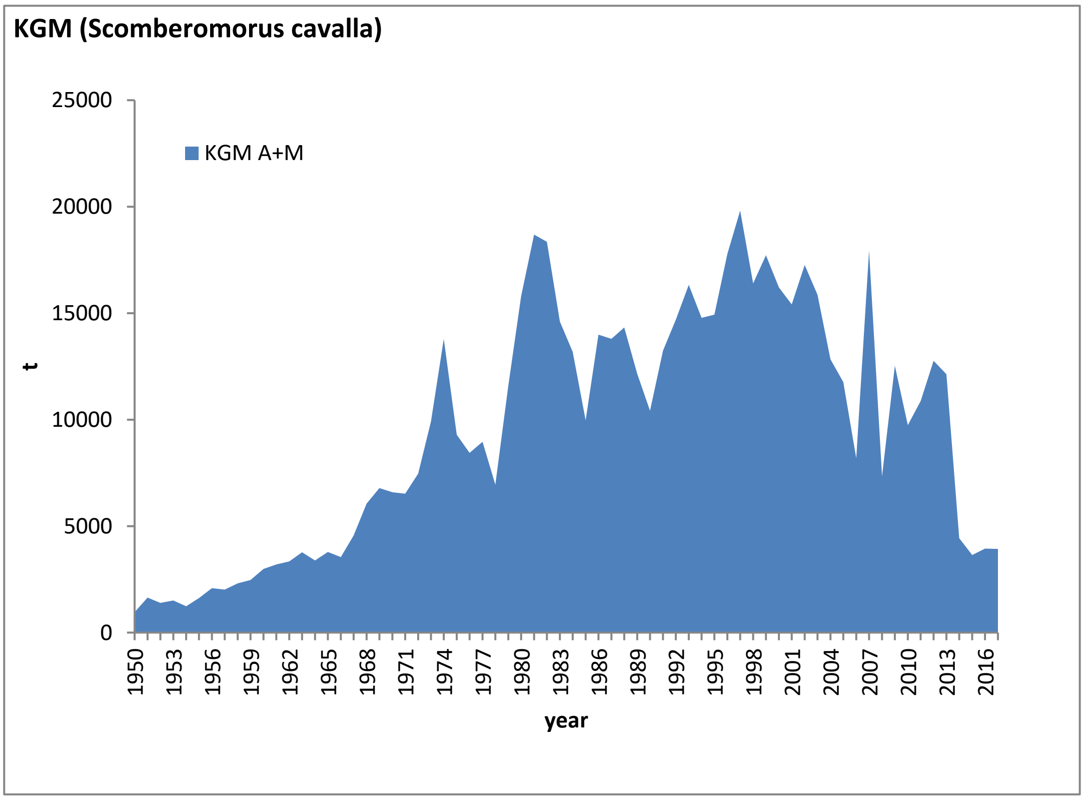
SMT-Figure 1. Estimated landings (t) of small tunas (combined) in the Atlantic and Mediterranean, 1950-2017. The data for the last three years are incomplete.

a)


b)


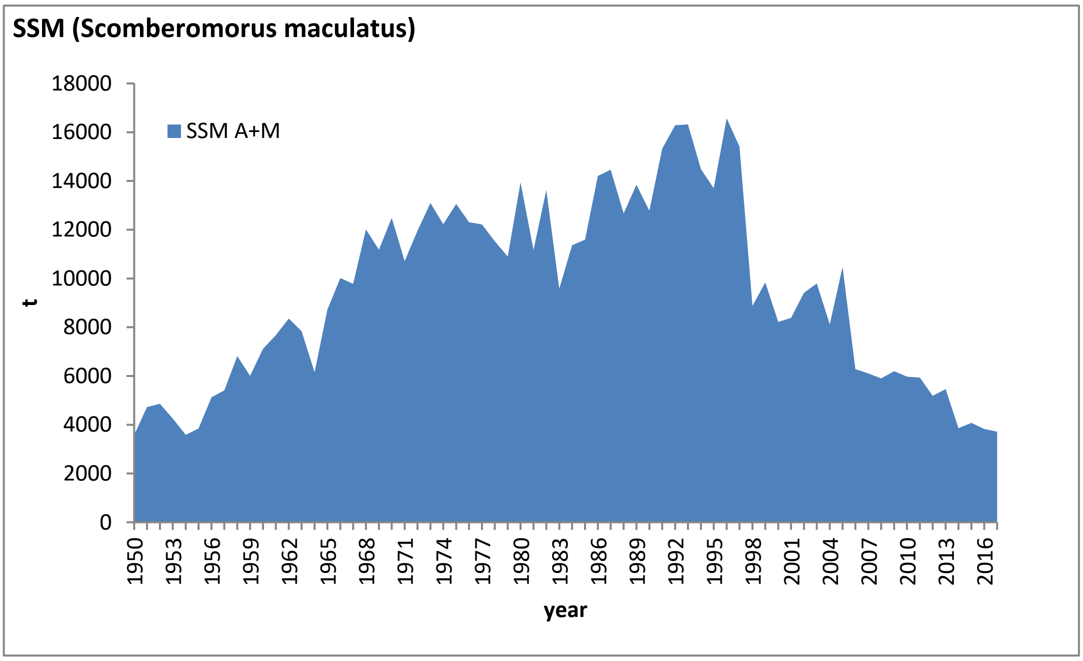
SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2017. The data for the last years are incomplete.

c) 

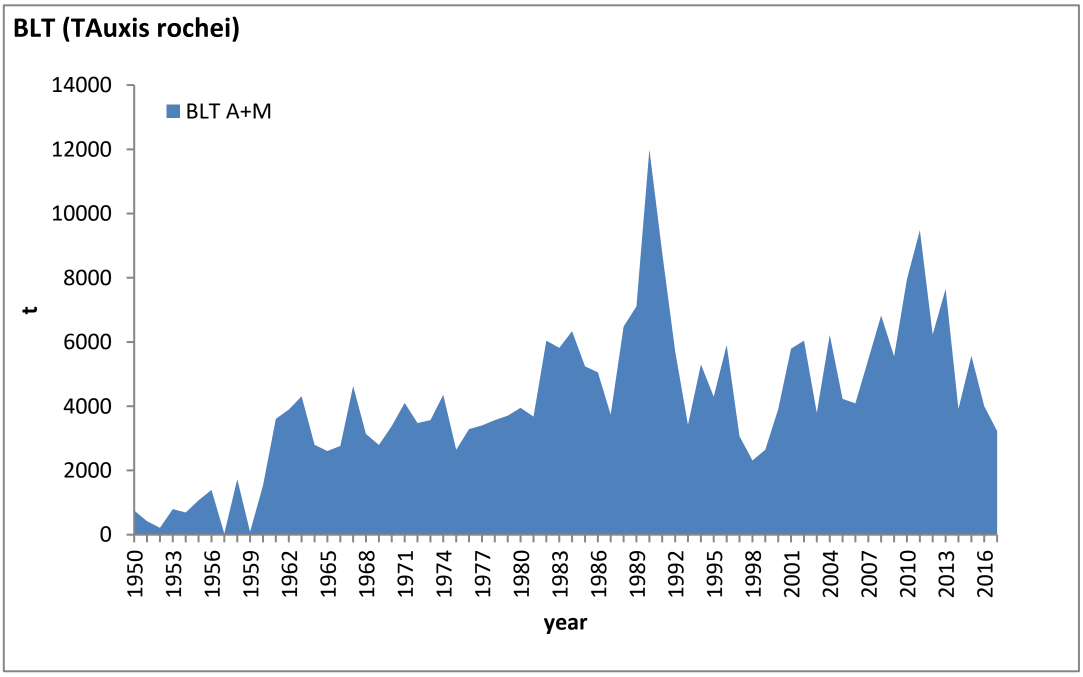
d) 

SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2017. The data for the last years are incomplete.

e)

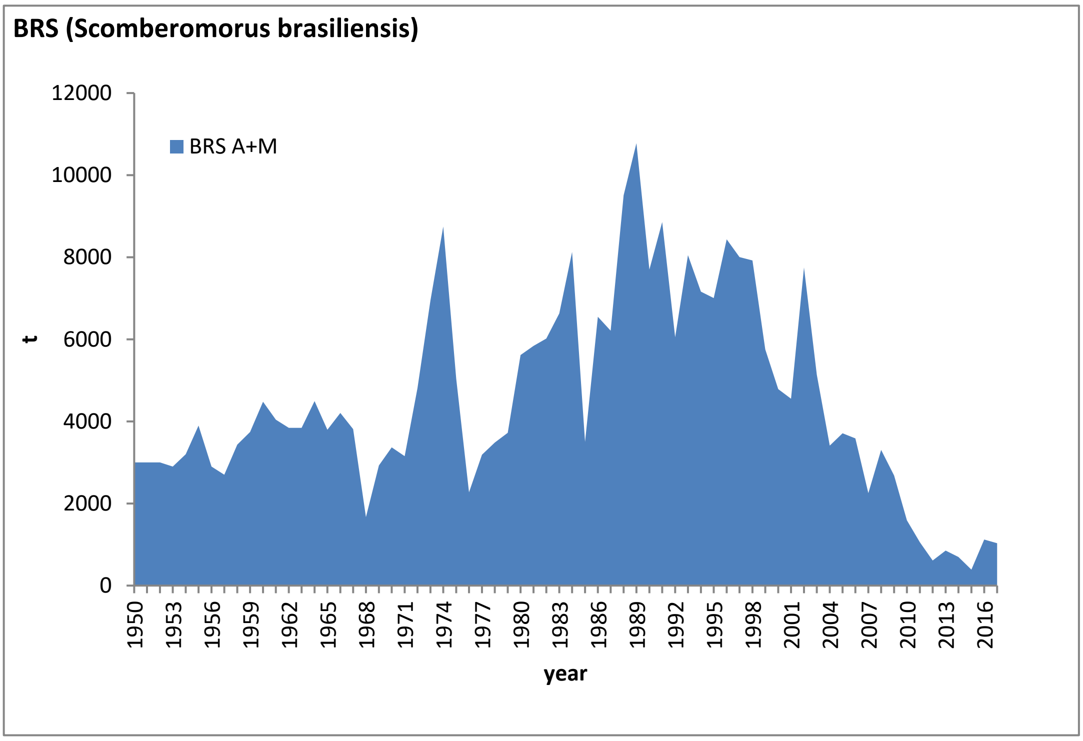


f)

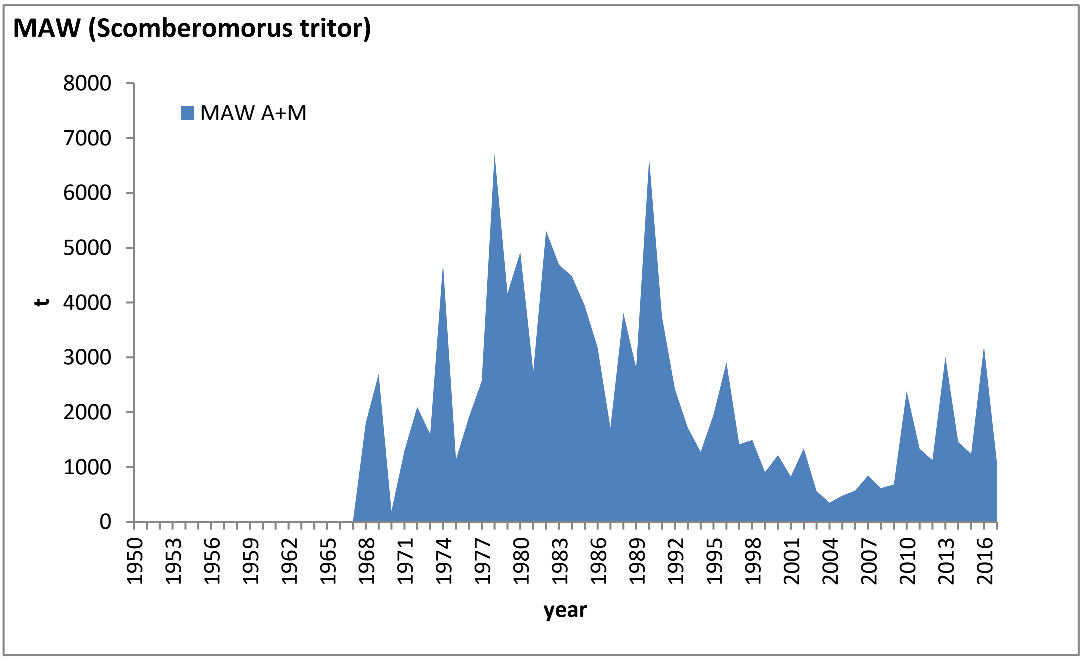


SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2017. The data for the last years are incomplete.

g)

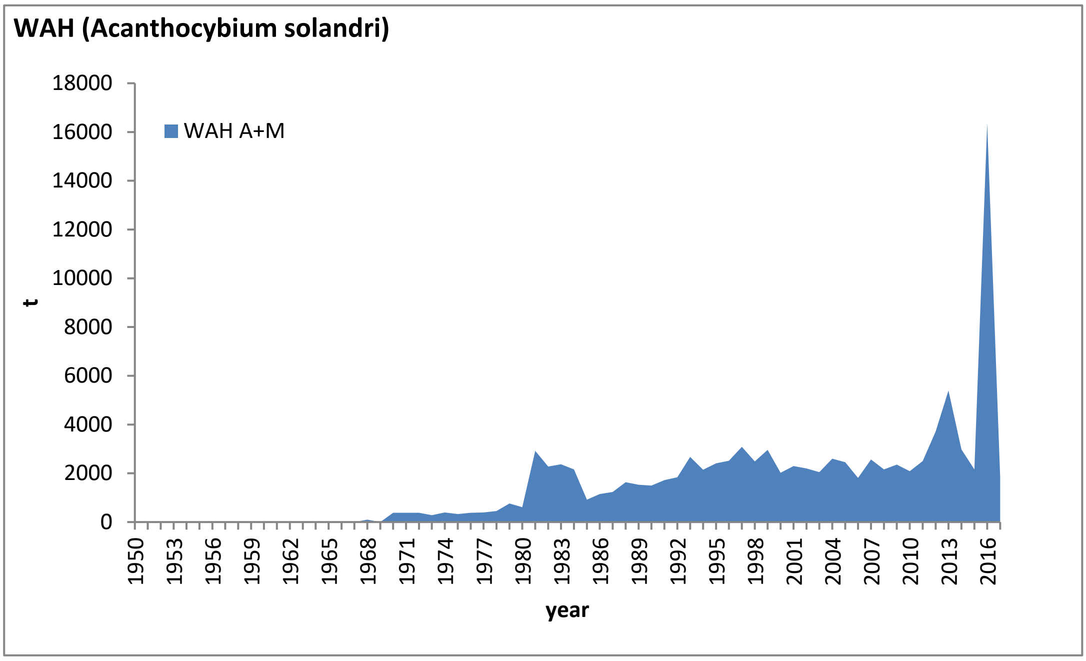


h)

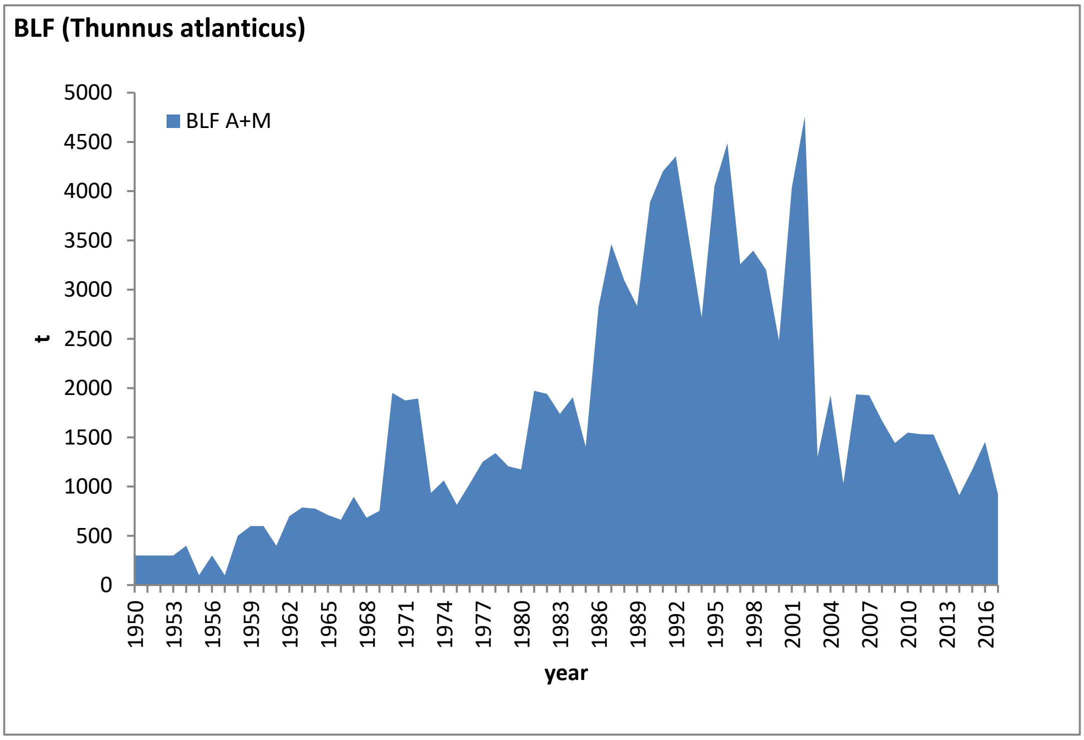


SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2017. The data for the last years are incomplete.

i)

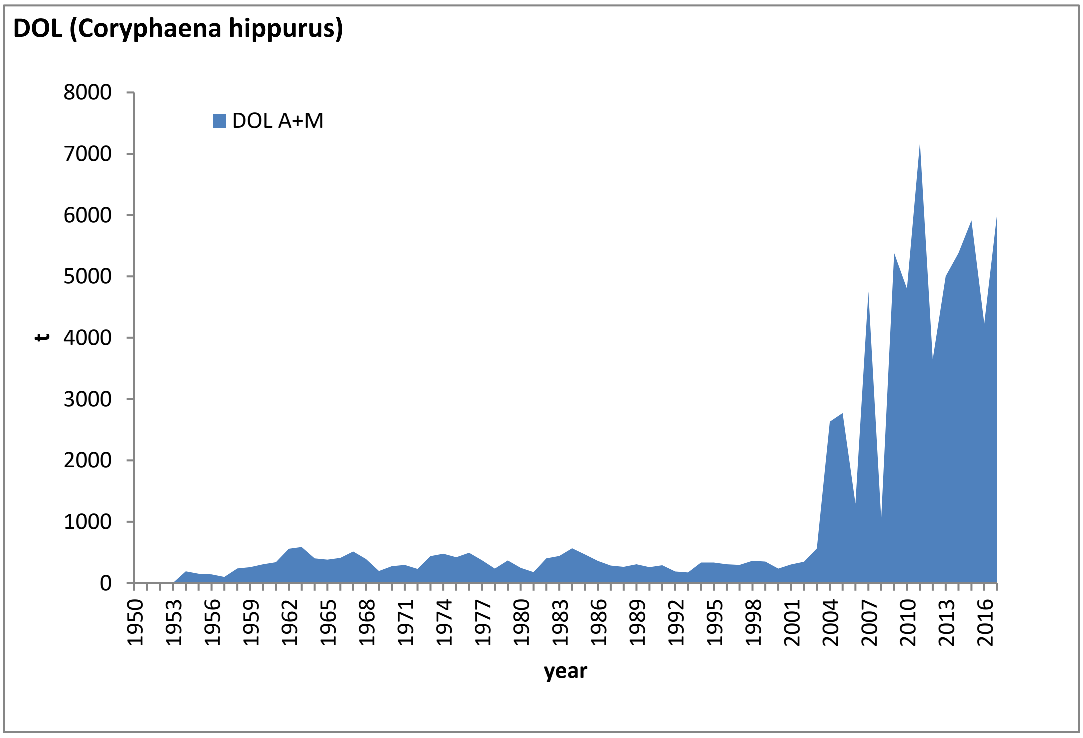


j)

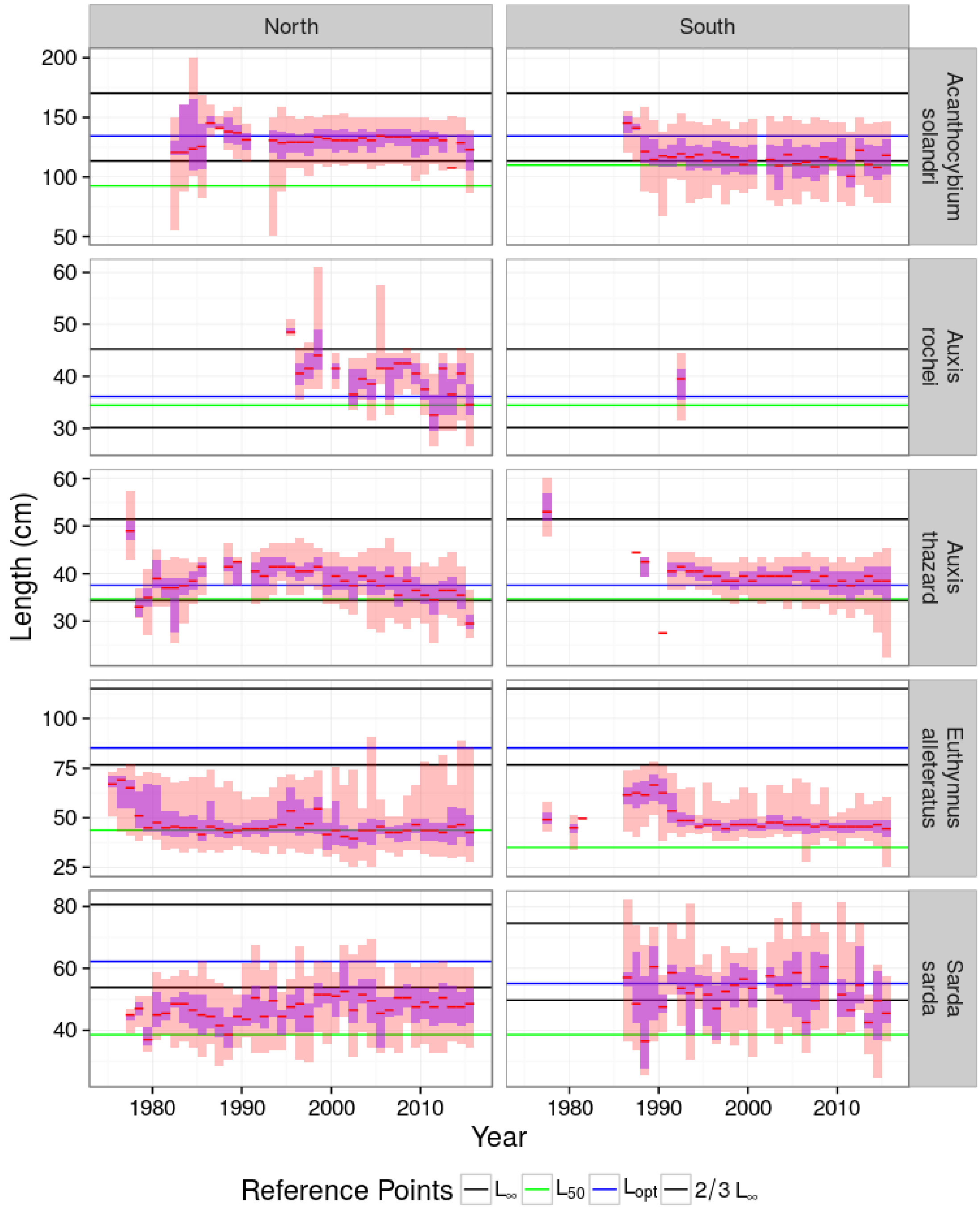


SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2017. The data for the last years are incomplete.

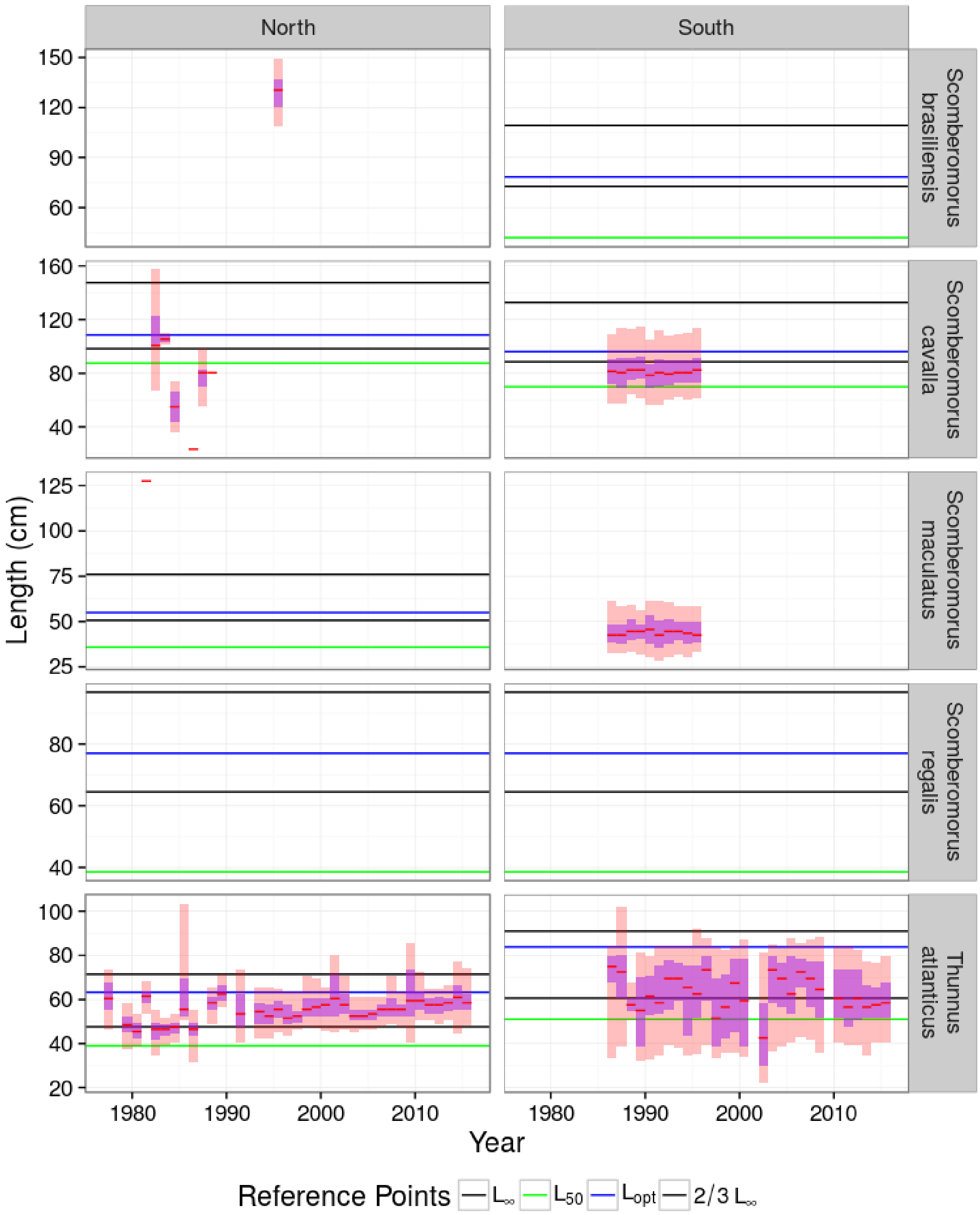
k)



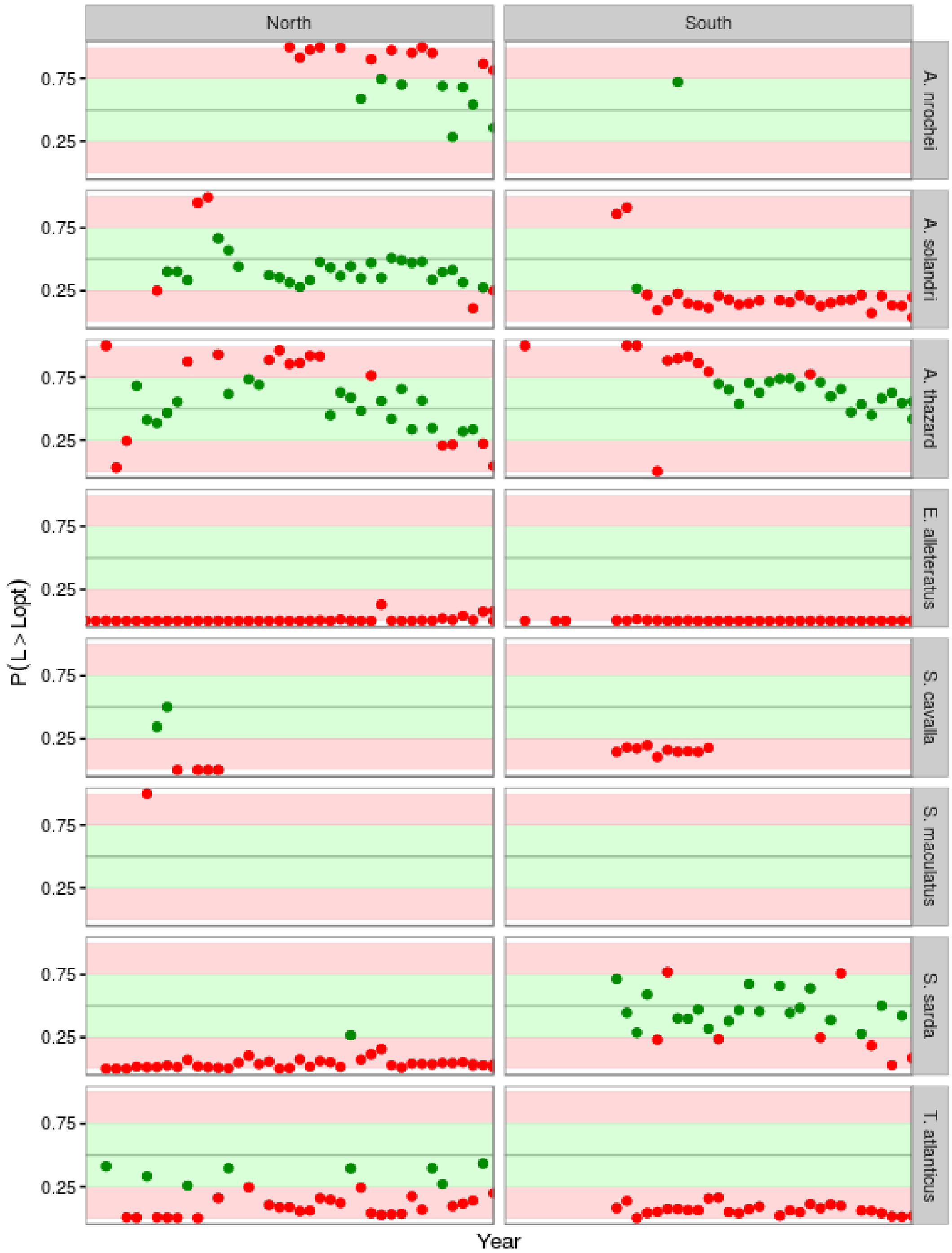
SMT-Figure 2. Estimated landings (t) of the major species of small tunas in the Atlantic and Mediterranean, 1950-2017. The data for the last years are incomplete.



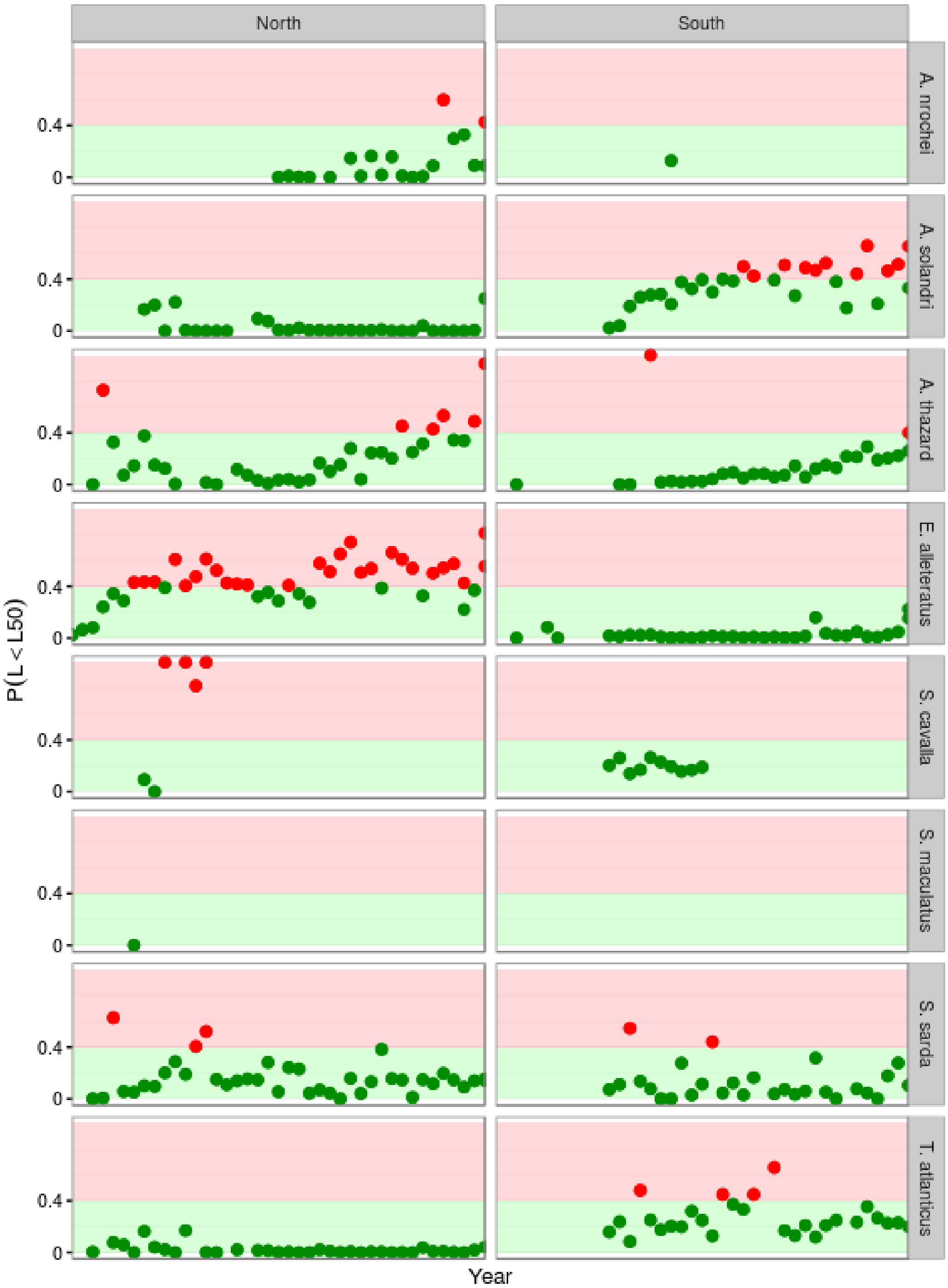
SMT-Figure 3a. Length distributions and reference points by species and Atlantic region for version 4 of Task II size data. The horizontal lines show the reference points i.e. asymptotic length (L_∞), length at 50% mature (L_{50}) and two estimates of the size at which a cohort reaches its maximum biomass (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 L50 by species and Atlantic region; 40% is used as a limit reference point and so when the proportion of individuals less than L50 is >40% is coloured red.

9.13 SHK – SHARKS

An intersessional meeting was conducted on 2-6 July 2018 in Madrid (Anon. 2018i). Information about the status of North and South Atlantic shortfin mako (*Isurus oxyrinchus*) stocks is available in the 2017 report of the assessment (Anon. 2017i), information about the status of the blue shark (*Prionace glauca*) is available in the 2015 report of the assessment (Anon. 2016), 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. 2014a).

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. In 2010, only new information from the Japanese longline fleet on the CPUE of shortfin mako and porbeagle was presented.

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 to prioritize research and management measures (**SHK-Table 2**). 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 level of 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 level of 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.

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 extreme 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 levels 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} level 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

For shortfin mako, 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. Projections indicated that current catch levels (3,600 t for the Task I catches [C1] and 4,750 t for the alternative catches estimated based on ratios [C2], mean of 2011-2015) in the North Atlantic will cause continued population decline and that catches would need to be 1,000 t or lower to prevent further population declines (**SHK-Figure 16**). However, the Kobe II strategy matrices showed that for a constant annual catch of 1,000 t, the probability of being in the Kobe plot green zone would only be 25% by 2040 (**SHK-Table 3**). The Committee notes that the Kobe II strategy matrices 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 is still under development. Although in terms of current stock size the SS3 model is more optimistic than the aggregated biomass dynamic (production) models, the future outlook is probably more pessimistic because the fisheries are removing mostly juveniles and thus it can be anticipated that spawning stock size will keep declining for years after fishing pressure has been reduced until recruits reach maturity. It should be noted that ICCAT fisheries are not removing mature females.

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

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 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 adopted in 2012 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

For the North Atlantic stock of shortfin mako, the probabilities in the Kobe matrices indicate that to stop overfishing and start rebuilding, the constant annual catch should be reduced to 500 t or less. This will achieve the goal of stopping overfishing in 2018 with a 75% probability, but it only has a 35% probability of rebuilding the stock by 2040. Only a 0 t annual catch will rebuild the stock by 2040 with a 54% probability.

The Kobe II strategy matrix (**SHK-Table 3**) shows the range of possible options for the Commission to consider. If the Commission wishes to stop overfishing immediately and achieve rebuilding by 2040 with over a 50% probability, the most effective immediate measure is a complete prohibition of retention. Additional recommended measures that can potentially further reduce incidental mortality include time/area closures, gear restrictions, and safe handling and best practices for the release of live specimens (since post release survival can reach 70%).

The Committee emphasizes that there will be a need for CPCs to strengthen their monitoring and data collection efforts to monitor the future status of this stock, including but not limited to total estimated dead discards and the estimation of CPUE using observer data.

For the South Atlantic stock given the uncertainty in stock status, the large fluctuations in catch, the high intrinsic vulnerability of this species, and the depleted status for the North Atlantic stock, the Committee recommends that until this uncertainty is reduced, catch levels should not exceed the minimum catch in the last five years of the assessment (2011-2015; 2,001 t with catch scenario C1).

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 (2017)		39,675 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 (2017)		28,232 t[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 (2017)		3,112 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 (2017)		2,742 t[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} F_{2008}/F_{MSY}	0.02-0.03[3] 0.04-3.45[4]
Stock Status (2008)	Overfished Overfishing	Yes 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.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				9600	11300	11584	11650	39578	35623	37023	40664	35800	32765	37983	36305	43072	43888	50464	53901	58842	65193	73192	63241	57830	62956	62749	70213	68011
	ATN			9589	8590	8468	7395	29283	26763	26172	28174	21709	20066	23005	21742	22359	23217	26927	30723	35198	37178	38083	36778	37058	36574	39627	44067	39675
	ATS			10	2704	3108	4252	10145	8797	10829	12444	14043	12682	14967	14438	20642	20493	23487	23097	23459	27799	35069	26421	20672	26148	22457	25417	28232
	MED			0	6	8	2	150	63	22	45	47	17	11	125	72	178	50	81	185	216	40	42	100	235	665	729	105
Landings	ATN		Longline	7458	7645	7547	6130	28678	26152	25382	27305	20699	19290	22880	21297	22167	23067	26810	30514	35031	36952	37777	36549	36875	36241	38777	42859	38509
			Other surf.	994	373	300	559	426	419	681	732	905	708	70	380	126	104	63	80	63	59	100	109	74	205	725	1120	1033
	ATS		Longline	10	2704	3108	4246	10135	8790	10801	12444	14042	12678	14961	14339	20638	20434	23417	22708	23453	27785	34532	25878	20387	24203	21694	24643	27522
			Other surf.	0	0	0	0	6	4	27	0	1	4	6	99	3	59	10	375	6	14	534	411	152	1831	635	634	487
	MED		Longline	0	5	7	1	147	61	20	44	47	17	10	43	71	83	48	81	18	50	40	41	68	190	664	728	92
			Other surf.	0	1	1	1	2	2	2	1	1	1	0	81	0	95	2	1	167	165	0	0	32	45	1	2	13
Discards	ATN		Longline	1136	572	621	602	180	170	104	137	105	68	55	63	66	45	53	129	102	167	205	119	109	128	124	88	133
			Other surf.	0	0	0	103	0	22	4	0	0	0	0	1	0	0	0	1	1	1	2	1	0	0	0	0	0
	ATS		Longline	0	0	0	7	5	4	1	0	0	0	0	0	0	0	60	14	0	0	4	132	132	114	122	139	218
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	5
	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	0	9	6	7
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	461	1039	903	1216	392	4	6	201
			Brazil	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Canada	1702	1260	1494	528	831	612	547	624	1162	836	346	965	1134	977	843	0	0	0	0	1	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	0	185	104	148	0	0	0	367	109	88	53	109	98	327	0	1	27	2
			EU.Denmark	0	1	2	3	1	1	0	2	1	13	5	1	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	0	0	0	0	24497	22504	21811	24112	17362	15666	15975	17314	15006	15464	17038	20788	24465	26094	27988	28666	28562	29041	30078	29019	27316
			EU.France	322	350	266	278	213	163	399	395	207	221	57	106	120	99	167	119	84	122	115	31	216	132	259	352	124
			EU.Ireland	0	0	0	0	0	0	66	31	66	11	2	0	0	0	0	0	0	0	1	3	2	1	0	0	0
			EU.Netherlands	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.Portugal	5726	4669	4722	4843	2630	2440	2227	2081	2110	2265	5643	2025	4027	4338	5283	6167	6252	8261	6509	3768	3694	3060	3859	7819	5664
			EU.United Kingdom	0	0	12	0	0	1	0	12	9	6	4	6	5	3	6	6	96	8	10	8	10	10	12	17	11
			FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	0	1203	1145	618	489	340	357	273	350	386	558	1035	1729	1434	1921	2531	2007	1763	1227	2437	1808	3287	4011	4217	4460
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	537	299	327	113	0	10	103
			Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	873	1623	1475
			Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	
			Mexico	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
			Panama	0	0	0	0	0	0	9	0	0	0	0	0	0	254	892	613	1575	0	0	0	289	153	0	262	
			Senegal	0	0	0	0	0	0	0	0	0	456	0	0	0	0	43	134	255	56	0	5	12	17	13	3	4
			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	119	
			Trinidad and Tobago	0	0	0	0	0	0	0	0	0	6	3	2	1	1	0	2	8	9	11	11	8	10	4	2	2
			U.S.A.	680	29	23	283	211	255	217	291	39	0	0	7	2	2	1	8	4	9	65	56	32	39	31	30	24
			UK.Bermuda	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Venezuela	23	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	0	487	167	132	203	246	384	165	59	0	171	206	240	588	292	110	73	99	148	94	113	77	220	259	42
			Suriname	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	181	281	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	0	16
			Belize	0	0	0	0	0	0	0	0	0	0	0	37	259	0	236	109	0	273	243	483	234	171	105	167	200
			Brazil	0	0	0	743	1103	0	179	1683	2173	1971	2166	1667	2523	2591	2258	1986	1274	1500	1980	1607	2013	2551	2420	1334	2177
			China PR	0	0	0	0	0	0	0	0	565	316	452	0	0	0	585	40	109	41	131	84	64	48	20	30	283
			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	0	92	16	9	8
			EU.España	0	0	0	0	5272	5574	7173	6951	7743	5368	6626	7366	6410	8724	8942	9615	13099	13953	16978	14348	10473	11447	10133	10107	11486
			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	0	1	0	0	0	0	0	0	0	0	0	0

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			EU.Portugal	0	0	847	867	1336	876	1110	2134	2562	2324	1841	1863	3184	2751	4493	4866	5358	6338	7642	2424	1646	1622	2420	5609	6663
			EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	239	0	0	14	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	1583	396	436	479
			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	0	16	6	
			Japan	0	1388	437	425	506	510	536	221	182	343	331	209	236	525	896	1789	981	1161	1483	3060	2255	3232	2236	2127	3115
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	222	125	112	61	10	71	252	87
			Namibia	0	0	0	0	0	0	0	0	0	2213	2316	1906	6616	3536	3419	1829	207	2352	2957	1439	1147	2471	2137	2775	1357
			Panama	0	0	0	0	0	0	168	22	0	0	0	0	0	0	0	521	0	0	0	0	0	0	0	0	0
			Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0	18	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	0	143	147	152	156	206	183	
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	203	51	60	0	18	15	11
			South Africa	0	0	0	0	0	23	21	0	83	63	232	128	154	90	82	126	119	125	318	158	179	524	402	356	275
			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	17	
			U.S.A.	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
			Uruguay	10	84	57	259	180	248	118	81	66	85	480	462	376	232	337	359	942	208	725	433	130	0	0	0	**0**
		NCC	Chinese Taipei	0	1232	1767	1952	1737	1559	1496	1353	665	0	521	800	866	1805	2177	1843	1356	1625	2138	1941	2125	2128	1731	1853	1852
		NCO	Benin	0	0	0	0	6	4	27	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	0	1	0	**0**
			EU.Cyprus	0	0	0	0	0	0	0	9	0	0	3	6	5	0	0	0	0	0	0	0	0	0	0	0	**0**
			EU.España	0	0	0	0	146	59	20	31	6	3	3	4	8	61	3	2	7	48	38	39	37	53	65	58	40
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	5	15	0	2
			EU.Italy	0	0	0	0	0	0	0	0	0	0	0	113	1	95	46	75	175	165	0	0	57	173	0	18	59
			EU.Malta	0	1	1	1	2	2	2	1	1	1	0	0	0	0	1	1	2	1	1	2	2	4	5	3	4
			EU.Portugal	0	0	0	0	0	2	0	5	41	14	3	0	56	22	0	0	0	2	0	0	0	0	0	0	**0**
			Japan	0	5	7	1	1	0	0	0	0	0	1	1	2	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	0	580	650	**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	5	16	32
			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	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.	1136	572	618	704	180	192	100	137	106	68	55	65	66	45	54	130	103	167	206	106	99	122	82	43	38
			UK.Bermuda	0	0	3	1	0	0	8	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	14	10	6	19	27	34
	ATS	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	14	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	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	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	0	6	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	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	0	17
			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	1
			South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
			U.S.A.	0	0	0	7	5	4	1	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	4	132	132	112	122	139	201
	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 oxyrinchus*) by area, gear and flag.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				5856	5923	8474	7739	5735	5862	4384	5109	4694	5332	7815	6456	6823	6582	7031	5682	6605	7254	6979	7338	5778	6126	5764	6116	5854
	ATN			4114	3690	5295	5277	3517	3829	2830	2552	2637	3373	4034	3988	3646	3564	4179	3800	4541	4767	3718	4431	3595	2852	2991	3351	3112
	ATS			1743	2233	3179	2461	2212	2025	1549	2553	2050	1957	3779	2466	3161	3008	2850	1881	2063	2486	3258	2905	2183	3274	2773	2765	2742
	MED			0	0	0	0	6	8	5	4	7	2	2	2	17	10	2	1	1	2	2	2	0	0	0	0	
Landings	ATN		Longline	3420	3338	3817	5024	3334	3654	2729	2232	2407	3102	4017	3559	3338	3292	3997	3622	4344	4587	3496	4145	3312	2576	2638	3118	2710
			Other surf.	670	331	1448	252	183	175	99	320	231	271	17	429	308	273	175	169	177	178	213	267	278	265	342	225	397
	ATS		Longline	1732	2212	3164	2445	2187	2012	1539	2530	2032	1942	3747	2391	3146	2964	2809	1799	2057	2485	3196	2842	2149	3241	2759	2748	2575
			Other surf.	11	21	15	16	25	12	10	22	18	15	31	76	14	43	30	82	7	1	62	55	34	31	12	13	162
	MED		Longline	0	0	0	0	6	8	5	4	7	2	2	2	17	10	2	1	1	2	2	2	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	
Discards	ATN		Longline	24	21	29	1	0	0	0	0	0	0	0	0	0	0	7	9	20	2	9	19	5	12	10	8	4
			Other surf.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
	ATS		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	8	0	2	2	3	3
			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	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	0	4	3	3
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	28	69	114	99	1	1	1	9
			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	0	111	67	110	69	70	78	69	78	73	80	91	71	72	43	53	41	37	29	35	55	85	82	109
			China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	16	19	29	18	24	11	5	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	0	0
			EU.España	1964	2164	2209	3294	2416	2223	2051	1561	1684	2047	2068	2088	1751	1918	1816	1895	2216	2091	1667	2308	1509	1481	1362	1574	1784
			EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	2	0	0	0	1	1	2	1
			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	796	649	657	691	354	307	327	318	378	415	1249	473	1109	951	1540	1033	1169	1432	1045	1023	820	219	222	264	276
			EU.United Kingdom	0	0	0	0	0	0	2	3	2	1	1	1	0	0	0	1	15	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	1	2	0	4	0	0	4	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	425	214	592	790	258	892	120	138	105	438	267	572	0	0	82	131	98	116	53	56	33	69	45	74	89
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	27	15	8	2	1	3
			Maroc	0	0	0	0	0	0	0	0	0	0	147	169	215	220	151	283	476	636	420	406	667	624	947	1050	450
			Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
			Mexico	0	0	10	0	0	0	0	10	16	0	10	6	9	5	8	6	7	8	8	8	4	4	4	3	5
			Panama	0	0	0	0	0	0	1	0	0	0	0	0	0	0	49	33	39	0	0	0	19	7	0	0	0
			Philippines	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	17	21	0	0	2	0	2	2	2	68
			St. Vincent and Grenadines	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
			Trinidad and Tobago	0	0	0	0	0	0	1	0	1	2	3	1	2	1	1	1	1	1	0	2	1	1	1	1	2
			U.S.A.	894	574	1658	400	345	296	198	414	350	372	106	477	422	353	319	296	314	335	331	365	355	346	282	266	296
			UK.Bermuda	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Venezuela	1	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	9	61	21	16	25	31	48	21	7	0	84	57	19	30	25	23	11	14	13	14	8	4	13	7	1
		NCO	Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	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	0	31
			Belize	0	0	0	0	0	0	0	0	0	0	0	0	38	0	17	2	0	32	59	78	88	1	15	14	34
			Brazil	122	95	119	83	190	233	27	219	409	226	283	238	426	210	145	203	99	128	192	196	276	268	173	124	275
			China PR	34	45	23	27	19	74	126	305	22	208	260	68	45	70	77	6	24	32	29	8	9	9	5	3	1
			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	10	20	13	15	23	10	10	9	15	15	30	15	14	16	25	0	5	7	0	20	34	19	11	13	161
			EU.España	772	552	1084	1482	1356	984	861	1090	1235	811	1158	703	584	664	654	628	922	1192	1535	1207	1083	1077	862	882	1049
			EU.Portugal	0	0	92	94	165	116	119	388	140	56	625	13	242	493	375	321	502	336	409	176	132	127	158	393	503
			EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	11	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	701	1369	1617	514	244	267	151	264	56	133	118	398	0	0	72	115	108	103	132	291	114	182	108	77	96
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	13	7	7	4	4	18	8
			Namibia	0	0	0	0	0	0	1	0	0	459	375	509	1415	1243	1002	295	23	307	377	586	9	950	661	799	194
			Panama	0	0	0	0	0	0	24	1	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
			Philippines	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	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	0	13	34	23	0	11	6	39
			South Africa	45	24	49	37	31	171	67	116	70	12	116	101	111	86	224	137	146	152	218	108	250	476	613	339	261
			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	28	12	17	26	20	23	21	35	40	38	188	249	146	68	36	41	106	23	76	36	1	0	0	0	**0**
			Vanuatu	0	0	0	0	0	0	0	0	0	0	0	52	12	13	1	0	0	0	0	0	0	0	0	0	**0**
		NCC	Chinese Taipei	31	116	166	183	163	146	141	127	63	0	626	121	128	138	211	124	117	144	203	150	157	158	152	92	85
	MED	CP	EU.Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	**0**
			EU.España	0	0	0	0	6	7	5	3	2	2	2	2	2	4	1	0	0	1	2	2	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.Portugal	0	0	0	0	0	1	0	1	5	0	0	0	15	5	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	0	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
			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

			1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		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
		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
		Korea Rep.	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	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
		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	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.	24	21	28	1	0	0	0	0	0	0	0	0	0	0	7	10	20	2	9	18	5	11	8	6	4
		UK.Bermuda	0	0	0	0	0	0	2	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	1	0	0	1	1	0
ATS	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	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	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	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
		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
		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
		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
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	2	2	3	3
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.

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL				1910	2729	2140	1560	1859	1469	1403	1469	509	848	648	745	571	507	525	611	484	136	90	149	185	67	60	22	27
	ATN			1909	2726	2136	1556	1833	1451	1393	1457	507	838	604	725	539	470	512	524	421	119	68	111	156	29	56	20	26
	ATS			1	2	3	3	26	17	10	11	1	11	43	17	31	37	13	85	62	16	21	37	29	38	4	1	0
	MED			0	0	0	1	0	1	0	1	1	0	0	3	2	1	0	2	1	1	0	1	0	0	0	1	1
Landings	ATN		Longline	1156	1734	1405	1169	1407	1089	975	920	33	297	257	466	234	225	384	355	203	85	38	79	115	8	8	4	2
			Other surf.	753	991	731	386	426	362	418	537	474	541	347	259	305	245	127	169	219	31	29	32	39	13	13	11	15
	ATS		Longline	0	1	3	3	21	15	4	11	1	11	43	17	31	37	13	85	62	16	21	37	29	13	4	1	0
			Other surf.	1	1	0	0	4	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	
	MED		Longline	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	1	0	0	1	0	0	0	0	0
			Other surf.	0	0	0	1	0	1	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1
Discards	ATN		Longline	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	2	8	34	3	7
			Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2
	ATS		Longline	0	0	0	0	0	1	1	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	0
Landings	ATN	CP	Canada	919	1575	1353	1051	1334	1070	965	902	8	237	142	232	202	192	93	124	62	83	30	33	19	9	4	2	2
			EU.Denmark	91	93	86	72	69	85	107	73	76	42	0	0	0	0	0	0	0	0	0	2	0	0	0	0	**0**
			EU.España	21	52	19	41	25	25	18	13	24	54	27	11	14	34	8	41	77	0	0	0	0	0	0	0	**0**
			EU.France	633	820	565	267	315	219	240	410	361	461	303	413	276	194	354	311	228	0	2	4	0	0	3	0	1
			EU.Germany	0	0	0	0	0	0	0	17	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.Ireland	0	0	0	0	0	0	8	2	6	3	11	18	0	4	8	7	3	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	
			EU.Portugal	0	0	0	0	0	0	0	7	4	10	101	50	14	6	0	3	17	7	0	0	0	0	0	0	0
			EU.Sweden	3	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU.United Kingdom	0	0	0	0	0	1	6	8	12	10	0	0	24	11	26	15	11	0	0	0	0	0	0	0	**0**
			Iceland	3	4	6	5	3	4	2	2	3	2	1	1	0	1	0	1	0	1	0	0	0	0	0	0	**0**
			Japan	0	0	0	5	4	0	0	0	0	0	0	0	0	0	12	10	13	13	14	49	98	0	0	2	**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**
			Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	**0**
			Norway	24	24	26	28	17	27	32	22	11	14	19	0	8	27	10	12	10	12	11	17	9	5	4	6	6
			U.S.A.	50	106	35	78	56	13	3	1	1	1	0	1	0	0	0	1	1	1	11	4	27	7	9	5	8
		NCO	Faroe Islands	165	48	44	8	9	7	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATS	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	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	0	0	0	0	2	2	2	7	1	2	9	4	0	3	5	4	13	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	
			EU.Poland	0	1	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	4	2	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	25	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	0	0	0	
			Japan	1	0	0	3	14	0	1	0	0	0	0	0	0	0	5	41	34	8	7	25	15	13	4	1	0
			Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	**0**
			Uruguay	0	0	3	0	5	13	2	4	0	8	34	8	28	34	3	40	14	6	12	12	0	0	0	0	**0**

				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	
		NCO	Benin	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Chile	0	1	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	0	1	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.Italy	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	2	0	0	0	0	0	0	0	1	1
			EU.Malta	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0
Discards	ATN		Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	2
			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.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	2	7	34	1	6
		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	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
			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
			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
			Uruguay	0	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. Kobe II strategy matrix giving the probability that the fishing mortality will be below the fishing mortality rate at MSY (top), the probability that the biomass will exceed the level that will produce MSY (middle), and the two combined (bottom) based on production model (BSP2-JAGS) projection results for North Atlantic shortfin mako.

Probability that $F<F_{MSY}$

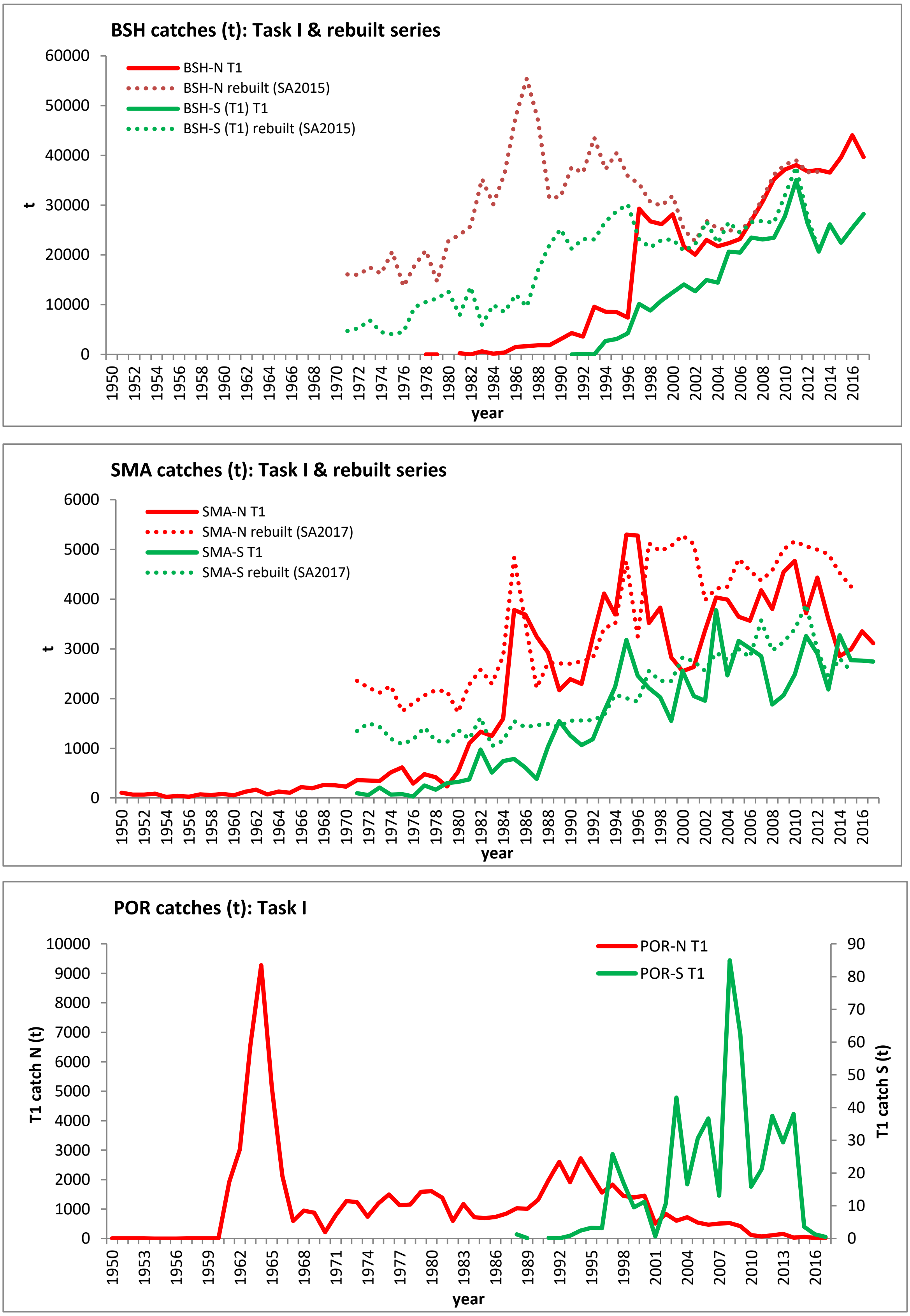
Catch (t)	2018	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
0	100	100	100	100	100	100	100	100	100	100	100	100
500	75	74	75	75	74	75	75	76	76	75	75	75
1000	30	32	32	32	34	35	36	35	38	38	38	38
1500	11	10	11	13	14	14	14	15	15	16	16	16
2000	2	3	4	4	4	5	4	5	5	5	6	6
2500	1	1	1	1	2	2	2	2	2	2	2	2
3000	0	0	0	0	0	0	0	0	0	0	0	0
3500	0	0	0	0	0	0	0	0	0	0	0	0
4000	0	0	0	0	0	0	0	0	0	0	0	0

Probability that $B>B_{MSY}$

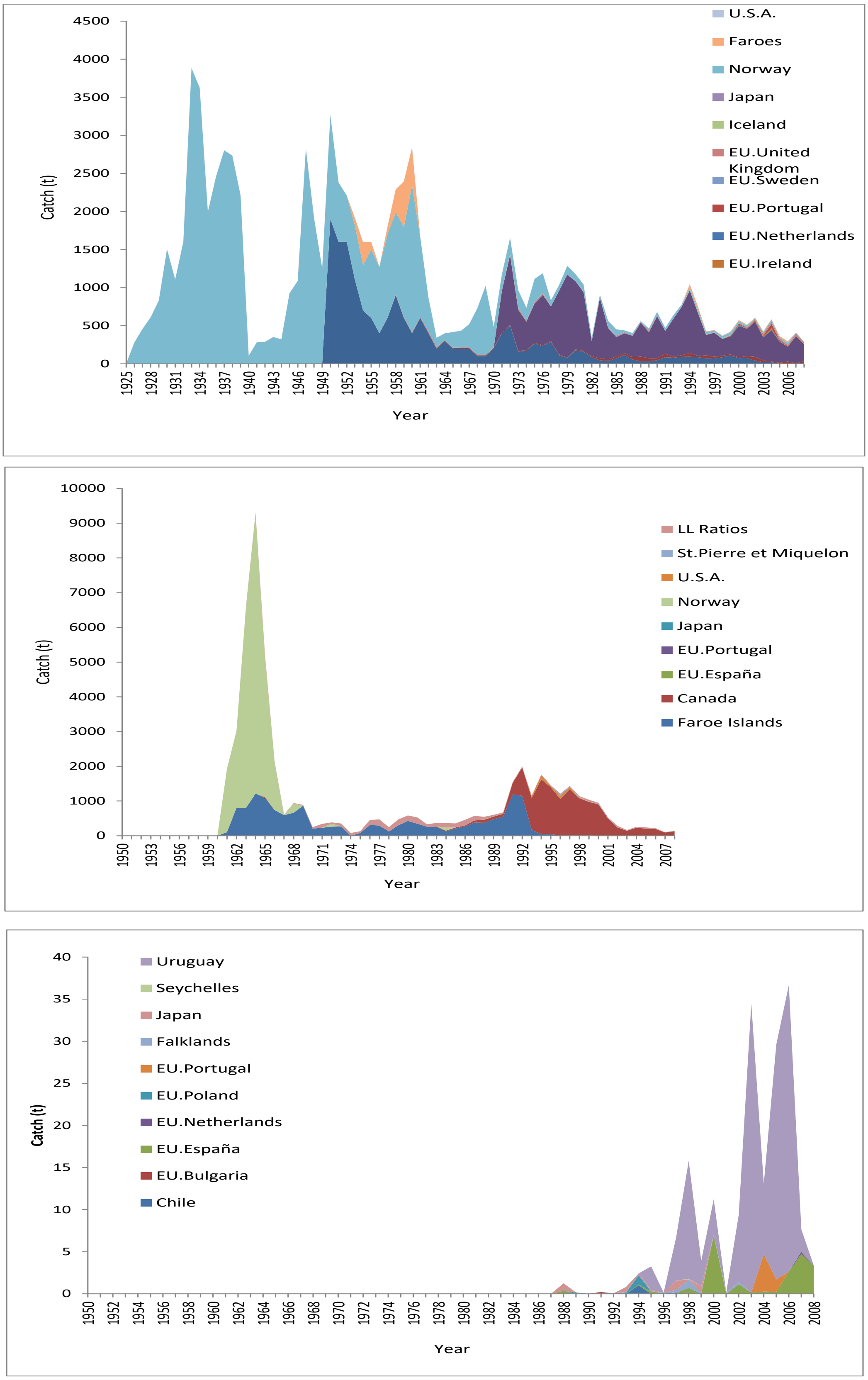
Catch (t)	2018	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
0	6	10	16	21	27	31	36	41	43	46	50	54
500	4	9	12	15	19	21	24	27	29	30	33	35
1000	6	9	10	13	16	18	21	22	23	25	25	27
1500	6	8	10	11	12	12	13	15	16	17	16	16
2000	5	7	7	8	9	9	8	9	8	9	9	9
2500	6	7	7	6	7	6	7	7	6	6	6	6
3000	5	6	5	5	5	5	4	4	3	3	3	3
3500	6	6	5	5	5	3	3	2	2	2	2	2
4000	6	4	3	2	2	2	1	1	1	1	0	0

Probability of being in the green zone ($F<F_{MSY}$ and $B>B_{MSY}$)

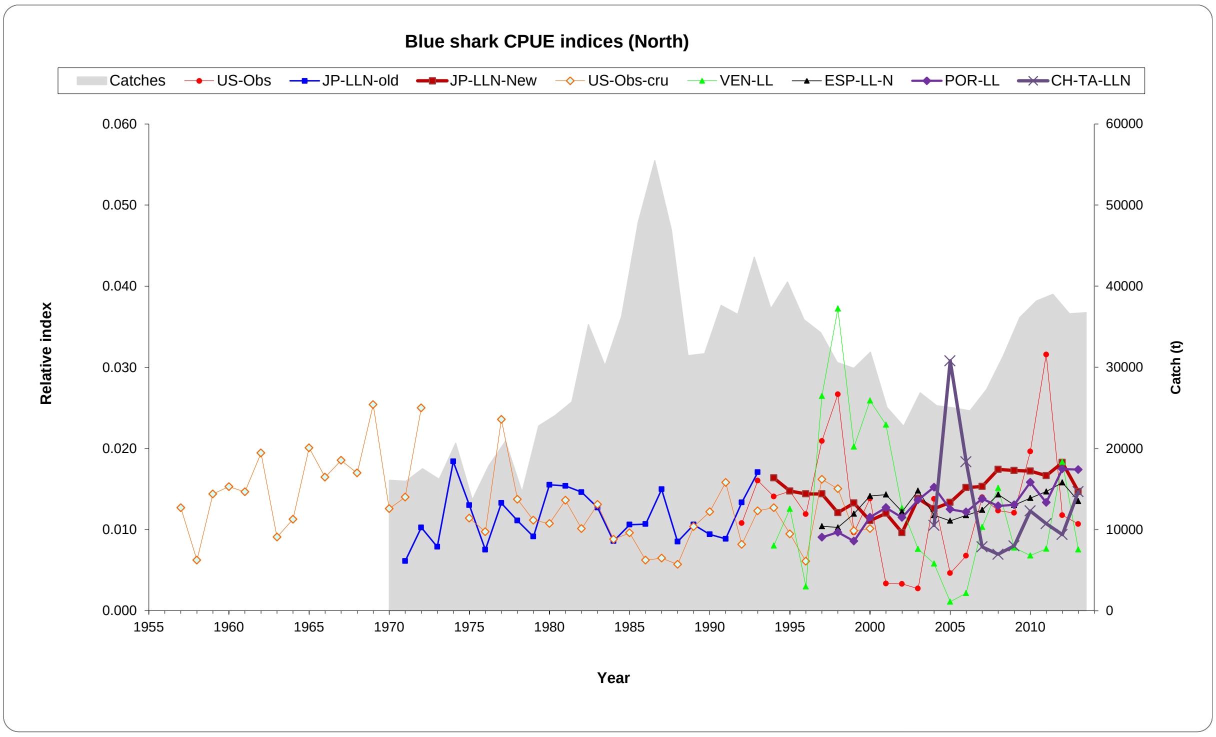
Catch (t)	2018	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
0	6	11	16	21	27	31	36	41	43	46	50	54
500	4	9	12	15	19	21	24	27	29	30	33	35
1000	5	8	9	11	15	15	19	20	21	23	23	25
1500	3	4	5	7	7	8	9	10	11	12	12	12
2000	0	2	2	3	3	3	3	4	4	4	5	5
2500	0	1	1	1	1	2	2	2	2	2	2	2
3000	0	0	0	0	0	0	0	0	0	0	0	0
3500	0	0	0	0	0	0	0	0	0	0	0	0
4000	0	0	0	0	0	0	0	0	0	0	0	0

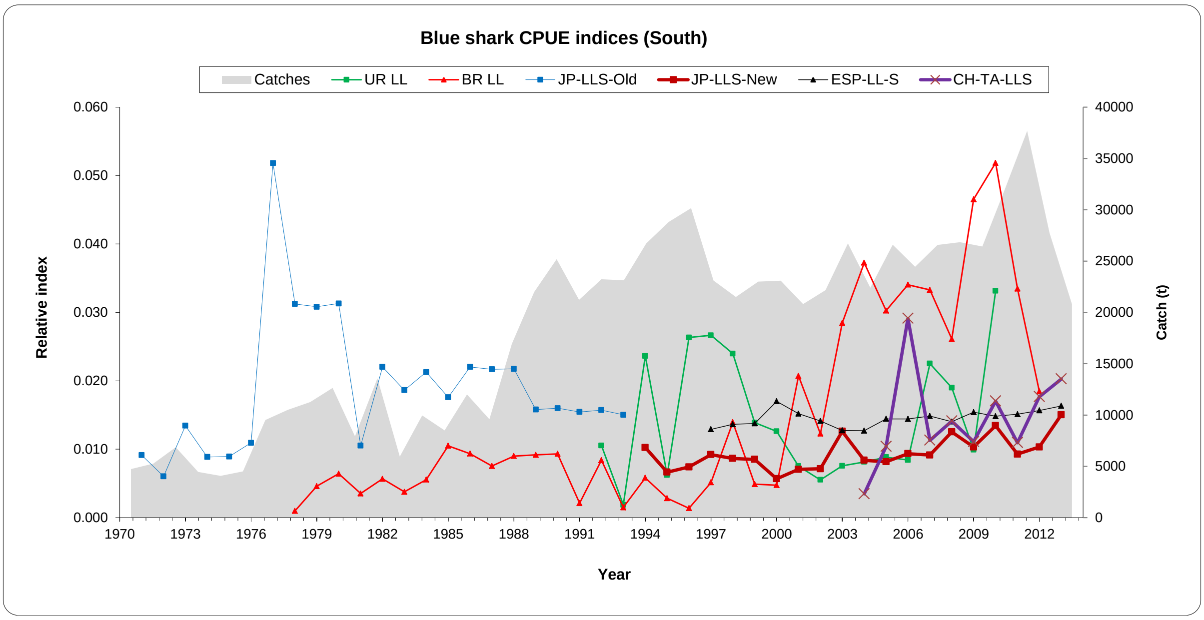


SHK-Figure 1. Blue shark (BSH, top panel) and shortfin mako (SMA, middle panel) catches reported to ICCAT (Task I) and estimated by the Committee, and Task I porbeagle (POR bottom panel, POR-S catch series is preliminary).

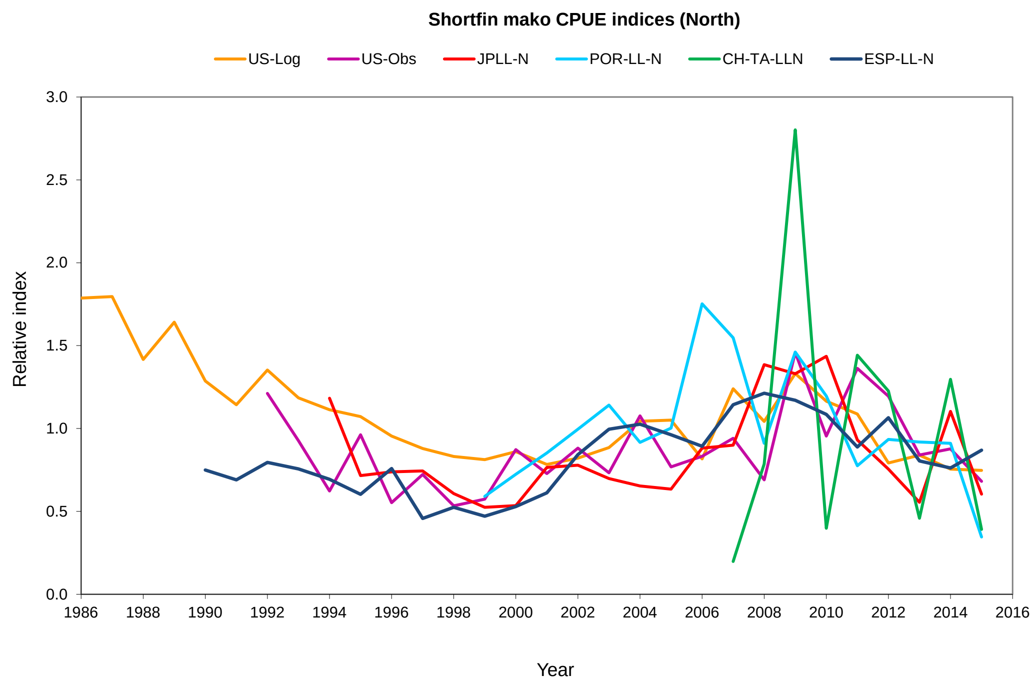


SHK Figure 2. Catch by flag of porbeagle sharks from the northeast Atlantic (top), northwest Atlantic (middle), and southwest Atlantic (bottom) used in the 2009 stock assessment. While these catches are considered the best available, NE catches are believed to underestimate the pelagic longline catches 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.

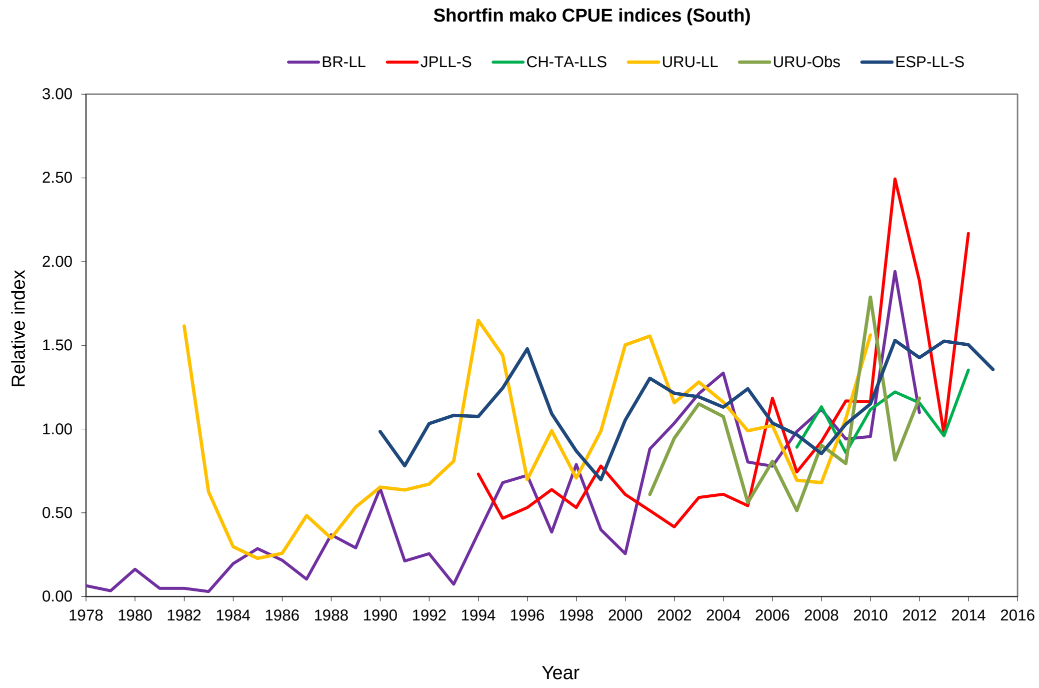




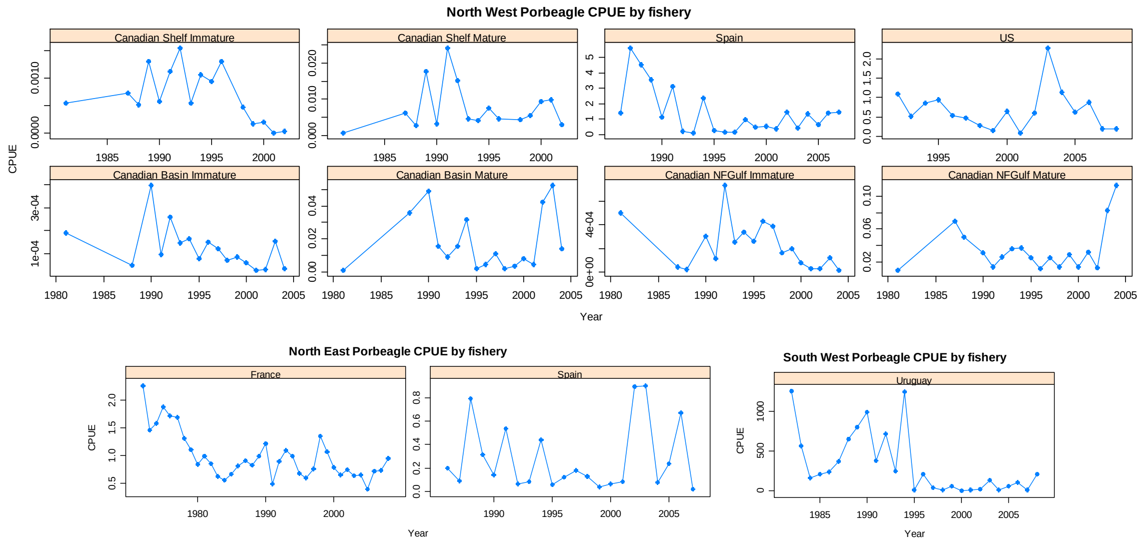
SHK-Figure 3. CPUE series used in the 2015 assessments of North and South Atlantic blue shark (BSH) stocks. Total catches (in t) used in the assessments are also shown.



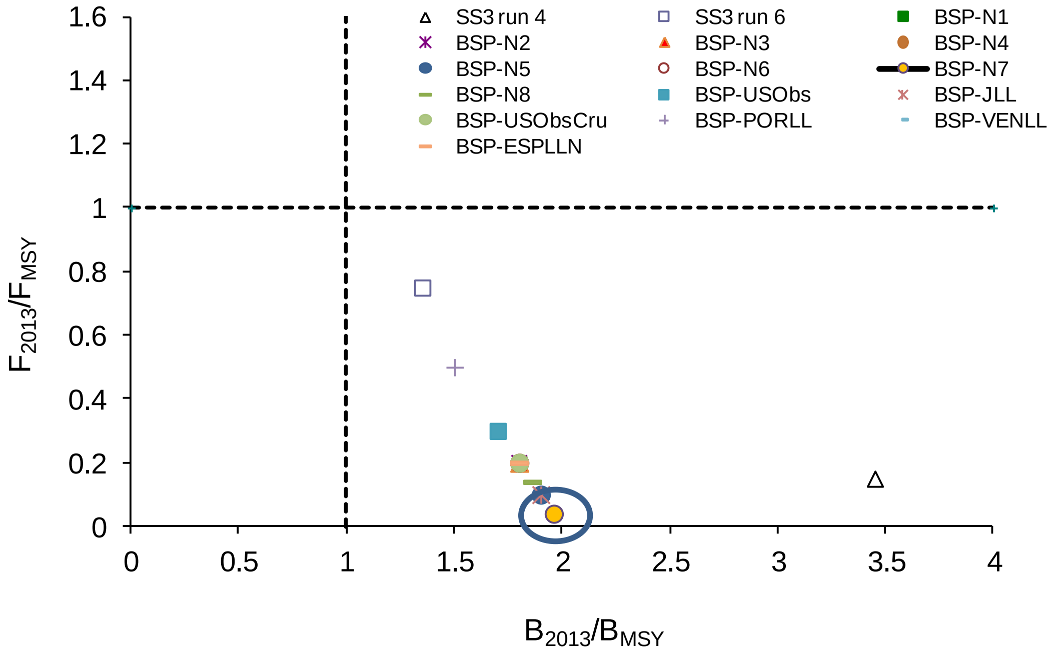
SHK-Figure 4. Indices of abundance for North Atlantic shortfin mako shark used in the 2017 stock assessment.



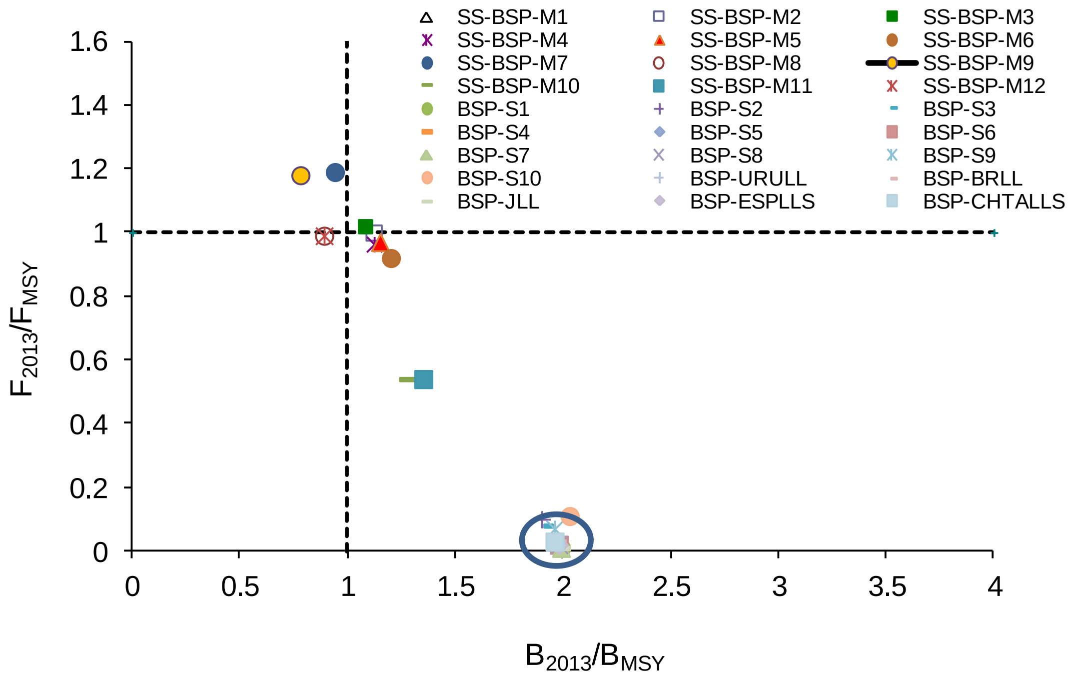
SHK-Figure 5. Indices of abundance for South Atlantic shortfin mako shark used in the 2017 stock assessment.



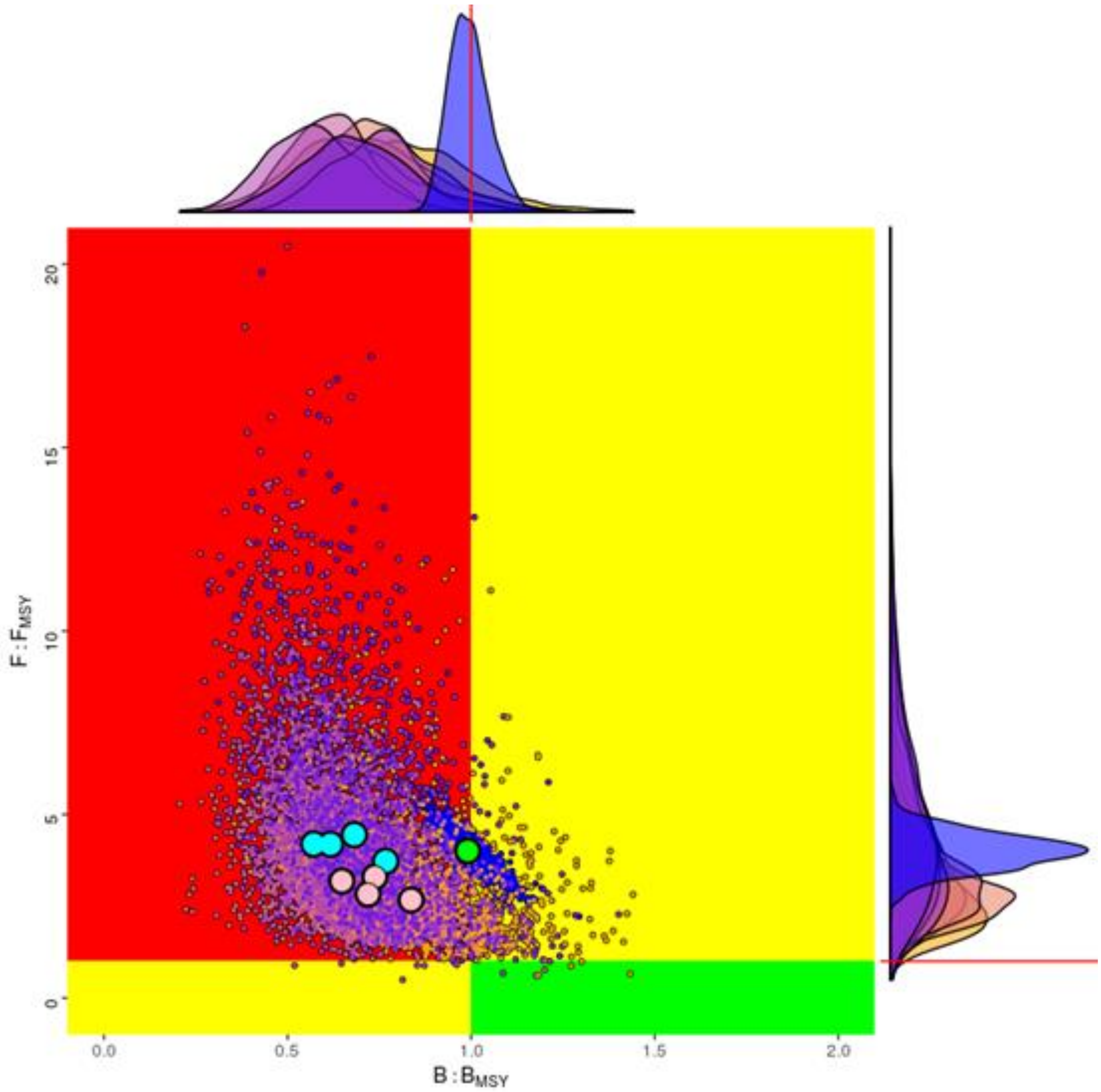
SHK-Figure 6. CPUE series for the porbeagle used in the last (2009) assessment NW stock (upper figures), NE stock (lower left figures) and SW stock (lower right figure).



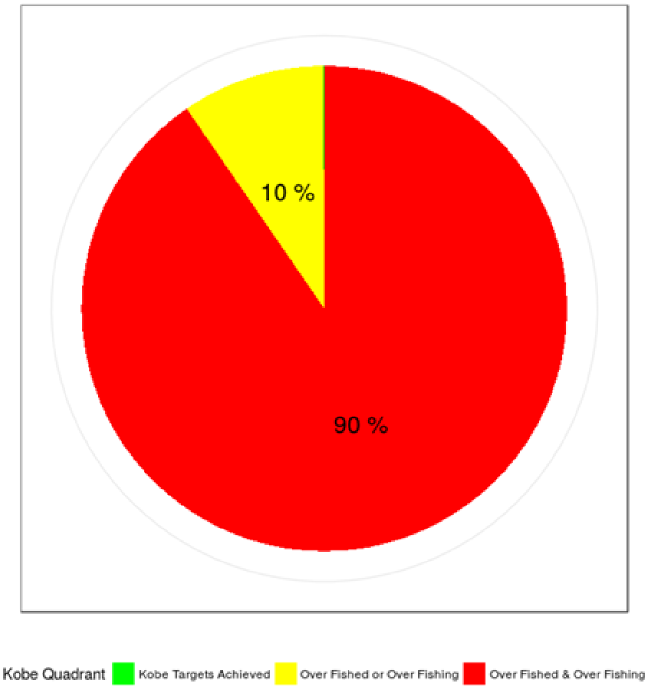
SHK-Figure 7. Phase plots summarizing scenario outputs for the current (for 2013) stock status of North Atlantic blue shark (BSH). BSP=Bayesian surplus production model; SS3=Stock synthesis model. The circle denotes common status for several BSP runs. Note that the x-axis values for SS3 are SSF_{2013}/SSF_{MSY}.



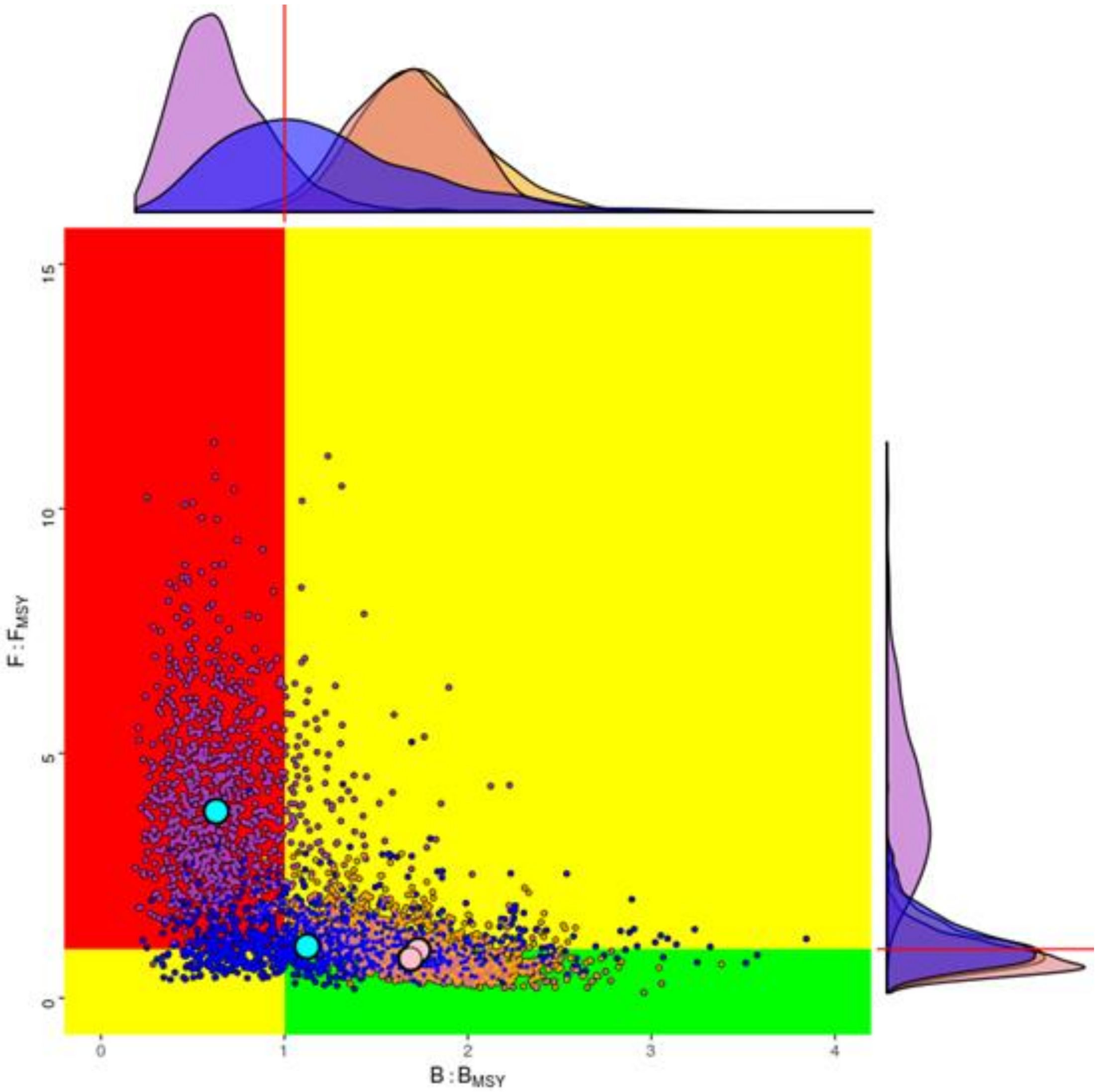
SHK-Figure 8. Phase plots summarizing scenario outputs for the current (for 2013) stock status of South Atlantic blue shark (BSH). BSP=Bayesian surplus production model; SS-BSP=State-space Bayesian surplus production model. The circle denotes common status for several BSP runs.



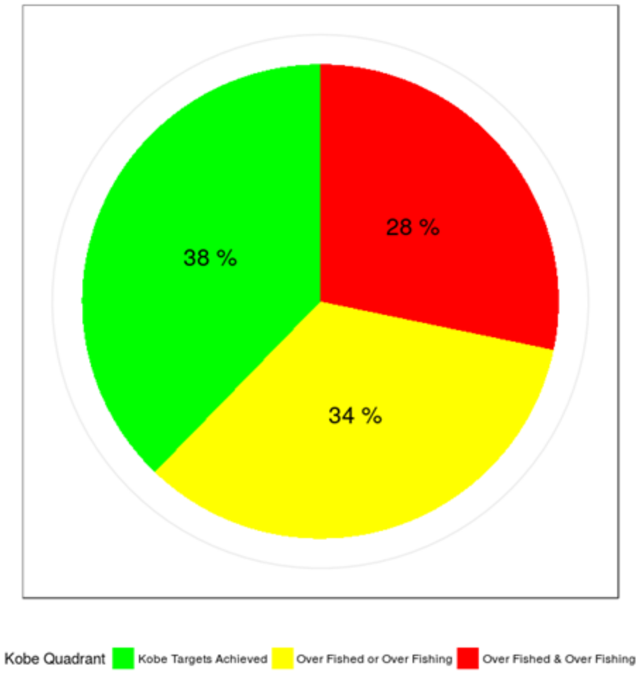
SHK-Figure 9. Stock status (2015) of North Atlantic shortfin makos based on Bayesian production models (4 BSP2JAGS and 4 JABBA runs) and 1 length-based, age-structured model (SS3). The clouds of points are the bootstrap estimates for all model runs showing uncertainty around the median point estimate 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).



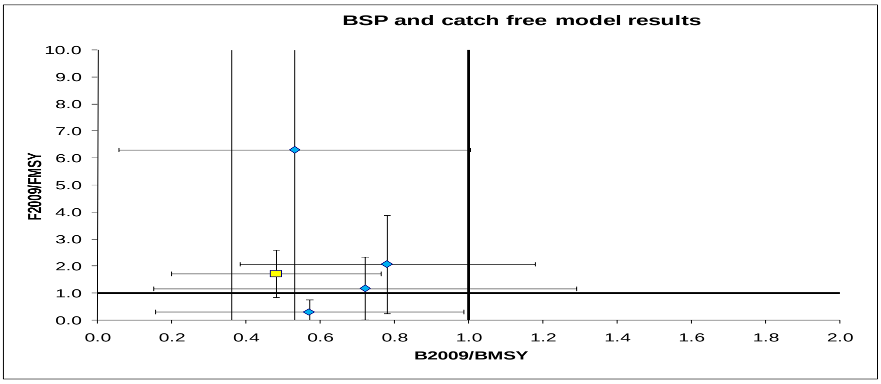
SHK-Figure 10. Kobe pie chart summarizing stock status (for 2015) for North Atlantic shortfin makos based on Bayesian production models (4 BSP2JAGS and 4 JABBA runs) and 1 length-based age-structured model (SS3). Probability of being in the green quadrant is less than 0.5%.



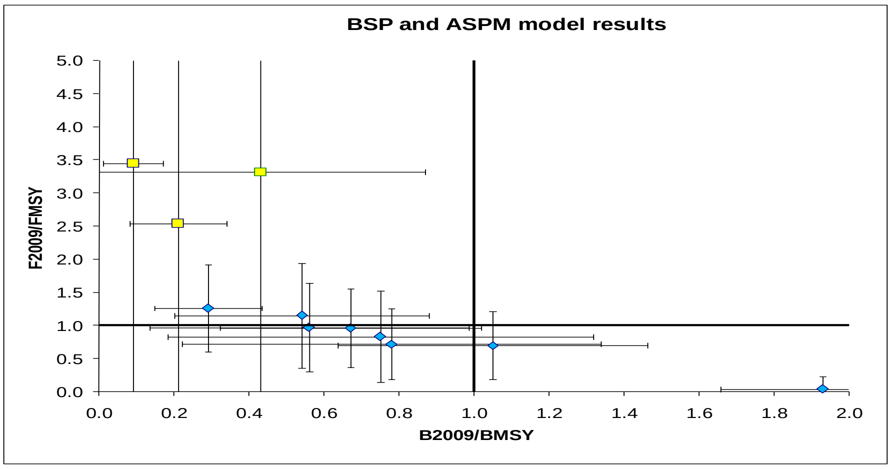
SHK-Figure 11. Stock status (2015) of South Atlantic shortfin makos based on a Bayesian production model (BSP2JAGS) and a catch-only model (CMSY). The clouds of points are the bootstrap estimates for all models combined showing uncertainty around the median point estimate for each of four model formulations (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).



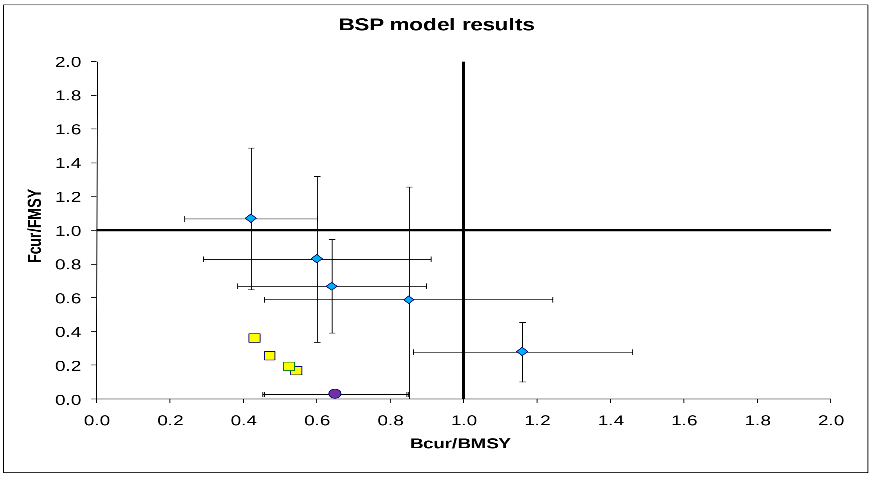
SHK-Figure 12. Kobe pie chart summarizing stock status (for 2015) for South Atlantic shortfin makos based on a Bayesian production model (2 BSP2JAGS runs) and a catch-only model (2 CMSY runs).



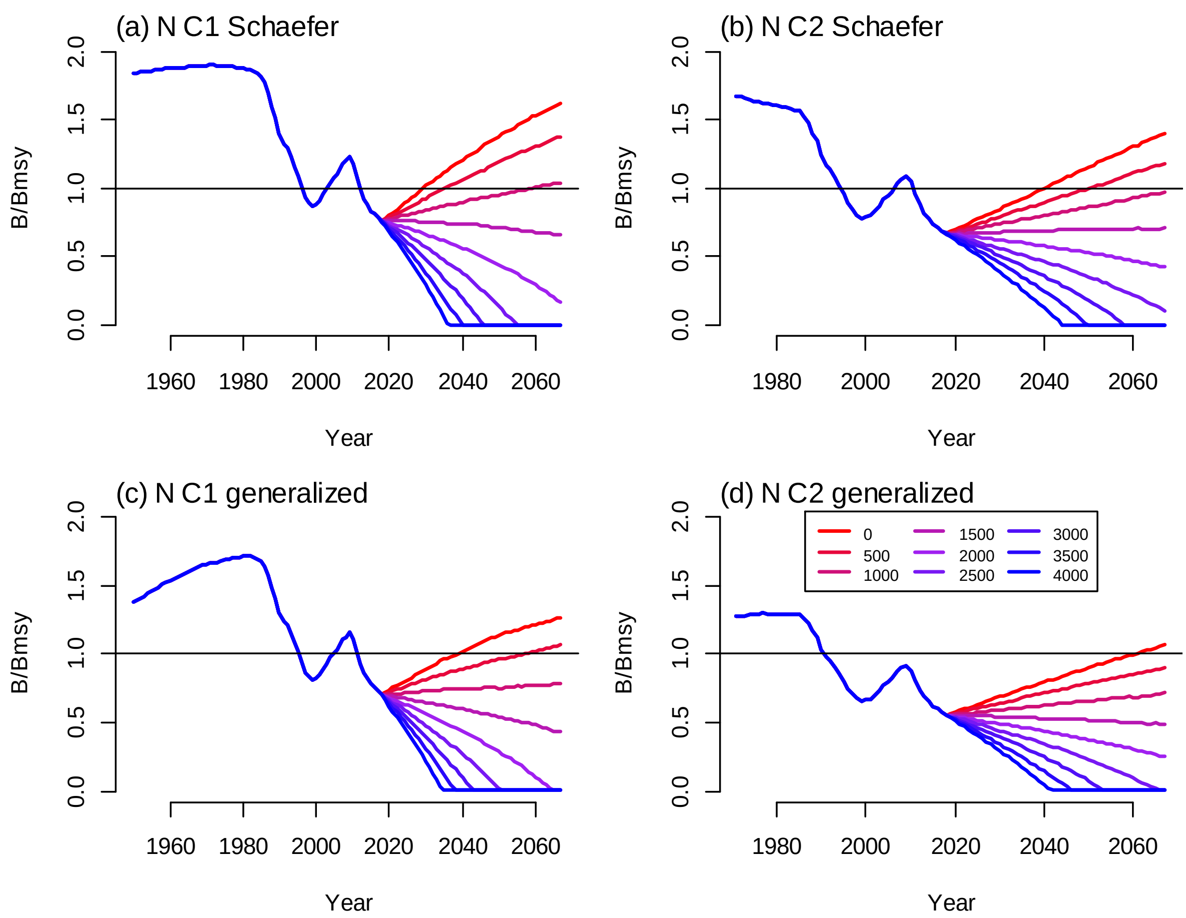
SHK-Figure 13. Phase plot for the southwest Atlantic porbeagle, showing status in 2009 from both the BSP model runs (diamonds) and the catch free age structured production model (square) results. Error bars are plus and minus one standard deviation.



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. Median constant catch projections (0 – 4000 t) from BSP2-JAGS for the North Atlantic shortfin mako (Anon. 2017i). for 4 model runs: (a) C1 catch with a Schaefer model, (b) C2 catch with a Schaefer model, (c) C1 catch with a generalized production model, and (d) C2 catch with a generalized production model.

10. Report of Special Data Collection Research Programmes

10.1 Atlantic-wide Research Programme for Bluefin Tuna (ICCAT GBYP)

The activities of the GBYP officially started in March 2010. The seventh phase of GBYP activities was completed in February 2018 and most of the activities were reported to the SCRS and the Commission in 2017.

Phase 8 of GBYP started on 21 February 2018 and it will be active until 20 February 2019, covering the same main lines of activity covered during Phase 7. Specifically, the most relevant research activities developed within this reporting period (October 2017-September 2018) have been:

a) ***Data mining and recovery*** - In Phase 7, additional data from Italian longline fisheries were produced. In Phase 8 three data recovery activities have been carried out: 1) old data on BFT catches from 5 Italian traps data, 2) tuna catches from ICES reports, containing information on bluefin tuna landings by different entities from 1962 to 1978, and 3) obtainment of 41 electronic tag datasets deployed by Stanford University in 2016 and 2017.

b) ***Aerial survey on bluefin tuna spawning aggregations*** - In Phase 7 the fifth aerial survey on bluefin tuna spawning aggregations was successfully carried out and the results were made available in time to the bluefin tuna stock assessment session and used for the first time in the MSE-OM. In Phase 8 the aerial surveys have been successfully carried out following exactly the same sampling strategy and methodology. Detailed data analysis has shown that sampling strategy and methodology can be further improved, and specific proposals to this end are being developed.

c) ***Tagging* -** Conventional tagging has continued along Phases 7 and 8 as a complementary (and partially opportunistic) activity. Tag reporting has further improved, though the recovery rate remains low (2.73%). The deployment of miniPATs tags conducted since 2011 have further enhanced the knowledge on bluefin tuna behaviour and help address several previous hypotheses. Data from the electronic tagging have been used within the framework of MSE development. Preliminary results from Phase 8 (60 tags deployed in several areas in North Atlantic) have shown that despite some methodological improvements the percentage of premature releases is still high, and hence further methodological improvements should be explored and applied. A new Shiny application was developed in Phase 8 for visualization and analysis of electronic tagging data.

d) ***Biological studies* -** In Phase 7 a large amount of samples was collected in relation to a possible CKMR study. Moreover, a particular effort for enhancing the ageing of bluefin tuna was devoted in this phase, and a new ALK based on 2000 otoliths new reading was elaborated. A broad study based on histological analysis of several hundreds of gonads from western stock individuals was also initiated, though the final results will only be available in November 2018. Microchemical analysis have demonstrated that mixing of the bluefin tuna populations occurs at variable rate in successive years. Given that at the end of Phase 7, it was decided to cancel Close Kin related activities, in Phase 8, sampling has concentrated on sampling potential mixing areas in the Atlantic and some additional areas in the Mediterranean Sea, though sampling of adult bluefin tuna in Mediterranean farms has been maintained. Sample analyses in Phase 8 will focus on individual population assignment of bluefin tuna caught in potential mixing zones in the Atlantic, including special analysis to explore the presence of a possible "third" population of Atlantic bluefin tuna in the Slope Sea. As regards ageing, a new set of 2000 otoliths are being aged, and a calibration exercise will be conducted.

e) ***Modelling approaches*** - The main objectives for Phase 8 are to ensure that the OM scenarios agreed by the Bluefin Tuna MSE Technical 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 that robustly meet the management objectives. In April 2018, the Bluefin Tuna MSE Technical Group held an intersessional meeting 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.

An internal review of GBYP programme performance has been carried out in Phase 8. As a result, the major problems affecting programme funding, planning, coordination, communications and data use policy, as well its potential solutions, have been outlined by the GBYP Steering Committee and the Coordination team.

The report was adopted and is attached as **Appendix 4**.

Discussion

The GBYP Coordinator presented to the Committee a very brief summary of the GBYP programme history and achievements, focusing on the main results from the tasks carried out from the last SCRS plenary meeting within each line of activity (data recovery, biological studies, aerial surveys, tagging and modelling). Moreover, some structural problems affecting the programme performance were highlighted, and a proposal for improving the management of the programme, aiming at overcoming such structural problems through the design and implementation of a new strategic plan and a multiannual detailed working plan, which should be developed following standard project planning methodologies, was presented. The GBYP Coordinator stressed the necessity of improving the coordination among the different actors involved in bluefin tuna research and assessment, looking for synergies and aiming to prevent any duplication of efforts between GBYP and the monitoring and research activities carried out by CPCs at national level or by other wide research programmes on bluefin tuna. It was also pointed out that further efforts should be devoted to the development of relational databases integrating all the information generated by GBYP, in order to facilitate its availability and use by the scientific community. Finally, a draft proposal outlining the tasks to be carried out within the next GBYP Phase 9 was presented for consideration by the Committee, including a specific petition for maintaining, and if possible increasing, the current budgetary support for the GBYP programme.

The Committee expressed their appreciation for the continued work that GBYP had done in supporting bluefin tuna assessment and management and welcomed the new GBYP Coordinator, acknowledging the work carried out by the former Coordinator. There was some discussion regarding the results presented on stock structure and distribution, highlighting the need to improve stock mixing estimations by refining the techniques for assigning individuals to a given stock and by putting more effort into obtaining information on the southern limits of Atlantic bluefin tuna stocks distribution. There was concurrence about the need for more strategic planning in the programme and it was noted that the data collected in GBYP needed to be catalogued and made available in order for the benefits of the programme be fully realized. It was reiterated that the ongoing bluefin sampling activities carried out directly by CPCs (e.g. within the framework of EU Data Collection, national observers or ICCAT ROPs) should be taken advantage of and that the coordination between different research teams and administrations should be strengthened in order not to duplicate efforts.

The Committee suggested that Working Groups focus on other species that might take advantage of methodological improvements achieved by GBYP.

Finally, it was agreed that special efforts should be made by all donors to maintain the economic support for GBYP programme activities.

10.2 Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP)

AOTTP has made substantial progress since the last SCRS Plenary in 2017. Last year AOTTP advertised, evaluated and awarded 14 contracts (35 since the project began) with a total value of 2.6 million euros. Overall, more than 1,400 days at sea have been spent on more than 150 tagging cruises/trips throughout the Atlantic. Tagging targets (120,000) will be met, within budget, by the end of the first quarter 2019 if all contractors reach their objectives. Over 92,000 fish (77% of the target) have now been tagged with conventional tags in the EEZs of 21 different countries, and the High Seas. More than 500 electronic tags (pop-ups and internals) have been deployed and are already providing new scientific information on tuna growth and behaviour. Scientists and technicians from developing countries have tagged over two-thirds of all these 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 the People's Republic of China. More than 13,500 tags have been recovered (overall recovery rate is 14%) for which rewards (t-shirts, caps, lottery entry, cash, and mobile phone top-ups) have been paid. Tag-seeding experiments are ongoing with an extensive network of observers throughout the Atlantic, and reporting rates for the most important purse seine fleets are 81% for bigeye, 71% for yellowfin and 73% for skipjack against a target of 80%. More than 15,000 fish have been double-tagged allowing tag-shedding rates to be estimated, and 7,000 chemically tagged (70% of the target) which improves our ability to age recaptured fish. AOTTP partners from Brazil and Senegal are currently creating an Atlantic-wide Otolith Reference Set to standardize age-determination of tropical tunas. All AOTTP data are uploaded rapidly into relational databases using smartphone applications, while messaging software is being 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. Taggers trained during the first phase of the AOTTP have now won their own contracts and have trained local teams (e.g. in Côte d'Ivoire and São Tomé and Príncipe). AOTTP organized three capacity-building workshops this year which were very successful. The first focused on the structure of the conventional tag-recapture data within the database, the second on estimating the growth and mortality of tropical tuna from tag-recapture data, and the last on algorithms for estimating tuna movement from electronic tags. Raw AOTTP tag-recapture data are now being distributed to colleagues according to an April 2018 recommendation by the SCRS.

The report was adopted and is attached as **Appendix 5**.

Discussion

The AOTTP Coordinator outlined the programme's objectives and outlined the programme's progress. Broadly the programme intends to collect tagging data in order to estimate key parameters (e.g. growth, mortality and migration) for stock assessment and to build capacity in coastal states to collect and analyze such data. The Coordinator provided some preliminary examples of the data collected and a summary of the releases and recoveries of these tags and capacity building activities. He outlined future work that included tagging plans, plans for data availability, hard part ageing and validation work, a soon to be released Call for tenders for the analysis of the tagging data, and a final AOTTP symposium (early 2020).

The Committee expressed their appreciation for the programme's contributions as well as the support from the Secretariat and the contributing parties. They discussed the potential usefulness of the data for specific scientific subjects such as movement to and from the moratorium area, and studying the effects of FADs. The Coordinator responded that the data still await a detailed analysis.

The Committee requested that the changes that were discussed during the Tropical Tuna Species Group meeting concerning improving the details of the tag recovery data (i.e., collecting information on the location and timing of each set found in a purse seine tank, and recording information on the quality of measurements) be added to the report.

The Committee expressed concern about the fate of the data once the programme is complete: a need to continue funding so that tag recoveries can continue once the programme is complete was identified in order to benefit from the additional information gained from tags recaptured later. The programme Coordinator noted that the programme will end with an exit strategy to continue tag recovery (and other) beyond the programme end date. It was highlighted that capacity building is a major component of the programme and that it is particularly important that the programme leave a legacy of expertise in the coastal States.

The Committee recognized the need to pay special attention and continue to provide support and engagement in AOTTP activities to CPCs that have very limited capacity to develop such activities on their own.

10.3 Small Tunas Research Programme (SMTYP)

In 2018, SMTYP continued the recovery of historical Task I and Task II data series and launched a call for the collection of biological samples for the main small tuna species for the third consecutive year. This will reinforce data mining of Task I and Task II and enhance biological knowledge on those species, aiming at future small tuna stock assessments. In that regard, a single contract was issued to a consortium of 12 institutions (11 CPCs) by the ICCAT Secretariat in 2018. Preliminary results of the research conducted in the previous year were presented during the annual meeting of the Small Tunas Species Group.

The Group identified the priorities that should be taken into account in terms of the species and areas to be sampled, and the biological data to be collected under the SMTYP in the following biennium. These priorities are presented in the Small Tunas Work Plan for 2019 (**Appendix 12**).

The SMTYP report was presented by the Coordinator.

The report was adopted and is attached as **Appendix 6**.

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, the Group focused 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. The population genetics study to estimate stock structure and phylogeography of shortfin mako continued, with the proposal to use next generation sequencing 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 34 tags (14 sPATs and 20 miniPATs) have been deployed to date for this project in the northwest, northeast, tropical northeast and equatorial region, and southwest Atlantic. Data available from 28 of the 34 tagged specimens revealed a 25% rate of post-release mortality. Of the 34 tags deployed, 32 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 1,260 tracking days have been recorded to date with results showing that shortfin makos moved in multiple directions and travelled considerable distances. An additional 12 tags have been acquired for shortfin mako and are awaiting deployment. Two projects on porbeagle initiated in 2017 continued: a reproductive biology study aimed at improving the knowledge of its reproductive cycle and a study aimed at better understanding the movement patterns, stock boundary, and habitat use of this species in the Atlantic. A total of 16 miniPATs were acquired for the second project, which are awaiting deployment by EU-France, EU-Portugal and Norwegian collaborators in the North Atlantic, and Uruguayan colleagues in the South Atlantic. Finally, an additional 8 tags were acquired and will be deployed on silky sharks, which were deemed by the Group to be another priority species.

The SRDCP report was presented by the Coordinator.

The report was adopted and is attached as **Appendix 7**.

10.5 Enhanced Programme for Billfish Research (EPBR)

The EPBR continued its activities in 2018. The Secretariat coordinates the transfer of funds information and data. The overall programme Coordinator and Coordinator for the western Atlantic during 2017-2018 was Dr John Hoolihan (USA). Dr Fambaye Saw Ngom (Senegal) was Coordinator for the eastern Atlantic Ocean. 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 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.

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. It will also 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 2018 sample kits were distributed among SCRS scientists responsible for local sampling programmes. No sample kits distributed in 2017 or 2018 have yet been returned as of 15 September 2018.

Following the SCRS request, in February 2018 through the ICCAT Science Envelope, the Secretariat hired an expert to develop a *Comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/central American region*, which has recently been presented to the Sub-Committee on Statistics. The study aimed at conducting an inventory of existing data collection programmes in ICCAT fisheries of the Caribbean/Central America States and develop specific recommendations to improve data reporting in artisanal fisheries in the region.

The EPBR report was presented by the Coordinator.

The report was adopted and is attached as **Appendix 8**.

10.6 Other research activities

Due to the lack of time, this agenda item was not discussed.

10.7 Composition of Programmes Steering Committees

Due to the lack of time, this agenda item was not discussed.

11. Report of the Meeting of the Sub-committee on Statistics

The SCRS Chair presented on behalf of Dr Guillermo Diaz, Convener of the Sub-committee on Statistics, the 2018 Sub-committee's report (Madrid, 24 and 25 September 2018) to the SCRS. The Sub-committee acknowledged the work of the Secretariat and all the support it provides to this Sub-committee and the SCRS in general. In the report, the Convener referenced the Secretariat report on Statistics which has detailed explanations of the work of the Secretariat including the current CPCs reporting status (using the SCRS filtering criteria to validate 2017 Task I Task II data), the improvements made in statistics (historical revisions and recoveries) and related data handling tools (databases, infrastructure, technologies, etc.), and the progress made in various Secretariat ongoing projects (historical data recoveries, online reporting prototyping, etc.). The ongoing preliminary work of the Secretariat on the ICCAT "scorecard" on fisheries data availability was again welcomed by the Sub-committee which supported its future development and recommended that the Methods Working Group be involved in the revision and improvement of the methodology.

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 imperative need to improve this aspect in the short term. The Convener also recalled that, as in the last few years, Task I updates that are provided during the SCRS Species Groups meeting will only be incorporated into the ICCAT-DB after the SCRS meeting.

The Convener also summarised the accomplishment status of the 2017 Sub-committee recommendations, reiterating the need to continue advancing on the ones that have not been completed, as is the case of the need for active participation of the species group rapporteurs and CPC statistical correspondents. 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 Task I and Task II forms (currently all Task II must be reported by month, and allow submissions with multiple years).

The further progress made on the ICCAT online reporting system deserved also a special mention. The Convener informed that the efforts by the Commission and the SCRS to develop an online reporting system share common goals and should converge in the future, if possible under the guidance of the Commission's Online Reporting Technology Working Group. It was also commented that the SCRS statistical online validation system made by the Secretariat was sufficiently advanced to start a testing phase in 2018 which will continue during 2019 (details in the report). The Sub-committee considers that the Commission should continue to support this work on online reporting.

Finally, the Sub-committee presented to the SCRS its 2018/2019 work plan (**Appendix 12**).

The Report was adopted and is attached as **Appendix 9**.

Discussion

The European Union asked how/when the problematic of "faux poissons" estimations is going to be addressed by the Sub-Committee on Statistics. The Chair of the SCRS informed that, this matter was not addressed during the meeting, but intersessionally during 2018 by the tropical tunas and billfishes data preparatory meetings. The Secretariat confirmed this and explained that during those meetings, several studies were presented trying to identify the problem, and the possible approach that could improve the overall knowledge of "faux poissons" in terms of catch estimations by species and fleet. The Committee recommends that this issue is properly addressed in preparation for the upcoming yellowfin stock assessment and by the Sub-committee on Statistics.

12. Report of the Sub-committee on Ecosystems and By-catch

The meeting was held in Madrid, Spain, 4-8 June 2018. 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 Sub-committee presented to the SCRS its 2018/2019 work plan (**Appendix 12**).

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 Report Card, 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 bycatch, 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 bycatch. The Sub-Committee on Ecosystems also reported on other collaborative work to assess sea turtle bycatch in longline fisheries. The details of these projects, recommendations and work plan are summarized in the Species Group's documents.

The Report was adopted and is attached as **Appendix 10**.

Discussion

The Committee articulated its support for Ecosystem Based Management.

The Co-convener responsible for the by-catch component proposed to the Committee the continuation of the scientific collaborative process related to seabirds and marine turtles. The Committee supported this proposal.

12.1 Ecosystem report card prototype

The content of the Ecosystem report card prototype was discussed (**Appendix 13**). Given the breadth and complexity of potential studies involved in producing it, the Committee highlighted the need to prioritize the components that require immediate focus. In addition, the Committee identified the need to cooperate with other ICCAT Species Groups (including the Methods Working Group), and/or management organizations to get this research done. Further, it identified the need for both the Commission and the SCRS to provide some guidance about what regions and components are areas worth investing effort in and to cooperate with the Secretariat about how data will be managed and maintained to support the work.

13. Considerations of implications of the Meeting of the Standing Working Group on Dialogue between Fisheries Scientists and Managers (SWGSM)

The meeting was held in Funchal, Portugal, 21-23 May 2018. The objectives of this meeting were to: i) review the status of the development of Harvest Control Rules (HCRs) for the stocks of tropical tunas, northern albacore, northern swordfish and bluefin tuna; ii) to inform on which performance indicators have been identified; and, iii) to report on identification of operation management objectives for northern swordfish and tropical tunas. As regards to the northern albacore MSE, the meeting discussed at length, the concept of exceptional circumstances, and the nature of the peer review. For the bluefin tuna MSE, the meeting focused on the development of operational management objectives, candidate management procedures and transparency in the process of communication of MSE results. In the case of northern swordfish MSE, the SWGSM mainly discussed operational management objectives. For tropical tunas the meeting discussed the pros and cons of developing individual MSE for each stock or a multispecies MSE and how performance indicators may be developed for both options. SWGSM then discussed the overall roadmap **(Appendix 16)** for the ICCAT MSE processes. The SWGSM developed a series of recommendations on MSE for the SCRS and the Commission that are included in the report of the meeting. Among the most important recommendations directed to the SCRS that have yet to be acted upon by the SCRS are the following:

- Defining criteria for the identification of exceptional circumstances and their severity;
- Evaluate the benefit of developing of individual MSE for each tropical tuna stock vs an MSE for all stocks;
- Continue capacity building efforts;
- Re-evaluate the need for resources, including funding, to support the MSE process in the short and long term;
- Reconsider the roadmap for all MSE but particularly for tropical tunas because of the added complexity of its multi-species fishery.

In addition the meeting proposed to modify the terms of reference of the SWGSM by adding the following sentence:

"The identification of the specific mechanisms to ensure that more scientists with knowledge of the fisheries and MSE process participate in stock assessment meetings and are directly involved in assessment teams."

SWGSM also briefly heard and discussed an update on the progress to implement Ecosystem Based Fisheries Management in ICCAT.

The Report of the meeting is contained in ANNEX 4.4 to the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 1*.

14. Considerations of implications of the Intersessional Meeting of Panel 1

The report of the meeting contains details of the presentations and discussions that took place at the meeting that was held in Bilbao, Spain, 23-25 July 2018. Initial discussions were related to the summary of the preliminary outcome of the bigeye assessment that took place the week prior to the Panel 1 meeting. These discussions focused on the stock status of bigeye and the preliminary evaluation of impacts on the bigeye stock of changing the proportion of harvest coming from the major fishing gear categories. The panel also discussed current management measures for tropical tunas and possible alternatives to these measures including alternatives to the current TAC and the inclusion of additional CPCs in the TAC allocation tables, different types of fishery closures and FAD management measures. There was also considerable discussion on possible operational management objectives for tropical tunas.

The panel then made a series of recommendations to the Commission and the SCRS. The most important recommendations for the SCRS were:

- To elaborate a set of definitions of FAD-related activities to be taken into account at the next Commission meeting (see Section 20.4 of this report for details on progress of this item);

- To provide TAC projections for the three stocks of tropical tuna for a range of probabilities (50%, 55%, and 60%) corresponding to situations where the three stocks of tropical tuna are simultaneously in the green quadrant of the Kobe matrix.

Finally, the panel addressed the table of recommendations developed during the second Performance Review of ICCAT.

The Report of the meeting is contained in ANNEX 4.6 to the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 1.*

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 being hampered by the lack of experience on MSE in ICCAT, by technical challenges in the development of stock specific simulation frameworks and by the limited resources at the SCRS and the Commission to participate in both the MSE process as well as in the current stock assessment and management process.

During 2018 the ICCAT MSE process, however, has had some major accomplishments including leading the Second joint tRFMO MSE Working Group meeting, fruitful discussions on exceptional circumstances at the SWGSM, the completion of peer-review of the North albacore MSE computer code, the improved integration of the Bluefin Tuna Species Group in the development of the GBYP-MSE framework, the first meeting of the Swordfish Species Group focus on MSE, the beginning of the development of the MSE framework for tropical tunas and the completion of three MSE training courses for scientists and managers. Many challenges remain ahead including, finding mechanisms to gather input on operational objectives from the Commission, improving the ability of the Tropical Tunas Species Group to engage in their MSE process and obtaining sufficient funding to properly support the process. In the following sections more details are provided on each of the ICCAT MSE processes.

Discussion on this item was conducted as part of the discussion on item 15.6.

15.1 Work developed by the Joint t-RFMO MSE Working Group

A meeting of the Group was held in June 2016 with participation of MSE experts representing all tRFMOs, and a few other RFMOs. The meeting discussed the following topics: MSE process and stakeholder dialogue, conditioning of operating models, global albacore case study, provisions for exceptional circumstances, computational aspects and dissemination of results. The meeting made some important recommendations including 1) to have a clear and agreed timeline for the MSE process, with strong emphasis on abiding by agreed milestones; 2) to be inclusive and allow a wide spectrum of stakeholders to participate early in the process; 3) to have technical groups that are tasked to bridge the communication gap between stakeholders and MSE scientists; 4) to have a comprehensive review process ranging from broad process issues to computer coding and to initiate such review early; 5) to engage in a dialogue with the Marine Stewardship Council about how MSE fits into their certification process; 6) make well-documented MSE computer code publically available; 7) test visualization tools to facilitate presentation of results and 8) create a common repository for code. The Group also developed a plan for the future, including adding to the topics of the next meeting discussions on exceptional circumstances, and the relative merits of model-based vs empirical management procedures. Since the June meeting, the Group has worked on the development of a non-technical glossary of MSE relevant terms to facilitate communication between managers, stakeholders and scientists in all tRFMOs.

15.2 Work conducted for bluefin tuna

Work on the bluefin MSE has progressed appreciably since last year. A thorough check of the appropriateness of the "operating models" covering the primary sources of uncertainty to be used to check candidate management procedures, which is now close to complete. This emphasizes the recent joint tRFMO MSE meeting conclusion that a well-conducted MSE process is time-intensive and needs considerable resources. Six groups of scientists are already testing candidate procedures against these operating models, using a computer package developed by the consultant to make this a relatively straightforward and user-friendly process.

The work accomplished included taking account of tagging data, and the development of a method to analyse microchemistry and genetic data to determine the proportion of eastern and western origin bluefin present in various geographical areas across the Atlantic at various times during the year. This has served to confirm earlier indications that mixing of these fish across the whole Atlantic is appreciable and variable, which will probably have important implications for management of bluefin.

Finalisation of the MSE process must include adequate opportunity for feedback from stakeholders regarding objectives and acceptable trade-offs in their attainment. For that reason, completion of this MSE process by 2020, provided that scheduling allows completion of the roadmap (**Appendix 15**), that sufficient funding can be made available and that no assessment is required in either 2019 nor 2020, is considered a realistic achievable target. **Appendix 15** provides a roadmap for MSE bluefin tuna work with detailed milestones.

Discussion

The Committee discussed the need for time at the Commission meeting to discuss BFT MSE. Dialogue between scientists and Commission members related to MSE should be scheduled within the panel meeting of the respective species according to the progress achieved.

15.3 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 B_{MSY}, a $B_{THRESHOLD}$ = B_{MSY}, a B_{LIM}=0.4B_{MSY} and an F_{MIN}=0.1F_{MSY} (see **ALB-Figure 12**), 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 the SCRS to pursue an independent peer review during 2018, to develop criteria for the identification of exceptional circumstances, and to test several variants of the interim HCR, with a view to adopt a long term HCR in 2020.

During 2018, the Committee was able to complete the peer review (see Response to the Commission, Item 19.8). On the exceptional circumstances, the Committee has come up with a generic set of indicators that would be useful to determine if exceptional circumstances exist. The Albacore Species Group has slightly adapted these to the North Atlantic albacore case (see Response to the Commission, Item 19.7). Moreover, the Committee evaluated some of the variants to the interim HCR, as requested by the Commission, and the outcomes of these evaluations are reflected in the Executive Summary.

The main priority for 2019 is to address the recommendations identified by the external peer reviewer to improve the MSE framework, in anticipation to adopting a long term HCR in 2020. The Group recommends that this should be done through a contract to experts that can carry out this type of work.

15.4 Work conducted for northern swordfish

The 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 SWO working 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 (Kell and Levontin, 2018a and b). The Operating Model proposed can 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. These initial scenarios investigate the impact of different hypotheses about natural mortality, steepness of the stock recruitment relationship, vulnerability of the stock to the various fisheries and alternative data weighting schemes.

The Working Group asked the contractor to develop the candidate OMs in steps: 1) conditioning the model to the main effects of the main uncertainties identified by the group (varying one parameter at a time whilst maintaining the others to the most plausible value). 2) Develop a suite validation procedures, including runs tests, plausibility of estimated parameters and cross-validation. 3) Based on these validation tests develop an automated validation procedure so that additional OM scenarios can be validated and thus be accepted, rejected and possibly weighted.

Several candidate MPs have already been proposed and are currently being evaluated (Kell and Levontin, 2018b) to test the appropriateness of the MSE framework. A visualization app is being constructed to help interpretation of the results of MSE in terms of acceptability and robustness of the MP under different definitions for management objectives.

In addition, and following the capacity building courses in MSE provided in 2018 by ICCAT, a work was prepared with an example for the development of an Operating Model for North Atlantic swordfish (Rosa *et al*. 2018). In this example, a grid of Stock Synthesis models was constructed based on identified structural uncertainty in the current stock assessment, specifically in terms of steepness, natural mortality, data weighting (effective sample size), fleet selectivities, catchability increase, recruitment deviation, CPUE variation and environmental effects. The current grid resulted in 288 model runs, of which 173 converged, producing alternative population trajectories and productivity estimates for the stock. Those models were further inspected for plausibility of some estimated parameters.

The plans for the continuation of the North Atlantic swordfish MSE work will be to further develop the preliminary OM until December 2018. For 2019, the current ICCAT-MSE roadmap requested for the development and evaluation of alternative management procedures. However, the Swordfish Species Group/SCRS believes that this is not realistic and therefore proposes to put as the main objectives for 2019 the finalization of the OM and start development of management procedures. It is also noted that, as a priority, the ICCAT Commission needs to establish the objectives for management of North Atlantic swordfish, in order to allow interpretation, acceptability, ranking and robustness of the candidate MPs.

15.5 Work conducted for tropical tunas

In 2018 some preliminary steps have been made towards the development of MSE to support a robust advice framework for the Atlantic tropical tuna stocks. Some of these steps will be undertaken by a consortium of researchers that have been contracted by ICCAT. These steps include (i) the planification of Operating Models for bigeye, yellowfin and skipjack, (ii) the identification of multi-specific Management Procedures that could potentially be applied, and (iii) the investigation on communication tools. Item (i), and (iii) have been mainly progressed through the work of the consortium. Initial discussion on item (ii) took place at the Panel 1 Commission meeting in July.

The Tropical Tuna Species Group had limited discussion on MSE during the bigeye stock assessment session meeting in July and the Species Groups Meeting in September. It is foreseen that such discussion will continue and be more focused so that MSE development is supported by a broad consultation and dialogue between the contractors and other experts from the Atlantic Tropical Tunas Species Group.

15.6 Coordination and resourcing of the ICCAT MSE processes

It is clear that proper coordination of the work on MSE will benefit the SCRS and the Commission by: increasing effectiveness, making better use of the available resources and enhancing our ability of timely delivery of MSE products. Coordination is therefore essential to improving the quality of the ICCAT MSE process.

The challenge of running so many MSE for different stocks has been identified by the SCRS, the tRFMO MSE Working Group and SWGSM. All of these groups recommend that either the number of stocks under concurrent MSE development is reduced or the pace of development of the MSE is slowed down.

The SCRS recommends the second option, slowing down the pace of development of MSEs according to the priority order provided by the Commission: northern albacore, bluefin tuna, northern swordfish and tropical tunas. The SCRS also recommends that the MSE processes adopt a standard set of principles that should guide and facilitate the coordination process:

- Transparency in the process;
- Continuous and thorough review of the process and simulation by the species working group and also by independent reviewers;
- Creation of a technical MSE group for each species which includes the modelling team but that is open to input from the species group;
- Maintenance of a living document with specifications of the Modelling Framework;
- Use of standardized communication tools for MSE results, including use of the t-RFMO MSE glossary;
- An annual SCRS intersessional meeting on MSE that includes a plenary session and sessions for each Working Group engaged in MSE;
- Updates of progress to each SWGSM;
- Having regular agenda items on MSE at meetings of Commission panels where updates of research progress can be provided and discussions about operational objectives and management procedures can proceed;
- Development of a detailed roadmap for each stock specific MSE that is consistent with the overall ICCAT MSE roadmap. If progress on MSE does not comply with the roadmap to adjust the schedule of stock assessments.

On the basis of these principles, the need to rationalize the progress of the MSE processes and the recommendations of individual MSE processes, the SCRS has modified the roadmap developed by SWGSM this year (see Appendix 7 of ANNEX 4.4 to the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 1*). The roadmap reflects the need to expand the timeline of MSE to be able to stagger the development of MSE for the different stocks. Although the Committee has set the order of completion of MSEs to be ALB N, BFT, SWO N and TRO, the Committee requests from the Commission a clear indication of which stocks need to be completed earlier and which stocks can be considered for a later completion.

Discussion

The SCRS Chair presented a proposal that outlined the need to slow down the existing roadmap for MSE processes and that also proposed that the MSE processes within ICCAT be made more consistent among the different species. The proposal recommended that the MSE processes adopt a standard set of principles that could guide and facilitate the coordination process. These principles were derived from the recommendations of the 2nd meeting of the t-RFMO MSE Technical Group held in June 2018. The proposal also modified the roadmap developed by SWGSM this year (see Appendix 7 of ANNEX 4.4 to the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 1*) to meet the principles above.

The Committee discussed the proposal and made several observations. First it noted that the proposal for a unique MSE meeting for all species, with concurrent discussions on species-specific MSEs was impractical. The Committee noted that the roadmap of concurrent development for four MSE species stretches the capacity of the SCRS and the Commission, and suggested the MSEs be prioritized, indicating that for example, the tropical tunas MSE could be postponed due to the complexity of a multispecies MSE.

Recognizing the trade-off between doing MSE processes and doing stock assessments, the Committee and the Commission would also need to prioritize them relative to each other. The Committee inquired about what specific feedback was being requested by the Committee on the proposal. The SCRS Chair responded that the primary objective was to have them assess the feasibility of completing the activities outlined in the current MSE roadmap.

The Committee did agree to a new road map **(Appendix 16)** and request feedback from the Commission on the relative priority of each MSE.

16. Report on the implementation of the Science Strategic Plan for 2015-2020 in 2018 and work plan for 2019, which includes the update of the stock assessment software catalogue

The SCRS provided the Commission a mid-term review of the progress towards the Science Strategic Plan for 2015-2020 in 2017. No new assessment of progress has been conducted in 2018. The SCRS Chair will lead a final review of progress in the year of finalization of the plan in 2020 and will develop a new plan for the period 2021-2025.

The ICCAT stock assessment software catalogue is now on the following github site:
https://github.com/ICCAT/software/wiki

For those software that have available web pages this site provides updated links to the developers repositories of each catalogued entry.

16.1 Reflections about the structure and work of the SCRS

One CPC noted that since the United Nations Conference on Sustainable Development, held in Rio de Janeiro (Brazil) in June 2012, processes have been established that require the active participation of the scientific community involved in marine resources and the ecosystems contained therein. The most important processes to be developed are linked to the decade of ocean science (2021-2030), as proposed by the United Nations. On one hand, there are the Sustainable Development Goals (SDGs); the FAO has been designated as the custodian agency for 21 indicators, for some of these SDGs, in particular No. 14 "life below water" (http://www.fao.org/state-of-fisheries-aquaculture/en/). In parallel, based on Resolutions 69/292 and 72/249, the United Nations decided to develop an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (http://www.un.org/Depts/los/biodiversityworkinggroup/marine_biodiversity.htm). These processes will strongly impact the activities of tuna RFMOs and in particular, these organizations' current research and conservation objectives related to marine resources. Therefore, it is important to take into account both initiatives when defining ICCAT research strategies and activities.

Discussion

The SCRS Chair reminded the Committee that the SCRS provided an interim report on the strategic plan to the Commission last year, so the discussion focused instead on a document that the Chair had prepared on the structure and function of the SCRS. The document proposed changes to the existing schedule and activities of the SCRS. Among other things the proposed changes were to: conduct a full assessment every 3-4 years for main species and every 5 years for other species; schedule assessment of two major stocks for each full assessment session; schedule bi-annual intersessional meetings for the Small Tunas Species Group, Sub-committee on Ecosystem and By-catch, and WGSAM; as well as develop a process to respond to stock status updates outside the schedule. Finally, it included to simplify the existing Executive Summaries as explained in Section 20.5 of this report.

The Committee discussed this document which contained a list of potential principles to modify the work of the SCRS Working Groups and Sub-committees. The principles were intended to improve the work of the SCRS by reducing the number of SCRS meetings and simplifying the production of Executive Summaries. A suggestion was made that the idea of bi-annual meetings for some of the groups may be feasible in the medium term, but not in the near future. It was pointed out that such lack of continuity could undo the progress achieved by some groups that have been meeting annually. There was unanimous opposition to the idea that a joint MSE meeting with concurrent sessions for each species group as most CPCs would not properly pay attention to the different species MSEs concurrently. It was suggested that a better option would be to have an annual MSE meeting to focus on a single MSE process. There were doubts that assessments of BET and YFT could proceed together. It was also requested that the SCRS should always retain the ability to reschedule assessments when needed. It was agreed that proposals such as the document presented should be available to the Committee much earlier so that they could be properly discussed.

Although there was some support for selected components of the proposal among some CPCs, the Committee agreed that such modifications required further discussion in future meetings.

The Committee noted that this proposal implies major changes for the structure and function of the SCRS and it will require more time for consideration and review before reaching an agreement. Furthermore, because there was not enough time for discussion, the Committee did not agree on any specific item put forward in the proposal.

It was suggested to establish a procedure for submitting new proposals that did not originate from the Species Group for the Committee's consideration. This procedure would allow early circulation and discussion during the SCRS plenary meeting.

17. Consideration of plans for future activities

17.1 Annual Work Plans

The Rapporteurs summarized the Work Plans for 2019 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 12.**

17.2 Intersessional meetings proposed for 2019

Taking into account the assessments mandated by the Commission and the Committee's recommendations for research coordination, the proposed intersessional meetings for 2019 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 2018 and the meetings scheduled by other RFMOs.

Côte d'Ivoire expressed its willingness to host the 2019 yellowfin stock assessment meeting.

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 30 September to 4 October 2019; the Species Groups will meet from 23-27 September 2019 at the ICCAT Secretariat (Madrid, Spain).

Table 17.2. Calendar of the inter-sessional meetings for 2019.

	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			
										BFT Tech MSE							BFT														SWO						
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
																		WHM data prep																			
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					
										Ecosystems / WGSAM														YFT data preparatory													
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		
												J-TRFMO FAD WG												Sharks (SMA update)													
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
																	WHM assessment														SMT						
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				
										YFT stock assessment																											
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 Tech MSE							SPECIES GROUPS (*,+)													
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, SWO, TRO and SC-STATS

(+) SC STATS will be on 23 Sep 2018

Free day in ICCAT

Meeting of technical nature

18. General Recommendations to the Commission

18.1 General recommendations to the Commission that have financial implications

Eastern and western Atlantic bluefin tuna

- Continued funding to support the essential work of GBYP including funding of the MSE development process, biological studies and the full GBYP work plan.

- Three meetings devoted primarily to MSE development (two Bluefin Tuna MSE Technical Group meetings, coordinated by GBYP, and a Joint BFT/MSE intersessional meeting).

Albacore

- The Committee recommends continued funding of the albacore research programme 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 1.1 million Euros for a four year work plan, with a cost of €742,000 for the top priority tasks. More details of the proposed research and economic plan are provided in the albacore 2019 work plan (**Appendix 12**).

- 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 contributing to Working Group meetings.

Tropicals

- The Committee notes that the development of an aggregated longline index applied to the catch-effort data from major longline fisheries (i.e. Japan, Korea, Chinese Taipei, United States) resulted in notable improvements to the stock assessment of bigeye tuna. Therefore, the Committee recommends that a Call for tenders be developed to hire a contractor to coordinate data aggregation and produce an aggregated index for longline fleets targeting yellowfin tuna. This approach will greatly facilitate the work of the SCRS by coordinating the data from various CPCs while assuring data confidentially. Funds requested for this activity in 2019 amount to €35,000.

- The Committee recommends the procurement of additional funds to support the continued development of the MSE for tropical tunas. Specifically, the Committee supports extending the current contract to support "Phase 2 and 3" activities. Funds requested for this activity in 2019 amount to €140,000.

Billfishes

- The Commission should continue to support the initiatives that seek to improve data collection for billfish in the Caribbean and West African regions through activities that implement the most important recommendations provided by the initial findings of the projects conducted by ICCAT in the recent years. In 2019 the SCRS will draft a work plan for new data collection initiatives aiming to improve the estimations of catches from the artisanal fisheries considering the recommendations presented in the studies. The Committee recommends that the Commission continue the financial support for this project.

- The Group recommends to continue with the financial support for the biological sampling of billfish in the eastern Atlantic for age and growth and maturity. Also the Group recommends a study, with financial support, that will provide photographic and biological sampling evidence to confirm sex determination in samples from the western Gulf of Mexico longline fisheries.

Sharks

- Provide funding for the SRDCP for Year 5 (€115,000) to complete work on shortfin mako genetics, continue work on the reproductive biology of porbeagle and shortfin mako, and start work on movement and habitat characterization of silky and other ICCAT priority species through satellite tagging.

Small tunas

- The Group recommends continuing with the ICCAT SMTYP research programme activities in 2018-2019 to further improve the biological information (growth, maturity and stock identification) for the species/areas prioritized (additional information provided in **Appendix 6**, Tables 2 and 3).

- The Group recommends that a workshop on the application of data-limited methods be scheduled to increase the participation of national scientists in the evaluations of small tuna species. This workshop should take place in 2019.

North and South Atlantic swordfish

- *On research funding for biology and stock structure (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 continues for at least the next two years and is provided with financial support. The costs for continuing such work would be €295,000 for 2019 (€200,000 for continuation of the biology project currently being developed by the Consortium, €45,000 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 work plan (**Appendix 12**) with the specific details on costs for each study.

- *On the 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 to continue the swordfish MSE work in 2019. 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 2019 to continue this work amount to €80,000.

Mediterranean swordfish

- Data recovery plan: The Group noted that the catch and CPUEs time series currently in use in the stock assessment models start 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.

- Size and age at maturity: As there are ecological differences between the East and West Mediterranean, the Committee recommended that future work is conducted to explore possible differences in swordfish life-history at the spatial scale.

- Habitat use and availability to the different gears: The Group recommended the use of satellite tagging to provide information on habitat use to compare the availability of swordfish in the various fisheries, including comparisons between traditional and mesopelagic longlines.

Stock assessment methods

- The Group recommends that an age and growth workshop be created to facilitate the exchange and agreement of age techniques, the establishment of reference ageing sets, and the quantification of the error and bias inherent in this science.

- The Group recognized the need for a process, one that currently does not exist, that helps ensure that current and future MSE efforts maintain an open and transparent environment and encourages regular review of the work as it progresses and before methodology and results are considered final and ready to proceed to the next step. Furthermore, allowing for such review and input at the initial stages of developing the MSE work plan and OM structure is likely to improve the efficiency of the process. Towards this end, the Group recommends that a more formalized approach be put into place.

Sub-committee on Ecosystems and By-catch

- The Sub-committee requested financial assistance to support the attendance of five to seven CPC scientists at a collaborative workshop to evaluate the impact of ICCAT fisheries on seabirds. This is in support of an ongoing process that will continue over the coming years.

- 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.

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 recent return of bluefin to areas of historical significance, the Group requests that observations of bluefin in other areas, particularly the South Atlantic and the Black Sea, be reported to the Bluefin Tuna Species Group.

- The Committee recommends that all CPCs, in coordination with GBYP, institute or maintain biological sampling programmes designed to collect an adequate number of tissue, otoliths and other biological samples in a representative fashion from all fishing fleets.

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, and recommends further research into the use of larval indices to supplement fisheries dependent data in stock assessments. As for Atlantic albacore, the Committee recommended that the feasibility of a joint South Atlantic albacore CPUE analyses for longline fleets (Brazil, Chinese Taipei, Japan and Uruguay) using fine scale, operational level data be explored, and to continue efforts to produce new standardized CPUE series from swordfish directed pelagic longline fisheries throughout the Atlantic.

- The Committee recommends to conduct 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 update 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 von Bertalanffy growth function (VBGF) be explored to ensure accurate parameter estimation.

North and South Atlantic swordfish

- To CPCs on submission of data for use in the stock assessments: All data to be used in the assessment, including Task I and II data, including discards and, when possible live releases, standardized CPUE series, new biological information, etc., should be available at least one week in advance of the data preparatory meetings.

- 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) animals 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. Such permission could be similar to what is already established for no retention shark species (ICCAT Rec. 13-10).

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.

- 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 considers establishing a new ICCAT Recommendation allowing such procedures. The sampling on undersized swordfish would only be carried out if 1) animals 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. Such permission could be similar to what is already established for no retention shark species (ICCAT Rec. 13-10).

Tropicals

- Complete the re-estimation of the historic Ghanaian statistics for yellowfin, bigeye and skipjack up to 2018, and develop analytical tools to automate this task in future years. Additional details are available in the 2019 work plan of the Tropical Tunas Species Group.

- Abundance indices from surface fleets, particularly those that capture newly recruited fish could be useful if properly adjusted for changes in fishing power. Future work to develop, document and maintain indices from these fleets is desirable.

- The Group encourages the submission of new scientific information pertaining to, or to be used for estimation of mortality, growth rate, spatial structure, movement, etc.

- Update conventional and electronic tagging information about movements using most recent results of the AOTTP.

- The Committee recommends an evaluation of the potential differences between the catches of tropical tunas estimated using the EU software T3 and those from other sources (e.g. recorded on sale slips at canneries) and requests the managers of the T3 software describe any necessary improvements and the implications of recommended changes.

- The Committee recommends that the Commission urge CPCs using purse seiners that operate with the assistance of support vessels to report all required information regarding their activities, including all historical records. In addition, the Committee recommends that the Commission consider extending the requirements of form ST01FC to all vessels that assist, in part or in full, purse seine fishing activities. This shall include registration of these vessels with ICCAT as support vessels, regardless of whether they are also registered for other activities, indication of which purse seiners they support, and the number of days/hours they operated in their support. This information will facilitate the estimation of effective fishing effort by the fleets, estimation of potential fishing capacity and effort allocation distributions. Estimates are required for better evaluation of alternative management options to respond to Commission requests pertaining to the tropical tuna fisheries.

- The Committee recommends the development and funding of a "maintenance plan" to support essential activities of the AOTTP programme after the existing programme is completed. To maximize the value of estimates derived from AOTTP data, it is essential to continue tag recovery and biosampling (e.g. hard parts) until a significant number of larger fish with longer "time-at-large" can be recovered.

Billfishes

- In order to improve the monitoring and reporting of billfish statistics:
  - The Group recognizes the benefit of the effort that WECAFC is pursuing to develop software and monitoring structures through capacity building that could help Caribbean countries report ICCAT species fishery statistics to both the WECAFC and ICCAT databases. The Group recommends the Secretariat and CPCs support this effort by collaborating with WECAFC.

  - The SCRS should develop an inventory of sport fishing activities that may interact with billfish through a collaboration with organizations such as the IGFA and The Billfish Foundation. Such inventory should seek to establish a list of countries, and where possible, ports within the ICCAT Convention area where sport fishing activities are known to be interacting with billfish. Activities should include, established charter companies and tournaments. This inventory will help the SCRS and CPCs in the design of data collections and sampling programmes.

- The SCRS should put in place tools and mechanisms that encourage all CPC scientists with fisheries that have significant interactions with billfish to support the work of the Billfish Species Group by contributing papers, relative abundance indices and by being present during the data preparatory and assessment meetings of billfish stocks.

Sharks

- CPCs should report on how they implemented Rec. 17-08 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 total observed or fleet-level estimates.

Small tunas

- The application of data-limited assessment models, especially length-based and catch-based methods, however special attention should be given to the input data availability and of their quality. At the moment, for the next intersessional meeting, model applications should be evaluated for the following species: LTA, BON, FRI, WAH, KGM, and BLT. The first 5 species have been already considered priority by the Group. The BLT was suggested by the Group to be included as priority given its importance in the catches for countries of the North African region. And, to extend the PSA analysis to catches of small tunas with gillnets, which is one of the main fishing gear targeting these stocks, taking into consideration the five geographical areas adopted by ICCAT for small tuna reporting and endorsed by the Group.

- That CPCs provide indices of abundance and size catch data preferable from fishery independent surveys and/or other National programmes, which would substantially improve assessments.

Working Group on Stock Assessment Methods (WGSAM)

- The Group recognized the need for a process, one that currently does not exist, that helps ensure that current and future MSE efforts maintain an open and transparent environment and encourages regular review of the work as it progresses and before methodology and results are considered final and ready to proceed to the next step. Furthermore, allowing for such review and input at the initial stages of developing the MSE work plan and OM structure is likely to improve the efficiency of the process. Towards this end, the Group recommends that a more formalized approach be put into place (see Anon. 2018h, Section 3).

- Open intersessional Species Group meetings focused on the MSE process that must be held, supplemented as needed by webinar's enabling broad participation, particularly during the initial development of the MSE work plan and OM structure.

- The Group further recommends that as a first step Terms of Reference would be created outlining the roles and authorities of this Groups.

Sub-committee on Ecosystems and By-catch

With regard to Ecosystems:

- It is recommended that the SCRS include web access to the B and F ratio time series, or proxies, on its "Stock Assessments and Executive Summaries" page. Furthermore, it is recommended the Species Working Groups provide these ratios for the base case models in an Excel file and that guidelines be prepared to clarify the role of the data rapporteur.

- It is recommended that the different Species Groups include in their annual meetings, an item that reports on the work and discussions related to the ecosystem in order to facilitate the dissemination of information that may inform the assessment of single species. This information is to be reviewed by the Species Groups. Furthermore, it is recommended that ICCAT provide web support (data portal) to facilitate the exchange of relevant data.

With regard to by-catch:

- Various collaborative efforts to assemble and analyse observer shark, seabird and sea turtle by-catch data are active. The Sub-committee encouraged 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.

Sub-committee on Statistics

- 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.

- 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 explore ways to provide capacity building to those CPCs that need it to comply with the discard reporting requirements.

- The Sub-committee recommends that CPCs that are involved in the landing or marketing of "faux-poisson" provide the information necessary to help the Sub-Committee evaluate whether the current reports of reported catch properly account for "faux-poisson".

19. Responses to Commission's requests

19.1 Ghana's comprehensive and detailed capacity management plan on the level of catches. Rec. 16-01, paragraph 12c

***Background**: (Rec. 16-01), paragraph 12c. Ghana shall be allowed to change the number of its vessels by gear type within its capacity limits communicated to ICCAT in 2005, on the basis of two baitboats for one purse seine vessel. Such change must be approved by the Commission. To that end, Ghana shall notify a comprehensive and detailed capacity management plan to the Commission at least 90 days before the Annual Meeting. The approval is notably subject to the assessment by the SCRS of the potential impact of such a plan on the level of catches.*

No new information was submitted this year to allow further evaluation of the Ghana's capacity management plan.

19.2 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. As soon as possible and at the latest by 2018, the SCRS shall evaluate the efficacy of the area/time closure referred to in paragraph 13 for the reduction of catches of juvenile bigeye and yellowfin tunas. In addition the SCRS shall advise the Commission on a possible alternative area/time-closure of fishing activities on FADs to reduce the catch of small bigeye and yellowfin tuna at various levels.*

A number of moratorium analyses were conducted in previous years. 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 (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 SCRS is requested to evaluate, at the latest by 2018, the efficacy of the time-area closure referred to in paragraph 15 of Rec. 16-01 for the reduction of catches of juvenile bigeye and yellowfin. The new time-area closure adopted was applied in January 2017 for the first time. The Committee was only able to assess the impact of the time-area closure in 2017 as only data for this year was available at the time of the review. Thus the potential impact was predicted using the available ICCAT catch, effort and size data for 1990 to 2017.

Based on these data, it could be hypothesized, assuming no change on fleet behaviour that the effects could be a major reduction of the Ghanaian catches, because the closed area will reduce most of the traditional Ghanaian fishing zones.

Without any redistribution of effort, a reduction of 10 to 15% of small bigeye associated to FAD catches could be expected from purse seiners. However, the Committee noted that the number of purse seiners operating in the Atlantic Ocean had increased in recent years and the combination of this increase plus redistribution of effort to areas outside the moratorium by other fleets have not been effective in reducing the capture of small fish and has diminished the expected effectiveness of the time area closure. In addition, the Committee noted that for the time being, it is not possible to discriminate the impact of the moratorium from the impact of the previous moratoria or other management measures (e.g. TAC and FAD limitation) implemented by the ICCAT.

Notwithstanding the above, the Committee noted that most of the juvenile bigeye and yellowfin tuna caught by purse seiners come from FADs. There does not seem to be a difference in the length distributions of bigeye tuna inside and outside the closure area.

The Committee reiterated that additional years of data (beyond 2017) would be required to adequately assess the result of the new closure, and those data will not be available until after the deadline provided by the Commission.

The Committee noted that preliminary results indicate that further increases in the number of purse seiners and relocation of effort to areas outside the moratorium has undermined the effectiveness of the moratorium in achieving the objective set by the Commission.

The Committee noted that while more time is needed to be able to answer the request from the Commission to evaluate de current moratorium, preliminary results show that FAD effort relocation to areas outside the moratorium and/or future increases of the effort (number of purse seiners, number of FADs sets, etc.) may render this measure ineffective unless additional measures are adopted to address these impacts.

The Committee considered that a larger area, possibly combined with a longer closure, may address the issue of redistribution of effort. Along with a thorough analysis of the AOTTP data and of the interplay between fishing capacity, fishing effort and fishing mortality, these considerations will allow the further exploration of the effectiveness of any time/area closures within a much broader management context.

19.3 Recommendations made by the FAD Working Group (Annex 8) and develop a work plan. Rec. 16-01 paragraph 49(a)

Background*: (Rec. 16-01), paragraph 49(a). Address to the extent possible the Recommendations made by the FAD Working Group in 2016 (Annex 8) and for the remaining ones develop a work plan to be presented to the Commission at its 2017 Annual meeting.*

The use of FADs throughout this document refers to drifting FADs.

The activities listed in Annex 8 of Recommendation 16-01 were integrated in the work plan of the Committee in 2017. In 2018 the Committee has continued working on definitions and in reviewing and developing minimum standard reporting requirements on data to be collected in FAD fisheries through logbooks and buoy tracking information.

The Committee reviewed Grande *et al*. 2018 that describes the life cycle of buoys used in FAD[1] fishing and proposes a set of definitions of terms on the use of instrumented buoys to monitor the activity of the purse seine fleet on FADs. The Committee also noted the definitions recently adopted by IATTC and IOTC and proposes the following definitions on the use of satellite buoys in FAD fishing operations.

The Committee noted that in order to use the instrumented buoys as a robust system to monitor the activity of the purse seine fleet fishing on FADs, the following specific measures should be considered:

- Prohibition of the use of radio buoys;
- No FAD should be deployed without a satellite buoy;
- The activation of the buoys to be deployed should always be done onboard in order to avoid remote reactivations.

1. Definitions

Set of terms related to FAD fishing operations (**Figure 19.3.1** and **Figure 19.3.2**). Some of these terms reflect the ICCAT staff's definitions used in the Recommendation 16-01 and ST08 Forms.

- *Buoy (also GPS Buoy or instrumented buoy):* A signal device used to indicate a geographical position. Drifting FADs can be equipped with transmitter buoys so that they can be located. Buoys have a clearly marked reference number that allows their identification.

- *Buoy in stock:* A buoy acquired by the owner that has been recorded by the owner and has the capacity to transmit.

[1] The term FAD refers more precisely to FOB (floating object) that can be either a FAD or a log. Table 1 of Annex 3 of Recommendation 16-01 shows the definitions of the different types of floating objects.

- *Activation:* Action of registering a buoy which implies that the satellite communication service is initialized. It is done by the buoy supplier company upon request of the vessel owner. From then on the vessel owner starts paying the communication service. The buoy can be transmitting or not, depending if the magnet has been applied to switching it on.

- *Switching on:* Action of applying a magnet on the activated buoy to allow satellite connection. From then on, the buoy transmits, and the user receives buoy position.

- *Deactivation:* Action of de-registering a buoy. It is done by the buoy supplier company after the request by the vessel owner. From then on, the communication service is no longer billed, and the buoy stops transmitting.

- *Reactivation:* Action of registering a deactivated buoy that was previously activated.

- *Active or activated buoy:* Buoy which is subjected to the action of activation and, therefore, it is capable of transmitting. However, the magnet still needs to be applied to start the transmission of a signal.

- *Operational buoy:* Active buoy that is transmitting a signal and is drifting in the sea. The number of operational buoys should be used for the verification of the fulfilment of the limitations in force.

- *Buoy Owner:* Unique purse seiner vessel to which the buoy is assigned when activated and receives the telecommunication bills. Buoys can be owned only by a purse seiner operating in the corresponding ocean.

- *Tracked / Followed buoys:* Buoys owned by a purse seiner that are in operational condition.

- *Acquired buoy:* Buoy purchased and assigned to a purse seiner vessel to whom the purchase invoice is issued.

- *Loss of FAD*: FAD that can no longer be tracked by a vessel because the information of the buoy attached is no longer received due to several reasons (robbery, beaching, sinking, etc.).

- *Abandoned FADs:* FAD from which the communication has been intentionally stopped by deactivating the buoy attached or has been left at sea without a buoy.

It is very important to note that the terms ACTIVE and ACTIVATED that appear in Recommendation 16-01 should be interpreted as OPERATIONAL according to the new definitions proposed.

These definitions should be considered as interim, subject to further improvements, especially in the context of the work of the joint t-RFMO FAD Technical Working Group.

2. ICCAT Reporting Requirements of Recommendation 16-01 and interpretation proposed

The Committee also reviewed Grande *et al*. 2019 that proposes Best Standards for Data collection and Reporting Requirement on FADs to give response to Annex 8 of Recommendation 16-01. New ST08a and ST08b forms for data reporting on FADs and buoys are proposed, replacing ST08 currently used (2018a version). In addition, the Committee proposes the best standards for data collection included in Grande *et al*. 2019 to be consider as a minimum standard for data collection.

ICCAT 16-01 (23)	*Reporting from FAD Logbook*	*Reporting from Buoys transmissions*	*Interpretation*
1x1 (but not specified for all data required)			Harmonize Grid size to 1x1.
Monthly			Harmonize time scale to a monthly basis.
The number of FADs actually deployed on a monthly basis per 1°x1° statistical rectangles, by FAD type, indicating the presence or absence of a buoy or of an echo-sounder associated to the FAD and specifying the number of FADs deployed by associated support vessels, irrespective of their flag.	X		Total number of FADs deployed in the 1-degree square: refers only to the first deployment event of a FAD.
The number and type of buoys (e.g. radio, sonar only, sonar with echo-sounder) deployed on a monthly basis per 1°x1° statistical rectangles.	X		Total number of buoys deployed in the 1 degree square refers only to the first deployment of a FAD with its buoy, the deployment of a buoy on a log [see CECOFAD categories] that was not previously tracked by any vessel, i.e. buoy transfer events are not reported here (i.e. the change of buoy).
The average numbers of buoys activated on a monthly basis that have been followed by each vessel; the spatial resolution is not specified.		X	This information should correspond to the average number of operational buoys followed in a monthly basis and in 1ºx1º.
The average numbers of buoys deactivated on a monthly basis that have been followed by each vessel; the spatial resolution is not specified.	X		If deactivated, a buoy cannot be followed by the vessel. This field would be covered with the field related to FAD lost (see below).
Average numbers of lost FADs with active buoys on a monthly basis. The spatial resolution is not specified.	X		FAD that can no longer be tracked by a vessel because the information of the buoy attached is no longer received. It should be provided in 1ºx1º scale.
For each support vessel, the number of days spent at sea, per 1° grid area, month and flag State.	Other sources	Other sources	Not provided from FAD logbooks or buoy transmission data.

Purse seine and baitboat catches, efforts and number of sets (for purse seines) by fishing mode (floating-object associated schools and free school fisheries) in line with Task II data requirements (i.e. per 1°x1° statistical rectangles and per month).	Other sources	Other sources	Report catches and effort in line Task I and Task II requirements.
When the activities of purse seine are carried out in association with baitboat, report catches and effort in line Task I and Task II requirements as “purse seine associated to baitboats” (PS+BB).	Other sources	Other sources	Report catches and effort in line Task I and Task II requirements.

3. New Data Submission Forms (i.e. ST08)

Regarding the previous experiences, the Committee recommends using two specific templates for the provision of data to the Secretariat according to the data collection sources (FAD logbook and buoy transmission data):

- Form ST08a to report information on buoy densities, which is extracted from buoy transmission information (**Annex 1** – ST08a);

- Form ST08b to collect activities on FADs (based on the categories defined in Recommendation 16-01) which are extracted from the FAD logbooks (**Annex 2** - ST08b).

These forms should be considered as interim, subject to further improvements, especially in the context of the work of the joint tRFMO FAD Technical Working Group.

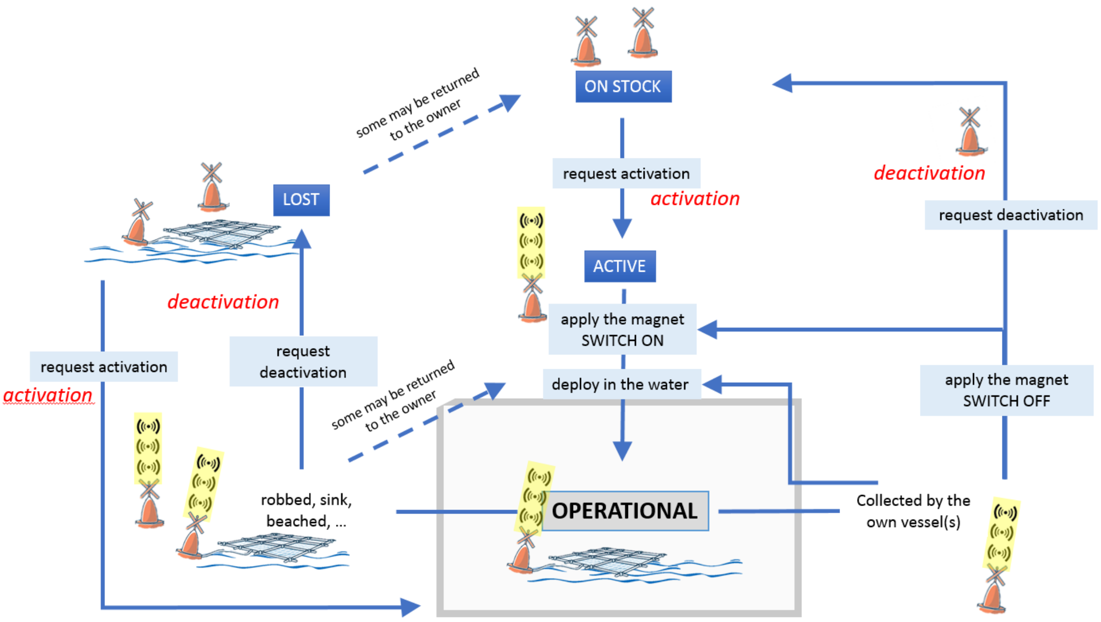


Figure 19.3.1. Life cycle of an instrumented buoy (Grande *et al*. 2018).

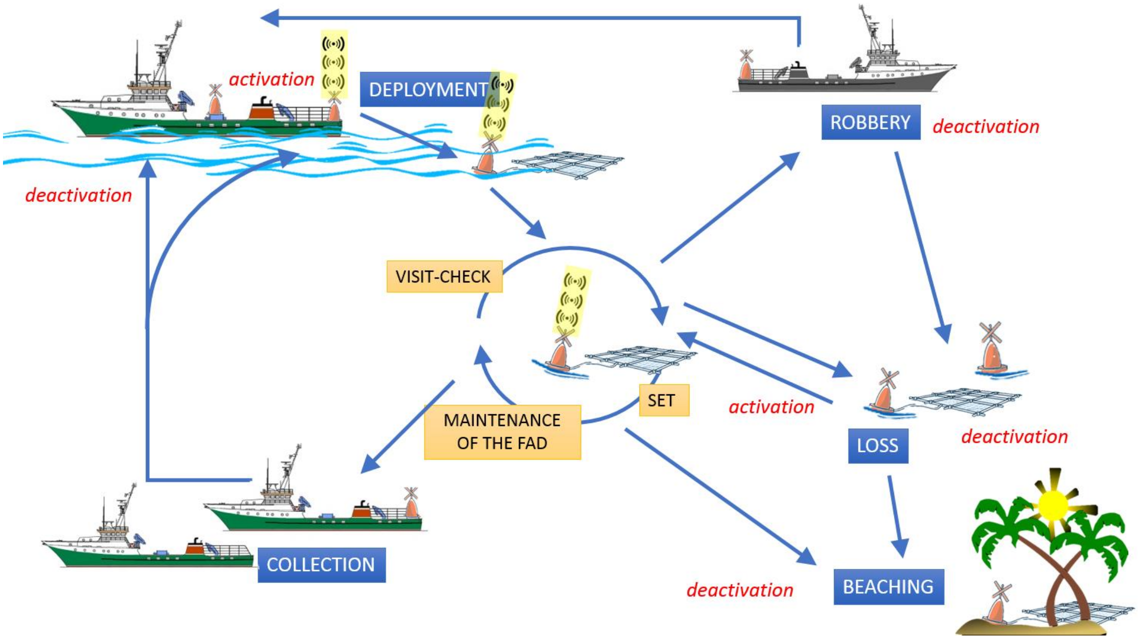


Figure 19.3.2. Life cycle of a buoy in connection with FAD activities (Grande *et al*. 2018).

Annex 1

ST08a_Buoys densities

ST08a_Buoy Densities	BUOY DENSITIES IN THE SPECIFIED YEAR INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS	Version	Language ENG

Header

Reporting Flag				*Secretariat use only*
Reporting Agency		Phone		Date reg.
Address		Fax		Ref.
Person in charge		Email		

Report for year (previous)

Notes

Flag (current) cod.	Month	Number of vessels	Lat	Lon	Buoy type	Average No. of Operational Buoy

Annex 2

ST08b_FAD

ST08b-FADs	**FADs IN THE SPECIFIED YEAR** INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS	Version	Language **ENG**

Header

				Secretariat use only	
Reporting Flag					
Reporting Agency		Phone		Date reg.	
Address		Fax		Ref.	
Person in charge		Email			

Report for year (previous)

Notes

Flag (current) cod.	Month	Number of vessels	Vessel Type	FOB type	Buoy Type	Lat	Lon	No. buoys Deployed	No. FOB Lost

19.4 Develop a table that quantifies the expected impact on MSY, B_{MSY}, and relative stock status for both bigeye and yellowfin resulting from reductions of the individual proportional contributions of major fisheries to the total catch. Rec. 16-01, paragraph 49 (c)

***Background**: (Rec. 16-01), paragraph 49(c). Develop a table for consideration by the Commission that quantifies the expected impact on MSY, B_{MSY}, and relative stock status for both bigeye and yellowfin resulting from reductions of the individual proportional contributions of longline, FAD purse seine, free school purse seine, and baitboat fisheries to the total catch.*

The Committee completed a series of analyses for each stock using a new Decision Support Tool (DST) developed specifically for this purpose. The tool used the outputs of selected stock assessment models from the runs used to develop the management advice for bigeye in 2018 and yellowfin in 2016. Additionally, a fisheries impact analysis was conducted for bigeye, using the 18 uncertainty grid used for the provision of the management advice in 2018.

DST

Using the DST, the Group examined the approximate relative changes to yield at MSY, SSB required to produce MSY, and the SSB/SSB_{MSY} ratio that can be expected from a series of changes to fleet allocation in the projection. The group tested reductions in fishing mortality (F) of 10, 20, 50, and 100 percent for each of the main gear types (longline, purse seine – free school, purse seine – FAD, and baitboat), with the reduced F reallocated, proportionally, to the remaining fleets. The Group chose to apply reductions to the relative Fs of the fleets because it was consistent with the model projections used to produce management advice for yellowfin and bigeye.

Based on the selectivities of the Ghanaian purse seine and baitboat fleets, all Ghanaian catch was combined with purse seine – FAD for the purpose of this examination. Additionally, the Group examined how reverting to selectivity patterns characteristic of the 1980s would affect the metrics listed above. This was accomplished in the DST by simply running the tool using the selectivities characteristic of that decade. The period of 1980-1989 was chosen because this period is before the increase in activity by the purse seine – FAD fishery that primarily catches juvenile bigeye and yellowfin. The selectivities for all the other fleet groups from that period were also utilized for that analysis.

Finally, to account for uncertainty in the stock assessment results, the Group examined three of the 18 Stock Synthesis model runs for bigeye. Run 3 was chosen because it most closely aligned with the median of the 18 model runs; Run 6 and 13 were chosen because they represent the upper and lower bounds on current stock status form the 18 uncertainty grid models. As all three runs had very similar results to the median run; hence only this results for this run are shown. To account for uncertainty in the yellowfin stock assessment, these analyses were conducted for the all of the (two) SS3 model runs and averaged.

The tables below show the results of the analyses using the DST. Each cell represents the percent change from the baseline of that model run (= status quo) after reducing the effort for the relevant fleet by the percentage on the left.

Changes in MSY caused by fleet allocation are summarized in **Table 19.4.1 and 19.4.4**. Reductions in F allocated to PS-FAD+Ghana were observed to produce increased maximum sustainable yield (MSY) as F was reallocated to fleets that catch higher proportions of larger, older fish. The magnitude of the change was proportional to the reduction applied and increases as large as 46% with a total removal of PS-FAD+Ghana. Conversely, reductions in F allocated to LL were observed to produce decreased maximum sustainable yield (MSY) because F was reallocated to fleets that catch a higher proportion of smaller, younger fish. The magnitude of the decrease in MSY was proportional to the reduction applied and decreases as large as ~30% with a total LL removal. Only small changes in MSY (1-2%) were achieved by adjusting the F allocated to the PS-Free School and BB components.

With regard to SSB_{MSY} (**Tables 19.4.2 and 19.4.5**), changes in fleet allocation resulted in little change. However, there was some increase in the SSB required to support MSY from 2 to 13% when reductions in F of 50% and 100 % respectively were applied to the PS-FAD+Ghana for bigeye and from 6 to 17% for yellowfin.

Although the Committee is uncertain what is meant by relative stock status in paragraph 49c of Rec. 16-01, to explore the likely impacts on stock condition due to changes in fleet allocation, the Group evaluated the hypothetical stock status (SSB/SSB_{MSY} in 2014 for yellowfin and 2017 for bigeye) relative to the spawning biomass benchmarks for each respective fleet reallocation scenario. These changes are summarized in **Tables 19.4.3 and 19.4.6**. The results of applying the historical selectivity (1980-1989) are summarized in **Table 19.4.7**.

Bigeye Historical Fisheries Impact Analysis

The method used to analyze the historical impacts of each main gear type is based on the idea that given an estimated historical evolution of the stock biomass, one can determine the relative impact of an individual fleet by removing the historical mortality generated by that fleet. As that mortality is removed, the stock responds by growing in size. This growth is a measure of the foregone growth potential resulting from the past harvests of each fleet through time, thus it is an indicator of the impact of each fleet on the overall spawning stock biomass.

This analysis was conducted using the results of all 18 SS3 stock assessment model runs used to develop Kobe plots and matrices for bigeye in 2018. The fleets were binned into four categories: purse seine – free school, purse seine – FAD, baitboat, and longline. As in the DST analysis, the Ghanaian catch was binned with purse seine – FAD.

The results of the fisheries impact analysis by each fishing strategy are summarized in **Table 19.4.8** and **Figure 19.4.1**. To date, fishery impacts on the current status of the bigeye stock (as represented by the average SSB over the three year period 2015-2017) are the result of fishing activity by purse seine – FAD (0.32), longline (0.28), bait boat (0.16), and purse seine – free school (0.10) fleets. These results are presented for all 18 SS3 model runs. The trajectories of these relative impacts indicate substantial historical changes along with the development of fisheries using each gear type. At the beginning of the fishery, in the 1950s, baitboat and longline fisheries had the most impact on the bigeye stock. Purse seine – free school and purse seine – FAD fisheries developed and began impacting the stock in the 1970s and late 1980s, respectively. The longline fishery, which primarily catches larger bigeye, historically had the largest impact on the stock but has showed a slightly declining trend since 2000. Conversely, the other fishing strategy with a significant impact on the bigeye stock (purse seine – FAD) primarily harvests juvenile bigeye, has had the largest impact on the stock since 2010, relative to unfished biomass.

Table 19.4.1. Percent change in bigeye tuna maximum sustainable yield (MSY) associated with a reallocation of fishing mortality from an individual fleet to the other fleets. Scenarios examined included a 10%, 20%, 50%, and 100% reallocation of F from purse seines on free schools, fishing on FADs+Ghana, baitboats, and longlines. Under the current fleet allocation (i.e. status quo) the MSYs estimated for bigeye using the DST were 76,087 t, 77,536 t and 77,401 t for Run 3 which is the closest to the median run.

Bigeye Run 3 Maximum Sustainable Yield				
Treatment	*PS Free School*	*FADs+Ghana*	*Baitboat*	*Longline*
10% reduction	-0.2%	10%	0.2%	-2%
20% reduction	-0.5%	17%	0.3%	-5%
50% reduction	-1%	32%	1%	-13%
100% reduction	-2%	46%	2%	-30%

Table 19.4.2. Percent change in bigeye tuna spawning stock biomass that would produce maximum sustainable yield (SSB_{MSY}) associated with a reallocation of fishing mortality from an individual fleet to the other fleets. Scenarios examined included a 10%, 20%, 50%, and 100% reallocation of F from purse seines on free schools, fishing on FADs+Ghana, baitboats, and longlines.

Bigeye Run 3 Spawning Stock Biomass to produce MSY				
Treatment	*PS Free School*	*FADs+Ghana*	*Baitboat*	*Longline*
10% reduction	-0.1%	-2%	0.2%	0.1%
20% reduction	-0.2%	-3%	1%	0.1%
50% reduction	-1%	-8%	2%	-0.1%
100% reduction	-1%	-13%	4%	-3%

Table 19.4.3. Percent change in hypothetical stock status of bigeye tuna in 2017 (SSB/SSB_{MSY}) associated with a change in the spawning biomass benchmarks that would have occurred with a reallocation of fishing mortality from an individual fleet to the other fleets. Scenarios examined included a 10%, 20%, 50%, and 100% reallocation of F from purse seines on free schools, fishing on FADs+Ghana, bait boats, and longlines.

Bigeye Run 3 Stock Status in 2017 (SSB/SSB_{MSY})				
Treatment	*PS Free School*	*FADs+Ghana*	*Baitboat*	*Longline*
10% reduction	0.1%	1.7%	-0.2%	-0.1%
20% reduction	0.2%	3.4%	-0.7%	-0.1%
50% reduction	0.6%	8.1%	-1.7%	0.1%
100% reduction	1.3%	14.6%	-3.7%	3.1%

Table 19.4.4. Percent change in yellowfin tuna maximum sustainable yield associated with a reallocation of fishing mortality from an individual fleet to the other fleets. Scenarios examined included a 10%, 20%, 50%, and 100% reallocation of F from purse seines on free schools, fishing on FADs+Ghana, baitboats, and longlines. Under the current fleet allocation (i.e. status quo) the MSYs estimated for yellowfin using the DST were 123,765 t and 126,314 t for Run 5 and 7, averaged.

Yellowfin averaged Maximum Sustainable Yield				
Treatment	*PS Free School*	*FADs+Ghana*	*Baitboat*	*Longline*
10% reduction	-2%	6%	0.0%	-0.6%
20% reduction	-4%	12%	0.0%	-1.3%
50% reduction	-9%	27%	-0.1%	-3%
100% reduction	-19%	49%	-0.2%	-7%

Table 19.4.5. Percent change in yellowfin tuna spawning stock biomass that would produce maximum sustainable yield (SSB_{MSY}) associated with a reallocation of fishing mortality from an individual fleet to the other fleets. Scenarios examined included a 10%, 20%, 50%, and 100% reallocation of F from purse seines on free schools, fishing on FADs+Ghana, baitboats, and longlines.

Yellowfin averaged Spawning Stock Biomass to produce MSY				
Treatment	*PS Free School*	*FADs+Ghana*	*Baitboat*	*Longline*
10% reduction	-0.6%	-1%	0.1%	0.1%
20% reduction	-1.2%	-2%	0.2%	0. 3%
50% reduction	-3%	-6%	0.5%	0.5%
100% reduction	-9%	-17%	1%	1%

Table 19.4.6. Percent change in hypothetical stock status of yellowfin tuna (SSB/SSB_{MSY}) in in 2016 associated with a change in the spawning biomass benchmarks that would have occurred with a reallocation of fishing mortality from an individual gear fleet to the other fleets. Scenarios examined included a 10%, 20%, 50%, and 100% reallocation of F from purse seines on free school, fishing on FADs+Ghana, bait boats, and longlines.

Yellowfin Stock Status in 2014 (SSB/SSB_{MSY})				
Treatment	*PS Free School*	*PS FAD/Ghana*	*Baitboat*	*Longline*
10% reduction	0.6%	0.6%	-0.1%	0.1%
20% reduction	1.2%	1.6%	-0.2%	-0.3%
50% reduction	3.6%	6.5%	-0.5%	-0.4%
100% reduction	9.8%	19.8%	-1.0%	-1.0%

Table 19.4.7. Percent change in bigeye and yellowfin tuna estimated benchmarks and stock status projected under historical fleet F allocations compared to the current allocations. Scenarios examined included the fleet allocations during 1980-1989, and 2000-2015.

Historical Allocations (using 1980-1989 selectivity pattern and allocation)		
Benchmark	*Bigeye Run 3*	*Yellowfin*
PME	41%	-6%
SSB_{PME}	-15%	-11%
SSB/SSB_{PME}	17,5%	12,4%
Historical Allocations (using 2000-2015 selectivity pattern and allocation)		
Benchmark	*Bigeye Run 3*	*Yellowfin*
PME	8%	-6%
SSB_{PME}	1%	-2%
SSB/SSB_{PME}	-0,8%	2,2%

Table 19.4.8. The results of the fisheries impact analysis by each fishing strategy. The trajectories of these relative impacts indicate substantial historical changes along with the development of fisheries using each gear type.

model	FSC	FAD	BB	LL
1	0.11	0.32	0.17	0.29
2	0.11	0.32	0.17	0.29
3	0.10	0.33	0.16	0.29
4	0.10	0.31	0.16	0.29
5	0.09	0.32	0.15	0.28
6	0.07	0.32	0.14	0.27
7	0.13	0.32	0.18	0.29
8	0.12	0.32	0.18	0.29
9	0.10	0.33	0.17	0.29
10	0.11	0.32	0.17	0.28
11	0.09	0.32	0.16	0.28
12	0.08	0.33	0.14	0.28
13	0.13	0.31	0.19	0.29
14	0.12	0.32	0.18	0.29
15	0.10	0.33	0.17	0.29
16	0.11	0.32	0.17	0.28
17	0.09	0.32	0.16	0.28
18	0.08	0.33	0.14	0.28
average	0.10	0.32	0.16	0.28

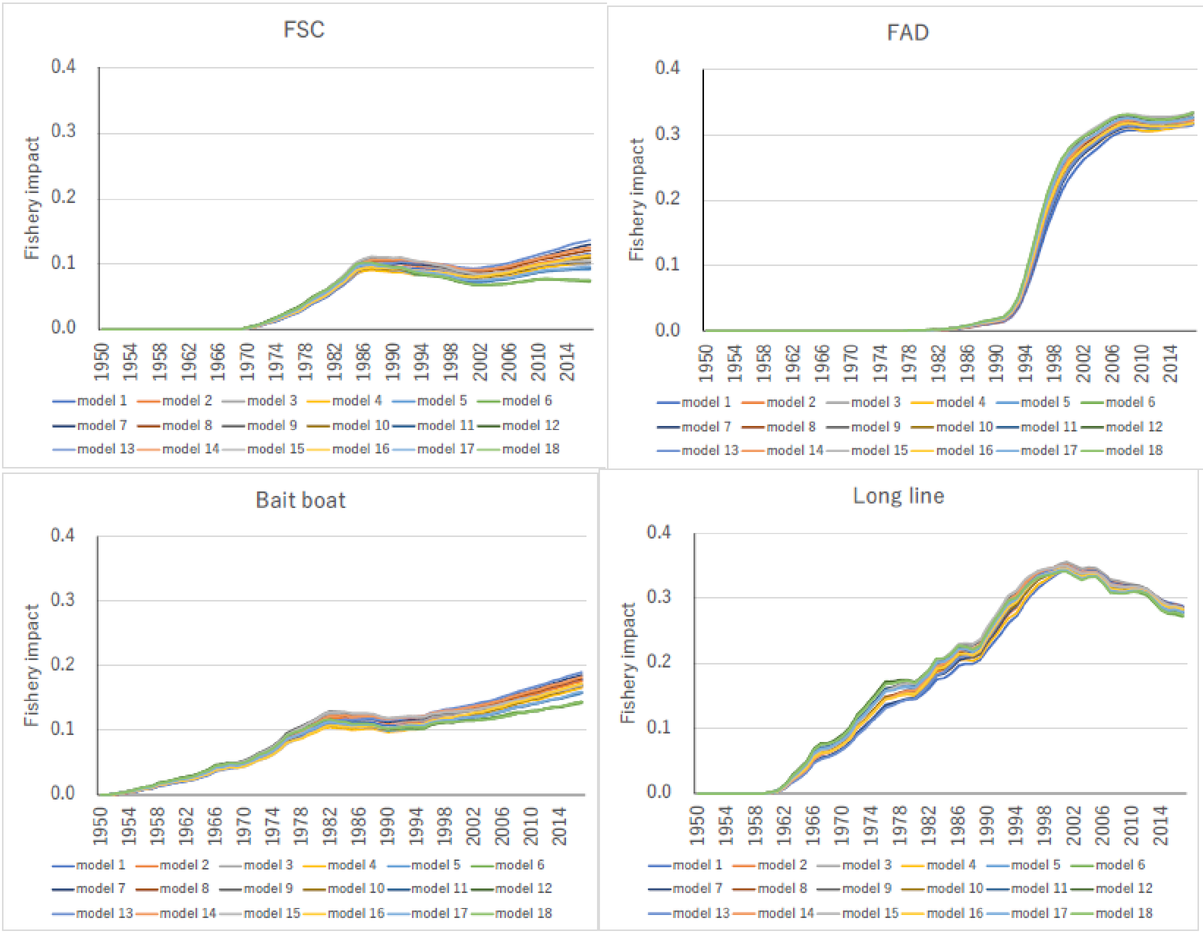


Figure 19.4.1. The results of the fisheries impact analysis by each fishing strategy. The trajectories of these relative impacts indicate substantial historical changes along with the development of fisheries using each gear type.

19.5 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.*

Summarizing observer data information reported by CPCs using the ST-09 form is a complex task given the changes in format that this form had undergone. A summary of the information reported for 2017 can be found in the Secretariat Report on Statistics and Coordination of Research in 2018, Section 1.4 and Tables 8 to 11.

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*

The SCRS has not received enough information on national observer programmes to assess the effectiveness of these programmes to meet the data needs of the Commission. It is expected that through the use of the ST-09 observer data form enough information will be collected in the future to assess these programmes.

19.6 The SCRS should continue to monitor and analyze the effects of the minimum size/weight measure on the mortality of immature swordfish. Rec. 17-02 paragraph 10 (N-SWO) and Rec. 17-03 paragraph 7 (S-SWO)

Background: *(Rec. 17-02), paragraph 10. Notwithstanding the provisions of paragraph 9, any CPC may choose, as an alternative to the minimum size of 25 kg/ 125 cm LJFL, to take the necessary measures to prohibit the taking by its vessels in the Atlantic Ocean, as well as the landing and sale in its jurisdiction, of swordfish (and swordfish parts), less than 119 cm LJFL, or in the alternative 15 kg, provided that, if this alternative is chosen, no tolerance of swordfish smaller than 119 LJFL, or in the alternative 15 kg, shall be allowed. For swordfish that have been dressed, a cleithrum to keel (CK) measurement of 63 cm can also be applied. A Party that chooses this alternative minimum size shall require appropriate record keeping of discards. The SCRS should continue to monitor and analyze the effects of this measure on the mortality of immature swordfish.*

Background: *(Rec. 17-03), paragraph 7. Notwithstanding the provisions of paragraph 5, any CPC may choose, as an alternative to the minimum size of 25 kg/125 cm LJFL, to take the necessary measures to prohibit the taking by its vessels in the Atlantic Ocean, as well as the landing and sale in its jurisdiction, of swordfish (and swordfish parts), less than 119 cm LJFL, or in the alternative 15 kg, provided that, if this alternative is chosen, no tolerance of swordfish smaller than 119 LJFL, or in the alternative 15 kg, shall be allowed. For swordfish that have been dressed, a cleithrum to keel (CK) measurement of 63 cm can also be applied. A Party that chooses this alternative minimum size shall require appropriate record keeping of discards. The SCRS should continue to monitor and analyze the effects of this measure on the mortality of immature swordfish.*

An answer to these requests was provided by the Committee in 2017, referring to Recommendations 16-03, paragraph 10 and 16-04, paragraph 7. At this time the Committee does not have any further updates.

19.7 The SCRS is requested to develop in 2018 criteria for the identification of exceptional circumstances. Rec. 17-04 paragraph 12 (N-ALB)

Background: *(Rec. 17-04), paragraph 12. The SCRS is requested to develop in 2018 criteria for the identification of exceptional circumstances, taking into account, inter alia, the need for an appropriate balance between specificity versus flexibility in defining exceptional circumstances, and the appropriate level of robustness to ensure that exceptional circumstances are triggered only when necessary.*

The concept of "exceptional circumstances" has been an integral part of the process in establishing MPs adopted in other RFMOs. Generally speaking, "exceptional circumstances" are triggered when reality clearly diverges from what was simulated in the analyses conducted to adopt the HCR. In such cases, the existing framework of the HCR is not adequate to allow managers to respond in a manner that is appropriate to the circumstances. Examples include: stock trajectories out of the ranges tested by the MSE, an extreme environmental regime shift, or inability to update the stock status.

The SCRS Working Group on Stock Assessment Methods (WGSAM) as well as the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers (SWGSM) developed and discussed a set of potential principles that could inform the development of criteria for exceptional circumstances. These groups identified two general principles that would signal the possibility of exceptional circumstances:

1. When there is evidence that the stock is in a state not previously considered to be plausible in the context of the MSE and/or;

2. When there is evidence that the data required to apply the HCR are not available or are no longer appropriate.

These principles are general in nature and can be modified for use with any stock. In the case of North Atlantic albacore tuna, the Committee adopted the following table that identifies the list of indicators that could be used to judge whether exceptional circumstances exist.

Principle	*Indicator*	*Frequency of estimation*	*Normal range criterion*	*Frequency of evaluation of Exceptional Circumstances*
System state	Stock biomass	Each full assessment	As defined by full range of values in the OMs used in the MSE	Each full assessment
	Fishing Mortality			
	Growth	After completion of new study		After completion of new study
	Maturity			
	Natural Mortality			
Application of the HCR	CPUE	Potentially annually	As defined by full range of values in the OMs used in MSE	Each time MP is to be applied
	Catch	Annually		

Nevertheless, the SCRS notes that it is not straightforward to define the exceptional circumstances, detect whether they are occurring and assess their severity. In addition, there is a need for the Commission to decide what to do in such circumstances. The Committee notes that it might take several years and a feedback process.

19.8 The SCRS is requested to initiate a peer-review, in time for the 2018 Commission meeting. Rec. 17-04 paragraph 15 (N-ALB)

Background: *(Rec. 17-04), paragraph 15. The SCRS shall initiate a peer-review, in time for the 2018 Commission meeting, of the northern albacore MSE, including the operating models, management procedures, calculations of the performance indicators and code. Based on this review and potential refinement of the MSE to be described in a single consolidated report, the Commission may consider additional refinements of the interim HCR in 2018.*

In 2017, the ICCAT Commission adopted Recommendation 17-04, that, among other management measures, included an interim Harvest Control Rule (HCR) for North Atlantic albacore (*Thunnus alalunga*), which represents the first harvest control rule adopted in the history of ICCAT.

The adoption of the interim HCR by the ICCAT Commission was based on simulations conducted using a specifically designed Management Strategy Evaluation (MSE) framework that was endorsed by the SCRS. The SCRS considered that the advice provided was robust to a wide range of uncertainties, including those affecting the 2016 assessment and that, although further work in reviewing and improving the MSE was advisable, none of the concerns was sufficient to preclude the interim implementation of any of the HCRs proposed by the SCRS.

Recommendation 17-04, while adopting the interim HCR, acknowledged the intention of the SCRS to further explore and consolidate the MSE framework, and requested the SCRS to initiate a peer-review of the North albacore MSE process, in time for the 2018 Commission meeting, including the operating models, management procedures, calculations of the performance indicators and code.

During 2018, ICCAT Secretariat contracted an external expert (Dr Michelle Sculley) to conduct such peer review. The expert conducted the peer review before the SCRS meeting and reported on the outcome at the Albacore Species Group (Sculley, in press).

Based on the peer review conducted, the SCRS considers that the interim HCR adopted by the Commission in 2017 had a robust scientific basis. The MSE framework appears to be scientifically sound and robust to the major sources of uncertainty.

The operating model appears to be fully conditioned with respect to the most important sources of uncertainty. Still, the report identified some issues and offered some suggestions to further check the behaviour of some models in the future, and made suggestions to improve communication of results. The report also suggests to consider separating the currently large number of OMs into a reference set and a robustness test. The SCRS considers that some of the issues identified by the peer review were already identified by the Species Group. Some have been addressed during 2018 and the rest are planned to be addressed in the near future.

19.9 Review on specific spawning times and areas of bluefin tuna in the western Atlantic. Rec. 17-06 paragraph 23 (W-BFT)

Background: *(Rec. 17-06), paragraph 23. The SCRS shall review any new available information related to the identification of specific spawning times and areas of bluefin tuna within the western Atlantic Ocean, including from those CPCs that harvest western Atlantic bluefin tuna, and advise the Commission on the results of this review for its consideration.*

There was no new information available this year for the SCRS to review on specific spawning times and areas of bluefin tuna in the western Atlantic. Although it is difficult to quantify, the reduction of catch of BFT in the Gulf of Mexico due to the directed fishery restriction in place since 1983 likely reduces fishing mortality of spawning age western population bluefin tuna. This is true even though the same tonnage may be harvested elsewhere in the West Atlantic as it is thought that the BFT in the GoM are entirely of western origin as opposed to other areas of western Atlantic where eastern BFT also occur at varying levels.

Certain CPCs plan to conduct research to explore the efficacy of the Gulf of Mexico directed fishery restriction, but at this time, the SCRS has been unable to conduct a substantive evaluation of the question on which to base new advice. However, it should be noted that the advice on catch levels by SCRS in 2017 does not take into account the mixing of the two stocks, i.e. there is no differentiation of impacts on the two stocks between the catch in GoM and other western Atlantic Ocean in the assessment. In general, the efficacy of the protection of spawning areas of BFT has yet to be demonstrated.

19.10 Provide guidance on a range of fish size management measures and their impact on yield per recruit and spawner per recruit considerations. Rec. 17-06 paragraph 27 (W-BFT)

Background: *(Rec. 17-06), paragraph 27. SCRS should provide guidance on a range of fish size management measures for western Atlantic bluefin tuna and their impact on yield per recruit and spawner per recruit considerations. The SCRS should also comment on the effect of fish size management measures on their ability to monitor stock status.*

The Committee reiterates its advice in 2012 in response to Rec. 10-03:

"The Committee reviewed yield-per-recruit calculations using various selectivity patterns by gear based on the 2010 assessment results and for decreased selectivity pattern by up to 40% for ages 1 to 6 for the whole fishery based on the 2012 assessment results. The Committee recognized that Y/R and SSB/R could be improved by changing the selectivity pattern (decreasing the selectivity of ages 1-6 by 40% resulted in only modest improvements), but these would imply allocation changes with implications beyond strict Y/R and SSB/R considerations. In addition, the Committee was concerned that such changes in selectivity would affect the availability and utility of indices of stock sizes currently used in the assessment. Furthermore, regulations to decrease the catches of ages 1 to 6 bluefin tuna may have unintended negative consequences such as increased discard mortality, which may be difficult to monitor, and changes due to reallocation of effort which may be difficult to predict."

19.11 Review the data on dead and live discards submitted by CPCs to determine the feasibility of estimating fishing mortality by commercial fisheries, recreational, and artisanal fisheries. Rec. 15-05 paragraph 10 (BIL)

Background: *Rec. 15-05 paragraph 10. Request the SRCS to review the data on dead and live discards submitted by CPCs to determine the feasibility of estimating fishing mortality by commercial fisheries, recreational, and artisanal fisheries.*

A preliminary revision of Task I Discards (DD:dead; DL:alive) of the major billfish species provided by the Secretariat showed that since 2006, only two CPCs (Mexico and U.S.A.) have consistently reported dead and live discards for all major billfish species throughout the time period revised (2006-2015). The rest of the seven CPCs that report DD and DL, do not have discard information for the complete time period reviewed. The review conducted does not allow the Committee to determine the feasibility of estimating fishing mortality by commercial, recreational, and artisanal fisheries.

During the 2018 blue marlin intersessional meetings, the lack of reported billfish discards was discussed. While it was understood that differences in targeting, domestic regulations, and economics can lead to the level of discarding to be different between the fleets of different CPCs, it was reported that discards levels in general were higher than what was reported. Since discarded fish obviously are not trackable through commercial landings records, the alternative mechanisms for recording discards are logbooks (which are recognized as tending to underreport discards) or some combination of observer data and estimation methods. The Group considers that CPCs should establish discard estimation procedures, and review the adequacy of their observer programmes (in terms of coverage, and type of data collected) to provide the requested data. CPCs are reminded that the Working Group and the By-catch Coordinator at the ICCAT Secretariat can help to develop such procedure. CPCs will be requested to provide estimate of discards and the methodology used at the next white marlin data preparatory meeting.

19.12 Develop a new data collection initiative as part of the ICCAT Enhanced Program for Billfish Research to overcome gaps in fisheries catching billfish, particularly in artisanal fisheries. Rec. 15-05 paragraph 10 and Rec. 16-11 paragraph 3 (BIL)

Background: *Rec. 15-05 (end of) paragraph 10, and Rec. 16-11 paragraph 3. Request the SCRS to develop a new data collection initiative as part of the ICCAT Enhanced Program for Billfish Research to overcome gaps in fisheries catching billfish, particularly in artisanal fisheries.*

In 2018 a comprehensive study of strategic investments related to artisanal fisheries data collection in the Latin America/Caribbean region was awarded and the initial results presented to the SCRS. This study in conjunction with a similar one done in 2014 for the western African regions, presented a general overview of artisanal fisheries in these regions confirming that tuna and tuna-like species are regularly caught in artisanal fisheries, although the magnitude of catches is still difficult to estimate due to several reasons, mostly related to the lack of comprehensive sampling and monitoring of these fleets.

In 2019 the SCRS will review these reports and will make a work plan for new data collection initiatives aiming to improve the estimations of catches from the artisanal fisheries considering the recommendations presented in the studies. The Committee recommends that the Commission continue the financial support for this project.

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

In 2017 the Commission reviewed the recommendations produced by the Ad Hoc Working Group to Follow-up on the Second Performance Review. A number of tasks were agreed to be carried out by the various subsidiary bodies of the Commission based on the issues identified in the Second independent ICCAT Performance Review, including the SCRS.

In 2018 only the Billfish Species Group and the Sub-committee on Ecosystems revised these recommendations and provided feedback to the Committee.

Discussion

The SCRS Chair recommended that Species Group Chairs for other species examine these recommendations and provide similar responses to what the Billfish Species Group provided. The SCRS Chair emphasized the importance of completing these responses for next year.

20.2 Collaboration with other International Organizations (ICES, CITES, GEF, etc.)

Several collaborations were summarized.

ISSF

The International Seafood Sustainability Foundation (ISSF) continues to provide the Secretariat with catch details (by vessel trip, species and commercial size category) for all purchases made by ISSF-participating companies. These correspond to unloading of Atlantic catches of tropical tunas (bigeye, yellowfin and skipjack) and albacore to canning plants around the world. This information has previously been used by SCRS scientists to supplement and improve Ghanaian Task II statistics. It has been noted that submissions have been made in a diverse range of formats. As such, ISSF is looking to standardise data submissions in the future. Furthermore, ISSF is working to provide to ICCAT, by 2019, all currently available data in such a format that would allow its use by the SCRS. As such, the data received to date are still being stored by ICCAT, but have not been made available for use by the SCRS at this stage.

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 by-catch, sharks and stock assessment issues, through our Sub-committee on Ecosystems and By-catch, 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.

GEF- 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 previous SCRS plenary, the ICCAT Secretariat has participated in several Common Oceans ABNJ/ Tuna project initiatives. These include participation in the following meetings that were funded or partially funded by the project:

- CWP (FAO Coordinating Working Party on Fisheries Statistics) technical workshop on global harmonization of tuna fisheries statistics, held in Rome, Italy, 19-22 March 2018;
- Joint tuna RFMO MSE Working Group meeting held at University of Washington in Seattle, USA, 13-15 June 2018;
- Fifth project Steering Committee (PSC) meeting of the Common Oceans ABNJ tuna project held in Rome, Italy, 16-18 July 2018;

- 2nd meeting of the ICCAT Expert Port Inspection Group for Capacity and Assistance, held in , Madrid, Spain, 18-19 September 2018.

In addition, ICCAT coordinated and concluded during 2017 together with the Common Oceans ABNJ/ Tuna Project a Feasibility study on the development of an Online Reporting System (FORS). This includes both a feasibility study to determine the resources, costs, technologies required to implement an online reporting system, as well as the production of a demo online reporting tool. During 2018, various "outcomes" of the FORS study (technology, development model, concepts, recommendations, etc.) were used by the Secretariat aimed at improving the SCRS statistical online validation system. This prototype tool went into a testing phase during 2018. Following the objectives of the Common Oceans ABNJ Tuna project, the FORS tool and study results are generic and can potentially be applied across multiple tuna RFMOs.

Further information regarding ICCATs involvement in the GEF-Common Oceans ABNJ/Tuna Project are also provided in **Appendix 14**.

Discussion

This collaboration was discussed briefly, noting that the Common Oceans ABNJ/Tuna project, Phase I continues, however any activities conducted in it will need to be completed before July 2019. FAO has started planning for Phase II of the Common Oceans ABNJ/Tuna project, which will include a number of collaborative projects and hopes to collaborate very closely with ICCAT representatives in the planning process.

The terms of reference for the second Phase of Common Oceans ABNJ/ Tuna project will be similar to those presented in Phase I with particular emphasis on developing capacity in developing CPCs. The Committee strongly supports involvement of CPCs and the ICCAT Secretariat in the planning process for the next phase of the Common Oceans ABNJ/Tuna project so that ICCAT can continue to benefit from the support of the project.

20.3 Consideration of implications of the Sixth Meeting of the Working Group on Convention Amendment

The Working Group on Convention Amendment held its sixth meeting in May 2018 (Madeira, Portugal) and significant agreements were achieved.

As regards the *Fishing Entity Annex*, the Working Group agreed to forward a *Draft Resolution by ICCAT Regarding Participation of Fishing Entities Under the Amended ICCAT Convention* to the Commission for consideration as an integral part of the Convention amendment package.

In what relates to the *Dispute Resolution Procedures* the Working Group agreed to retain Annex 1, with additional text to make clear that the parties to any dispute may agree on the procedures for arbitration, including those set out in Annex 1 or any others that they mutually agree upon. Regarding paragraph 4 of Article VIII bis, the Working Group agreed to refer to "relevant standards recognized by the parties to the dispute." Changes were also suggested to paragraph 5 to make it more forward looking.

The Working Group also revised *Article XIII* such that only the Commission, by consensus decision, can propose amendments to the Convention.

Finally, the Working Group developed a *Draft Recommendation by ICCAT on Species Considered to be Tuna and Tuna-Like Species or Oceanic, Pelagic, and Highly Migratory Elasmobranchs*, which listed all the species subject to ICCAT competence upon entry into force of the amendments to the Convention. It also agreed to submit the draft recommendation to the SCRS for a final technical review, in particular to ensure the taxonomic information was up-to-date, prior to the 21st Special meeting of the Commission in 2018. The Working Group also repeated its request that SCRS provide, in all three ICCAT languages, the common names of the elasmobranch species listed in the measure.

The Sharks Species Group revised this list of species during its 2018 intersessional meeting, and considered it to be a living document that is to be periodically reviewed by the SCRS whenever changes in the taxonomy require it. The Group reviewed the taxonomic revision recently conducted on mantas and devil rays (White *et al.,* 2018) and updated the list of scientific names for rays.

Discussion

The Committee also revised this list of species during the meeting, including the English, French and Spanish common names adopted by FAO and currently used in the ICCAT databases. The Committee noted that two of the species of rays do not currently have FAO common names (**Appendix 17**).

There was discussion as regards what constitutes the legal list of names in the Convention: the SCRS Chair noted that the SCRS would only modify the list of names used when it is warranted because of changes to the taxonomy of the listed species. The question was put to the Committee as to whether or not to use common names provided by FAO: the Committee agreed.

20.4 Update of the ICCAT glossary

The Chair informed the Committee that the joint t-RFMO FAD Technical Group, led by Dr Josu Santiago, has been established and will soon start working. Its tasks includes among other aspects i) conduct a revision of current definitions used in the different tRFMOs and other sources; and, ii) provide proposals to harmonized definitions related to science and management of FAD.

Additionally, the Chair informed that the t-RFMO MSE Technical Working Group on MSE that has been working on definitions related to the MSE process, shall soon make the results of such work available.

The SCRS Chair recommended that when Rapporteurs need to refer to software for stock assessments in Executive Summaries they avoid using the software name and rather use the lay person description for that software included in the ICCAT glossary (table below). Software names should be used when necessary in the Detailed Reports of intersessional meetings and SCRS Papers.

Table**.** Accepted terms from the ICCAT glossary, describing the class of population model underlying stock assessment software. Software which is not mentioned in the ICCAT glossary but included in the ICCAT software catalogue, is in italics.

Species Executive Summaries	***Meetings Detailed Reports***
• Production model	• ASPIC, GENPROD, PRODFIT, *MPB*
• Bayesian production model	• *JABBA*
• Age-structured production model	• ASPM
• Age-structured model	• VPA*2BOX*, ADAPT, *FLX*SA, ASAP
• Integrated analysis (current glossary)	• *SS3,* MULTIFAN CL

Discussion

It was agreed that terms related to FADs being developed by the joint t-RFMO FAD Technical Group, and terms related to MSE developed by the joint t-RFMO MSE Technical Group will be used to update the ICCAT Glossary.

It was also agreed to use the above table on software names to guide how to reference assessment models in the Executive Summaries. It was pointed out that this table should be modified to include data poor models.

Finally, it was agreed that all programmes in the software catalog should have an entry in the ICCAT glossary that describes the sort of assessment model it corresponds to, following the above table.

20.5 Consideration of new publication guidelines: Executive summaries, Detailed Reports and SCRS Report

Publications guidelines for Executive Summaries, Detailed Reports and the SCRS report were initially established in 1995, and revised in 2003 by the SCRS, aiming to make them consistent, concise and easy to read by end users. However, as in the past, year after year it has been noted that some of the publications are getting larger and not necessarily respecting the size limits adopted by the SCRS. On the other hand, the Commission has adopted a Resolution 11-04 in this regard and the Secretariat often receives requests to make these more concise and objective.

Accordingly in 2016 the Secretariat presented new publication guidelines for Executive Summaries, detailed reports and the SCRS Report. The Committee thanked the Secretariat for the work done to provide these revised guidelines. It was proposed that these guidelines should be brought to the awareness of the Commission in 2016, elaborating the intention of the SCRS to streamline the current Executive Summaries. Thereafter, the guidelines should be reviewed by the Working Group on Stock Assessment Methods (WGSAM) in 2017, particularly as regards those stocks for which it may not be possible to provide some of the information listed below (e.g. stock for which data poor models are used for the provision of advice). Using feedback from the WGSAM, the new guidelines would be revised and implemented for a few example species in 2017. Based on this comparative work, the SCRS were in a better position to potentially recommend the adoption of these guidelines in 2017. Due to the lack of time during the 2017 plenary session it was decided to postpone the discussions on this item to 2018.

In 2017 the WGSAM agreed on the need to better standardize the SCRS Executive Summaries. The Group recalled that the SCRS already provided guidelines for the standardization of the Executive Summaries as did the Commission through Res. 11-14, Res. 11-17, and Res. 13-15. Therefore, the current lack of standardization among some of the SCRS Executive Summaries is more the result of the different Species Groups not complying with the established guidelines than the lack thereof. The Group expressed concern that the proposed templates might result in an oversimplification of the information that is currently provided to the Commission in the Executive Summaries. For example, the proposed use of summary tables using colours to depict stock status was rejected by the Group as this approach cannot convey the complexities and caveats associated with the determination of stock status. In other words, the Group strongly felt that the best way to provide all the important information associated to the stock status determination and the management advice was by providing detailed explanatory text and that the SCRS should not provide a 'shortcut' in the form of the mentioned tables. The Group discussed that, generally speaking, the Commission only uses the SCRS Annual Reports to guide their discussions and that, only rarely, the Commission takes into consideration the information provided in the Detailed Reports. Therefore, the Group felt that reducing the information provided in the Executive Summaries might not be the best approach to guide the Commission in their deliberations. In addition, there is a disparity in the information provided by the Species Groups given the differences in the fisheries and the available data. Hence, the Group agreed that the proposed guidelines were not flexible enough to accommodate all situations.

The Chair introduced his proposals regarding the new publication guidelines.

Discussion

There was discussion on two separate components of the Chair's proposals, regarding the roles and responsibilities, including the deadlines for distribution and corrections related to SCRS documents and on the format of the Executive Summary. It was emphasized that Detailed Reports, data and analyses compiled in stock assessments and Executive Summaries are only adopted by the SCRS at the end of the plenary session.

With respect to the proposed changes to the Executive Summary it was noted that format of the Executive Summary had been discussed by the SCRS before without resolution and that in order to make progress, some feedback from Commissioners was needed. Accordingly, it was agreed to provide the Commission with the current examples of new Executive Summaries as a means to seek such feedback. Furthermore, the Committee agreed to modify such examples by distinguishing the colour of the two yellow quadrants of the current Kobe plot. For consistency with other tRFMOs, the upper right quadrant should be orange. A second request would be to make sure that the three Kobe matrices (probability in the green quadrant, probability of not overfishing and probability of not overfished) would be always included in the report. It was recommended that the Rapporteurs of Tropical Tunas and Swordfish Species Groups update their example Executive Summary documents for yellowfin tuna and northern swordfish, respectively.

The Committee agreed to consider feedback of the Commission on the new proposed format for Executive Summaries, and to deliberate again at the next SCRS plenary with a view of improving the format of the Executive Summaries.

The Committee agreed to the addition of a list of acronyms to the annual SCRS Report as proposed by the Chair (**Appendix 19**).

The Committee supported the idea of adding a table summarizing stock status of all assessed ICCAT species. Some modifications were done to the format of such table:

1) eliminate the column corresponding to management advice;
2) eliminate the row of TAC;
3) use the four colour coding convention for stock status, and
4) represent the historic stock status according to the results of the last assessment.

The Committee agreed that rapporteurs of Species Groups should be in a position to assist the Secretariat in 2019 by completing this table for each of the stocks their Group has assessed. The Committee will review such summary table for inclusion in the 2019 annual SCRS Report.

20.6 Peer review publication (SCRS documents): Agreement with Aquatic Living Resources journal

There has been an ongoing issue to identify SCRS papers that would be identified and submitted to a peer review journal. The Committee agreed to a proposal to have each Species Group Chair identify, in their work plans for 2020, a specific paper that will be put forward for publication in the primary literature. When possible, Species Group Chairs should identify such paper in 2019 also, even if it is not an objective of their current work plan.

20.7 Financial assistance for Rapporteurs from developing CPCs

The strategic research plan calls for an increase in the number of SCRS officers from developing CPCs. Although there has been progress made in this aspect, the ability of developing country scientists to take this position continues to be hampered by the cost associated with the travel to meetings of the SCRS meetings. Currently, ICCAT supports the travel of one developing country scientist to each SCRS meeting.

The SCRS Chair proposes to the Commission that SCRS officers from developing countries are provided financial support by ICCAT to attend the meetings that they chair, and that such support does not count toward the limit of one SCRS scientist per meeting mentioned above. This proposal aims at enhancing the number of participants from such CPCs in the SCRS meetings, which is currently limited due to the fact that according to the *Rules of Procedure for the Administration of the Special Meeting Participation Fund* only one delegate from each developing CPC can receive financial assistance to each SCRS meeting.

Discussion

The Committee agreed to recommend the Commission that SCRS officers from developing CPCs should be funded to attend the meetings that they Chair. This funding will not count towards the limit of one scientist per CPC to be funded from ICCAT funds that support attendance of developing country scientists to SCRS meetings.

21. Current workload and election of the Chair

21.1 Considerations on current workload of the SCRS Chair

The SCRS Chair put forward for the consideration of the Committee a document (SCI_84) describing the role of the SCRS and the process for selection of the SCRS Chair as defined in the Basic Texts of the Commission, which also defines the types of scientists that can provide input to the Commission processes. The Chair also noted that ICCAT has increased the scope of its responsibilities and has increased the demands for scientific advice from the SCRS. He also highlighted the fact that in recent years, the demands for an MSE process have also increased significantly the work of the SCRS. Furthermore, that the Commission has accepted that improved scientific advice requires increased communication within and across the different subsidiary bodies of the Commission, including the SCRS. The SCRS Chair has to have the ability to communicate scientific results to a wide audience including other scientists and to the Commission. This evolution has also shaped the role of the SCRS Chair who is currently expected to be responsible for a number of activities and attend many meeting throughout the year.

As such, the Chair came up with a proposal for the position of SCRS Vice-Chair, which would be responsible for an agreed subset of the responsibilities of the SCRS Chair that have been delegated to her/him. The lists of responsibilities taken over by the Vice Chair should be clearly defined and maintained for the duration of one term (2 years) of the Chair's appointment. In the process of supporting the appointment of the SCRS Chair and Vice-Chair the SCRS would also support the sharing of responsibilities of these two positions.

Discussion

The Committee thanked the Chair for his substantial contributions to the SCRS. In general, the Committee was supportive of the concept of having a Vice-Chair and debates about how the Chair would be identified and selected ensued. Moreover, the Committee noted that one tack for addressing the high workload problem of the Chair would be to manage the Committee's commitments in such a way that the overall workload was reduced.

The Committee reviewed the following proposal:

- For all meetings, other than the SCRS plenary, either the SCRS Chair or their Vice-Chair would attend the meeting;
- Only the Chair would be elected by the SCRS.

With respect to the election of the Vice-Chair, the Committee decided that while they would prefer to elect only the Chair, they would like to know the Vice-Chair and the linguistic capacities of both.

The proposal that was agreed was to elect a candidate, and that the individual would then be asked if they would propose a Vice-Chair or not. If a Vice-Chair is proposed, he/she would be named by the Chair candidate. The linguistic competencies of both the Chair and the Vice-Chair would be considered.

The Committee recommends the Commission to ensure the necessary funds to provide financial support for the SCRS Vice-Chair to attend the annual meetings of the SCRS and Commission. In addition, the Commission should also provide for financial support for the SCRS Vice-Chair to attend intersessional meetings not attended by the Chair.

21.2 Election of the Chair

The outgoing SCRS Chair (Dr David Die) opened the proceedings for the election of the new SCRS Chair. He reiterated the responsibility of the position especially with regard to the implementation of the new Science Strategic Plan of the SCRS. He noted the SCRS commitment to scientific transparency and dialogue which are among the main values to take into account when considering the position.

Dr Gary Melvin (Canada) was nominated for the position of Chair. He thanked the Committee for their nomination. He appreciated the opportunity to have a Vice-Chair and proposed that the Vice-Chair be the current Swordfish Species Group Coordinator, Dr Rui Coelho (Portugal). The Vice-Chair indicated his willingness to take the position.

The outgoing Chair congratulated the newly elected Chair and Vice-Chair and expressed his gratitude for the support of the CPCs and the responsibility entrusted to them. The ICCAT Executive Secretary expressed his congratulations to the new Chair and Vice-Chair for their willingness to stand for this difficult positions and ensured the commitment of the Secretariat to fully collaborate and support them during the upcoming 2-year mandate. The Executive Secretary then thanked Dr Die for his work, and presented a token of appreciation on behalf of the Secretariat and the SCRS.

The Executive Secretary's congratulations to Dr Die were reiterated by the Committee who also welcomed the new Chair and Vice-Chair and expressed their gratitude to Dr Melvin and Dr Coelho for their participation in this important SCRS process. Dr Melvin and Dr Coelho thanked the SCRS for its support and wished D. Die the best, as well as his continued support. Lastly, Dr Die expressed his gratitude for the privilege of representing the SCRS.

22. Adoption of report and closure

The Chair thanked the SCRS for its hard work this year.

Dr Die thanked the Secretariat staff for their excellent work, as well as appreciating their professional attitude. Dr Die then expressed his appreciation towards the interpreters.

The Executive Secretary showed his appreciation towards Dr Die for the work carried out during his fourth Plenary meeting as SCRS Chair. Mr. Camille Jean Pierre Manel also thanked Dr Die for the trust he placed in the Secretariat and expressed his appreciation towards the Secretariat staff for their efforts in supporting the SCRS work throughout the year and during the meeting. Finally, Mr. Manel thanked the interpreters for their hard work during the week and wished everyone a safe journey home.

The Report of the 2018 SCRS meeting was adopted and the 2018 Meeting of the SCRS was adjourned.

Appendix 1

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. Report of inter-sessional SCRS meetings
   - 8.1 Bigeye data preparatory and stock assessment meetings
   - 8.2 Blue marlin data preparatory and stock assessment meetings
   - 8.3 MSE Bluefin tuna intersessional meeting
   - 8.4 MSE Northern swordfish intersessional meeting
   - 8.5 Small Tuna Species Group intersessional meeting
   - 8.6 Meeting of the ICCAT Working Group on Stock Assessment Methods
   - 8.7 Sharks Species Group intersessional meeting
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. Report of Research Programs
    - 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 Composition of Programmes Steering Committees
11. Report of the Meeting of the Sub-committee on Statistics
12. Report of the Meeting of the Sub-committee on Ecosystems and By-catch
    - 12.1 Ecosystem report card prototype
13. Considerations of implications of the Meeting of the Standing Working Group on Dialogue between Fisheries Scientists and Managers
14. Considerations of implications of the Intersessional Meeting of Panel 1
15. Progress related to work developed on MSE
    - 15.1 Joint t-RFMO MSE Working Group
    - 15.2 Work conducted for bluefin tuna
    - 15.3 Work conducted for northern albacore
    - 15.4 Work conducted for northern swordfish

15.5 Work conducted for tropical tunas

15.6 Coordination and resourcing of the ICCAT MSE processes

16. Report on the implementation of the Science Strategic Plan for 2015-2020 in 2018 and work plan for 2019, which includes the update of the stock assessment software catalogue

16.1 Reflections about the structure and work of the SCRS

17. Consideration of plans for future activities

17.1 Annual Work Plans and research programmes

17.2 Intersessional meetings proposed for 2019

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 recommendations

19. Responses to Commission's requests

19.1 Ghana's comprehensive and detailed capacity management plan on the level of catches. Rec. 16- 01, paragraph 12c

19.2 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

19.3 Recommendations made by the FAD Working Group (Annex 8) and develop a work plan. Rec. 16-01, paragraph 49 (a)

19.4 Develop a table that quantifies the expected impact on MSY, B_{MSY}, and relative stock status for both bigeye and yellowfin resulting from reductions of the individual proportional contributions of major fisheries to the total catch. Rec. 16-01, paragraph 49 (c)

19.5 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)

19.6 The SCRS should continue to monitor and analyze the effects of the minimum size/weight measure on the mortality of immature swordfish. Rec. 17-02 paragraph 10 (N-SWO) and Rec. 17-03 paragraph 7 (S-SWO)

19.7 The SCRS is requested to develop in 2018 criteria for the identification of exceptional circumstances. Rec. 17-04 paragraph 12 (N-ALB)

19.8 The SCRS is requested to initiate a peer-review, in time for the 2018 Commission meeting. Rec. 17-04 paragraph 15 (N-ALB)

19.9 Review on specific spawning times and areas of bluefin tuna in the western Atlantic. Rec. 17-06 paragraph 23 (W-BFT)

19.10 Provide guidance on a range of fish size management measures and their impact on yield per recruit and spawner per recruit considerations. Rec. 17-06 paragraph 27 (W-BFT)

19.11 Review the data on dead and live discards submitted by CPCs to determine the feasibility of estimating fishing mortality by commercial fisheries, recreational, and artisanal fisheries. Rec. 15-05 paragraph 10 (BIL)

19.12 Develop a new data collection initiative as part of the ICCAT Enhanced Program for Billfish Research to overcome gaps in fisheries catching billfish, particularly in artisanal fisheries. Rec. 15-05 paragraph 10 and Rec. 16-11 paragraph 3 (BIL)

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
    - 20.2 Collaboration with other International Organizations (ICES, CITES, GEF, etc.)
    - 20.3 Consideration of implications of the sixth Meeting of the Working Group on Convention Amendment
    - 20.4 Update of the ICCAT glossary
    - 20.5 Consideration of new publication guidelines: executive summaries, detailed reports and SCRS report
    - 20.6 Peer review publication (SCRS documents): agreement with Aquatic Living Resources journal
    - 20.7 Financial assistance for rapporteurs from developing CPCs
21. Current workload and election of the Chair
    - 21.1 Considerations on current workload of the SCRS Chair
    - 21.2 Election of the Chair
22. Adoption of report and closure

Appendix 2

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Appendix 3

List of 2018 SCRS Documents and Presentations

Reference	Title	Authors
SCRS/2018/001	Report of the Blue marlin data preparatory meeting	Anon.
SCRS/2018/002	Report of the Small Tunas Species Group intersessional meeting	Anon.
SCRS/2018/003	Report of the MSE Bluefin tuna Technical Working Group meeting	Anon.
SCRS/2018/004	Report of the MSE North Atlantic swordfish Technical Working Group meeting	Anon.
SCRS/2018/005	Report of the Bigeye tuna data preparatory meeting	Anon.
SCRS/2018/006	Report of the Working Group on Stock Assessment Methods	Anon.
SCRS/2018/007	Report of the Sub-Committee on Ecosystems intersessional meeting	Anon.
SCRS/2018/008	Report of the Blue marlin stock assessment session	Anon.
SCRS/2018/009	Report of the Sharks Species Group intersessional meeting	Anon.
SCRS/2018/010	Report of the Bigeye Tuna stock assessment session	Anon.
SCRS/2018/011	Report of the Sub-Committee on Statistics meeting	Anon.
SCRS/2018/012	Comprehensive study of Strategic Investments related to Artisanal Fisheries Data Collection in ICCAT Fisheries of the Caribbean/Central American Region: Interim Report (Part 1)	Arocha F.
SCRS/2018/013	Report of the ICCAT GBYP Planning Workshop on Atlantic Bluefin Tuna Reproductive Biology	Anon.
SCRS/2018/014	Assessing blue marlin catch rates based on Brazilian sport fishing tournaments (1996-2018), using a generalized linear model with tweedie distribution	Mourato B.L., Hazin H., Hazin F., Travassos P., and Amorim A.F.
SCRS/2018/015	Catch rate standardization for blue marlin caught by the Brazilian pelagic longline fleet (1978-2016)	Mourato B.L., Hazin H., Amorim A.F., Travassos P., and Hazin F.
SCRS/2018/016	Comparison of logbook data to observer data using a longline simulator with blue marlin as an example	Forrestal F., Schirripa M., and Goodyear C.P.
SCRS/2018/017	Habitat covariates for standardizing longline CPUE: an example with blue marlin	Goodyear C.P., Schirripa M., Forrestal F., and Lauretta M.
SCRS/2018/018	Standardizing us blue marlin longline CPUE using habitat covariates	Goodyear C.P., Forrestal F., Schirripa M., and Lauretta M.
SCRS/2018/019	Updated standardized CPUE of the Atlantic blue marlin caught by Japanese longliners	Ijima H.
SCRS/2018/020	Blue marlin (Tetrapturus albidus) standardized indices of abundance from the U.S. pelagic longline and recreational tournament fisheries	Lauretta M., and Goodyear C.P.
SCRS/2018/021	Catches of blue marlin *Makaira nigricans* (Lacepède, 1802) by artisanal fishers from Côte d'Ivoire, 1988-2016	Bahou L., Diaha C.N., Kouadio J.K., and Amandé J.M.

SCRS/2018/022	CPUE standardization of blue marlin (*Makaira nigricans*) for the Taiwanese distant-water longline fishery in the Atlantic Ocean for 1968-2016	Nan-Jay S., and Yi-Sin L.
SCRS/2018/023	On the catches of minor tunas by the EU purse seiners: data analysis and proposal to correct the task1 and to create task2 catch and effort and catch at size files for minor tunas landed by the EU purse seiners	Fonteneau et al.
SCRS/2018/024	Element de biologie de l'*auxis rocheï* échantillonnée au niveau de la cote algérienne centre.	K.Ferhani, A.Kouadri Krim
SCRS/2018/025	The current status of the small tuna fishery in Atlantic Ocean and Mediterranean: perspectives for stock assessment	Lucena Frédou, F. and Frédou, T.
SCRS/2018/026	Updated annual indices of spawning biomass of Little tunny, auxis sp., king mackerel, Spanish mackerel and common dolphin Based on ichthyoplankton surveys In the Gulf of Mexico (1986-2016)	Ingram, G.W. Jr., Hanisko, D.S., Pollack, A.G. and Zapfe, G.
SCRS/2018/027	Preliminary stomach contents analysis of bullet tuna *Auxis rochei* (Risso, 1810) in Tunisian waters	Hajjej G., Missaoui H., and Jarboui O.
SCRS/2018/028	Biological aspects of Atlantic Bonito *Sarda sarda* from Spanish and Portuguese waters	Saber S., Ortiz de Urbina J., Lino P.G., Gómez-Vives M.J., Ciércoles C., Coelho R., Lechuga R., and Macías D.
SCRS/2018/029	Biological aspects of Little Tunny *Euthynnus alletteratus* from Spanish and Portuguese waters	Saber S., Ortiz de Urbina J., Lino P.G., Gómez-Vives M.J., Coelho R., Lechuga R., and Macías D.
SCRS/2018/030	Annual abundance indices for wahoo based on recreational fishery surveys in the U.S. Gulf of Mexico and U.S. South Atlantic (1986-2015)	Ingram, G.W. Jr.
SCRS/2018/031	Etude de la biologie et de l'exploitation de la bonite à dos rayé au Sud du Maroc	Baibbat S., Abid N., Abdeillah I., Mohamed F., and Benazzouz B.
SCRS/2018/032	Standardization of bigeye tuna CPUE in the Atlantic Ocean by the Japanese longline fishery	Matsumoto et al.
SCRS/2018/033	The simplified evaluation of the possible future Russian small tunas by-catch	Petukhova, N.G
SCRS/2018/034	Etude de quelques paramètres de la biologie de reproduction de *Auxis rochei* (Risso, 1810) capture dans de Golfe Guinée par les Pêcheurs artisans	Edoukou A., Diaha N.C., Amandé M.J., Assan N.F, N'guessan Y., and N'da K.
SCRS/2018/035	Gender specific length-weight conversions for North and South Atlantic Swordfish	Hanke A., Coelho R., and SuN.-J.
SCRS/2018/036	An update of the revision of swordfish size and sex-ratios distribution in the Atlantic	Coelho R., Hanke A., SuN.-J., Bahou L., and Rosa D.
SCRS/2018/037	Bigeye (*Thunnus obesus*) bycatch estimates from the Albacore Spanish surface fishery in the North East Atlantic from 2015 to 2017	Ortiz de Zárate V., and Pérez B.
SCRS/2018/038	Combining dFAD catch data and ecological factors for detecting hotspots of juveniles of bigeye tuna: First results	Deledda G., Gaertner D., and Demarcq H.
SCRS/2018/039	Using AOTTP conventional tags to inform selectivity for bigeye tuna in the Eastern Atlantic Ocean	Gaertner D., Pascual Alayon P., Amande J., Goni N., N'Gom F., Pereira J., Addi E., and Beare D.

SCRS/2018/040	First estimate of tag-shedding for bigeye tuna in the Atlantic ocean from AOTTP data	Gaertner D., Goni N., Amande J., Pascual Alayon P., N'Gom F., Pereira J., Addi E., and Beare D.
SCRS/2018/041	Potential further considerations on the conditioning of Operating Models of Atlantic bluefin tuna	Kimoto A., Walter J., Lauretta M., Sharma R., and Rouyer T.
SCRS/2018/042	Propose of stock assessment model specification of bigeye tuna in the Atlantic Ocean	Satoh K., Yokoi H., Takayuki M., and Kitakado T.
SCRS/2018/043	Relative habitat size for swordfish stocks based on a global habitat model	Arrizabalaga H., Erauskin M., and Coelho R.
SCRS/2018/044	Geographical variability in the amount of BET caught under FADs by purse seiners in the Eastern Atlantic: from the multispecies samples and the ICCAT statistics	Fonteneau A. and Pascual-Alayón P.J.
SCRS/2018/045	An overview of statistical problems identified for bigeye in the ICCAT statistics of purse seine fisheries	Fonteneau A. and Pascual-Alayón P.J.
SCRS/2018/046	Do Atlantic bigeye tuna tag-recapture data support a two-stanza growth model? An exploration incorporating recent data from ICCAT/AOTTP	Arregui I., Goñi N., Ngom-Sow F., Addi E., Amandè M.J., Pereira J.G., Pascual P.J., Gaertner D., and Murua H.
SCRS/2018/047	Results for initial explorations of simple candidate "fixed proportion" MPs for Atlantic Bluefin tuna based on the operating models package circulated	Butterworth D.S., Miyagawa M., and Jacobs M.R.A.
SCRS/2018/048	The tuna fisheries on 'associated school' in Brazil: description and trends	Silva G.B., Hazin H.G., Hazin F.H.V., and Travassos P.
SCRS/2018/049	Standardized CPUE of bigeye tuna, *Thunnus obesus*, based on data gathered by the National Observer program on board the Uruguayan longline fleet (2003-2012)	Forselledo R., Mas F., Pons M., and Domingo A.
SCRS/2018/050	Length-length and length-weight relationships for bigeye tuna, *Thunnus obesus*, caught by longliners in the Southwestern Atlantic Ocean	Mas F., Forselledo R., Ortiz M., and Domingo A.
SCRS/2018/051	Standardized CPUE of bigeye tuna (*Thunnus obesus*) of the Taiwanese longline fisheries operated in the Atlantic Ocean (1967-2016)	Hsiang-Wen H.
SCRS/2018/052	Catch rate standardization for bigeye tuna caught by the Brazilian pelagic longline fleet (1978-2016)	Hazin H., Sant´Ana R., Mourato B.L., Travassos P., Silva G., and Hazin F.
SCRS/2018/053	Brazilian tuna fisheries: an review (2010 – 2016)	Hazin H., Hazin F., and Travassos P.
SCRS/2018/054	Standardized catch rates of bigeye tuna (*Thunnus obesus*) from the United States pelagic longline fishery	Walter J., and Lauretta M.
SCRS/2018/055	Designing and testing a multi-stock spatial management procedure for Atlantic bluefin tuna	Carruthers T.
SCRS/2018/056	Statistics of the European and associated purse seine and baitboat fleets, in the Atlantic ocean (1991-2017)	Pascual-Alayón P., Floch L., Dewals P., Irié D., Amatcha A.H., Amandè M-J., and N'Gom F.
SCRS/2018/057	Estadística de las pesquerías Españolas atuneras, en el Océano Atlántico tropical, período 1990 a 2017	Pascual-Alayón P., Rojo V., Amatcha H.,N' Sow F., Ramos M.L., and Abascal F.J.

SCRS/2018/058	Collaborative study of bigeye tuna CPUE from multiple Atlantic Ocean longline fleets in 2018	Hoyle S.D., Hsiang-wen J.H., Kim D.N., Lee M.K., Matsumoto T., and Walter J.
SCRS/2018/059	A candidate Management Procedure for bluefin tuna	Hanke A.
SCRS/2018/060	Standardized bigeye tuna CPUE index of the baitboat fishery based in Dakar (2005-2017)	Santiago J., Merino G., Murua H., and Pascual-Alayón P.
SCRS/2018/061	Caractérisation du sexe ratio du patudo (*Thunnus obesus*) dans l'Atlantique Est à partir des débarquements des thoniers senneurs	Amandè M.J., Diaha N.C., Guillou A., Sabarros P., Pascual P., Floch L., Dewals P., N'Guessan Y., Hervé A, Irié B. Y., Cauquil P., and Bach P.
SCRS/2018/062	Updated fishery statistics of tuna species caught off Madeira archipelago	Gouveia L., Amorim A., Alves A., and Hermida M.
SCRS/2018/063	Characterizing exceptional circumstances in iccat: a summary of experience in other RFMOs	Arrizabalaga H., Merino G., Murua H., and Santiago J.
SCRS/2018/064	Analytical approach for management strategy evaluation	Mikhaylov A.
SCRS/2018/065	Trends in total mortality using a length-based indicator applied to Atlantic blue marlin (Makaira nigricans)	Schirripa M. and C.P. Goodyear
SCRS/2018/066	A method for nonlinear standardization of zero-inflated CPUE to account for mesoscale oceanographic variability	Alvarez-Berastegui D., Ingram Jr. G.., Rueda L., and Reglero P.
SCRS/2018/067	Extending the indicator-based ecosystem report card to the Atlantic ecosystem; a preliminary example based on the Sargasso Sea	Kell L.T., and Luckhurst B.
SCRS/2018/068	Socio-economic aspects of the iccat fisheries	Tsuji S., and Sabarros P.
SCRS/2018/069	Indicators for ICCAT species that are retained and assessed	Hanke A.R., Juan-Jordá M.J., and Coelho R.
SCRS/2018/070	Indicators for ICCAT species that are retained but not currently assessed	Hanke A.R., and de Bruyn P.
SCRS/2018/071	An assessment of marine turtles interactions with longline gear in the North Atlantic Ocean	Swimmer Y., and Hanke A.
SCRS/2018/072	An assessment of marine mammal interactions with longline gear in the North Atlantic Ocean	Hanke A.R., and de Bruyn P.
SCRS/2018/073	A proposal of ecosystem indicators to monitor the trophic relationships component for the ICCAT ecosystem report card	Juan-Jordá M.J., Zarrad R., and Hanke A.
SCRS/2018/074	ACAP advice for reducing the impact of pelagic longline fishing operations on seabirds	Wolfaardt A., and ACAP Seabird Bycatch Working Group
SCRS/2018/075	Update on the seabird component of the Common Oceans tuna project – seabird bycatch assessment workshop	Abraham E., Carneiro A., Fahmi Z., Inoue Y., Kathena J.N., Kim D.N., Lee S.I., Maree B., Oshima K., Parsa M., Rice J., Sant'Ana R., Sharma R., Small C., Tsuji S., Wanless R., Winker H., and Wolfaardt A.
SCRS/2018/076	Thoughts for developing a potential indicator for non-retained sharks in support of an ecosystem report card	Cortés E., Coelho R., Domingo A., (and Tolotti M.)
SCRS/2018/077	Selecting ecosystem indicators for fisheries targeting highly migratory species	Juan-Jordá M.J., and Murua H. (on behalf of consortium members)

SCRS/2018/078	At-sea trialling of the HOOKPOD: a 'one-stop' mitigation solution for seabird bycatch in pelagic longline fisheries	Sullivan B.J., Kibel B., Kibel P., Yates O., Potts J.M., Ingham B., Domingo A., Gianuca D., Jiménez S., Lebepe B., Maree B.A., Neves T., Peppes F., Rasehlomi F., Silva-Costa A., and Wanless R.M.
SCRS/2018/079	Listado de especies de peces (excluyendo túnidos) capturadas de forma accesoria por la flota de cerco tropical española en el área ICCAT	Báez J.C., Pascual-Alayón P., Ramos M.L., and Abascal F.J.
SCRS/2018/080	Report of collaborative work to assess sea turtle bycatch in pelagic longline fleets operated in the Atlantic Ocean	Oshima K., Giffoni B., Forselledo R., Sales G., and Domingo A.
SCRS/2018/081	Standardization of bigeye tuna CPUE in the Atlantic Ocean by the Japanese longline fishery which includes cluster analysis	Matsumoto T., Satoh K., Kitakado T., and Hoyle S.
SCRS/2018/082	Environmental variability in three major Mediterranean tuna spawning grounds	Alvarez-Berastegui D., Mourre B., Saber S., Ortiz de Urbina J., Macías D., and Reglero P.
SCRS/2018/083	Report of the Workshop II: Collaborative work to assess seabird bycatch in pelagic longline fleets (South Atlantic and Indian Oceans)	Anon.
SCRS/2018/084	Effects of the best practices to reduce seabird bycatch in pelagic longline fisheries on other threatened, protected and bycaught megafauna species	Jiménez S., Forselledo R., and Domingo A.
SCRS/2018/085	Observations on interaction between seabirds and the Spanish surface longline fishery targeting swordfish in the Atlantic Ocean during the period 1993-2017	Fernández-Costa J., Ramos-Cartelle A., Carroceda A., and Mejuto J.
SCRS/2018/086	HOOKPOD trials in Brazilian pelagic longline fishery, from 2011 to 2017	Gianuca D., Costa A., Sampaio G.C., Neves T.
SCRS/2018/087	A trial evaluation of the effectiveness of the use of circle hooks to reduce mortality of shortfin mako shark in pelagic long line fisheries - mortality of shortfin mako shark on circle hooks vs j-hooks	Semba Y., Kai M., Oshima K., Ochi D., and Honda H.
SCRS/2018/088	Proposals of discussion for the re-evaluation of stock status for the Atlantic shortfin mako	Semba Y., Kai M., and Honda H.
SCRS/2018/089	Análisis de la captura, distribución de longitud, relación longitud-peso y proporción de sexo del marlín azul (*Makaira nigricans*) capturado incidentalmente por la flota palangrera mexicana en el golfo de México	Ramírez- López K., and Gutiérrez-Benítez O.
SCRS/2018/090	Catch estimates and size compositions of blue marlin for the Taiwanese tuna longline fishery in the Atlantic Ocean	Su N.-J., and Lu Y.-S.
SCRS/2018/091	Stock assessment of Atlantic blue marlin (*Makaira nigricans*) using a Bayesian state-space surplus production model JABBA	Mourato B.L., Winker H., Carvalho F., and Ortiz M.
SCRS/2018/092	Unifying parameterizations between age-structured and surplus production models: an application to Atlantic blue marlin (*Makaira nigricans*)	Winker H., Carvalho F., Sow F.N., and Ortiz M.
SCRS/2018/093	Canada's biological sampling program of Atlantic Bluefin tuna (*Thunnus thynnus*)	Dalton A., and Hanke A.

SCRS/2018/094	Habitat use and migrations of shortfin mako in the Atlantic using satellite telemetry	Santos C.C., Domingo A., Carlson J., Natanson L., Cortes E., P. Miller P., and Coelho R.
SCRS/2018/095	Age and growth of shortfin mako in the South Atlantic	Rosa D., Mas F., Mathers A., Natanson L.J., Domingo A., Carlson J., and R. Coelho
SCRS/2018/096	An updated revision of shortfin mako size distributions in the Atlantic	Coelho R., Domingo A., Courtney D., Cortés E., Arocha F., Liu K-M., Yokawa K., Yasuko S., Hazin F., Bowlby H., Abid N., Rosa D., and Lino P.G.
SCRS/2018/097	Current status of the blue marlin (*Makaira nigricans*) stock in the Atlantic Ocean 2018: Pre-decisional stock assessment model	Schirripa M.
SCRS/2018/098	Exploitation des requins en Algérie	Labidi-Neghli N.
SCRS/2018/099	Continuity stock assessment for Atlantic bigeye using a biomass production model	Merino G., Murua H., Urtizberea A., Santiago J., Winker H., and Walter J.
SCRS/2018/100	Alternatives for the stock assessment for Atlantic bigeye using a biomass production model	Merino G., Murua H., Urtizberea A., Santiago J., Winker H., and Walter J.
SCRS/2018/101	Standardized catch rates of shortfin mako sharks Caught by the Brazilian tuna longline fleet (1978-2016) using generalized linear mixed models (GLMM)	Hazin F.H.V., Hazin H.G., Sant'Ana R., and Mourato B.
SCRS/2018/102	Spatiotemporal distribution of shortfin mako sharks (*Isurus oxyrinchus*) in southwestern Atlantic waters: Possible influence of climatic and environmental drivers	Hazin H., Comassetto L., Mourato B., Afonso A.S., Sant'Ana R., Da Mata-Oliveira I., Menezes R., and Hazin F.H.V.
SCRS/2018/103	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 Baibbat S.
SCRS/2018/104	Shortfin mako (*Isurus oxyrinchus*) bycatch fishery in the south of the Moroccan Atlantic waters	Baibbat S.A., Abid N., Serghini M., and Ikkiss A.
SCRS/2018/105	Post-release mortality of shortfin mako in the Atlantic using satellite telemetry: preliminary results	Domingo et al
SCRS/2018/106	Datos estadísticos de la pesquería de túnidos de las Islas Canarias durante el periodo 1975 a 2017	Delgado de Molina R.A.
SCRS/2018/107	Outline of a risk analysis approach to address recent Commission recommendations to reduce mortality for north Atlantic shortfin mako	Courtney D., Coelho R., and Rosa D.
SCRS/2018/108	Updated standardized bigeye tuna CPUE of Taiwanese longline fishery in the Atlantic Ocean	Hoyle S.D., and Huang J.H.
SCRS/2018/109	Estimation of Ghana tasks i and ii purse seine and baitboat catch 2006 – 2017: data input for the 2018 bigeye stock assessment	Ortiz M., and Palma C.
SCRS/2018/110	Bayesian State-Space Surplus production model JABBA assessment of Atlantic bigeye tuna (*Thunnus obesus*) stock	Winker H., Kerwath S., Merino G., and Ortiz M.
SCRS/2018/111	Atlantic bigeye tuna stock assessment in Stock Synthesis	Walter J., Hiroki Y., Satoh K., Matsumoto T., Urtizberea-Ijurco A., Ortiz M., and Schirripa M.

SCRS/2018/112	A simple operating model for a basis of a discussion about the development of a management strategy evaluation for tropical tuna fisheries	Urtizberea A., Merino G., García D., Korta M., Santiago J., Murua H., Walter J., Die D., and Gaertner D.
SCRS/2018/113	Evaluation of variants to the Harvest Control Rule adopted in 2017 for north Atlantic albacore	Merino G., Arrizabalaga H., and Santiago J.
SCRS/2018/114	Comprehensive study of Strategic Investments related to Artisanal Fisheries Data Collection in ICCAT Fisheries of the Caribbean/Central American Region: Draft final Report	Arocha F.
SCRS/2018/115	Canada's biological sampling program of Atlantic bluefin tuna (*Thunnus thynnus*)	A. Dalton and A. Hanke
SCRS/2018/116	Using effort control measures to implement catch capacity limits in ICCAT PS fisheries	R. Sharma and M. Herrera
SCRS/2018/117	Updated U.S. time series of shortfin mako shark landings for 1996-2016	Guillermo Diaz
SCRS/2018/118	The Spanish albacore (*Thunnus alalunga*) surface fishery operating in the North Eastern Atlantic in 2016 and 2017.	V. Ortiz de Zárate, P. Quelle, M. Ruiz
SCRS/2018/119	Using FADs to develop better abundance indices for tropical tuna	Herrera M., and Baez J.C.
SCRS/2018/120	Is the bluefin tuna slowly returning to the black sea? Recent evidences	Di Natale A., Tensek S., and Pagá García A.
SCRS/2018/121	Preliminary information on the Atlantic bluefin tuna (*Thunnus thynnus*) fishery in Lebanon	Bariche M., and Di Natale A.
SCRS/2018/122	Due to the new scientific knowledge, is it time to reconsider the stock composition of the Atlantic bluefin tuna?	Di Natale A.
SCRS/2018/123	Short note about the presence of bluefin tuna YOY in the Southern Spanish Atlantic waters in 2018	Di Natale A., López González J.A.
SCRS/2018/124	Evaluation of fishery impact on bigeye tuna spawning biomass in the Atlantic Ocean	Satoh K., Matsumoto T., Yokoi H.,and Kitakado T.
SCRS/2018/125	Supervised learning approach for detecting presence-absence of tuna under drifting FADs from echo-sounder buoys data	Baidai Y., Capello M., Amande M.J., Gaertner D., and Dagorn L.
SCRS/2018/126	New protocol to avoid bias in otolith readings of Atlantic bluefin tuna juveniles	Rodriguez-Marin E., Quelle P., Busawon D., and Hanke A.
SCRS/2018/127	Juvenile Atlantic bluefin tuna otoliths exchange	Rodríguez-Marín E., Quelle P., Busawon D., Addis P., Allman R., Bellodi A., Farley J., Garibaldi F., Ishihara T., Karakukak S., Koob E., Lanteri L., Luque P.L., and Ruiz M.
SCRS/2018/128	2018 attempts to tagging large Atlantic bluefin tunas for future large scale deployments in the Mediterranean	Rouyer T., Bonhommeau S., Giordano N., Giordano F., Wendling B., Ellul S., Ellul G., Psaila M.A., Deguara S., Bernard S., and Kerzerho.
SCRS/2018/129	Update of the French aerial survey index of abundance and first attempt at integrating bluefin tuna school size estimates from video cameras	Rouyer T., Brisset B., Tremblay Y., and Fromentin J.-M.
SCRS/2018/130	Updated fishing capacity estimates for bluefin tuna in the Eastern Atlantic and Mediterranean Sea	Rouyer T., and Miller S.

SCRS/2018/131	Statistics of the French purse seine fishing fleet targeting tropical tunas in the Atlantic Ocean (1991-2017)	Floch L., Depetris M., Duparc A., Lebranchu J., Hervé A., and Bach P.
SCRS/2018/132	Distribution de fréquence de taille de l'Espadon *Xiphias gladius* échantillonné le long de la côte Algérienne	Krim A.K., and Bouhadja A.
SCRS/2018/133	A mixture model interpretation of stock of origin data for Atlantic bluefin tuna	Carruthers T., and Butterworth D.S.
SCRS/2018/134	Updated summary of conditioned operating models for Atlantic bluefin tuna	Carruthers T., and Butterworth D.S.
SCRS/2018/135	Bluefin CPUE time series and catch at age of the Balfegó purse seine joint fishing fleet in Balearic waters from 2003 to 2018	Gordoa A.
SCRS/2018/136	On the potential biases of scientific estimates of catches of tropical tunas of purse seiners the EU and other countries report to the ICCAT and IOTC	Herrera M., and Báez J.C.
SCRS/2018/137	Determination of length-weight equation applicable to Atlantic bluefin tuna (*Thunnus thynnus*) in the Mediterranean Sea	Lombardo F., Gioacchini G., Pappalardo L., Baiata P., Candelma M., Pignalosa P., and Carnevali O.
SCRS/2018/138	Length-weight relationships for the Mediterranean swordfish, Xiphias gladius L.	Lombardo F., Gioacchini G., Pappalardo L., Candelma M., Pignalosa P., and Carnevali O.
SCRS/2018/139	Localisation des captures de thon rouge réalisées par les thoniers senneurs Algériens en 2016 et 2017	Krim A.K.
SCRS/2018/140	Model diagnosis for stock synthesis on bigeye tuna in the Atlantic Ocean	Yokoi H., Matsumoto T., Satoh K., and Kitakado T.
SCRS/2018/141	How much tags recovered onboard purse-seiners from multi-sets wells can impact the estimation of the growth and movements parameters?	Akia S., Amandé J.M., and Gaertner D.
SCRS/2018/142	Peer review of the code and algorithms used within the management strategy evaluation framework for the north Atlantic albacore stock	Sculley M.
SCRS/2018/143	Preliminary evaluation of a candidate management procedure for Atlantic bluefin tuna	Merino G., Arrizabalaga H., Santiago J., Gordoa A., and Rouyer T.
SCRS/2018/144	Linking tuna recruitment with spontaneous spawning activities of sea-cage farmed bluefin tuna in the Adriatic Sea	Šegvić-Bubić T., Grubišić L., Žužul I., Lepen-Pleić I., Talijančić I., Tičina V., and Katavić I.
SCRS/2018/145	Acoustic-based fishery-independent abundance index of juvenile bluefin tunas in the Bay of Biscay: results from the first three surveys and challenges	Goñi N., Uranga J., Arregui I., Onandia I., Martinez U., Boyra G., Melvin G.D., Godard I., and Arrizabalaga H.
SCRS/2018/146	The steps to consider during the conditioning of the OMS of a multispecific model of tropical tuna fisheries in a Management Strategy Evaluation frame work	Urtizberea A., Merino G., García D., Korta M., Harford W., Die D., Walter J., Gaertner D., Santiago J., and Murua H.
SCRS/2018/147	Management procedure options for a Management Strategy Evaluation in tropical tuna fisheries	Urtizberea A., Merino G., García D., Harford W., Die D., Walter J., Gaertner D., Santiago J., and Murua H.
SCRS/2018/148	External review of ICCAT bigeye tuna stock assessment	Fernandez C.

SCRS/2018/149	An update of the longline fishery targeting swordfish (*Xiphias gladius*) in the south Atlantic coast of Morocco	Ikkiss A., Baibbat S.A., and Abid N.
SCRS/2018/150	Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP) by numbers: progress towards objectively verifiable indicators	AOTTP coordination team
SCRS/2018/151	Research priorities concerning upcoming ICCAT-AOTTP tagging data analyses	Ailloud L., and Beare D.
SCRS/2018/152	Estimating density of non-tracked dFAD with spatial capture-recapture models	Guéry L. , Kaplan D., Gimenez O., and Gaertner D.
SCRS/2018/153	A proposal for diagnostic and presentation of uncertainty in stock projections	Kimoto A., Ortiz M.
SCRS/2018/154	Increase in growth rates of Atlantic Bluefin Tuna (*Thunnus thynnus*) juveniles over prolonged caging in the Central Eastern Adriatic	Katavic I., Grubisic L., and Segvić-Bubic T.
SCRS/2018/155	Improving the sampling protocol of electronic and human observations of tropical tuna purse seiner discards	Briand K., Sabarros P.S., Maufroy A., Relot-Stirnemann A., Le Couls S., Goujon M., and Bach P.
SCRS/2018/156	Are life-history parameters for bluefin tuna anomalous?	Carruthers T, and Hordyk A.
SCRS/2018/157	An Operating Model for the North Atlantic Swordfish: an output from the Capacity Building Training Workshops in MSE analysis	D. Rosa, Schirripa M., Mosqueira I., and R. Coelho
SCRS/2018/158	The use of instrumented buoys to monitor the activity of the purse seine fleet fishing on FADs	Grande M, Santiago J., Zudaire I., Ruiz J., Murua J., and Murua H.
SCRS/2018/159	Best standards for data collection and reporting requirements on FOBs: towards a science-based FOB fishery management	Grande *M, Baez J.C., Ramos M.L., Ruiz J., Zudaire I., Murua H., Santiago J., Pascual P., Abascal F., Gaertner D., Cauquil P., Floch L., Maufroy A., Muniategi A., and Herrera M.
SCRS/2018/160	An Atlantic and Mediterranean-wide sampling programme for swordfish growth, reproduction and genetics	Gillespie K.M., and Hanke A.R.
SCRS/2018/161	Consideraciones sobre proporción de sexos de marlín azul (*Makaira nigricans*) en el Golfo de México	Ramírez-López K.
SCRS/2018/162	Atlantic bigeye tuna stock synthesis projections and Kobe 2 matrices	Walter J., Hiroki Y., Satoh K., Matsumoto T., Winker H., Urtizberea A., and Schirripa M.
SCRS/2018/163	Annual summer forecasts of the northern habitat of north Atlantic bluefin tuna	Payne M.R., and MacKenzie B.R.
SCRS/2018/164	Electronic tagging of adult bluefin tunas by sport fishery in the Skagerrak, 2017	MacKenzie B.R., Aarestrup K., Birnie-Gauvin K., Cardinale M., Casini M., Harkes I., Onandia I., Quilez-Badia G., and Sundelöf A.
SCRS/2018/165	Updated standardized joint CPUE index for bluefin tuna (*Thunnus thynnus*) caught by Moroccan and Portuguese traps for the period 1998-2017	Lino P.G., Abid N., Malouli M.I., and Coelho R.
SCRS/2018/166	Design document for the north Atlantic swordfish management strategy evaluation. Operating model (OM) and observation error model	Kell L.T., and Levontin P.

SCRS/2018/167	Potential management procedures for north Atlantic swordfish	Kell L.T., and Levontin P.
SCRS/2018/168	A comparative review of size-weight relationships in North Atlantic Swordfish *(Xiphias gladius)* based on records obtained in the Spanish surface longline fleet	Ramos-Cartelle A., García-Cortés B., González-González I., Carroceda A., Fernández-Costa J., and Mejuto J.
SCRS/2018/169	Considerations regarding combined strategies for gathering information and sampling of multiple variables for statistical tasks and scientific studies regarding fisheries targeting tuna and tuna-like species: ethical reflections on scientific activity in the context of the t-RFMO	Mejuto J.
SCRS/2018/170	A review of sex-ratio patterns in the Atlantic Swordfish (*Xiphias gladius*): background, progress, updates and limitations	Mejuto J.
SCRS/2018/171	ICCAT Atlantic-Wide Research Programme for Bluefin Tuna (GBYP) Activity report for the last part of Phase 7 and the first part of the Phase 8	Alemany F., Tensek S.and Pagá García A.
SCRS/2018/172	Review and insights into the differences in reproductive parameter estimates between Eastern and Western Atlantic bluefin tuna stocks	Farley J., Ohshimo S.
SCRS/2018/173	Preliminary analysis of bluefin tuna depth and temperature preferences revealed by ICCAT GBYP electronic tags	Tensek S. Pagá García A., and Alemany F.
SCRS/2018/174	Shiny application for visualisation of movements of electronic tags deployed within ICCAT GBYP	Tensek S.
SCRS/2018/175	ICCAT GBYP aerial survey for bluefin tuna spawning aggregations in 2018	Vázquez BonalesJ.A. , Cañadas A., Alemany F., Tensek S., and Pagá García A.
SCRS/2018/176	Overview of the bluefin tuna data recovered by GBYP in the first part of Phase 8	Pagá García, A., Tensek, S. and Alemany, F.,
SCRS/2018/177	Preliminary results of the north Atlantic albacore tuna reproductive biology study	Arocha F., Narváez M., Ariza A., and Núñez J.G.
SCRS/2018/178	Electronic tagging of bluefin tunas in Scandinavian waters 2018	Birnie-Gauvin K., MacKenzie B.R., and Aarestrup K.
SCRS/2018/179	Overview of bluefin and other tuna research conducted at technical University of Denmark since early 2000s	MacKenzie B.R., Aarestrup K., Mariani P., Nielsen A., Payne M.R., Thygesen U.H.
SCRS/2018/180	Update of the Gulf of St Lawrence Atlantic bluefin tuna fishery independent acoustic index of abundance	Melvin G.D., and Minch T.
SCRS/2018/181	Further investigations of simple “fixed proportion” candidate management procedures for north Atlantic bluefin tuna using operating model package version 3.3.0	Butterworth D.S., Miyagawa M., and Jacobs M.R.A.
SCRS/2018/182	A comparison of Candidate management procedures for Atlantic bluefin tuna	Rice J.
SCRS/2018/183	Chair and Rapporteurs’ report of bluefin MSE technical group meeting over 24-25 September 2018	Butterworth D.S., Fernandez C., and Carruthers T.
SCRS/2018/184	Atlantic bluefin tuna Species Group meeting summary report (25-28 September, 2018)	Anon.

SCRS/P/2018/001	Preliminary Results: Age and Growth for Atlantic Blue Marlin	Hoolihan J.P., Luo J., and Arocha F.
SCRS/P/2018/002	Size class of Atlantic Blue marlin in Liberia fisheries waters	Wehye A.S.
SCRS/P/2018/003	Blue marlin (*Makaira nigricans*) size sampling data review 1970-2016	Ortiz M.
SCRS/P/2018/004	A metier approach of sustainable development: an active cooperation between ICCAT and WECAFC	Reynal L.
SCRS/P/2018/005	Artisanal fishing in São Tomé and Príncipe	Conceição I,
SCRS/P/2018/006	Living Working Document: Gonad stages of small tunas	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/P/2018/007	Preliminary results from the implementation of data-poor methods for small tunas	Pons M., Cope J., Kell L., and Hilborn R.
SCRS/P/2018/008	Reconstitution des statistiques de capture des thons mineurs pêches au large de la Mauritanie	Meissa B., and Isselmou C.B.
SCRS/P/2018/009	Production of small tunas in Liberia in 2017	Wilson III, R.B.
SCRS/P/2018/010	Preliminary results on the estimation of growth parameters for *Euthynnus alletteratus* and *Sarda sarda*	N'gom F., Goudiaby K.D., and Ndiour Y.
SCRS/P/2018/011	AOTTP –Preliminary Observations on Little Tunny and Wahoo	ICCAT Secretariat
SCRS/P/2018/012	Multilocus evidences of genetic population differentiation at small geographical range for a migratory pelagic species Bullet tuna	Ollé J., Pérez-Bielsa N., Saber S., Allaya H., Macías D., and Viñas J.
SCRS/P/2018/013	Review of Small Tunas data: sharing and standardizing	Lino P.G., and Coelho R.
SCRS/P/2018/014	Fishing for Small Tunas in São Tomé and Principe	Conceição I.
SCRS/P/2018/015	Preliminary evaluation of MPs for Atlantic bluefin using MSE	Merino G., Arrizabalaga H., Rouyer T., and Gordoa A.
SCRS/P/2018/016	An extremely preliminary evaluation of some empirical management procedures	Walter J.
SCRS/P/2018/017	Overview of a MSE reference document: 'Specifications for MSE Trials'	Carruthers T., and Butterworth D.
SCRS/P/2018/018	Improving communication: the key requirement to improve the effectiveness of MSE processes	Miller S., Anganuzzi A., Butterworth D., Davies C., Donovan G., Nickson A., Rademeyer R., and Restrepo V.
SCRS/P/2018/019	Current state of MSE/HCR Process in ICCAT	Die D.
SCRS/P/2018/020	What makes an MP an MP and an MSE an MSE?	Punt A.E.
SCRS/P/2018/021	Operating model for North Atlantic swordfish (*Xiphias gladius*)	Carruthers T.
SCRS/P/2018/022	Tag-recapture data for Bigeye tuna from the Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP)	AOTTP coordination team
SCRS/P/2018/023	Atlantic bigeye tuna longline CPUE analysis	Hoyle S.D., Hsiang-wen J.H., Kim D.N., Lee M.K., Matsumoto T., and Walter J.

SCRS/P/2018/024	A simple & efficient way to synthesize the growth of tagged tunas: 1) estimating the monthly growth rate between tagging & recovery 2) Assigning this growth rate to the average size between tagging & recovery	Fonteneau A.
SCRS/P/2018/025	Ghanaian statistical problems in 2018?	Fonteneau A.
SCRS/P/2018/026	Geographical variability in the amount of BET caught under FADs by purse seiners in the Eastern Atlantic	Fonteneau A., and Pascual-Alayón P.J.
SCRS/P/2018/027	Uncertainties/errors in the Length-Weight relationship of tropical tunas in the Atlantic Ocean & their potential consequences on the species composition and CAS of YFT, SKJ & BET caught by the EU&al PS	Fonteneau A.
SCRS/P/2018/028	An overview of statistical problems identified for bigeye in the ICCAT statistics of purse seine fisheries	Fonteneau A., and Pascual-Alayón P.J.
SCRS/P/2018/029	Indian Ocean ET: catch at size of PS and LL	Fonteneau A.
SCRS/P/2018/030	Bigeye tuna stock assessment modeling	Walter J.
SCRS/P/2018/031	Using a longline simulator to examine different methods of CPUE standardization with Atlantic blue marlin as an example	Forrestal F., Schirripa M. and C.P. Goodyear
SCRS/P/2018/032	Performance evaluation of CPUE standardization procedures to account for multispecies targeting	Winker H.
SCRS/P/2018/033	Operational Oceanography for supporting Sustainability of Top Predators, an open network	Alvarez-Berastegui D., on behalf of the OOSTOP members
SCRS/P/2018/034	JABBA: Just Another Bayesian Biomass Assessment	Winker H., Carvalho F., and Parker D.
SCRS/P/2018/035	Testing data limited approaches for HCRs and indicators in small tunas	Gillespie K.
SCRS/P/2018/036	Longline bycatch of loggerhead sea turtle in the Western Mediterranean (2000-2016)	Báez J.C., Macías D., García-Barcelona S., and Camiñas J.A.
SCRS/P/2018/038	Perspectives on estimates of blue marlin growth	Goodyear P.
SCRS/P/2018/039	The Caribbean Billfish Project Summary of achievements and developing plans	Bealey R.
SCRS/P/2018/041	Stock production models using ASPIC for blue marlin in the Atlantic Ocean from 1959-2016	Forrestal F.C., and Schirripa M.J.
SCRS/P/2018/042	JABBA Atlantic Blue Marlin Assessment : Robustness runs and retrospectives analysis	Winker H., Mourato B., Carvalho F., and Ortiz M.
SCRS/P/2018/043	Status of the Liberian Shark Fisheries	Daniels R.S.
SCRS/P/2018/044	Catch state of Shortfin Mako off the coastal waters of Côte d'Ivoire (West Africa)	Konan K.J., Diaha N.C., and Bahou L.
SCRS/P/2018/045	ICES Working Group Elasmobranch Fishes	Walker P.
SCRS/P/2018/046	Bigeye tuna Size frequency samples Input stock synthesis	Ortiz M., and Palma C.
SCRS/P/2018/047	JABBA goes bigeye: Sensitivity tests to prior assumptions, revised B_{MSY}/K values	Winker H., Merino G., and Walter J.
SCRS/P/2018/048	JABBA goes bigeye: Additional sensitivity runs	Winker H., and Kitakado T.
SCRS/P/2018/049	JABBA goes bigeye: Hind Casting and Cross-Validation	Winker H., and Kitakado T.

SCRS/P/2018/050	Canadian indicators of bluefin tuna abundance	Hanke A.R.
SCRS/P/2018/051	Assessment of the bluefin tuna larval abundances in the Balearic Sea and advances on the oceanographic characterization of the Western Mediterranean spawning grounds	Alvarez-Berastegui D., Reglero P., Ingram W., Martín M., Díaz-Barroso L., Mourre B., Balbín R., and Alemany F.
SCRS/P/2018/052	Initial development of a stock synthesis model for Eastern skipjack tuna to support tropical tuna management strategy evaluation	Harford W.J., Die D., Urtizberea A., Murua H., Walter J.F., and Merino G.
SCRS/P/2018/053	The initial steps of a shiny web application developed to facilitate communication and share the results of the management strategy evaluation model for tropical tuna fisheries	Urtizberea A., Merino G., García D., Korta M., Harford W., Die D., Walter J., Gaertner D., Santiago J., and Murua H.
SCRS/P/2018/054	Integrating reproductive ecology, early life dynamics and mesoscale oceanography to improve albacore tuna larval abundance estimations in Western Mediterranean Sea	Alvarez-Berastegui D., Saber S., Ingram Jr. G.W., Martín M., Díaz-Barroso L., Reglero P., Macías D., García-Barcelona S., Ortiz de Urbina J., Balbín R., and Alemany F.
SCRS/P/2018/055	United States bluefin tuna index updates: Rod and reel Gulf of Mexico Longline Larval index	Lauretta M., Walter J., and Ingram W.
SCRS/P/2018/056	Fisheries & biological data submitted during 2018, data deficiencies & ongoing recovery plans	Palma C., and Mayor C.
SCRS/P/2018/057	Secretariat yearly based estimations (CATDIS, EFFDIS, CAS/CAA)	Palma C., Ortiz M., and Beare D.
SCRS/P/2018/058	Review of the ICCAT coding system and ICCAT-DB development status	Palma C., and Mayor C.
SCRS/P/2018/059	Progress on Online reporting	Mayor. C., and Palma C.
SCRS/P/2018/060	Effect of the time/area closure in the Atlantic area	Amandé M.J.
SCRS/P/2018/061	Overview of the Liberian Tropical Tuna species Fisheries	Leesolee D.C.
SCRS/P/2018/062	A spatially-explicit larval survival index compared to recruitment indices from standarized CPUE fisheries data for Atlantic bluefin tuna	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 Jr. G.W., and Hidalgo M.
SCRS/P/2018/063	Preliminary results of age and growth of Atlantic yellowfin tuna (*Thunnus albacares*) based on dorsal spines an otoliths	Silva G., Mourato B., and Travassos P.

Appendix 4

Report of the ICCAT Atlantic-Wide Research Programme for Bluefin Tuna (ICCAT GBYP)

(Activity report for the last part of Phase 7 and the first part of Phase 8 (2017-2018), including a general overview of the activities up to 2018)

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 the continuity of the programme. The general information about GBYP activities and its results, as well on budgetary and other administrative issues of the GBYP programme, from the very beginning of the programme till 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 seventh phase of the GBYP officially started on 21 February 2017 following the signature of the Grant agreement for the co-financing of the GBYP Phase 7 (SI2.752957) by the European Commission and ended on 20 February 2018. The activities carried out during the first six months of Phase 7 and their preliminary results were presented to the SCRS and the Commission in 2017 (Di Natale *et al*. 2017b) and approved. The eighth phase of the GBYP officially started on 21 February 2018, following the signature of the Grant agreement for co-financing of the Phase 8 (SI2.777629) by the European Commission and will end on 20 February 2019.

The activities planned within both phases have been or are being developed without any major problems, implementing successfully the respective workplans stated in the proposals submitted to the EU. Therefore, it can be concluded that GBYP has continued to be, in spite of budgetary cuts, a very successful programme from an operative point of view, providing a huge amount of information that is potentially useful for the achievement of the general objectives of the programme. However, it must be recognized that several problems, both structural ones affecting the general performance of the programme and other more specific ones, affecting some of the main lines of activity, have been detected. Some of these problems have been repeatedly highlighted by the GBYP Coordinator, by the GBYP Steering Committee (hereinafter GBYP SC) and even by the contracted external experts who carried out independent evaluations of the programme in 2013 (Phase 4) and 2016 (Phase 6), but unfortunately many of them have not been solved yet. Because of that the GBYP SC, at its last two meetings, held in February and April 2018, discussed this issue again, concluding that a new global review and evaluation of the programme achievements should be carried out by external experts, in collaboration with the GBYP Coordination Team, in order to produce information that is relevant for improving the management of the programme and guarantee wider achievement of the programme objectives in a near future. As a first step to this end the new GBYP Coordinator, with the assistance of the GBYP Coordination Team and taking advantage of all the documentation that is already available on this issue, initiated this global review by identifying general and specific problems and exploring possible solutions, and then proposing a new strategic approach for the planning of the next GBYP Phases.

Thus, the present report summarizes the main scientific activities carried out throughout GBYP Phase 7 and those launched during the first part of Phase 8, and the final or preliminary results of the associated studies, as well as the related coordination activities. In addition, it also presents the first conclusions from the global evaluation of the programme initiated within Phase 8 by the GBYP Steering Committee and the GBYP Coordination Team, including identification of general problems and possible solutions to be taken into account in the planning of the next and further phases of the GBYP. Moreover, it also includes a proposal of activities to be carried out within Phase 9, for the consideration and eventual support of the SCRC.

2. Coordination activities and general issues of GBYP programme management

The GBYP SC is currently composed of the SCRS Chair, the West bluefin tuna Rapporteur, the East bluefin tuna Rapporteur, the ICCAT Executive Secretary and the external expert. While the external expert was not contracted in Phase 7, in Phase 8, Dr Ivan Katavic was contracted for the purpose.

The GBYP Coordination Team was composed of the Coordinator, Assistant Coordinator and Database Specialist. Due to the retirement of the former Programme Coordinator, Dr Antonio di Natale at the end of Phase 7, Dr Francisco Alemany was appointed as new Coordinator, who assumed responsibility from 15 January 2018.

The GBYP SC held two meetings within Phase 7 (March 2017 and February 2018) and a further two meetings were held in Phase 8 (April 2018 and September 2018), mainly dedicated to the review of the previous Phase and planning of the current one. In Phase 8, the GBYP SC meetings recorded that some CPCs had expressed some concerns about the programme results. This was mainly attributed to the fact that lately the Programme has not been successful in communicating all the achievements made to the ICCAT scientific community and the Commission. The SC recognized that the programme reached a critical moment when some important changes in the management had to be introduced and the future activities had to be re-planned in order to guarantee the best use of available resources and the highest cost/benefit ratio as regards the achievement of the general objectives. Therefore, it was decided to develop a new communication strategy and to carry out a new global review of the programme to identify the current problems preventing full achievement of the objectives and explore ways to optimize the management of the programme. Based on the results of this review and current assessment priorities, the GBYP SC considered that the SCRS should develop a recommendation with respect to the programme, to be presented to the Commission at the Annual meeting.

The GBYP SC 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 SC and the direct help of ICCAT Secretariat staff, managed a total of 7 Calls for tenders, two official invitations and one request for offers in Phase 7. As a result, a total of 17 contracts were awarded to various entities and two purchase orders were processed. In Phase 8, up to 31 August 2018, five additional Call for tenders and three invitations have been announced, and a total of 16 contracts have been awarded to date.

Other relevant coordination tasks have been those related with:

- Research Mortality Allowance: To cover the potential mortality caused by GBYP related sampling activities in the second part of Phase 7, the list of organizations allowed to make use of RMA was updated on 12 September 2017 (No. 1386/17), including 43 entities. In Phase 8, the initial Circular was issued on 10 May 2018 (No. 502/18) including 17 entities and it was updated on 18 July 2018 (No. 695/18) including 26 entities. In Phases 7 and 8 a total of 772 and 3 RMA certificates were issued, respectively.

- Cooperation with the ROP: Alongside GBYP Phases 7 and 8 the ICCAT ROP observers have engaged directly in checking bluefin tuna at harvesting to improve tag recovery and reporting and identifying the right people to provide the rewards for the recovered tags. Moreover, they have registered and reported any natural marks and taken biological samples for genetic studies. Specific forms and equipment to carry out these tasks have been provided to ROPs.

- GBYP web page: Phase 7 the GBYP Web page was regularly updated, and in GBYP Phase 8 the GBYP webpage was extensively restructured, incorporating a document search tool to facilitate identification and downloading of GBYP documents.

2.1 Financial aspects

So far, in the first seven Phases, GBYP received and used only 68.62% of the funds originally approved for the six-year period (€13,091,190 against €19,075,000). In Phase 7, the budget had the following funders (in order of contribution already received): European Union (grant agreement) €1,274,181.32; Japan (donation according to quota) €57,024.88; Tunisia (donation according to quota) €53,447.40; Turkey (donation according to quota) €52,972.61; United States (donation) €50,000.00; Kingdom of Morocco (donation) €50,000.00; Libya (donation according to quota) €41,406.40; Canada (grant agreement) €20,448.50; Norway (donation) €20,000.00, Chinese Taipei (donation according to quota) €3,000.00; China (P.R.) (donation according to quota) €1,931.09; Iceland (donation according to quota) €1,566.12.

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 7 will be used for the following Phases of GBYP. Contributions for the current and previous GBYP Phases are still pending from some ICCAT CPCs.

Due to the fact that some activities could not be completely developed by some contractors, as a result of causes of *force majeure* (i.e. study of endocrine hormones in the Slope Sea) or activities expenses were not properly justified, the final amount spent was lower than approved.

In Phase 8 the donors have provided the following funds (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, Chinese Taipei (donation) €3,000.00, China (P.R.) (donation according to quota) €2,050.03.

Up to now the envisaged activities are being developed without major problems.

The approved budget for Phase 7 and Phase 8 is summarised in the **Table 1**. The actual costs of Phase 7 are also provided.

3. Summary of Phase 7 and Phase 8 GBYP activities and results by main line of research

The GBYP activities developed or launched from October 2017 to September 2018 and their main results have been presented to the SCRS Bluefin Tuna Species Group by Alemany *et al*. 2018. Such activities and results are summarized below by main line of research.

3.1 Data mining and data recovery

The objective of data recovery and data mining activities is to fill the many gaps existing in several data series currently present in the ICCAT database, concerning both recent and historical data, which causes a large amount of substitutions in the assessment process, increasing uncertainties.

In Phase 7 the recovery of some recent or historical catch datasets was performed to support the improvement of the assessment of analytical work and the MSE process. Two contracts were awarded, both for recovering recent data from the Italian longline fisheries, including catches by vessel, area and day, partly with effort data (Pagá-García *et al*. 2017b). In addition to these data recovery activities, the GBYP provided an additional key for interpreting the historical trap data (Pagá-García *et al*. 2017a). Furthermore, an updated bibliography for the bluefin tuna traps was made available to the SCRS Bluefin Tuna Species Group (Di Natale 2017a). Moreover, following a specific request from the ICCAT Statistics Department, GBYP carried out an extensive analysis of the available literature on the bluefin tuna fishery data from the Black Sea, whose results were reported to the ICCAT Statistics Department and to the 2017 ICCAT Bluefin Tuna Data Preparatory Meeting (Madrid, 6-11 March) (Di Natale 2017b). These GBYP data were used also for two additional papers (Ortiz and Palma 2017b and Macías *et al*. 2017), which were submitted at the 2017 ICCAT Bluefin Tuna Stock Assessment Meeting (Madrid, 20-28 July). Moreover, the GBYP supported the Bluefin tuna Data Preparatory Meeting, directly providing 7 papers (Apostolaki *et al*. 2017, Vidal-Bonavila 2017, Di Natale 2017b, Di Natale *et al*. 2017c, Di Natale *et al*. 2017d, Tensek *et al*. 2017 and Pagá-García *et al*. 2017a). Furthermore, the GBYP data have been used for the papers by Carruthers 2017, Rodriguez-Ezpelta *et al*. 2017, Brophy *et al*. 2017 and Galuardi *et al*. 2017.

In Phase 8 three data recovery activities have been carried out: a) recovery of old data on bluefin catches in several EU-Italy traps data, b) recovery of data on tuna catches from ICES reports and c) obtainment of electronic tags datasets deployed by Stanford University in 2016 and 2017.

The first activity has recently finished, providing data on daily or annual catches from five Italian tuna traps. The second activity has been completed by the GBYP database specialist, providing a total of 4,653 registers containing information on bluefin tuna landings by different entities in the Atlantic and Mediterranean from 1962 to 1978, including the details on flag, geographical location, fishing gear and biological data (length and/or weight), by year, month or even week (Pagá García *et al*. 2018). The third activity is ongoing. It will provide rough data from 41 electronic tags deployed in 2016-2017 off Canada and in 2017 off Ireland, with a mean duration on fish of 190 days.

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, for the first time, the two last GBYP aerial surveys have been developed following the same standardized methodology.

The aerial survey was resumed in Phase 7, after being cancelled in Phase 6, on the four overlapping areas (Balearic Sea, southern Tyrrhenian Sea, central-southern Mediterranean Sea and Levantine Sea) which had been already defined and standardised in the previous analyses. It was designed using the software DISTANCE, the “industry standard” software for line and point transect distance sampling, as equal spaced parallel lines (transects) which should be surveyed four times (4 replicates). Prior to the activity, the training course for pilots, professional spotters and scientific observers was organized at the ICCAT Secretariat in Madrid and the updated GBYP Protocol for Aerial Survey for Bluefin Tuna Spawning Aggregation and the details for filling the sighting forms were presented. The aerial survey was successfully carried out from an operative point of view, although facing numerous logistical problems. A data elaboration report was provided in real time, therefore allowing to submit a paper detailing the results to the 2017 ICCAT Bluefin Tuna Stock Assessment Meeting (Di Natale *et al*. 2017a). The number of bluefin tuna schools detected on effort (91) was the highest so far, confirming a good presence of the species. For the very first time, the series of the GBYP aerial survey data was used in the MSE and the OM, while the Bluefin Tuna Species Group considered that it is still limited in number of years for it to be used in the assessment.

The aerial survey in Phase 8 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 have been presented by Vázquez Bonales *et al*. 2018.

With the aim of improving data analysis and survey methodology, a meeting was held in September 2018 between Alnilam specialists and the GBYP Coordination Team. It was concluded that it would be recommendable to develop habitat models that account for the effect of environmental variability among areas and years, which would allow for standardization of observations. In addition, it was recommended that some type of calibrations exercise should also be designed and developed in the next Phase of the GBYP to improve the reliability of GBYP aerial survey outputs, as previously recommended by the GBYP SC. Moreover, it was also agreed that other methodology issues should be addressed to optimize the surveys and overcome some of the problems detected, such as optimization of delimitation of surveyed areas, and changes in the structure and working methodology of the teams of observers, which would permit minimization of potential sources of bias.

3.3 Tagging activity

According to the general programme, after the adoption of the GBYP Tagging Design and GBYP Tagging Manual in Phase 1, it was planned to begin the tagging activity in the GBYP Phase 2 and to continue in the following Phases. The tag awareness and recovery programme was also launched in Phase 2 and continued in the following Phases, including a new tag rewarding policy.

The specific objectives of the GBYP tagging activity in the medium term were as follows:

a) Validation of the current stock status definitions for populations of bluefin tuna in the Atlantic and Mediterranean Sea. If the hypothesis of two stock units (eastern and western stocks) is maintained, the tags should provide estimates of mixing rates between stock units by area and time strata (ICCAT main area definitions and quarter at least). It is also important to consider possible sub-stock units and their mixing or population biomass exchange, particularly in the Mediterranean Sea.
b) Estimation of the natural mortality rates (M) of bluefin tuna populations by age or age-groups and/or total mortality (Z).
c) Estimation of tagging reporting rates for conventional tags, by major fishery and area, also using the observer programmes currently deployed in the Mediterranean fisheries (ICCAT ROP-BFT).
d) Evaluation of habitat utilization and large-scale movement patterns (spatio-temporal) of both the juveniles and the spawners.
e) Estimation of the retention rate of various tag types, due to contrasting experiences in various oceans.

Unfortunately, up to now, this line of research has faced two important problems which have prevented or limited the full achievement of these initial objectives. 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 of most of the electronic pop up tags on fish, which limits the effectiveness of the recorded data to achieve the stated objectives. 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 different ways, as the use in Phase 8 on a new reinforced model of MiniPat satellite tag designed to minimize "pin broke" problems, selection of tagging areas with lower fishing pressure and exploring and applying whenever possible improved tagging methodologies.

As recommended by the Steering Committee, the tagging activities in Phase 7 were limited again to the deployment of electronic tags, keeping the deployment of conventional tags only as a complimentary activity. A contract was awarded for the deployment of 20 PSATs in waters near Sweden and 20 in waters near Denmark. A second contract was awarded to tag 40 bluefin tunas in EU-Portugal traps. The results were suboptimal, given the high number of premature releases, mostly due to the technical failure of the electronic tags (pin-broke). Nevertheless, although the deployments were short, they showed that the majority of tagged individuals from EU-Portugal traps moved towards the northern Atlantic, while one moved towards the Azores.

As regards conventional tags, 10,000 conventional "spaghetti" tags were purchased to be deployed in the ongoing and subsequent phases. The number and location of conventional tags deployed, as well the number of conventional tag recoveries reported during this period by geographical area are detailed by Alemany *et al*. 2018. The resulting data have been included in the ICCAT tagging database, making them available to scientific community for analysis.

In Phase 7 the first electronic tag database was developed, along with a Shiny application which allows for the visualization of the tracks and temperature and depth parameters. A description of this database was presented by Tensek 2017.

As a possible alternative to conventional tagging or as an additional tagging approach, the GBYP Steering Committee recommended to explore and evaluate close-kin genetic tagging (Close Kin Mark Recapture, CKMR) at the end of Phase 5. Consequently, an initial feasibility study was carried out by The Commonwealth Scientific and Industrial Research Organisation (CSIRO) from Australia. Following this, the CSIRO informed that it was not unavailable to carry out the second part of the feasibility study in Phase 7 (as planned), which included a realistic cost estimation of the CKMR study, due to a considerable workload but also to the need to further check the CKMR technique applied to tunas. In any case, the GBYP Steering Committee decided to start collecting the necessary samples so as to assess in practical terms the feasibility and actual costs of carrying out a CKMR study for EBFT. Thus, enhanced sampling was carried out within the biological studies for both juveniles and adults in the major spawning areas, starting from Phase 6 and continued in Phase 7, but no other CKMR related activities were carried out.

Tagging in Phase 8 has again focused on deployment of electronic tags, keeping the deployment of conventional tags only as a complimentary activity. Considering the current needs of the MSE modelling process the specific objective of GBYP tagging programme in Phase 8 has been improving 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, two contracts were awarded, one for tagging 30 bluefin tunas in Portuguese traps, and the second one for deploying 10 tags in the Celtic area. In addition a Memorandum of Understanding was signed between GBYP and the Institute of Marine Research of Norway, for deploying 20 tags in western Norway. Tagging operations in Southern Portuguese traps were carried out successfully in August 2018, whereas tagging campaigns in Celtic Seas and Norwegian coasts have just started in September 2018.

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, by allowing the use of the GBYP RMA in the case of BFT casualties during tagging operations and the use of the GBYP Argos system account for data transmission. Resulting tagging datasets will be shared with GBYP and, along with other electronic tag datasets, will be used for the MSE process.

As regards conventional tags, within Phase 8 “spaghetti” tags, along with applicators and the tagging protocols, forms to report tagging operations were delivered to various institutions and the teams in charge of deployment of satellite tags. The resulting data have been included in the ICCAT tagging database, making them available to scientific community for analysis.

A new Shiny application was developed in Phase 8 for visualization of multiple tracks on the interactive map, including filtering and grouping according to several criteria. More details on this activity are presented in the communication by 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). Up to now, only data on time spent by fish in the different statistical areas has been delivered to the person responsible for the MSE modelling to determine the mixing rates between East and western stocks. However, a clear data policy to define the conditions of access to the GBYP etags database will be agreed shortly, allowing the direct use of these data from electronic tagging by the scientific community and hence promoting deeper analysis of the information gathered, with the aim of generating information that is useful for improving BFT management.

Throughout the reported period, the tag awareness campaigns and reward policy from the previous phases have been maintained; a reward of €1000 is given for recovery of electronic tags and €50 or a dedicated T-shirt for conventional tags.

3.4 Biological studies

The main objective of this task is to improve understanding of key biological and ecological processes through broad scale biological sampling of live fish to be tagged and dead fish landed (e.g. gonads, muscles, otoliths, spines, etc.), histological analyses to determine bluefin tuna reproductive state and potential, and biological and genetics analyses to investigate mixing and population structure, namely to define the population structure of Atlantic bluefin tuna (*Thunnus thynnus*), with particular attention to the age structure and the probable sub-populations identification. All the activities carried out in previous Phases and the first part of Phase 7 concerning the biological sampling and analyses were presented to the SCRS and the Commission in through the document by Di Natale *et al*. 2017b.

Sampling in Phase 7 was performed by the various entities that operated under different contracts. It was also carried out in farms, since the experience from the previous year demonstrated that it can be a useful strategy for obtaining the needed adult samples from the spawning areas. Opportunistic sampling was also performed by ICCAT-ROP observers. ROPs have been engaged in collecting small tissue samples of all accessible bluefin tuna individuals at the harvesting in farms or when dead bluefin tunas were taken on board of vessels having an ICCAT observer on duty. As a result of the aforementioned sampling activities around 3600 bluefin tuna individuals were sampled, and the resulting samples stored properly in the GBYP tissue bank. It is worth mentioning that a Shiny application was developed to facilitate the inspection of available samples in bank and to aid sample selection following different criteria to help better design future experiments and analyses.

As for the samples analyses, due to the limited budget in Phase 7, priority was given to different activities from the usual ones. Therefore, the activities that had already been initiated in earlier phases of the GBYP, such as microchemical analyses on otoliths for stable isotopes and genetic analyses using RAD-seq methodology and SNPs, have been postponed to the following phase. Nevertheless, the budget allowed for contracting of some additional genetic analyses that have not been carried out so far on bluefin tuna. These activities included the analysis of transcriptomic and genomic data exploiting previous available data for defining the genomic variability of the species and experimental trials for developing a genetic test for sex assignment. In addition, a special study was contracted in the Slope Sea and surroundings, for trying to fill knowledge gaps in bluefin tuna reproductive biology in the NW Atlantic; with the expectation that the results might add additional evidence to the existence of a further spawning area in this part of the Atlantic Ocean. The age determination analyses were performed on 2000 otoliths that had not been read before and the results are already available, although pending calibration. In addition, reading and counting of daily rings was carried out on 20 YOY to establish their birthdate.

Following the request coming from the SCRS BFT Species Group and the recommendation made by the Steering Committee, a first limited workshop on the reproductive biology of the Atlantic bluefin tuna was held within Phase 7. One of the objectives of the workshop was identifying the feasible priorities of biological studies which could be carried out within the GBYP, especially in Phase 8, while the other one was preparing the larger biological workshop in Phase 8, including the drafting the agenda and identification of the most adequate experts to participate as invited speakers.

Some of the most relevant results in Phase 7 were the following:

- Otolith microchemistry analyses showed that mixing rate estimates in the coast of Morocco varied considerably in preceding years, with catches in 2011 and 2014 dominated by the western population and catches in 2012, 2013 and 2015 dominated by the Mediterranean population. The results for 2016 confirm that mixing of the two populations occurs at variable rate, but Mediterranean bluefin tuna may be the principal contributors to the fishery in Moroccan traps.

- A massive ageing of otoliths previously collected and stored in the GBYP Tissue Bank has been initiated, but the results are still to be calibrated before using them for development of the bluefin age length key.

- The daily ageing analysis of some young of year bluefin tuna which were larger than expected indicated that all the fish were born during the known spawning season in the Mediterranean Sea, confirming that the growth rates can vary a lot between individuals born in the same season.

- A genome-wide annotation of protein-coding genes was performed and 41,508 protein-coding genes were identified. All the 41,508 predicted BFT proteins were subjected to functional annotation and 63% of the candidate sequences (26,151 protein) were associated to functions assigned by accurate homology-based approaches according to the standard catalogue of Gene Ontology (GO), covering, with different proportions, the three ontology aspects: biological process, molecular function and cellular component, with a total of 13,915 different GO terms.

- The specific study on the presence of candidate genes for sex-related traits provided a first preliminary identification of putative regions prone to be further investigated using data from BFT individuals of known sex. To develop a test for sex identification, further work, based on known sex individuals, should be carried out.

- A collection of slides for histological analysis from bluefin tuna gonads samples collected in the Slope Sea and surroundings was compiled and analysed, while the results will be presented within the framework of the GBYP workshop on BFT reproductive biology that is going to be held in November 2018.

The specific objectives of the biological studies stated for Phase 8 were keeping an GBYP tissue bank able to provide the samples required to carry out the studies necessary for improving the understanding of key biological and ecological processes affecting BFT, providing updated, representative and reliable ALKs useful for BFT stocks assessment and providing accurate and reliable estimations of mixing rates between BFT western and eastern stocks. Apart from those, GBYP in Phase 8 focuses also on obtaining improved knowledge on reproductive parameters of bluefin tuna. Both microchemistry analyses of otoliths and genetic analyses of tissue samples were resumed in this Phase.

Due to the cancellation of Close Kin study, sampling activities have been reduced this year and concentrated on samples from potential mixing areas in the Atlantic and some additional ones from the Mediterranean Sea.

In addition, sampling of adult bluefin tuna in farms has continued. Sample analyses this year will be focused on individual population assignment of bluefin tuna caught in potential mixing zones in the Atlantic by using both otolith microchemistry stable isotope analyses and genetic RAD-seq derived SNPs analyses, including special analysis to explore the presence of a possible "third" population of Atlantic bluefin tuna in the Slope Sea. Additional analyses will be performed in order to refine the Mediterranean baseline used in the integrated method for stock discrimination. The set of plausible hypotheses about stock structure consistent with the MSE operational model will be tested, by using as a basis the individual origin assignments obtained by different methods and aggregated by geographic area and year. In Phase 8, an additional study will be developed on samples collected in Norway in order to explore their origin and cohort composition.

Pursuant to the conclusions of the Preparatory Workshop on bluefin reproductive biology held in Phase 7 two independent experts have been contracted to review the current assumptions on reproductive parameters of eastern and western bluefin tuna stock and the review was presented to the Bluefin Tuna Species Group (Farley and Ohshimo 2018).

As regards ageing related activities, the Phase 8 proposal included specific budgets for carrying out, similarly to Phase 7, the reading of 2000 otoliths and, additionally, a calibration exercise of BFT otoliths readings. However, since a group of specialists that were elaborating BFT ALKs in the last years, had already organized a wide international calibration exercise on this topic, it was decided to support this initiative and postpone the envisaged GBYP calibration exercise until the ongoing exchange has been finished. Moreover, since this activity, the results of which are presented by Rodríguez Marín *et al*. 2018a, has resulted in an improved protocol for BFT otoliths interpretation (Rodríguez Marín *et al*. 2018b), it has been also decided to postpone the contract for massive otolith ageing until such new improved protocol for BFT otoliths interpretation has been agreed and endorsed by the SCRS. Moreover, a further calibration exercise, involving both sets of otoliths already aged and those used for elaborating previous ALK will be developed within Phase 8 to ensure that such previous ALK is comparable to the ones that should be generated by applying the new protocols for BFT otoliths interpretation arising from the aforementioned calibration exercise. Consideration should be given to conducting an ageing workshop following SCRS general recommendations to the Commission and conclusions from the recent calibration exchange.

3.5 Modelling approaches

Following the recommendations of the Steering Committee and the SCRS, the GBYP carried out many modelling activities since Phase 2. The modelling programme addresses the GBYP programme general objective 3, it is "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". In addition, in 2012 the Commission requested the SCRS (*Report for Biennial Period 2012-2013, Part I (2012), Vol. 1*) to conduct a stock assessment in 2015 and to:

a) Develop a new assessment model allowing the inclusion of the last updated knowledge on the biology and ecology of bluefin tuna, in particular life-history parameters, migration patterns, and aiming at identifying and quantifying uncertainties and their consequences on the assessment results and projections.

b) Release stock status advice and management recommendations, supported by a full stock assessment exercise, based on the new model, additional information and statistical protocols mentioned in points above and on which basis all actions may be adopted and updated by the Commission through the management plan to further support the recovery.

To achieve these objectives the GBYP Core Modelling MSE Group (CMG) was created in 2014, with the initial specific objectives of: 1. collate, manage and synthesise new data and information collected through the GBYP programme and other appropriate sources; 2. facilitate consultation and capacity building on Reference Points, Harvest Strategies and MSE for bluefin for the SCRS and Commission; 3. develop, document and maintain an integrated MSE modelling platform and 4. facilitate the evaluation, selection and adoption of harvest strategies for bluefin that meet the objectives of ICCAT, as specified by the SCRS and Commission.

The GBYP activities in the previous Phases were consistent with these objectives, within the timeframe set by the CMG.

The contract for developing the Operating Model and MSE framework and related code was awarded to the same expert who initiated this work in Phase 4. The focus of the work in Phase 7 was the production of a fully documented working MSE framework including all finalized operating models (both reference and robustness) to allow stakeholders to develop and test their own Management Procedures. The software was updated in order to accommodate the requirements of the reference and robustness operating models. The Trial Specifications and the meta-data base were also updated to include new OM definitions, performance metrics and data sources. All reference operating models were fitted to data and presented to the CMG by Carruthers and Butterworth 2017a, 2017b and 2017c. Other peer-review paper on description and testing a multi-stock, multi-index management procedure designed specifically for Atlantic bluefin tuna was drafted as well. The user guides for M3 and ABT-MSE R package were updated with new tutorials and examples of MP development. In order to promote the work of stakeholders in developing management procedures, it was recommended that the contract of the external modelling expert be continued in GBYP Phases 8 and 9.

Within the framework of the Phase 7, a technical meeting on modelling and MSE was held in Madrid from 15 to 19 May 2017, including a working group to develop a stock assessment model (SAM) for East Atlantic and Mediterranean bluefin tuna. In this meeting the working group used a state-space SAM as a new approach to evaluate the impact of uncertainty. Additionally, a comparison of the results of VPA and SAM was conducted. To evaluate the robustness of SAM a range of diagnostics and scenarios was ran according the 2017 Bluefin Tuna Data Preparatory Meeting (Ben Mhamed *et al*. 2017).

GBYP data were used for drafting the following scientific papers in connection with bluefin tuna stock assessment by Kell *et al*. 2017, Kerr *et al*. 2017, Cadrin and Kerr 2017, Morse *et al*. 2017 and Rodríguez Marín *et al*. 2017b.

The main objectives in Phase 8 were ensuring the OM scenarios agreed by the CMG 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, that robustly meet the management objectives. The contract for modelling approaches was extended to the same expert.

In April 2018, the MSE intersessional meeting of the BFT Species Group was held, partly together with the Swordfish Species Group, where the CMG presented their 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. At the meeting, it was decided to formalize the creation of the BFT MSE Technical Group. In addition, the meeting of the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers, was held in May 2018, with an agenda item specific to bluefin tuna MSE.

The latest outputs from GBYP MSE modelling activities, as specifications for MSE trials for bluefin tuna in the North Atlantic and an ABT-MSE Operating model fitting report, were presented by Carruthers and Butterworth 2018a and 2018b.

4. Preliminary results of the GBYP programme global internal review: identified general problems and potential solutions. New strategic approach and proposed activities for GBYP Phases 9.

4.1 Structural problems and potential solutions

GBYP has achieved many successes through the dedication of the former GBYP coordinator, his assistants; the indispensable help of the ICCAT Secretariat staff and the advice from GBYP SC (see GBYP Mid-term review 2013 and GBYP second review 2016). Nonetheless, as is the case with any broad, international and multidisciplinary research programme, it is necessary to evaluate its performance, identify areas for improvement and to make strategic adjustments.

To meet objectives to improve basic data collection, understand key biological and ecological processes and provide scientific advice for sustainable management of Atlantic bluefin tuna, the GBYP has initiated a broad review of the programme intended to identify strengths and weakness. This will facilitate building the strategic plan for the next Phases of GBYP.

In consequence, the first step is to outline the major problems and potential solutions, summarized as follows:

4.1.1 Funding

Issue:

1. Annual nature of GBYP funding does not permit strategic investment in activities of a continuous nature such as long-term surveys and compresses the timeframe of calls for tender, research activities and completion into a single year.
2. Decrease in the annual budgets from €2,875,000 in Phase 4 to €1,750,000 in Phase 8.
3. Funding relies upon voluntary contributions.

Potential solutions:

1. Build dedicated research funding into the Annual ICCAT Budget and/or CPC's Contribution.
2. Create dedicated Monitoring/Research Quota (as proposed by Anon. 2017j and by GBYP Steering Committee (2015)) to fund ongoing research.
3. Longer than annual funding commitments.

4.1.2 Planning

Issue:

1. Research priorities shift with differing needs, changing funding levels require altering or cancelling certain projects, methods for carrying out research change over time and unforeseen circumstances cause certain activities to diverge from initial expectations.
2. Lack of precise indicators to evaluate programme achievements.

Potential solutions:

1. Implement standard project planning methods (e.g. Logframe approach), to define specific objectives linked to specific activities designed to achieve short-, mid- or long-term objectives with explicit performance criteria.
2. More direct involvement of SCRS experts in planning of research and related activities, through ad hoc workshops or taking advantage relevant SCRS meetings to inform about GBYP matters.
3. Add a second independent external expert to GBYP SC.
4. Implement a clear decision making process.

4.1.3 Coordination

Issue:

1. Limited and insufficiently detailed coordination between SCRS, GBYP SC, GBYP and CPC.
2. Inconsistent or incomplete guidance from the Steering Committee due to limited time for review.
3. Lack of formal mechanisms to ensure coordination between GBYP and CPC-specific research programs.

Potential solutions:

1. Reinforce the membership of the GBYP Steering Committee, strengthen involvement of SCRS experts in the GBYP programme and dedicate more time to GBYP matters within SCRS meetings.
2. Improve synergies between GBYP and CPC-specific research programs.
3. Ensure that GBYP research activities represent more homogenously the geographic extent of the Convention area.
4. Hold an annual coordination meeting between the GBYP Steering Committee and Coordination Team and representatives of national programs such as NOAA Bluefin Tuna Research Program (BTRP), Canada DFO, Mexico, National Research Institute of Far Seas Fisheries and other national research programs.

4.1.4 Communication

Issue:

1. From the feedback received from some CPCs it is clear that GBYP achievements have not been always fully understood or disseminated.

Potential solutions:

1. Publish periodic leaflets by GBYP phase intended for Commission officers, Head Delegates, scientists, Cooperating Parties and Fishing Entities which details results and progress.

2. Promote wider dissemination of results to the scientific community through peer reviewed publications resulting from GBYP workshops, both review papers involving as co-authors all the scientists that have participated in a given line of research and monographies on a given topic.

4.1.5 Data dissemination policy

Issue:

1. Lack of a clear data policy, both regarding the mechanisms to store and manage the data generated by GBYP activities and criteria to make this information publicly available.

Potential solutions:

1. Devote special efforts to the development and implementation of such databases to house and disseminate data.

2. SCRS should adopt a clear data policy to define the mechanisms to make use of GBYP data and biological samples.

4.2 New strategic approach for next GBYP phases

Aiming at overcoming the aforementioned structural problems, the first step to improve the capability of the GBYP programme to provide the scientific basis for meeting the Commission objectives for bluefin tuna in a cost effective way should be the development of a new strategic plan. Next, a detailed work plan stating short, mid and long term objectives, including a clear roadmap of actions to be carried out and performance metrics, should be designed and implemented.

To this end, the GBYP Steering Committee should commit to designing such strategic plan and, once agreed, develop a detailed work plan for the forthcoming GBYP Phases.

4.3 Proposal for GBYP Phase 9 activities

The ICCAT GBYP Steering Committee recommends the following activities for Phase 9 with a provisional budget of €1,750,000.

a) Data recovery and data mining: This activity should be limited to sets of data that are really useful and relevant for improving the current BFT management.

b) Aerial survey: As a first step, it should be designed a calibration and validation study, including a feasibility study for its practical implementation in one of the main spawning areas. Next, a calibration and validation exercise should be carried out at the beginning of the spawning season. In parallel, an in-depth review of available data from previous surveys should be carried out to identify and quantify the potential sources of bias. Consequently, an improved GBYP aerial surveys sampling strategy and methodology protocol should be developed. Finally, the aerial survey should be carried out on the four overlapping areas considering the outputs of the previous tasks.

c) Tagging: Firstly, an extensive and deep analysis of available information on electronic tags performance should be carried out to identify the causes of current problems limiting the time spent on fish.

   Next, a new GBYP tagging protocol should be elaborated. Electronic tagging should continue, applying the newly developed protocol, focusing the distribution of tags according to the emerging needs set by the SCRS. Tag awareness activity should be continued.

d) Biological and genetic sampling and analyses: An ad hoc workshop should be organized involving the different actors carrying out BFT sampling activities, to look for synergies and prevent any duplication, as well as to define priorities, proposing as the main deliverable a new sampling and biological analysis proposal, which should be used as a reference for implementing such activities in Phase 9. The biological data generated up to now by GBYP should be integrated in a relational database designed to this end. Field sampling should be continued in the prioritized areas and gears. The analyses of the available samples should be improved, particularly for microchemistry, genetics and ageing, the latter taking into account the dedicated effort carried out in Phase 8.

e) Modelling: The development of the ICCAT BFT MSE process should continue according to the outputs of the BFT MSE Technical Group. The modelling capacity building shall be further improved through training workshops and scientist exchanges.

Table 1. Approved budget and actual costs of GBYP Phase 7 and approved budget for Phase 8.

	Phase 7		*Phase 8*
	Approved budget	*Actual costs*	*Approved budget*
Coordination	€415,745.00	€371,485.40	€328,000.00
Data recovery	€25,000.00	€24,032.92	€30,000.00
Aerial survey	€405,000.00	€389,565.05	€433,000.00
Biological studies	€580,000.00	€533,056.14	€619,000.00
Tagging	€262,000.00	€199,817.22	€166,000.00
Modelling	€121,240.00	€91,935.70	€174,000.00
Total	**€1,808,985.00**	**€1,609,892.43**	**€1,750,000.00**

Appendix 5

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 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.

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 ICCAT CPCs. Since we last reported 13 contracts (>60,000 euros) 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

AOTTP tagging began at the end of June 2016 around the Azores (EU Portugal). Since then, AOTTP has tagged tuna: around the Canary Islands, around Madeira, off Senegal/Cabo Verde/Mauritania, in the Gulf of Guinea, in the territorial waters of the USA, off South Africa, and off Brazil and Uruguay. Tagging is currently ongoing in the EEZ of Cote d'Ivoire, around Saint Helena (BOT), in the seas of the Caribbean/USA using sport and recreational fishers, and around São Tome and Príncipe.

A total of 91,918 tropical tuna across species have now been tagged and released since the programme began (e.g. **Figure 1** and **Table 2**), and 12,978 tagged fish have been recovered. All the data are stored in a relational database at ICCAT headquarters.

AOTTP has now achieved 77% of its overall tagging target. The distribution between the three main tropical species is less balanced than observed last year: BET at *ca* 21%; SKJ at *ca* 43%; and YFT at *ca* 31%. Accordingly the numbers of SKJ tagged are now being minimized. Tag-shedding rates are being estimated by double-tagging. So far, 15,747 fish have been double-tagged (66% of the 24,000 target).

Four thousand five-hundred and fifty-six (4556) little tunny (LTA) and 129 wahoo (WAH) have also been tagged (combined target of 10,000). In the coming months many more of these two neritic species will be tagged; particularly in the Gulf of Guinea and off northern Brazil.

AOTTP is also using electronic tags to study the migrations of tropical tuna. Retention times (**Table 3**) of the pop-up tags have generally been disappointing with an average of around 35 days. The maximum so far recorded for a Desert Star tag was 192 days, and 116 days on a Wildlife Computers tag (both on BET). Due to these generally poor performance of both Desert Star and Wildlife Computers satellite tags, AOTTP opted to purchase Microwave Telemetry tags for the second phase.

Recovery rates of the internal/archival tags have also been low with only a handful of tags recovered so far, although one was recently returned in South Africa with over 12 months of data (at 15 second intervals) 'on board'.

Twenty-one different boats have been used by ICCAT/AOTTP to tag fish in the Atlantic thus far, and have done 153 tagging trips, combined, since the project began, spending 1314 days at sea (73% of the 1800 day target).

2.2 Awareness campaigns and recovery schemes

Awareness and publicity campaigns are ongoing in the following countries: (1) Azores Islands (Portugal); (2) Madeira (Portugal); (3) Canary Islands (Spain); (4) Mauritania; (5) Senegal; (6) Cabo Verde; (7) Ghana; (8) Cote d'Ivoire; (9) Sao Tome and Principe; (10) South Africa; (11) Brazil; (12) Ghana; and (13) Uruguay, see **Figure 2**. Activities are also starting in the USA, and less formal arrangements are in place in the British Overseas Territories of Ascension Island and Saint Helena, Trinidad and Tobago, and in Japan, Chinese Taipei, and China (People's Rep.).

2.3 Recovery of tags and transmission of data to ICCAT Secretariat

TROs now work in the most important Atlantic ports for tropical tuna landing, and the data collected so far attest to the efficacy of these activities (**Figure 3** and **Table 4**). The number of valid tag recoveries is now (September 2018) 12,978 translating to an overall recovery rate of 14.1%; much more that the rate originally predicted (10%). Recovery rates for BET and YFT are both close to 20%.

Six thousand eight hundred and thirty-five (1753 BET, 2364 SKJ and 2718 YFT) have also been tagged chemically (**Table 5**) equaling 68.7% of the 10,000 target. Recovery rates of the chemically tagged fish are around 19% for BET and YFT (**Table 5**). AOTTP coordination maintains contact with TROs around the Atlantic with a messaging App. The "AOTTP Tag Recovery Group" (31 Members) thus, for example, enables TROs to upload data to ICCAT, and facilitates rapid correction of data helping to avoid mistakes.

Tag seeding experiments to estimate the Reporting rates are ongoing and so far 663 fish have been tagged with 'false tags (**Table 6**).

3. Key parameters supporting stock assessments are estimated on the basis of data collected through the programme and integrated in stock assessments

Preliminary biological parameters from AOTTP tag-recapture data for BET were estimated at the capacity building workshop in Abidjan prior to the BET data preparatory meeting in April 2018 but insufficient time had thus far elapsed for data to be informative in the assessment. We are pleased also to announce the recruitment of Dr L. Ailloud who arrived at ICCAT in early September. Dr Ailloud is an expert in tag-release data and their scientific analyses and interpretation. Her principle role will be to promote the production of scientific output from the programme, particularly integrating the new results into the stock assessments.

AOTTP will also improve the scientific understanding of the biology of two important neritic species (little tunny and wahoo) by calculating 'indicators'. So far 4556 little tunny have been tagged, and 393 recoveries recorded (**Tables 2** and **4**). These numbers, while providing novel information on, for example, growth are yet too few to permit the development of such indicators.

3.1 Reading of hard parts

AOTTP has now purchased and taken biological samples from 690 chemically marked fish (red tags) representing all size classes, 3 species, and both sexes (**Table 7**). Other biological information (weight, state of sexual maturity, and stomach contents) will complement analyses.

The AOTTP Otoliths Expert Group, set up by the AOTTP during the last reporting period, recommended the creation of a Reference Collection of Otoliths for 'calibrating' the age-readings. Twenty-five pairs, by length categories, of otoliths (also other hard parts) for BET, SKJ and YFT are, therefore, now being collected in Brazil, and another 25 pairs in West Africa. Images/photos of the hard parts will then be circulated (digitally) among the Expert Group which will read and age them, see **Figure 4**. When the reference sets and calibrations are done, a Workshop will be held in April 2019 to train future otolith/hard part age-readers around the tropical Atlantic (based on the Reference Set).

3.2 Tagging data analyses

The AOTTP now has a large and important dataset comprising: (i) mark-recapture data from conventional tags; (ii) tag seeding data; (iii) data from electronic tags; and (iv) biological samples such as otoliths. AOTTP data were approved for dissemination among attendees of the Capacity Building workshops and the SCRS BET Data Preparatory Meeting in April 2018. The AOTTP data will be analysed by contracting 'experienced scientists', coordinated by the Chair of the SCRS and the associated SCRS scientific community, and be integrated into the capacity building activities (see Training in data analysis section below).

3.3 Information from stakeholders

This activity relates to the organisation of the International Symposium planned for the final months of the AOTTP project in spring 2020. Plans for this work are in preparation.

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

During Phase 1, over 60 individuals attended training courses in conventional, chemical and electronic tagging, and associated data collection in West Africa, Brazil and South Africa. For the second phase, AOTTP Coordination organised tagger training in Madrid with CEFAS (contracted to tag 5,600 fish around St Helena) in April 2018, and with Ilair Conceção (Tagging Coordinator responsible for tagging 6,000 fish around Sao Tome and Principe) in May 2018 (**Figure 5**). Our colleague Inigo Onandia, an expert from AZTI, visited Madeira in June 2018 to demonstrate electronic tagging protocols and procedures (fish care etc.) to the team based there.

The AOTTP has clearly satisfied the requirement for training tagging teams. What is particularly encouraging is that people that worked on the first phase tagging, and attended training courses, are now teaching tagging during the second phase. For example, Prof G. da Silva ran tagging cruises off northern Brazil in 2017 as part of the FADURPE Consortium, and has now organised and taught tagging training in Sao Tomé and Príncipe. Similarly, Dr J. Monin Amandè (after receiving training in tagging from AZTI in May 2016) won a contract on behalf of CRO-CI (AOTTP Phase 2) to tag 11,000 fish in the EEZ of Côte d'Ivoire, for which he is also now training his own staff. On 26 February 2018, for example, two Ivorian technicians (Mr. Monin Edmond and Mr. Barrigah Simeon) were trained at sea in tagging and data transmission protocols by Dr Monin Amandè.

The numbers of fish tagged during the AOTTP programme by scientists from all countries are summarised in **Table 8**. It shows that nearly two-thirds (63%), have been tagged by scientists/technicians from developing countries.

4.2 Training in data analysis

Last year 3 workshops were organised to promote the involvement of the ICCAT SCRS scientific community in the analysis of AOTTP tag-recapture data, aimed at ICCAT CPC scientists actively involved in the provision of management advice on tuna fisheries (**Figure 6**). Recognized experts in each research sub-component, i.e. relational databases, tuna growth, mortality, and movement were invited to lead activities and discussions. 'Hands on' activities relating to the visualization (mapping, graphing etc.), analysis, and scientific interpretation of the tagging data were the focus. Detailed syllabuses, tutorials and presentations are available on request to the AOTTP Coordination. A total of 29 people attended the workshops from 13 countries including 5 participants from Cote d'Ivoire, 3 from Senegal, 3 from Brazil, and 2 from Uruguay.

Outcomes included: improved understanding of relational databases; increased capacity to work with the AOTTP in the development of the tag-recapture databases; and increased ability to connect with the remote databases using plotting and statistical software (R, QGIS, Excel).

5. Beneficiaries

The AOTTP is working directly with State authorities in Spain (Canary Islands), Portugal (Azores, Madeira), Cote d'Ivoire, Mauritania, Senegal, Brazil, United States, Ghana, Uruguay, Sao Tomé and Príncipe, Cabo Verde, UK (CEFAS, British Overseas Territories of St Helena and Ascension Island) and South Africa.

ICCAT CPCs have also contributed funds to the AOTTP programme, including China (People's Rep.), United States, Canada, and Chinese Taipei.

During the last reporting period the 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 (United States), University of Maine (United States), NOAA (USA), Directorate of Fisheries (Sao Tomé and Príncipe), and Capmarine (South Africa) to tag fish at sea. The AOTTP has recently started working with the Saint Helena Government (BOT).

In the United States, LPRC wrote in their Final Report that, "Our relationship with commercial fishermen tagging partners, all US Atlantic longliners, has been strengthened by this partnership, and the vessel crews have gained additional tagging and research experience and remain excited about future research opportunities".

From Trinidad and Tobago, we recently received an offer from a member of the Trinidad and Tobago Game Fishing Association, which is hosting a Recreational Fishing Tournament out of St. George's in Grenada, to tag YFT for the AOTTP. Similarly Dr Rui Coelho from the Division of Modelling and Management of Fishery Resources at IMAR in mainland Portugal has volunteered to tag tuna in traps there.

The AOTTP has so far worked with the skippers and crews of more than 20 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.

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 (https://www.iccat.int/AOTTP/en/aottp-about.html). A Training Manual/Handbook is available here: https://www.iccat.int/aottp/AOTTP-Document-Library/Manuals/AOTTP-Tagging-Handbook-EN.pdf

AOTTP Coordination publishes quarterly newsletters about the project which, in addition to being available on the website (https://www.iccat.int/AOTTP/en/aottp-documents.html), are also sent by email to all our partners working on the project.

AOTTP has been formally presented at many different fora around the Atlantic coastal States, including:

- Maio Island Fishermans Forum (Albertino Martins, Cabo Verde, December 2017)
- AOTTP Summary Presentation on Small Tunas (ICCAT Secretariat, Madrid, 5 April 2018)
- 2018 ICCAT Bigeye Tuna Data Preparatory Meeting (ICCAT Secretariat, Madrid, 25 April 2018)
- AOTTP Summary Presentation (Doug Beare, Sao Tomé, 13 June 2018)

AOTTP has already been published widely on the Internet, e.g.:

- http://pecnordestefaec.org.br/2017/wp-content/uploads/2017/07/O-estado-da-arte-da-pesca-do-atum-no-Brasil-e-no-mundo.pdf
- https://www.lagomera.es/cabildo-insular-se-suma-la-campana-marcado-atunes/
- http://www.lavanguardia.com/local/canarias/20160824/404168466987/la-gomera-se-suma-a-la-campana-de-marcado-de-atunes.html
- https://www.eldiario.es/agricola/pesca/Cabildo-Gomera-campana-marcado-atunes_0_551545265.html
- http://nordinfo.info/node/1724
- https://www.undercurrentnews.com/2016/06/13/azti-wins-iccat-tagging-contract/

Many of our partners have made videos and uploaded them to YouTube, eg.:

- Senegal (AZTI) https://www.youtube.com/watch?v=l9lzrqMI0lo&t=1s
- Northern Brazil (FADURPE) https://www.youtube.com/watch?v=YBm68tGOtRc&t=81s
- Central Brazil (FADURPE) https://www.youtube.com/watch?v=K10UfPFIRUw&t=51s
- Senegal (CRODT) https://www.youtube.com/watch?v=K10UfPFIRUw&t=51s

AOTTP video Training Tutorials can be found here:

- https://www.youtube.com/watch?v=BKEZKf4Vya0
- https://www.youtube.com/watch?v=EXx5Yf0NHBI&t=70s
- https://www.youtube.com/watch?v=8UF2Vp-XFKw&t=21s

7. Updated Action Plan

The overall target for AOTTP is to tag 120,000 tropical tuna. In February 2017 ICCAT signed a contract to tag 9,500 fish in the territorial waters of Venezuela as part of the Phase 1 target but the political situation in Venezuela led to a cancelation of the contract. Another Call for Tenders to tag tropical tuna in the NW Atlantic was thus re-launched and a contract with the University of Maine to tag 5,000 fish using sport/recreational fishers in the waters of the United States and Caribbean was signed recently. The current situation is summarised in **Table 9**. The AOTTP has currently tagged over 91,000 tuna, and has signed contracts committing to tag a further 28,000 by the first quarter of 2019 making a total of *circa* 119,000 which would leave another 1,000 or so fish to tag.

At the Bigeye Tuna Data Preparatory Meeting in April 2018, it was agreed that AOTTP tag-recapture data could be disseminated according to certain conditions (see Anon. 2018a).

The data are, therefore, now available to past and future participants of AOTTP Capacity Building Workshops and those attending the Bigeye Data Preparatory meeting (http://iccat.int/AOTTP/en/aottp-about.html). It is now anticipated that the data will be used for a range of important scientific analyses resulting in reports, SCRS working documents, and peer-reviewed scientific papers. This work will be coordinated by the Chair of the SCRS and the AOTTP Steering Committee, and associated SCRS scientific community.

Table 1. List of contracts (>60,000 euros) awarded by ICCAT during Reporting Period 3.

DATE	*SUPPLIER*	*OBJECTIVE*	*TOTAL*
7/6/2017	FLUTUANTODISSEIA LDA	Tagging activities in the Autonomous Regions of the Azores and Madeira	€311,400.00
9/25/2017	CENTRO INVESTIGACION Y CONSERVACION MARINA "CICMAR"	Recovery activities in the Atlantic	€22,470.00
9/27/2017	FUN FASHION T-SHIRT S.L.	Supply of visibility T-shirts as per programme	- €
11/8/2017	FADURPE LED CONSORTIUM	Creation of a reference collection of otholiths	€30,000.00
11/8/2017	IFAN-UNIVERSITE CHEIKH ANTA DIOP	Creation of a reference collection of otholiths	€24,077.00
12/12/2017	AGENCIA DESENVOLVIMENTO INVESTIGAÇAO TECNOLOGIA E INOVAÇAO	Recovery activities in Madeira	€16,200.00
2/26/2018	FADURPE LED CONSORTIUM Phase 2	Tagging activities in the West Atlantic	€850,000.00
2/26/2018	KAMAYA BUSINESS SARL	Tagging activities economic zone of Côte d'Ivoire	€542,082.00
	UNIVERSITY OF MAINE		
3/16/2018	MICROWAVE TELEMETRY	Supply of electronic tags	$114,020.00
4/11/2018	CENTRE FOR ENVIRONMENT FISHERIES & AQUACULTURE SCIENCE (CEFAS)	Tagging activities in South - East Atlantic	€382,296.44
4/13/2018	LARGE PELAGIC RESEARCH CENTER // TAG A TINY—PHASE 2	Tagging activities in North West Atlantic	€56,651.00
4/13/2018	BDO AUDITORES S.L.P. (3rd quarter)	Expenditure verification	€13,386.84
5/14/2018	FISHERIES DIRECTORATE OF SAO TOMÉ & PRÍNCIPE	Tagging activities in Sao Tomé and Príncipe	€249,993.30

Table 2. Total number of releases by species and release stage code.

	R-1	*R-2*	*R-3*	*Totals (species)*
BET	19029	124	1	19154
LTA	4547	9	0	4556
SKJ	39399	45	0	39444
WAH	129	0	0	129
YFT	28495	133	7	28635
Totals (codes)	**90304**	**311**	**8**	**91918**

Table 3. Electronic tag mean retention times (days) by species.

	BET	*YFT*
Desert Star	51.62	36
LOTEK ARCGEO9	25.5	NA
LOTEK LAT2810	190.9	213
Wildlife computers	96	25.5

Table 4. Total conventional tag-releases, recoveries (recaptured and dead fish only) and recovery rates by species.

	BET	*LTA*	*SKJ*	*WAH*	*YFT*	*Total*
Total released	19154	4556	39444	129	28635	91918
Total recovered	4077	393	2670	1	5837	12978
% recovered	21.3	10.4	6.8	0.8	20.4	14.1

Table 5. Chemically tagged totals by species.

	BET	*SKJ*	*YFT*
Releases	1753	2364	2719
Recoveries	343	163	428
% recovered	19.6	6.9	15.7

Table 6. Reporting rates (%) from tag-seeding experiments by species.

Species	*Baitboat*	*Purse seine*
BET	100	81
LTA	100	100
SKJ	89	74.6
WAH	NA	NA
YFT	71.4	70.6

Table 7. Biological samples collected.

	Female	*Immature*	*Male*	*Unknown*
BET	111	3	117	1
SKJ	55	0	63	0
YFT	139	3	198	0
Total	**305**	**6**	**305**	**1**

Table 8. Numbers of fish tagged by tagger nationality.

Nationality	*Number*
Brazil	31374
Cabo Verde	423
Côte d'Ivoire	8593
EU Spain	19822
EU France	26
EU Portugal	6602
EU United Kingdom	215
Ghana	7775
S. Tomé e Príncipe	4385
Senegal	9571
South Africa	228
UK St. Helena	238
Uruguay	25
Total	**89378**

Table 9. AOTTP tagging update.

	BET	*LTA*	*SKJ*	*WAH*	*YFT*	*Contracted*	*Total*
Senegal/Cabo Verde	3716	357	3696	1	3454	5000	16224
Gulf of Guinea	6754	3888	7487	53	16124	9000	43306
Canaries	3367	0	3146	0	76	3000	9589
Azores/Madeira	1353	1	6639	0	5	0	7998
Caribbean	0	0	0	0	0	2500	2500
Brazil/Uruguay	3907	310	18345	70	8419	0	31051
South Africa	0	0	109	0	120	0	229
USA	20	0	0	0	0	2500	2520
St Helena	28	0	22	5	398	5000	5453
Total	**19145**	**4556**	**39444**	**129**	**28596**	**27000**	**118870**

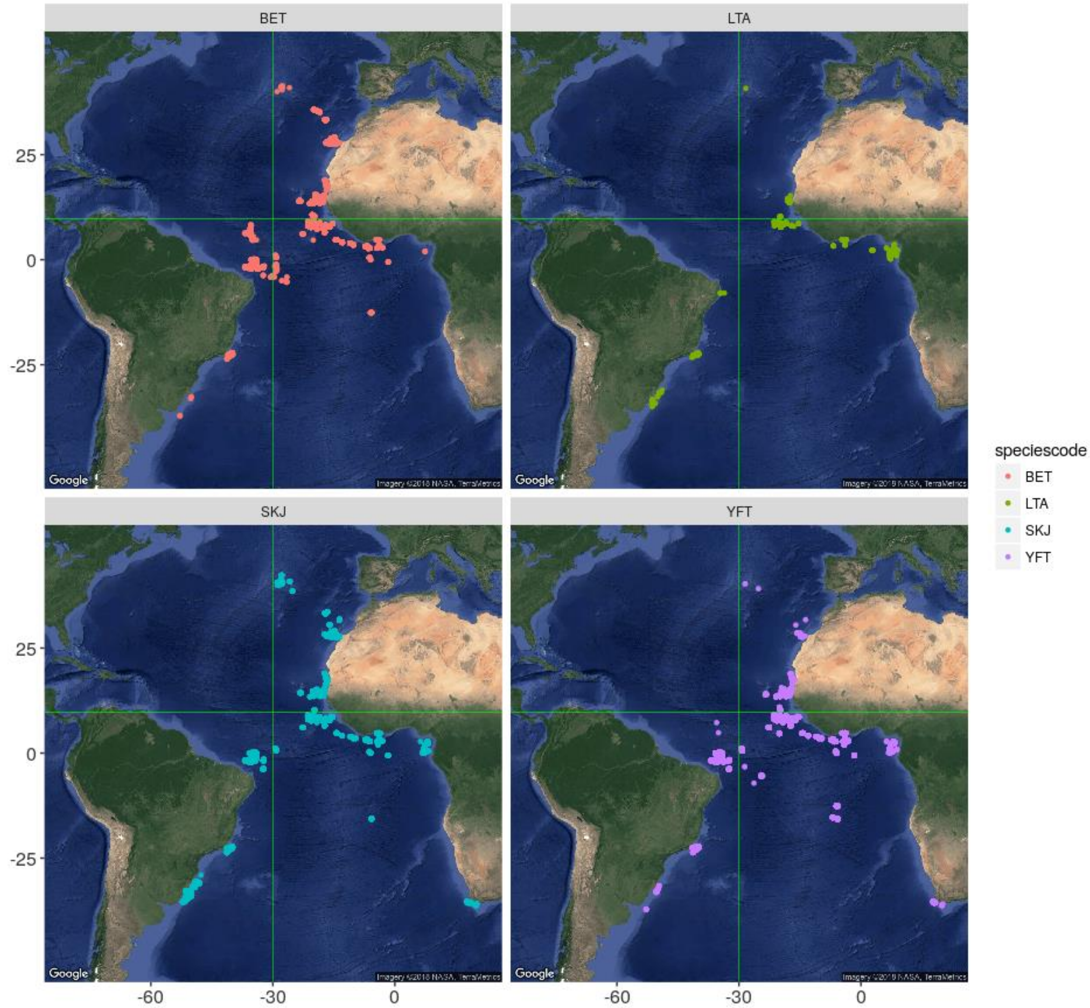

Figure 1. Distribution of tropical tuna (by species) tagged and released by ICCAT-AOTTP between July 2016 and September 2018.

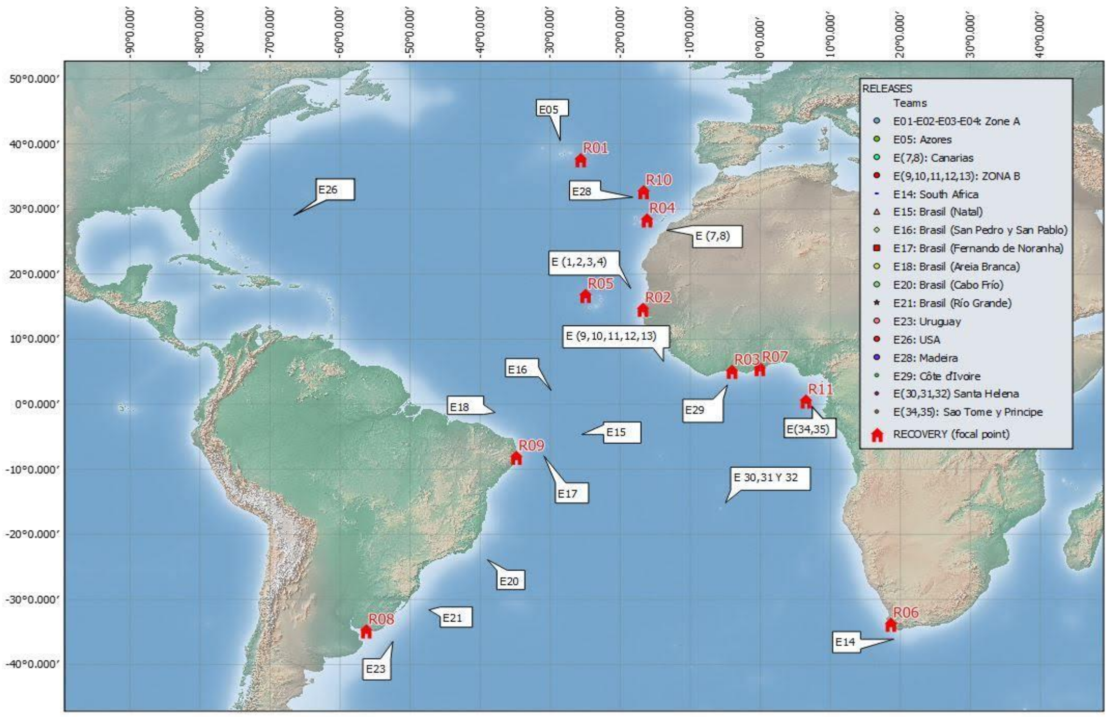

Figure 2. Summary of the distribution of AOTTP tag teams (E) and Recovery Teams (R) around the Atlantic Ocean.

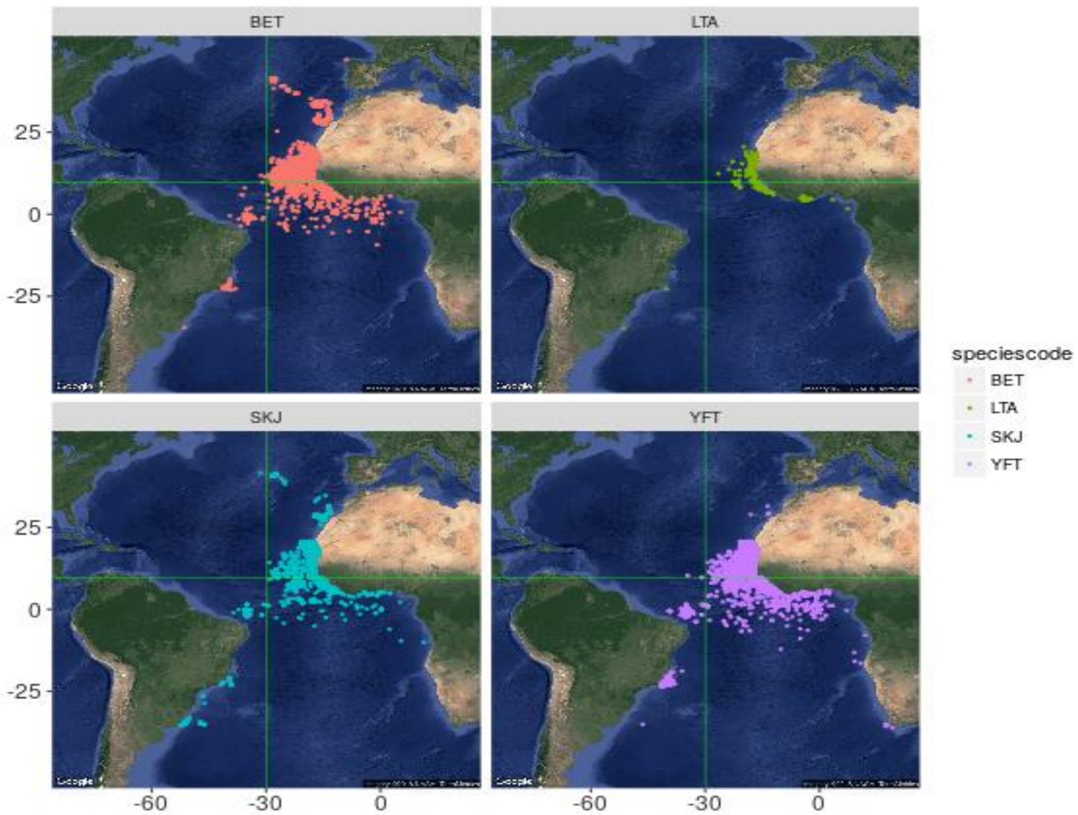

Figure 3. Spatial distribution of tropical tuna recovered by AOTTP between June 2016 and September 2018.

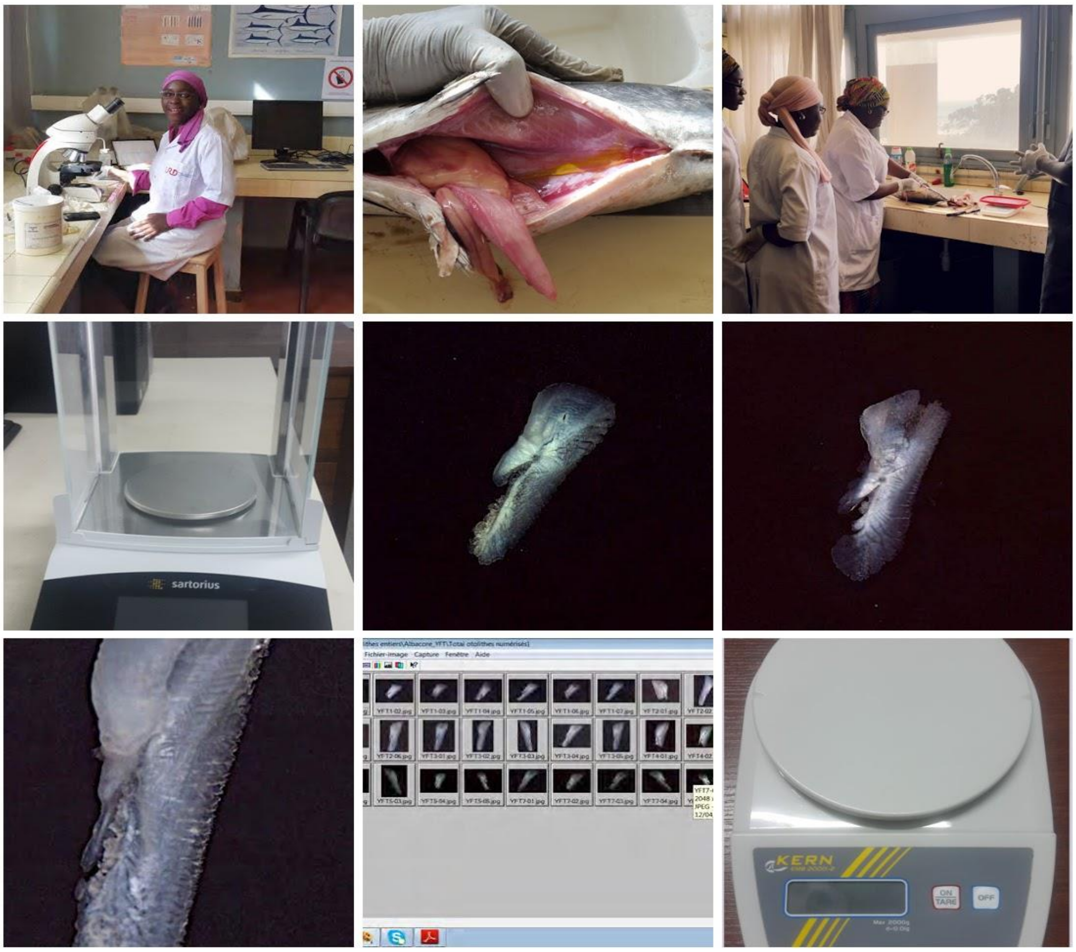

Figure 4. Creating an otolith reference set in Dakar, Senegal.

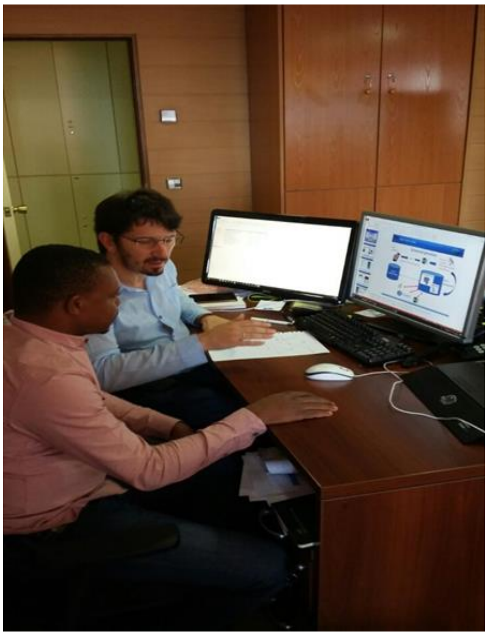

Figure 5. Demonstrating AOTTP tagging protocols to Ilair Conceição (São Tomé and Príncipe) in Madrid May 2018.

Figure 6. AOTTP Capacity Building Workshop (December 2017 in Madrid).

Appendix 6

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 and maturity 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, king mackerel and serra Spanish mackerel and dolphinfish.

2018 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**).

Activities planned for 2018-2019

During the period 2018-2019, the Group plans to continue collecting biological samples for priority species to further improve growth and maturity parameters estimates and also genetic analysis. 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 2018-2019.

2018 Expenditures

The total expenditures within SMTYP during 2018 amount to €50,000. The detailed costs per activity are summarized in **Table 1.**

Budget for 2018-2019 and expected expenditures

To implement the main activities planned in the framework of SMTYP in 2018-2019, 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 2018-2019 are shown in the **Table 3.**

Table 1. The detailed expenditures within SMTYP during 2018.

TOTAL BUDGET	ACTIVITY	
	Sampling, Reproduction and Age and growth studies	**Genetics analysis**
50.000,00	25.000,00	25.000,00

List of the Consortium partners:
UNIVERSITY OF GIRONA (Spain) – Consortium leader
CENTRE NATIONAL DE RECHERCHE DU DÉVELOPPEMENT DE LA PÊCHE ET DE L'AQUACULTURE, CNRDPA (Algeria)
UNIVERSIDADE FEDERAL RURAL DO SEMIÁRIDO (Brazil)
CENTRE OF OCEANOLOGY RESEARCH (Côte d'Ivoire)
INSTITUTO ESPAÑOL DE OCEANOGRAFIA (EU.Spain)
INSTITUTO PORTUGUÊS DO MAR E DA ATMOSFERA (EU.Portugal)
DIRECTION GENERAL DES PECHES ET DE L'AQUALCULTURE (Gabon)
NATIONAL FISHERIES AND AQUACULTURE AUTHORITY (Liberia)
LABORATOIRE DES PÊCHES (Dakhla) (Morocco)
LABORATOIRE EVALUTAION DES RESSOURCES VIVANTES AQUATIQUES (Mauritania)
DIRECÇÃO DAS PESCAS (S.Tomé e Príncipe)
CENTRE DE RECHERCHES OCEANOGRAPHIQUES DE DAKAR/THIAROYE (Senegal)
NATIONAL INSTITUTE MARINE SCIENCE AND TECHNOLOGY (Tunisia)

Table 2. The detailed information on the research activities to be carried out by species for 2018-2019 under the ICCAT SMTYP.

Species	Research line	Geographical area	CPCs	Coordinator
Little tuna	Aging and growth	North East Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Cabo Verde	S. Baibbat
		South East Atlantic	Angola, South Africa, Cote d'Ivoire, São Tomé e Príncipe, Gabon	
	Reproduction	North East Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Cabo Verde	D. Macias
		South East Atlantic	Angola, South Africa, Cote d'Ivoire, São Tomé e Príncipe, Gabon	
		Mediterranean Sea	Tunisia, EU-Spain, Algeria	
	Stocks structure/delimitation	North East Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Cabo Verde, Morocco	J. Vinas
		South East Atlantic	Angola, South Africa, Cote d'Ivoire, São Tomé e Príncipe, Gabon, Liberia	
		Mediterranean Sea	Tunisia, EU-Spain, Algeria	
Atlantic Bonito	Aging and growth	North East Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Cabo Verde, Morocco	S. Baibbat
		South East Atlantic	Angola, South Africa, Cote d'Ivoire, São Tomé e Príncipe, Gabon	
		Mediterranean Sea	Tunisia, EU-Spain	
	Reproduction	North East Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Cabo Verde, Morocco	D. Macias
		South East Atlantic	Angola, South Africa, Cote d'Ivoire, São Tomé e Príncipe, Gabon	
		Mediterranean Sea	Tunisia, EU-Spain, Algeria	
	Stocks structure/ delimitation	North East Atlantic	Senegal, EU-Spain, EU-Portugal, Mauritania, Cabo Verde, Morocco	J. Vinas
		South East Atlantic	Angola, South Africa, Cote d'Ivoire, São Tomé e Príncipe	
Wahoo	Aging and growth	North East Atlantic	EU-Spain, Mauritania	S. Baibbat
		South West Atlantic	Brazil	
	Stocks structure/ delimitation	North East Atlantic	EU-Spain, Cabo Verde, Mauritania	J. Vinas
		South East Atlantic	São Tomé e Príncipe	
		South West Atlantic	Brazil	

Table 3. Required budget for the research activities to be carried out during 2019 under the ICCAT SMTYP.

Activity	Amount (€)
Reproductive biology study	€20,000
Age and growth study	€20,000
Genetics study for stock differentiation	€50,000
Sampling collection and shipping	€10,000
Total	**€100,000**

Appendix 7

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, 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 two 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 in 2018.

2018 Activities

During the 2015 blue shark stock assessment meeting (Anon. 2016) 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. Following are the cumulative SRDCP activities conducted up to 2018.

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 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 Linf = 241.8 cm FL, k = 0.136 year^{-1} for males and Linf = 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. In 2018, results for the South Atlantic stock based on data from 332 specimens, ranging in size from 90 to 330 cm fork length (FL) for females and 81 to 250 cm FL for males, were analyzed (Hanisko *et al.* 2018). The von Bertalanffy growth equation with fixed L_0 (size at birth = 63 cm FL) with resulting growth parameters of Linf = 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. 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.

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 is currently non-existent, 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), and Brazil, and additional information from 20 miniPATs was also available to estimate post-release mortality. Of the 28 specimens with available information, seven died (25%), whereas the remaining 21 survived (75%), at least the first 30 days after tagging. The updated results from this project were reported and published in Domingo *et al.* 2018.

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) tags (23 tags: 9 miniPATs and 14 sPATs) and 11 tags (out of 13) from phase 2 (2016-2018) have been deployed by scientific observers on Portuguese, Uruguayan, U.S. and Brazilian vessels in the temperate Northeast, temperate Northwest and Southwest Atlantic. Additional tags from other projects (n=15) involving the same partners may also be deployed in these same areas, which cover both hemispheres and both sides of the Atlantic. In all, data from 32 of the 34 tags/specimens are available for a total of 1260 tracking days. 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.* 2018. The main plan for the next phase of the project is to continue tag deployment (12 additional tags were acquired) during the rest of 2018 and 2019 in several regions of the Atlantic.

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.

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 Uruguayan and United States vessels.

Movements, stock boundaries and habitat use of silky sharks in the Atlantic Ocean

The Group also decided that of 20 satellite tags that were acquired in 2018 for the SRDCP, 12 should be deployed on shortfin mako as initially planned (see section above), but that other tags could be allocated to other priority shark species, with particular emphasis on species that are currently prohibited to be retained in ICCAT fisheries. After a review of satellite tags previously deployed on these other species in the Atlantic, the Group recommended that 8 tags should be deployed on silky sharks because virtually nothing is known of their movements in the Atlantic (only three animals tagged off Cuba) and they were ranked as the most vulnerable species in the 2010 ERA (Cortés *et al.*, 2010).

2019 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 and hopefully Namibia in the southeast Atlantic.

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. To that end, additional samples from Uruguay with good temporal coverage will likely be needed. The Group will also investigate the possibility of acquiring samples from the southeast Pacific (e.g., from Chile) to determine if there is some type of relation 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 (phase 3) of 12 tags acquired in late 2018 during 2018-2019 with the final analysis of these projects expected during late 2019.

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 of reproductive organs of porbeagle (and shortfin mako) in the western North Atlantic in 2019. We also plan to conduct a workshop 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 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. For porbeagle, work concerning the existence of a resting stage that has not been previously documented for this species is also envisaged.

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 2019 we plan to finish deployment of the 16 miniPATs acquired in late 2018, which may 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 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 of 20 satellite tags acquired in 2018 for the SRDCP, 8 tags should be deployed on silky sharks. In 2019 we plan to finish deployment of the 8 miniPATs acquired in late 2018 which may not have been yet deployed. We also propose to acquire 12 additional tags to be deployed on silky sharks in 2019 to continue the project and 12 tags to be deployed on other species. As such, for 2019 we propose the acquisition of 24 miniPAT satellite tags for the SRDCP programme.

2018 budget and expenditures

This section presents a summary of the contributions for the SRDCP during 2018. The Shark Species Group developed a budget of €115,000 for Year 4 of the programme (**Table 1**). These funds were approved and allocated as follows: €15,000 for the shortfin mako genetic analysis, €20,000 for reproductive study; €80,000 for purchasing satellite tags (including satellite time and fish costs) to be deployed on porbeagle (16), shortfin mako (12), and silky sharks (8).

2019 budget and requested contributions

The proposed budget for Year 5 of the SRDCP (2019) amounts to a total of €115,000 (**Table 2**). Funds are being requested for research on shortfin mako, porbeagle, and silky sharks, distributed as follows:

- Reproductive study of porbeagle, including continuation of sample collection and organizing a workshop to standardize sampling and analytical methodologies and analyze results: €30,000;

- Shortfin mako genetics (NGS - next generation sequencing, with additional samples from Uruguay): €15,000;

- Silky sharks: €35,000 to study movement and habitat characterization studies for other priority ICCAT species (includes costs for purchasing 10 satellite tags, satellite use and fish);

- Tagging for other sharks: €35,000 to study movement and habitat characterization studies for other priority ICCAT species (includes costs for purchasing 10 satellite tags, satellite use and fish).

Table 1. 2018 SRDCP budget.

Project	*Participating CPCs*	*Project leader*	*Approved Budget (€) 2018*
SHORTFIN MAKO			
Stock boundaries (Genetics)	EU, Japan, Uruguay, US, etc.	Semba	15,000
Movements and habitat use (PSATs)	EU, Uruguay, US, etc.	Coelho/Domingo	35,000
PORBEAGLE			
Reproduction	EU, Canada, Japan, US, Uruguay	Cortés	20,000
Movements and habitat use (PSATs)	EU, Uruguay, US, etc.	Coelho/ Domingo	27,000
SILKY			
Movements and habitat use (PSATs)	EU, Uruguay, US, etc.	Coelho/Domingo	18,000
		Total	**115,000**

Table 2. Proposed budget for 2019 SRDCP.

Project	*Participating CPCs*	*Project leader*	*Budget requested (€) 2019*
SHORTFIN MAKO			
Stock boundaries (Genetics)	EU, Japan, Uruguay, US, etc.	Semba	15,000
PORBEAGLE			
Reproduction	EU, Canada, Japan, Uruguay, US,	Cortés	30,000
SILKY			
Movements and habitat use (PSATs)	EU, Canada, Uruguay, US	Domingo/Coelho	35,000
OTHER SPECIES			
Movements and habitat use (PSATs)	Canada, EU, Uruguay, US	Domingo/Coelho	35,000
		Total	**115,000**

Appendix 8

Report of the ICCAT Enhanced Programme for Billfish Research (ICCAT/EPBR)
(Expenditures/Contributions 2018 and Programme Plan for 2019)

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 2018 was Dr John P. Hoolihan (USA), Dr Fambaye Ngom Sow (Senegal) was the 2018 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 2017-2018 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. In 2018 funding from the ICCAT Science Envelope was requested 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 area, either from directed or bycatch billfish fisheries. It will also 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 2018 sample kits were distributed among SCRS scientists responsible for local sampling programmes. A sample kit from Senegal distributed in 2018 has been returned, in September.

United States: 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 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.

2018 Activities

In 2018 a Call for tenders was launched aiming the collection of hard parts (otoliths, spines or vertebra) and associated information for marlins and sailfish caught off West Africa from all fisheries in the ICCAT Convention area, either from billfish fisheries or from those catching these species as by-catch. Secondarily, it aims to 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). A contract was awarded by the Secretariat to a Consortium led by *Institut Fondamental d'Afrique noire Cheikh Anta DIOP* (Université Cheikh Anta Diop de Dakar, Senegal) for a total amount of €25,000. Due to the delay in the provision of funds, sampling for hard parts has not started in Côte d'Ivoire and São Tomé & Príncipe. Such activities will continue until the end of 2018 and extend thereafter pending the availability of funds.

The genetic sampling study to compare mixing and distribution of white marlin and roundscale spearfish is ongoing, and in 2018 sample kits were distributed among SCRS scientists responsible for local sampling programmes. One sample distributed in 2018 was returned from Senegal.

Following the SCRS request, in February 2018 through the ICCAT Science Envelope, the Secretariat hired an expert to develop a *Comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/Central American region*, which has recently been presented to the Sub-

Committee on Statistics. The study aimed at conducting an inventory of existing data collection programmes in ICCAT fisheries of the Caribbean/Central America States and develop specific recommendations to improve data reporting in artisanal fisheries in the region. The results of this study were presented to the Sub-Committee of Statistics and a draft final report are provided in Arocha, 2019.

2019 plan and activities

The highest priorities for 2019 are to support the objectives established by the billfish work plan and those of the EPBR, with specific emphasis on the collection and preparation of data relevant to the identification of white marlin and spearfishes and the collection of biological data on spearfishes:

- support the monitoring of the Brazilian, Uruguayan and Venezuelan fleets through on board observers, reporting of conventional tags, and biological sampling;
- support the blue marlin biological and photographic sampling in Gulf of Mexico;
- support the collection of billfish biological samples off West Africa;
- support the monitoring of billfish catches from West African artisanal fishing fleets;
- investigate possible unreported important billfish catches in the Caribbean, and take steps to develop capacity building where feasible.

All these activities depend on successful coordination, sufficient financial resources and adequate in-kind support. Details of EPBR funded activities for 2018 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 western Atlantic, sampling at landing sites will be conducted for artisanal gillnet landings off central Venezuela, pending available funds. In the eastern Atlantic, monitoring and sample collection will be supported for the artisanal fisheries of Côte d'Ivoire, Ghana, São Tomé and Senegal.

Tagging

The programme will need to continue to support the conventional tagging and recapture reporting conducted by programme partners.

Biological studies

The biological and genetic sampling programmes, particularly for white marlin and spearfish, will continue in 2019.

Continued efforts to collect biological samples for reproduction, age and growth studies for all billfish species requires EPBR support to facilitate cooperation from fleets that are monitored with EPBR funds.

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*).

2018 Budget and Expenditures

This section presents a summary of the EPBR budget for 2018, which amounted to €65,000 (**Table 1**). These funds were approved and allocated as follows: €40,000 for the comprehensive study of strategic investments related to artisanal fisheries data collection; €25,000 for studies related to three billfish species (BUM, WHM and SAI) on: age and growth and genetics studies, plus sample collection and shipping.

Table 1. 2018 EPBR budget.

Activity	*Budget (€)*	*Committed (€)*
Comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/Central American region	40,000	39,745
Genetics study for species and stock differentiation	5,000	25,000
Age and growth study	10,000	
Sampling collection and shipping	10,000	
Total	**65,000**	**64,745**

2019 Budget and requested contributions

The proposed 2019 budget, totalling €70,000 is detailed in **Table 2**. The programme is predicted to have a balance of €255 by the end of 2018 and therefore requests the Commission to provide a contribution of €69,745 for 2019. To achieve all its objectives in 2019 the programme will continue to require contributions from other sources, such as those so generously provided lately by the EU, US and Chinese Taipei.

Table 2. 2019 EPBR budget.

Activity	*Budget (€)*
Monitoring and collection statistics for the artisanal fisheries in eastern Atlantic	20,000
Age and growth study	20,000
Sampling collection and shipping	15,000
Gulf of Mexico blue marlin biological and photographic samples	15,000
Total	**70,000**

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.

The consequence of the programme failing to obtain the requested budget will be to stop or reduce programme activities for 2019 including: (1) collection and processing of genetic samples, collection and processing of gonad samples and hard structures (spines and otoliths), (2) at-sea observer trips in Brazil and Venezuela, (3) biological sampling and collection of statistics of catches from fleets in the western and eastern Atlantic, (4) promotion of conventional tagging activities, including distribution of tag recovery incentives. 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. 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 9

2018 REPORT OF THE MEETING OF THE SUB-COMMITTEE ON STATISTICS
(ICCAT Secretariat, 24-25 September 2018)

1. Opening, adoption of Agenda and meeting arrangements

The Sub-committee on Statistics met at the ICCAT Secretariat (Madrid, Spain) on 24-25 September 2018. 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 (see **Addendum 1 to Appendix 9**).

2. Review of fisheries and biological data submitted during 2018

The Secretariat presented information contained in the 2018 Secretariat Report on Statistics and Coordination of Research related to fisheries and biological data submitted for 2017 including revisions to historical data.

The activities and information included in this report refer to the period between 1 October 2017 and 13 September 2018 (the reporting period). All the basic fisheries and biological statistics have been presented by the Secretariat to the SCRS Working Groups during SCRS inter-sessional meetings. The Secretariat continues to note the improvements in terms of data submission using the ICCAT 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 to the Secretariat in the last six years, together with some lack of adherence to deadlines established for data submission, continues to constitute an enormous amount of work for the Secretariat which is not sustainable. This situation was particularly difficult during 2018 due to the increased number of SCRS and Commission meetings.

To the 2017 datasets reported, the Secretariat applied 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 75 flag related CPCs (50 CP + 1 CP [16 EU Member States] + 1 CP [4 UK Overseas Territories Member States] + 5 NCC) with possibly reporting obligations. The forms submitted with errors that the Secretariat was unable to correct were considered unreported data.

2.1 Basic Task I (T1FC and T1NC) and Task II (T2CE and T2SZ) statistics

The Secretariat presented 2017 data reporting status (Tables 1 and 2 to the 2018 Secretariat Report on Statistics and Coordination of Research) 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 overall reporting of ST01 increased slightly from 72% in 2017 to 75% in 2018 (56 flags). Four flags reported after the submission deadline. The Secretariat made corrections to the information reported by 10 flags CPCs, and, 5 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 2017 report card is presented in Table 2 to the 2018 Secretariat Report on Statistics and Coordination of Research. Like the T1FC reporting, 2017 reports showed a slight decrease in reporting (62 flags corresponding to 83%) compared to 2016 (85%). Five flags reported late and the Secretariat made corrections to 5 datasets. Thirteen CPCs (17%) have yet to report their T1NC data.

The T2CE (catch and effort) report card is presented in Table 3 to the 2018 Secretariat Report on Statistics and Coordination of Research. A total of 51 flags (68%), including 4 late reporting-flags, reported T2CE. This represents a significant decrease in T2CE reporting compared to 2017 (76% reporting). Twenty four 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 to the 2018 Secretariat Report on Statistics and Coordination of Research. The submission of 2017 size data also showed a significant decrease in reporting. A total of 47 flag CPCs (63%), including 4 late reports, submitted 2017 size data compared to 52 flags (70%) for 2016. Some of the submitted data are pending review and corrections by the Secretariat. A total of 27 CPCs have yet to submit 2017 size data.

2.2 Tagging

The different laboratories and scientific institutions conducting electronic tagging in the ICCAT Convention area reported a total of 274 releases and 80 recoveries made in late 2017 and during 2018. With respect to conventional tagging, a total of 93,972 were tagged and 13,398 tags were recovered during the same period. From September 2017 to September 2018, the Secretariat distributed about 3,225 conventional tags. These figures do not include any tags deployed and recovered by the AOTTP.

2.3 Complementary data obtained within ICCAT data collection and research programmes (GBYP, AOTTP, EPBR, SMTYP and SRDCP)

The data recovery activities made within ICCAT research programmes (GBYP, AOTTP, EPBR, SMTYP and SRDCP) have been important sources of improvements on fisheries statistics.

During 2018, the GBYP worked on three main bluefin data recovery tasks. The first two, already finalized, are the new and improved estimates of annual catches (historical and recent years) of 5 Italian tuna traps, and, the recovery the landings of some flags reported at ICES meetings (in paper) in the period 1962-1978 (incomplete or not available in ICCAT-DB). This work, presented in Pagá *et al*. 2019, should be evaluated and approved by the SCRS. The third task is currently ongoing and consists of the provision of datasets of 41 electronic tag deployed in 2016-2017 by Dr Barbara Block.

Under the SMTYP research programme, during 2018, several historical data recoveries of catches series were also made by Mauritania (2006-2018), Sao Tomé e Principe (2009-2017) and Liberia (2011-2017). These catch series were evaluated and adopted by the Small Tunas Species Group (Anon. 2018g).

2.4 Other relevant statistics (observer data, VMS, BCDs, ISSF, etc.)

The Secretariat indicated that for 2017, 21 CPCs reported observer data using the revised ST09 form (an increase of 5 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. As has already been recognized by the Sub-committee on Ecosystems, this Sub-committee once again reminds CPCs of their obligations to report by-catch data collected by their observer programmes. The limited available data so far has precluded the SCRS to advance the assessment of the efficacy of seabird mitigation measures as required by Rec. 11-09.

The Sub-committee reiterated the utility of VMS data for assessing fishing activity in the Atlantic Ocean. It was noted that the ICCAT Ad Hoc Working Group on FADs 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.

The Secretariat indicated once again that the data that have been provided by the ISSF are not in a standardized format and, therefore, they cannot be easily included into the ICCAT-DB. The Secretariat and the ISSF will continue to work together to solve this pending issue.

3. Review of Secretariat's standard (yearly based) datasets estimations

3.1 CATDIS and EFFDIS

The Secretariat continues to improve the CATDIS estimations in two main fronts, the level of detail and the automation process aiming to reduce the time to estimate it. A full revision of CATDIS 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. The resulting maps were published in the ICCAT Statistical Bulletin Vol. 44. (1).

With regard to EFFDIS, the Sub-committee noted that the version posted on the ICCAT web site might not be the latest one that incorporates the recent updates of the catch-and-effort data. This is because it was noted that there is a mismatch between CATDIS and EFFDIS where some cells with estimated catches have no effort in the EFFDIS file. As such, the Sub-committee requested the Secretariat to investigate this issue and make the necessary corrections to the EFFDIS estimations.

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 has an active connection between the size data and the substitution tables used for the CAS estimations. As required, the Secretariat also provided updated CAS and CAA matrices for the 2018 bigeye tuna stock assessment (Anon. 2018b).

4. Evaluation of data deficiencies pursuant to Rec. 05-09

4.1 2017 Report Cards applying SCRS validation criteria (Filters 1 and 2)

For the fifth consecutive year, the Secretariat applied, the SCRS filtering criteria (Filters 1 and 2 in 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 2017 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 2018 Secretariat Report on Statistics and Coordination of Research). 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).

Over these last five years, the Sub-committee and the Secretariat have observed continuous 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 Standard catalogues of major ICCAT species (1990-2017)

The Secretariat presented the Task I/Task II data SCRS catalogues for the major ICCAT species (1996 to 2017) in Appendix 1 to the 2018 Secretariat Report on Statistics and Coordination of Research). The Sub-committee acknowledged improvements in data submissions. 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 2019.

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. Management Strategy Evaluations (MSE) could be used to conduct cost benefit analyses. Particularly to evaluate how reducing uncertainty can help reduce the risk of failing to meet management objectives.

The Sub-committee continues to express particular concerns regarding the very limited data that so far has been provided from coastal fisheries (i.e., coastal longlines and gillnets) on vulnerable by-catch such as seabirds and sea-turtles. The Sub-committee on Ecosystems, in particular, continues to be concerned that this is limiting its ability to assess the impacts of the ICCAT fisheries on the status of those populations. In addition, the reporting of total dead discards and live releases (see Section 2.1) continue 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 activities, new plans, and improvements on national data collections systems

The Secretariat informed the Sub-committee that major revisions were made during the bigeye tuna data preparatory meeting (2018a) and the blue marlin data preparatory meeting (2018c), which improved the tropical species and the billfish species fisheries statistics, respectively. Some gaps were also completed and the unclassified gears properly discriminated. Many CPC scientists were involved with the Secretariat in these revisions. This joint effort has greatly contributed to improvements in Task I and Task II related to these species. For T2CE, the largest revision was presented by EU-France which splits the FIS (FRA+CIV+SEN) combined BB and PS fleets (1980 to 1990) into three flag independent series. The Ghanaian BB and PS series of T2CE (1996 to 2005), estimated during the 2013 Intersessional Meeting of the Tropical Tunas Species Groups (Anon, 2014b), held in Tenerife was finally adopted by the Group. The major T2SZ revisions were from Chinese Taipei longline fishery (1981-2007 on bigeye tuna), and, a full revision of the size samples of the European associated BB and PS fisheries (fleets: ESP, FRA, PAN, GTM, SEN, CPV, etc.) from 1980 to 2017 and for the three major tropical tuna species and the by-catch of albacore tuna, frigate tuna and little tuna.

5. Review of existing practices for data submission and validation

5.1 Formats (eFORMS), codes, and deadlines

The Sub-committee indicated that no changes have been made to the deadlines to report Task I and Task II data. However, the Sub-committee continues to recommend that CPCs make their utmost effort to report their data in advance of the 31 July deadline to help the Secretariat with its workload. With respect to providing data for intersessional meetings, the Sub-committee recommends that CPCs continue to make an effort to provide the requested data by the provided deadlines. However, for compliance purposes the data submission deadline continues to be 31 July.

The Secretariat also informed the Sub-committee on the advancements made in the improvement of the ICCAT coding system. The details can be found in the 2018 Secretariat Report on Statistics and Coordination of Research.

The Secretariat also proposed changes to the statistical forms to better indicate if the new reported data are partial or full. The Sub-committee agreed with the proposed changes, but it requested that the Secretariat provide a more detailed explanation of the each term to help CPCs to better interpret them. In addition, the Secretariat also proposed some changes to the ST03-T2CE form that will allow indicating the product type being reported for each species, in the place of the fishing operations mode (FAD and free school), that will be moved to the detail section. The Sub-committee also approved these changes to the ST03 form.

5.2 Progress on the work to develop an ICCAT Online Reporting System

Following the 2017 recommendations of the SCRS and the Commission’s Online Reporting Technology Working Group, the Secretariat has started the merge of the ICCAT Statistical Online Reporting System (“ICCAT forms”, a web application developed by the Secretariat during 2017 to integrate, validate, and store statistical forms online) and the FORS study (Fisheries Online Reporting, financed by ABNJ). The merging process (adding to ICCAT forms project many of the FORS design concepts, technologies, approaches, models, etc.) will continue in the future. The Secretariat is now working on improving the resulting web application by including technologies (e.g. REST API web-services implementation, using Angular 6 to implement the client side of the web application).

Meanwhile, as recommended by the SCRS in 2017, the Secretariat has deployed in the ICCAT Cloud infrastructure, a Cloud server (http://162.13.143.167:8080/prototype) having a prototype of the "ICCAT forms" web application. This prototype is online since April 2018 and with only a few users registered (mostly ICCAT Statistical Correspondents) aiming to collect the initial impressions of the system. The Sub-committee recommends extending the testing period and encourages all CPCs to participate.

6. Progress on the work developed by the ICCAT Online Reporting Technology Working Group

The Sub-committee briefly discussed the meeting of the ICCAT Online Reporting Technology Working Group (ANNEX 4.2 to the *Report for the Biennial Period, 2018-2019, Part I (2018) Vol. 1*) that met in March 2018 and that was attended by the Chair of this Sub-committee. The Sub-committee continues to fully support the efforts to develop the ICCAT Integrated Online Management System (IOMS) and it reiterates that the Commission should provide full support to the Secretariat (including financial) to advance and complete this task.

7. Review of the ICCAT relational database system (ICCAT-DB)

A detailed description of all the work involving the various parts of the ICCAT-DB (databases, applications, specific code, documentation, etc.) is presented in the 2018 Secretariat Report on Statistics and Coordination of Research. In addition, the Secretariat also did a presentation summarizing the current status of the ICCAT-DB (SCRS/P/2018/058), the progress made during 2018 (improvements, ongoing projects, documents, etc.), and the pending work that should continue in the future (ongoing and postponed tasks). This Sub-committee expressed its satisfaction and congratulated the Secretariat for the effort, dedication, and continuous commitment regarding the improvement of the ICCAT-DB system.

7.1 Improvements, ongoing work, and documentation work

Since 2017, the Secretariat has continuously worked on smoothly adapting the ICCAT-DB system foreseeing the "online reporting" process. A similar approach was adopted to document the ICCAT-DB system. 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 work is now continuously being merged and updated in parallel with the improvements made to the ICCAT-DB.

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, in April 2018, this web application was deployed online (as a prototype) for tests to be made by ICCAT Statistical Correspondents during 2018. Only three users did some testing over the last three months. The Secretariat recommends extending the testing period and encourages CPCs to participate.

8. International and inter-agency cooperation on statistical activities (FAO, CWP, FIRMS, CLAV)

The Secretariat continues to collaborate with several organizations for support of scientific dissemination of SCRS conclusions and recommendations of its activities in 2018. In this regard, the Secretariat provided results of the latest assessments of yellowfin, albacore, sailfish and Mediterranean swordfish stocks to the Fishery and Resources Monitoring System (FIRMS) and, participated in the Mediterranean Advisory Council (MEDAC) meeting (September 2017) providing a summary of the status of ICCAT species in the Mediterranean Sea. The Secretariat continues to provide regular updates of the ICCAT vessel registration to the CLAV database, and submitted the summary of the ICCAT Collect. Vol. of Sci. Pap., Volume 69, Issues 2, 3, and 4 to the ASFA - Proquest Database in 2018. The Secretariat has also participated in the annual meeting of the Coordinating Working Party on Fishery Statistics (CWP), Rome, Italy, March 2018, and the meeting of iMarine, an open collaborative support system for Ecosystem Approach for Fisheries Management (EAFM). The Secretariat also maintains active collaboration with ISSF, ICES, and GEF Common Oceans ABNJ Tuna Project on several research, statistics and scientific tasks in support of the SCRS work.

In 2017 the Secretariat also chaired the Second Joint t-RFMOS MSE Technical Working Group (Seattle, June 2018), and participated in the CCSBT preliminary MSE Technical Working Group (San Sebastian, September 2018). Important recommendations for the ICCAT MSE process were raised at these meetings.

9. Review of the Report of the short-term contract: *Comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/Central American region*

The abovementioned report was introduced (Arocha, 2019). The major recommendations of the report were as follows:

- SCRS would need to prioritize the level of investment for data enhancement programmes for artisanal/small-scale fisheries within the Caribbean/Central America Region.

    1. Decisions are required to define what the priorities are, such as, based on the major ICCAT species (under current management recommendations, and/or under rebuilding programme) or of least concern. However, all ICCAT species caught by artisanal fisheries in the region should be included in any data enhancement programme.

    2. Decisions need to be made on the duration of the investments.

- Countries with artisanal/small-scale fisheries in the Caribbean/Central America Region that catch species of great concern in ICCAT (e.g., billfishes and sharks) should be encouraged to declare their interest in data enhancement programmes on capacity building by presenting a scientific document at any of the SCRS Species Group meetings.

    1. It is important that the SCRS Chair and Species Groups Chairs reach out to scientists from countries that are of major interest based on their catches of ICCAT species in their artisanal/small-scale fisheries as noted in the study.

    2. The reach out should encourage participation in Species Groups meetings in order to share recorded information on statistical data from artisanal fisheries indicating limitations and procedures on how to correct them.

    3. Reiterate that funding is available for participation at the Species Groups meetings so their results can be presented and shared with the rest of the Species Groups.

- Investments in capacity building of data collection and reporting, and species identification workshops caught by artisanal/small-scale fisheries for all countries within the scope of the study are required urgently, considering the deficiencies in the catch matrix for several ICCAT species of interest caught by those fisheries.

    1. One or two workshops on data collection and reporting, and species identification should be planned for the region. Ideally, the first workshop should focus on training, and the second workshop should be follow-up of any information gaps as well as any corrections required.

- Medium to long term data enhancement programmes for artisanal/small-scale fisheries in countries with major catches of species of great concern in ICCAT (e.g., billfishes and sharks).

1. This recommendation depends on the decisions made on the first Recommendation above. It should be noted that some countries with limited capabilities for data recording in artisanal fisheries take substantial catches of ICCAT species.

- Harmonization between TFPs are strongly encouraged and needed, particularly with WECAFC/FAO since all countries in the region are members of the Organization and the synergy to be created between ICCAT and WECAFC will likely facilitate cooperation and enhancement in data collection of ICCAT species of concern within the region.

  1. It seems critical to find ways to establish a level of cooperation between WECAFC and ICCAT that would make it possible to encourage countries that are not ICCAT member countries to participate in ICCAT in any possible way.

The Sub-committee inquired if there is an estimate of what percentage of the total catches in the region corresponds to artisanal fisheries. The author of the report indicated that it is difficult to know because of the heterogeneity of the artisanal fisheries and the data collection programme among the assessed countries. The Sub-committee also wanted to know if the observed shark by-catch is retained or discarded, it was informed that all shark catches are retained and that there is full utilization of the carcasses, in addition shark finning does not seem to be a prevalent practice in these fisheries. The report mentioned that FADs are being used to catch ICCAT species. After further inquiry, the author of the report indicated that the Dominican Republic is the only country the uses moored FADs to catch ICCAT species, but these FADs are 'homemade' and completely unregulated. It was discussed that it would be important to obtain information, in addition to total catches information, on the size structure of the artisanal catches. The author also explained that some countries were unaware of some of the reporting obligations for ICCAT species, particularly for DOL (dolphinfish). The Sub-committee discussed the need to make some of these countries aware that ICCAT has funds available for scientists to attend SCRS meetings and it further discussed the need for capacity building in the region. Finally, a collaboration between ICCAT and WECAFC was discussed.

The Sub-committee commended the author of the report for his comprehensive work.

10. Considerations on the Sub-committee on Statistics recommendations (past and 2017)

10.1 Progress with prior year Recommendations of theSub-Committee

- The Sub-committee reminds CPCs of their obligation to report total discards and live releases. The Sub-committee also recommends that the SCRS explore ways to provide capacity building to those CPCs that need it to comply with the discard reporting requirements.

The Sub-committee continues to note that the reporting of dead discards and live releases continues to be poor and no improvements have been made in this area.

- The Sub-committee again reiterates that CPCs should report their observer data and any other information needed to advance the assessment of the efficacy of seabird mitigation measures as well as the impact assessment of ICCAT fisheries on sea turtles.

Only 21 CPCs reported observer data using the newly adopted ST-09 form. Although this is a very slight increase compared to the submission of 2016 data (2 CPCs), it is still unclear how many CPCs that have observer programmes are not reporting their data. In general, the reported data are still insufficient to advance the assessment of the efficacy of seabird mitigation measures.

- The Sub-committee recommended that CPCs revise their historical series of Catch-and-Effort and Catch-at-Size.

In general, CPCs tend to revise their historical series of C&E and CAS in preparation for particular stock assessments. Therefore, it is expected that the response to this recommendation will be positive over time.

- The Sub-committee reiterates previous recommendations that submission of T2CE data should be done for all species at once. When CPCs report T2CE data for several species separately, the Secretariat cannot interpret the effort data and, therefore, it is not possible to combine de different data sets.

The Secretariat informed the Sub-committee that even though improvements have been made on the reporting of T2CE data, there are still occasions when CPCs report this information in more than one submission.

- The Sub-Committee recommended that the Secretariat change the start of the 'reporting period' to 1 October from the current date of 1 December.

Following this recommendation from the Sub-committee, the Secretariat changed the start of the reporting period to 1 October.

- The Sub-committee endorsed the ongoing work by the Secretariat to develop an online reporting system for statistical data. The Sub-committee recommends that Statistical Correspondents interested in helping in the testing of this new system to work with the Secretariat.

The Secretariat contacted 13 Statistical Correspondents and invited them to participate in the testing of the online reporting system. Unfortunately, only three statistical correspondents replied and participated in the preliminary tests.

- The Sub-committee recommends that the Commission provide the Secretariat with all the support needed to complete the online reporting system. In addition, the Sub-committee recommends that the Commission Online Reporting Working Group be expanded to include members of the SCRS and Statistical Correspondents.

The Commission expanded the Online Reporting Working Group to include members of the SCRS. As such, the Chair of this Sub-committee participated in the March 2018 meeting of the Online Reporting Working Group. In order for the Commission to provide full support for this effort, the Online Reporting Working Group requested the Secretariat to prepare a budget to present to the Commission.

- The Sub-committee recommended that the Secretariat modifies the ST04-T2SZ and ST05-T2CS (renamed from ST05-CAS) form to allow the reporting of data only by month and for several years in the same form. Moreover, form ST04-T2SZ should drop geographical grids of type "20x20" and "10x20". These modifications should be made for the 2018 forms version (to report 2017 data). In addition, the Sub-committee also recommended that the Secretariat explore the possibility of further modifying these forms to allow the reporting of data for several species in the same form (study to be presented at the 2018 annual meeting).

The Secretariat informed the Sub-committee that it continues to find ways to modify the ST04 and ST05 forms to accommodate the Sub-committee's request with regard to these forms.

- The Sub-committee recommended that the ST08-FadsDep be revised by the Tropical Tunas Working Group taking into consideration the results presented in document Báez et al. 2017. The revised form should be presented at the next meeting of this Sub-committee.

The Sub-committee was informed that this work by the Tropical Tunas Species Group is ongoing and an update will be provided at the 2019 meeting of the Sub-committee.

10.2 Review ofRecommendations from 2018 inter-sessional meetings

The following recommendations for statistics from the 2018 inter-sessional meetings were reviewed and endorsed by the Sub-committee.

Billfish

- The SCRS recommends that countries that are engaged in fishing on moored FADs should report in their Annual Reports the prevalence of such mode of fishing and whenever possible the evolution of such fishing practice, including the number of moored FADs being used, the gear used around them and the species caught in them.

- The ICCAT Secretariat has again started to receive reports of billfish unclassified catches from some CPCs.

The Group reminds the CPCs that they should report these catches by species to facilitate the assessments and compliance on billfish recommendations on catch limits (Rec. 15-05). The Group noted that reports of Task I billfish catches in the Mediterranean and from many sport fishing fleets are not being provided on a regular basis.

The SCRS should investigate billfish catches reported to FAO by non-member countries in ICCAT and not included in ICCAT statistics with a view of improving the ICCAT Task I and Task II databases.

It is recommended that the Sub-committee on Statistics considers:

(a) adding a moored FAD fishing mode to the ICCAT codes;

(b) requesting that countries fishing on moored FADs report catch and effort of Task II by specifying a fishing mode: FAD or non-FAD.

- The Group recognizes that the most significant source of uncertainty in the blue marlin assessment is in the landings data. Furthermore, the number of dead discards and fate of the live discards is also not well known and a large contributor to uncertainty. As has been recommended in the past, data on landings as well as dead and live discards need to be more complete and accounted for.

- SCRS should develop an inventory of sport fishing activities that may interact with billfish through collaboration with organizations such as the IGFA and The Billfish Foundation. Such inventory should seek to establish a list of countries, and where possible, ports within the ICCAT Convention area, where sport fishing activities are known to be interacting with billfish. Activities should include, established charter companies and tournaments. This inventory will help the SCRS and CPCs in the design of data collections and sampling programmes.

- Commission should continue to support the initiatives that seek to improve data collection for billfishes in the Caribbean and West African regions through activities that implement the most important recommendations provided by the initial fact finding projects conducted by ICCAT in recent years.

Sharks

- 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.

Small tunas

The Group recommends that Statistical Correspondents and/or national scientists should revise, update, complete and submit their small tuna T1NC series to the Secretariat. This revision should take into account, the replacement of the carry overs, the split of “unclassified” gear catches to specific gear codes, and the completeness of Task I gaps identified. The Statistical Correspondents 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, FL 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 have such data.

Bigeye

- Consider establishing a database of raw data used to establish conversion factors used in stock assessments: length-weight, length-length, weight–weight and age-length, to facilitate the improvement and re-estimation of such relationships as new data becomes available. If the SCRS were to agree it should:
  - Develop a template so that such data could be stored at the Secretariat.
  - Engage in a data recovery project by either:
    - hiring an expert to compile all possible historical data for all ICCAT species or;
    - asking each Working Group to compile the historical information for their respective species.
  - Request that all subsequent papers presented to the SCRS regarding conversion factors and age-length relationships provide the raw data for incorporation in the ICCAT biological databases.
  - Request that data used to calculate conversion factors is regularly reviewed, especially when the fishery evolves and the spatio-temporal distribution or the operation of the fleet changes significantly.
  - Consider whether some of these measurements should be part of the list of requirements for data provision issued by the Commission.
  - All data use and publications derived from ICCAT AOTTP data will have to follow the publication policy included in the ICCAT AOTTP webpage.
  - ICCAT AOTTP conventional tagging data should be shared according to the following conditions:
    - raw data (not yet quality controlled) can be released to ICCAT AOTTP capacity building Working Groups and Tropical Tuna Species Group meetings;
    - raw data will be periodically updated (every six months) and quality controlled before widely released;
    - quality controlled data will be made available publically through the ICCAT webpage. The process of quality control will be described in the webpage and data sets made available will have information on individual fish data quality that can facilitate a broad set of analyses;
    - users of data will be encouraged to try to involve scientists from developing countries in their analysis of the ICCAT AOTTP data. This will be facilitated by providing, in the ICCAT AOTTP webpage, a list of interested scientists from developing countries that have requested to participate in these analyses and by listing all scientists that have participated in the ICCAT AOTTP training workshops.
  - Access to other data collected by AOTTP (otolith reference sets, electronic tagging data) will have to be requested directly to the ICCAT AOTTP Coordinator and access and use of these data will be governed by the following rules:
    - ICCAT AOTTP Steering Committee will decide on the release of such data considering, first the objectives of the ICCAT AOTTP programme, second the priority research needs established by the Tropical Tunas Species Group in their work plan and third the state of progress in the collection of these data sets.
    - Requesters of such data should make sure their request for use of such data is consistent with ICCAT AOTTP objectives and research needs. The ICCAT AOTTP webpage provides the list of research objectives for the programme. The annual work plan of the Group in the annual SCRS report provides the list of research priorities for the Tropical Tunas Species Group.
    - Requests for data analysis that do not fulfill such priorities and objectives will only be considered if the use of the data does not compromise, in any way, the ability of the ICCAT AOTTP to fulfill its objectives.

- The Group recommended close monitoring of the new school association Brazilian fishery by the CPC ensuring the complete data collection of fleet and fisheries statistics, as well as proper sampling of size and biological samples to better assess the impact of this fishery on the overall stock.
- To enable the SCRS to evaluate the impact of potential changes of the capacity management plan of Ghana, the Group recommends that the ICCAT Secretariat request Ghana to grant Ghanaian/SCRS scientists permission to access and analyze the AVDTH and VMS data from their purse seine and baitboat fleets to estimate fishing capacity by vessel type.
- The Group requests that CPCs that use FADs to capture tropical tunas prepare analyses reporting any changes in the distribution of effort and catch during and around the current moratoria and to compare such distributions to those prior to the implementation of the current moratoria.

Ecosystems

Various collaborative efforts to assemble and analyze observer shark, seabird and sea turtle by-catch data are active. The Sub-committee encouraged 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.

11. Replies to the Commission related to Rec. 16-14, paragraph 12, *c* and *d*

(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.

Summarizing observer data information reported by CPCs using the ST-09 form is a complex task given the changes in format that this form had undergone. A summary of the information reported for 2017 can be found in Section 1.4 and Tables 8-11 of the 2018 Secretariat Report on Statistics and Coordination of Research).

d) make recommendations, as necessary and appropriate, on how to improve the effectiveness of scientific observer programmes 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.

The SCRS has not received enough information on national observer programmes to assess the effectiveness of these programmes to meet the data needs of the Commission. It is expected that through the use of the ST-09 observer data from enough information will be collected in the future to assess these programmes.

12. Other matters

Document SCRS/2018/117 - This document presented the rationale for the U.S. to revise its historical commercial landings of shortfin mako (SMA). The revised series used a dressed weight – round weight conversion factor of 1.46 for commercial landings instead of the previous conversion factor of 1.96. The updated series also completed missing information on sampling areas in some years for both commercial and recreational landings.

The Sub-committee adopted the revised series of SMA landings which will be permanently integrated by the Secretariat into the ICCAT-DB.

Document SCRS/2018/155 - Electronic Monitoring System (EMS) in purse seine vessels was tested as an alternative technology to complement and improve on board observer programmes for tropical tuna purse seiners. The authors proposed an optimized sampling strategy for estimating discards applicable to both electronic and human observers that reduces sampling time with minimum estimation bias.

The Sub-committee found the results of the paper to be interesting and useful. It was discussed that the particular sampling strategy implemented could depend on the discard species of interest. For example, the sampling strategy implemented to estimate total bycatch of the most common species might not be the best strategy to implement for rare species. The Sub-committee also inquired about the heterogeneity with which bycatch species are loaded in the sorting belts and if there was a particular reason for this. The presenter explained that this might be related to how the brailer operations are conducted.

Document SCRS/2018/169 – The paper recalls combined systems applied to obtain representative multiple variables which are used to obtain statistical tasks and to carry out scientific studies of different species and topics. Pay special attention to observations at sea. The paper also proposes a critical consideration of some ethical issues that may arise as a result of the biased or misleading interpretation of data and scientific studies submitted, and of the omissions or misinterpretations that may appear as post truth in some cases regarding the tRFMO studies, reports and assessments.

The Sub-committee mostly discussed the ethical issues that were introduced in the document. The Chair of the Sub-committee indicated some of those ethical issues which have occurred in ICCAT. For example, he indicated that in his opinion biased results from studies funded by advocacy groups have been presented at the SCRS. Similarly, the misuse and misinterpretation by non-ICCAT groups of the results of studies and stock assessments conducted by the SCRS have occurred in the past. The Chair also emphasized that in his experience in ICCAT all scientific results presented at the SCRS have always been fairly assessed and treated with great respect by the members of the SCRS. The Sub-committee also indicated that the Commission tasked the SCRS with developing a 'Code of Conduct' for scientists participating in the SCRS to particularly avoid some of the ethical issues discussed in the document.

13. Future plans and recommendations

13.1 Recommendations

- The Sub-committee reiterates the request that the information of the vessels included in the ST01-FC 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 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 codes like 'NA' or 'NULL'.

- 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.

- The Sub-committee requests that the WGSAM and the Sub-committee on Ecosystems (SC-ECO) 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.

- 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 SCRS catalogues to identify data gaps that could be filled through data recovery efforts.

- The Sub-committee reiterates previous recommendations for CPCs to review their T2SC/CS data submission in particular for those species for which stock assessments will be conducted.

- The Sub-committee reviewed the latest version of the ST-09 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 SC-ECO review this form during its next meeting.

- 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.

- 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.

- The Sub-committee recommends that CPCs that report T2CE data for intersessional meetings for a particular species also include that species in the CE data submitted by the deadline of 31 July.

- The Sub-committee reiterates its support for the developing of the ICCAT Integrated Online Management System and the work of the ICCAT Online Reporting Technology Working Group. As such, the Sub-committee recommends that the Commission fully supports this effort.

13.2 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 work plan of the Secretariat.

The most important project the Secretariat has been working on since 2017 is the Statistical Online Reporting System web application, for which a preliminary prototype was deployed on the Web in April 2018 covering statistical forms of Task I and II. The SCRS and the Commission Online Technology Working Group has supported and recommended to continue with this project, extending to all compliance and statistical data submission requirements of CPCs. However, they also recognized that this new ICCAT IOMS system will require a commitment for financial and expertise support from the Commission for moving forward and completing an application in a near future that will fulfill the recommendations from the Online Reporting Technology Working Group meeting in March 2018.

The Secretariat also has other tasks and projects that will be extended over 2019. The main tasks that should be finalized in the first semester of 2019 are:

- The ICCAT RDMBS server migration from MS-SQL 2008-R2 to MSQ-SQL 2016, and;

- Replacement of the stand-alone MS-ACCESS Task II databases on the web by SQLite equivalent ones.

Other ongoing tasks represent continuous improvements that will continue during 2019 and beyond. The tasks that are a priority for 2019 are:

- Improvements to the applications that work with the various databases;
- Ongoing work on the tagging database including the revision of the database structure for electronic tagging data, TG forms standardization, and automatic reading of TG forms;
- the standardization of electronic forms of compliance and statistics for automatic data integration, and;
- Adaption of all the databases of ICCAT-DB to the foreseeing future “ICCAT Online Reporting” strategy.

14. 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 continuous support of the Sub-committee’s work and acknowledged how difficult its work would be without the full assistance of the Secretariat.

The report of the meeting was adopted by correspondence.

Addendum 1 to Appendix 9

Agenda

1. Opening, adoption of Agenda and meeting arrangements
2. Review of fisheries and biological data submitted during 2018
   - 2.1 Task I (T1FC and T2NC) and Task II (T2CE and T2SZ) statistics
   - 2.2 Tagging
   - 2.3 Complementary data obtained within ICCAT data collection and research programmes (GBYP, AOTTP, EPBR, SMTYP and SRDCP)
   - 2.4 Other relevant statistics (observer data, VMS, BCDs, ISSF, etc.)
3. Review of Secretariat's standard (yearly based) datasets estimations
   - 3.1 CATDIS and EFFDIS
   - 3.2 CAS (catch-at-size) and CAA (catch-at-age)
4. Evaluation of data deficiencies pursuant to Rec. 05-09
   - 4.1 Report cards for 2017 with SCRS validation criteria (filters 1 and 2)
   - 4.2 Standard catalogues of major ICCAT species (last 30 years)
   - 4.3 Report on data recovery activities, new plans, and improvements on national data collections systems
5. Review of existing practices for data submission and validation by the Secretariat
   - 5.1 Proposals for improving ICCAT eFORMS (structures, formats, codes, deadlines, etc.)
   - 5.2 Progress on the work to develop an ICCAT online reporting system
6. Progress on the work developed by the ICCAT Online Reporting Technology Working Group
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.)
   - 7.2 Plans to publish some ICCAT-DB data in the ICCAT cloud infrastructure
8. International and inter-agency cooperation on statistical activities (FAO, CWP, FIRMS, CLAV)
9. Review of the Report of the short-term contract: *Comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/Central American region*
10. Considerations on the Sub-committee on Statistics recommendations (past and 2018)
    - 10.1 Progress with prior year Recommendations of the Sub-Committee
    - 10.2 Review of Recommendations from 2018 inter-sessional meetings
11. Response to the Commission related to Rec. 16-14, paragraph 12, *c* and *d*
12. Other matters
13. Future plans and recommendations
14. Adoption of the report and closure

Addendum 2 to Appendix 9

List of Papers and Presentations

Reference	Title	Authors
SCRS/2018/114	Comprehensive study of Strategic Investments related to Artisanal Fisheries Data Collection in ICCAT Fisheries of the Caribbean/Central American Region: Draft final report	Arocha F.
SCRS/2018/117	Updated U.S. time series of shortfin mako shark landings for 1996-2016	Diaz G., E. Cortés
SCRS/2018/155	Improving the sampling protocol of electronic and human observations of tropical tuna purse seiner discards	Briand K., Sabarros P.S., Maufroy A., Relot-Stirnemann A., Le Couls S., Goujon M., and Bach P.
SCRS/2018/169	Considerations on combined strategies for collecting information and sampling of multiple variables for statistical tasks and scientific studies on tuna and tuna-like species: Ethical reflections on scientific activity in the context of tRFMOs	Mejuto J.

SCRS/P/2018/056	Fisheries & biological data submitted during 2018, data deficiencies & ongoing recovery plans	Palma C., and Mayor C.
SCRS/P/2018/057	Secretariat yearly based estimations (CATDIS, EFFDIS, CAS/CAA)	Palma C., Ortiz M., and Beare D.
SCRS/P/2018/058	Review of the ICCAT coding system and ICCAT-DB development status	Palma C., and Mayor C.
SCRS/P/2018/059	Progress on Online reporting	Mayor. C., and Palma C.

Addendum 3 to Appendix 9

SCRS Document and Presentations Abstracts as provided by the authors

SCRS/2018/114 - In 2014, ICCAT funded a Strategic Investment Inventory for artisanal fisheries of West Africa. Using that study as a model, this present project aims to get a clear understanding of existing data collection programmes and investments related to artisanal fisheries of the Caribbean/Central American region targeting ICCAT species (giving priority to those targeting billfish and shark species), in order to avoid duplication of effort and maximize the effectiveness of ICCAT's capacity building funds. The report presents the results of the study; the information and data presented represent a comprehensive view by country and the necessary information to maximize the effectiveness of ICCAT's capacity building funds.

SCRS/2018/117 – This document presented the rationale for the U.S. to revise its historical commercial landings of shortfin mako (SMA). The revised series used a dressed weight – round weight conversion factor of 1.46 for commercial landings instead of the previous conversion factor of 1.96. The updated series also completed missing information on sampling areas in some years for both commercial and recreational landings.

SCRS/2018/155 – Observer programmes have been implemented for many years in tuna purse seine fisheries. On board observers estimate discards using sampling and extrapolation methods when counting exhaustively is not possible. However, the flow of discards may be heterogeneous on the discard belt, and as a result, extrapolations may lead to biased estimates. Electronic monitoring system (EMS) has been tested as an alternative technology to complement and improve on board observer programmes for tropical tuna purse seiners. EMS allows monitoring discards at an acceptable species identification level and exhaustive counts on the discard belt. In this study, we used EMS "counts per minute" data from four French and one Italian purse seine vessels operating in Indian Ocean to analyse total discards in numbers, as well as discards per species for each fishing set. We analysed 48 fishing sets from 2017 and simulated different observer sampling strategies in order to optimise (i) the total sampling duration and (ii) the duration of sampling sequences. We propose an optimised sampling strategy for estimating discards applicable to both electronic and human observers that reduces sampling time with minimum estimation bias.

SCRS/2018/169 - The paper remind the combined systems regularly put in place by flag states and/or scientists to obtain multiple variables for fish and non-fish species which can be used to provide basic statistics and/or to prepare scientific studies on different species and topics, including observations at sea which should be considered together with the other mechanisms put in place. The paper underlines that most scientific groups tend to develop exclusively in a single language without interpretation. This fact undoubtedly hinders the equality between participants to raise arguments, hypotheses and ideas or present their studies. This is recognized as a limitation for scientists, but produces important economic advantages for the t-RFMOs. The confusion between compliance and scientific activity is also pointed out. The paper include critical considerations of some ethical issues that may arise in some cases as a result of the omission, biased or misleading interpretation of data and scientific studies submitted, or misinterpretations that may appear as post-truth in some cases regarding papers presented, the tRFMO studies, reports and assessments.

SCRS/P/2018/056 – Details are provided in the *Secretariat Report on Statistics and Coordination of Research in 2018* in the *Report for Biennial Period, 2018-19 Part I (2018) – Vol. 4*.

SCRS/P/2018/057– Details are provided in the *Secretariat Report on Statistics and Coordination of Research in 2018* in the *Report for Biennial Period, 2018-19 Part I (2018) – Vol. 4*.

SCRS/P/2018/058 – Details are provided in the *Secretariat Report on Statistics and Coordination of Research in 2018* in the *Report for Biennial Period, 2018-19 Part I (2018) – Vol. 4*.

SCRS/P/2018/059 – Details are provided in the *Secretariat Report on Statistics and Coordination of Research in 2018* in the *Report for Biennial Period, 2018-19 Part I (2018) – Vol. 4*.

Appendix 10

Report of the 2018 Intersessional Meeting of the Sub-committee on Ecosystems

(Madrid, Spain, 4-8 June 2018)

The Report of the 2018 Intersessional Meeting of the Sub-committee on Ecosystems has been published in the 2018-2019 ICCAT Col. Vol. Sci Papers. Please see the reference section in **Appendix 20** (Anon. 2018j).

Appendix 11

List of Statistical and Tagging Correspondents by Country

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Appendix 12

Work Plans for 2019

Tropical Tunas Work Plan

The Committee recommends that the planned skipjack assessment be postponed for one year, and instead, a yellowfin tuna assessment be conducted during 2019. The reasons for this recommendation include:

Skipjack:

1. Stock status estimated to be healthy.
2. Tropical Tunas Species Group recommended that the skipjack assessment not be conducted until sufficient AOTTP data were available.

Yellowfin:

1. Stock status estimated to be overfished in 2016 (0.95 B_{MSY}).
2. Overall catches of yellowfin tuna have exceeded TAC in every year but one since 2012. In the most recent years overall catches have exceeded TAC by 17-37%.
3. The Tropical Tunas Species Group is concerned that the yellowfin may currently be overfished and undergoing overfishing.
4. To address this concern, the Committee recommends a stock assessment of yellowfin tuna be conducted in 2019.

To accomplish a stock assessment of yellowfin tuna in 2019, and to further the development of the MSE for Tropical Tunas and the AOTTP programme, the following activities are planned:

Yellowfin Data Preparatory meeting (Quarter 2)

The Group requests that all data inputs be prepared through 2018. If the data meeting occurs before July 2018, the Group recognizes that some data inputs may be available only up to 2017 (which should be updated to 2018 before the stock assessment.

The Group considered the following work plan elements for the yellowfin data preparatory meeting:

1. Update yellowfin catches (T1 and T2CE: catch and effort, T2SZ: size frequency) for all CPCs and fleets up until the year 2018. Responsibility: CPCs; deadline: one week before the yellowfin data preparatory meeting.

2. Improve ICCAT Task I and II data, including complete the re-estimation of the historic Ghanaian statistics for yellowfin (bigeye and skipjack) up to 2018. The Group reiterates the need for scientists from EU and Ghana to collaborate to adapt the T3 software and engage in capacity building to facilitate its use. A potential approach:

   (a) A workshop/training on the T3 treatments procedure to correct logbook data (hypotheses, tools, etc.);
   (b) Comparison of catch estimation by T3+ process, methodology and the resulting estimation using alternative methods;
   (c) Organize capacity building for African nations and others CPCs involved in this issue.

   Responsibility: IRD, MFRD (Ghana) and national scientists in conjunction with the Secretariat; deliverable: SCRS document and estimation of tropical tuna fishery statistics for yellowfin, skipjack and bigeye up to 2018; deadline: one week before the yellowfin data preparatory meeting.

3. Evaluate the potential differences between the catches of tropical tunas estimated using the EU software T3 and those from other sources (e.g. recorded on sale slips at canneries) and requests the managers of the T3 software describe any necessary improvements and the implications of recommended changes.

4. Provide *faux poisson* estimates up to 2018. Responsibility: IRD/IEO/CRO; deadline: one week before the yellowfin data preparatory meeting; deliverable: SCRS document and estimation of tropical tunas fishery statistics for yellowfin, skipjack and bigeye up to 2018.

5. Prepare preliminary yellowfin CAS for discussion during the data preparatory meeting. Responsibility: Secretariat; deadline: National scientists will develop the CAA to be delivered one week before the yellowfin data preparatory meeting; deliverable: SCRS document.

6. Update standardized CPUE indices used in the previous assessment (i.e. Japan, Venezuela, United States, Chinese Taipei, Uruguay) through 2018 by year/quarter. Responsibility: CPCs; deadline: one week before the yellowfin data preparatory meeting; deliverable: SCRS document.

7. Develop an aggregated longline index applied to the catch-effort data from longline fisheries. The Committee recommends that a call for tenders be developed to hire a contractor to coordinate data aggregation and produce an aggregated index for longline fleets targeting yellowfin tuna. This approach will greatly facilitate the work of the SCRS by coordinating the data from various CPCs while assuring data confidentially.

8. Abundance indices from surface fleets, particularly those that capture newly recruited fish could be useful if properly adjusted for changes in fishing power. Future work to develop, document and maintain indices from these fleets is desirable.

9. Update biological information:

   (a) Review maximum age of yellowfin tuna. Consider AOTTP data. Review mortality and age vector and make revisions as needed.
   (b) Uncertainties in yellowfin growth could be also affect the stock assessment. AOTTP data would be very valuable to infer most appropriate growth curve for yellowfin for the Atlantic Ocean. Different growth curves should be used as sensitivity cases in the assessment. Responsibility: CPCs; deadline: one week before the yellowfin data preparatory meeting; deliverable: SCRS document.
   (c) Update conventional and electronic tagging information about movements using most recent results of the AOTTP. Responsibility: CPCs and Secretariat; deadline: one week before the yellowfin data preparatory meeting; deliverable: SCRS document.

Yellowfin stock assessment meeting (Quarter 3)

1. Update T1 and T2 data and produce the final Catch at Size matrix to be used in the stock assessment. Responsibility: Secretariat; deadline: one month before the yellowfin stock assessment meeting. National Scientists will prepare final CAA matrix no later than one week prior to stock assessment workshop.

2. Review diagnostics of stock assessment models and select final stock assessment models to be used for management advice.

3. Review and agree the input parameters for projections of the stock assessment models to provide the management advice.

4. Prepare the detailed report of the stock assessment meeting.

5. Discuss and develop draft executive summary of yellowfin.

MSE

1. Continue to communicate with the Commission to determine appropriate performance metrics for the Tropical Tuna MSE. Responsibility: SCRS Chair; deadline: one month before yellowfin assessment meeting.

2. The Group recommends that funds be secured to enable the continued development and evaluation of MSE operating models and candidate management procedures.

Ongoing review of AOTTP data and programme

1. Review data collected and give feedback. Responsibility: National scientists; deadline: one month before data preparatory meeting.

2. Evaluate new scientific information to be used for estimation mortality, growth rate, spatial structure, movement, etc. Responsibility: AOTTP staff and national scientists; deliverable: SCRS document(s); deadline: one month before yellowfin data preparatory meeting.

Albacore Work Plan

During 2018, an independent review of the North Atlantic albacore MSE was conducted. In general, the review was positive and identified several recommendations that need to be accomplished to improve the framework. There is a need to conduct this during 2019, as the adoption of a long term HCR is scheduled in 2020.

During 2017, the Mediterranean albacore stock was assessed and several research lines were identified in order to improve future stock monitoring.

In 2019, the Albacore tuna Species Group plans to further develop the MSE framework for North Atlantic albacore, addressing the recommendations of the external review, improve biological knowledge for Mediterranean albacore and improve CPUE series for all three stocks. No intersessional meetings are envisaged, but a three day meeting during the Species Groups is suggested.

North Atlantic Stock Proposed Work Plan

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 work plan). 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.

During 2019, the Committee will work to continue the development and documentation of the MSE framework, following the advice of the external review, as well as previous SCRS recommendations. This work will include conducting additional diagnostic checks (e.g. the characterization of the unrealistic runs), the revision of the set of operating models considered, and exploring additional management procedures (e.g. alternative stock assessment models, model free management procedures). As for the operating models, it is important to characterize those OMs that might not be behaving correctly or meeting the objectives under certain HCRs. Additional OMs that consider alternative realities (e.g. changes in catchability, regime shifts, auto correlated recruitment, changes in selectivity) will also be added to the current set of OMs. Finally, the documentation of the MSE framework will be improved and a Trial Specifications document will be produced.

Deadline: one week before the Species Group meeting. Deliverable: SCRS documents. Responsibility: Contractor.

As regards biology, it is envisaged to pursue a reproductive biology study as well as an electronic tagging study.

Deadline: one week before the Species Group meeting. Deliverable: SCRS documents. Responsibility: Contractor, CPCs.

In addition, it is recommended to produce new, or improve existing CPUE indices, namely:

- French MWT: standardize CPUE and present new index;
- Japanese longline: consider alternative ways to incorporate targeting effects (e.g. based on species composition) to try to recover the early periods;
- Korean, EU-Portugal and EU-Spain longline: consider using albacore by-catch information during swordfish oriented operations to produce an abundance index.

Deadline: one week before the Species Group meeting. Deliverable: SCRS documents, following the standards provided by the WGSAM. Responsibility: CPCs.

South Atlantic Stock Proposed Work Plan

It is recommended to produce new, or improve existing CPUE indices, namely:

- Compare and consider feasibility of joint CPUE analyses for longline fleets (Brazil, Chinese Taipei, Japan, Uruguay,) using fine scale, operational level data.

Deadline: one week before the inter-sessional meeting. Deliverable: SCRS documents, following the standards provided by the WGSAM. Responsibility: CPCs.

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;

4. Develop a Trial Specification (as has been created in the Bluefin Tuna MSE) document which should outline all the inputs into the MSE OMs and structure. This document should be presented to the SCRS in 2019.

During 2019, the Working Group will propose a concrete research programme for Mediterranean albacore.

Deadline: one week before the inter-sessional meeting. Deliverable: SCRS documents, following the standards provided by the Working Group on Stock Assessment Methods (WGSAM). Responsibility: EU-Spain, EU-Italy.

Addendum to the Albacore Work Plan

North Atlantic Albacore tuna Research Programme

The Albacore Species Group proposes to pursue a coordinated, comprehensive four yearlong 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 t-RFMO 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 (e.g. considering changes in catchability over time), considering alternative management procedures (e.g. harvest control rules that consider bounds to the management action, alternative stock assessment models, and CPUEs with different characteristics, such as very noisy CPUEs or CPUEs that track only some age classes), and considering implementation error (or systematic bias). There is also a need to discuss and propose alternative performance indicators and find better ways to communicate results.

The total requested funds to develop this research plan have been estimated in €1,092.000, with €742,000 to cover priority 1 tasks. The research programme will be an opportunity to join efforts from 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	150,000
Environmental influence on NE Atlantic surface CPUE	2	50,000
Distribution throughout the Atlantic (e-tags)	1	350,000
Population structure: contingents	3	120,000
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	200,000
	Total	**1,092.000**

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			
- Changes in catchability over time		x	x	
Operating models:				
- Regime shifts	x			
- Changes in selectivity		x	x	
- Auto correlated recruitment		x	x	
- Check correct behaviour	x	x		
- Decreasing catchability	x	x		
- Consider Reference Case and Robustness test scenarios	x	x		
- Broader scenarios using MFCL or SS			x	x
Management Procedure:				
- Delay difference models	x			
- TAC continuity when convergence not found	x	x		
Implementation error		x	x	
Communication:				
- Determine additional minimum standards for performance metrics (currently only B>B_{MSY}, prob=0.6)	x	x	x	x
- Performance indicators and plotting (represent variability across OMs with violin plots, etc.)	x	x	x	x

Bluefin Tuna Work Plan

Given the priority placed upon the MSE process the SCRS recommends three meetings, one very technical meeting focused on building operating models and a second intersessional meeting focused on finalizing operating models, evaluating candidate management procedures with additional time for presentation of scientific papers and a third technical meeting (additional information in **Appendix 15**).

The work plan for 2019 is as follows:

1. Update the scientific advice at the Species Groups meeting preceding the 2019 SCRS plenary based on updated fishery indicators. Action national scientists and Secretariat.

2. Hold three meetings:

   (a) Bluefin MSE Technical Group meeting (February 4-8);

   (b) Bluefin intersessional/MSE meeting (February 11-15);

   (c) Bluefin MSE Technical Group meeting (prior to September SCRS, TBD).

   All members of the Species Group are encouraged to attend the planned intersessional/MSE meetings in 2019.

3. Engage in research to address key uncertainties in the assessment, such as:

   (a) Update all indices used in the assessment to 2017 or 2018. Additionally for indices to be considered for CMPs (e.g. larval index, aerial survey, etc.), update annually with the agreed shortest time lag possible. To advise the Commission as to whether the updated indices in 2019 support the continuation of the management advice, it is suggested that this be done by comparing the updated indices with prediction intervals from the projections of the assessment models.

   (b) 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 potential for combining data to create joint indices that can reconcile conflicting trends should also be explored.

   (c) Complete aging of the backlog of hard parts, focusing primarily on the gaps in size and spatio-temporal fishery representativeness using agreed-upon methods for reducing aging biases. The effect of bin-size on age-length keys construction should be investigated. Identify gaps in the collection of routine hard part data paired with genetics and coordinate efforts of national programmes to provide biological data necessary for stock assessments.

   (d) Review progress on resolving aging bias issue.

   (e) Identify gaps in the Stock Synthesis composition data e.g. to improve partitioning of the time series of Mediterranean purse seine catches size composition.

   (f) Evaluate historical size composition and landings of age 0, 1 and 2 fish from early (1950-1985) fisheries for young fish (Rey and Cort 1985 and Rey *et al.* 1987). The issue of historical landings of small fish should be addressed before the end of 2018.

   (g) Review protocols and guidance developed by the Bluefin Tuna Species Group on model selection and projections (possibly through the SCRS Methods Working Group) with a view towards adopting a standard approach for provision of diagnostics, review and selection of models for provision of stock assessment advice.

(h) Evaluate potential for and persistence of spawning in regions outside the Gulf of Mexico and Mediterranean Sea (i.e. the Slope Sea, Atlantic Morocco/Canary Islands), including an evaluation of population structure. Use latest models that predict habitat/seasons of spawning bluefin together with observations of co-occurrence of bluefin in those areas/times to define areas of highest priorities for new larval surveys.

Billfish Work Plan

Assessment for the white marlin (WHM) stock was conducted in 2012 (Anon. 2013). Following the Strategic Science plan of the SCRS, the next stock assessment for white marlin is proposed for 2019. For the upcoming white marlin stock assessment in 2019 two intersessional meetings will be held, the first meeting will be a Data Preparatory (DP) meeting to compile and analyze all existing information required for the stock assessment, and the second meeting will be the stock assessment (SA) meeting.

Data Requirements:

Catch and Effort Data (Task I and II)

Important white marlin catches occur in the tropical and subtropical central Atlantic by both CPC and non-CPC fisheries, mainly in the Caribbean Sea and off West Africa. In past assessments, the quality and completeness of Task I and II data have been of great concern. Therefore, all countries catching billfishes (directed or by-catch) should report species-specific catch, catch-at-size, and effort statistics by as small an area as possible, and by month. Historical catch data should be revised at the species level and provided to ICCAT within the established deadlines.

Discards

Information on the number of white marlin landed, and the numbers discarded (dead and released alive) should be reported in order to fully quantify catches in all months and areas. Reporting of these data should meet the ICCAT deadlines for submission of Task I and II data. National scientists and the ICCAT Secretariat can collaborate to investigate whether the available observer data provide insights into the low reporting of dead/live discards. A need for determining levels of post release mortality warrants additional research, so that the full effects of white marlin discards can be included in the next stock assessment. This research must be presented at the data preparatory meeting.

Standardized CPUE series (Spatially explicit)

Noting the severe difficulties in interpreting and fitting indices within stock assessment models, it is recommended that national scientists of all CPCs coordinate their work to consider how to reconcile divergent CPUE patterns that may be a function of changes in fleet spatial distribution, oceanography, and/or targeting. Therefore, for the next white marlin assessment efforts should be made to include combined indices of fleets with similar operational characteristics, or that estimated indices be area specific indices of abundance and include additional gear types (not just longline). These standardized CPUE series must be provided at the data preparatory meeting for evaluation.

Life history parameters

Recent marlin and sailfish assessments have relied on growth parameter estimates from other oceans which may have an unwanted effect on the results of the Atlantic species assessments. Efforts should be made to coordinate interested national scientists in conducting growth and maximum age estimate studies for Atlantic white marlin. A review of all life history information for Atlantic white marlin will be compiled prior to the data preparatory meeting.

Continue the sampling of hard part and the study for the growth study on billfish caught off West Africa.

Tag-recapture information

The Secretariat will provide the tagging data and national scientists will conduct the analysis during or before the 2019 white marlin data preparatory meeting.

Atlantic and Mediterranean Swordfish Work Plan

North and South Atlantic

Assessments for North and South Atlantic swordfish were conducted in 2017 (Anon. 2017f). The next assessment is not yet scheduled. The Group requests to conduct an intersessional Swordfish Species Group meeting in 2019, 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.

A list of recommended work for the Swordfish Species Group was identified as high priority areas where continued efforts are required for North and South Atlantic swordfish:

***Size/Sex distribution study*:**

- *Background/objectives:* The Group recommends that at 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. A second call for data to be made in early 2019.
- *Timeframe:* Started in 2018, ongoing for 2019.

***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.

***Life history*:**

- *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 (9 institutes; 5 countries, both Atlantic and Mediterranean) started this work in 2018.
- *Timeframe:* Started in 2018; request funds to continue in 2019 (see **Table 1** at the end for costs).

***Weight-length relationships*:**

- *Background/objectives:* The Group recognizes that the adopted length-weight relationships for swordfish require validation with new field information. National scientists are requested to collect and submit observed values of length (LJFL) and round weight data to facilitate this task.
- *Priority:* High priority.
- *Leader/Participation:* Started in 2018 (lead by Canada), with the participation of CPCs that submitted length/weight observed data. A second call for data to be made in early 2019.
- *Timeframe:* Started in 2018, ongoing in 2019.

***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 scientists 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.

***Model predictions cross validation*:**

- *Background/objectives:* Model predictions should be compared to observations (e.g., nominal catch, CPUEs) rather than quantities such as F and SSB that cannot be observed, otherwise there is the risk of subjectively choosing model solutions. It is recommended that the WGSAM uses the North Atlantic swordfish assessment to explore the use of cross-validation of predicted data for model validation. This can also be used for weighting or selecting operating model scenarios in an MSE.
- *Priority:* Medium priority.
- *Leader/Participation:* Stock assessment modellers.
- *Timeframe:* For the next stock assessment.

Activities pertaining to the 2017 External Assessment Reviewer

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.

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 the development of the MSE framework. Work planned for 2019 is to finalize the conditioning of the Operating Model and start testing alternative management procedures.

- *Trial Specification document:* similar to bluefin tuna, develop a document outlining the information and decisions used to construct the OMs.
- *Priority:* High priority.
- *Leader/Participation:* A Contractor started this work in 2018.
- *Timeframe:* Process started in 2018. Funds requested to continue in 2019, taking into account the ICCAT Commission schedule regarding SWO MSE work.

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.

Table 1. Summary of funds requested for 2019 to continue the biological and stock structure work on Atlantic and Mediterranean swordfish.

Study	**Leader**	**Participating CPCs**	**Budget request (2019)**	**Notes**
Biology – Age and growth	Consortium (Project leader: Canada) (Med. coordinator: Univ. Genoa, Italy)	Consortium (participating CPCs/Institutes)	€70,000 (sampling + start processing)	
Biology - Reproduction			€30,000 (sampling + histology for validating macroscopic criteria)	
Biology - Genetics			€100,000 (sampling + start processing)	A Call for Tenders to start analyzing the genetic collection (NGS)
Workshop - Age and reproduction	Consortium	Consortium labs working on biology and experts on SWO biology	€45,000 (inter-lab calibration for age readings and reproductive scales)	Consider invitation of 1-2 external experts on SWO ageing and biology
Satellite tagging	Managed by SWO SG (represented by the Chair)	Any CPC with possibility to deploy satellite tags in the stocks mixing areas	€50,000 (including funds for tags + ARGOS + payment of release SWO)	
TOTAL			**€295,000**	

Mediterranean

For the Mediterranean stock, the last assessment was conducted in 2016 (Anon. 2017g). The next assessment should take place not before 2020 in order to give more time for additional data to be collected and see the effects of the recently adopted Rec. 16-05. Additionally, a data preparatory meeting should be conducted the year before, to analyze and prepare data for the stock assessment.

Given the questions raised during the latest assessment the Group should develop a work plan 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: next assessment
    - Priority: high, depends on funding. €10,000 requested for this work in 2019
    - Participation: mainly EU-Italy in collaboration with other CPs

- To improve stock delimitation and quantify stock mixing between the Mediterranean and North Atlantic swordfish stocks through multi-disciplinary research, including biological, tagging (both electronic and conventional) and genetic investigations. An integrated review of the existing relevant information should be prepared to identify current gaps and facilitate the development of future research regarding those issues.

    - Time-frame: 2019 for the integrated review; satellite tags were acquired and tagging will start in late 2018. Funding for 2019 is specified in **Table 1**.
    - Priority: high
    - Participation: all 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: next assessment
    - Priority: medium
    - Participation: all CPs

- To improve knowledge on the biology of the species including the investigation of possible regional differences on size/age at maturity and growth parameters, as well as, estimations of spawner and recruit proportions in the catches.

    - Time-frame: next assessment
    - Priority: medium, depends on funding
    - Participation: all CPs

- To examine the potential of using alternative indicators and reference points (L_{OPT}, measures based on reproductive potential, etc.).

    - Time-frame: next assessment
    - Priority: medium
    - Participation: all CPs

Small Tunas Work Plan

Research activities to be developed in 2019:

Research theme	*Activities*
Reproductive biology	To collect gonads samples for LTA, BON and WAH, and provide preliminary analysis results.
Age and growth	To collect two hard structures for LTA, BON and WAH, and provide preliminary analysis results.
Stock differentiation	To collect tissue samples for LTA, BON and WAH and provide preliminary analysis results based on genetics for at least one species.
Apply data-limited assessment models to small tuna species, especially length-based and catch-based methods	Improve the input data availability and quality. Apply these models to the following species: LTA, BON, FRI, WAH, KGM, and BLT. The first 5 species have been already considered priority by the Group. To extend the PSA analysis to gill net fisheries of small tunas, taking into consideration the 5 geographical areas adopted by ICCAT for small tuna reporting and endorsed by the Group.

Required budget for the research activities to be carried out during 2019 under the ICCAT SMTYP.

Activity	Amount (€)
Reproductive biology study	€20,000
Age and growth study	€20,000
Genetics study for stock differentiation	€50,000
Sampling collection and shipping	€10,000
Total	**€100,000**

Sharks Work Plan

Hold a single intersessional meeting to:

1. Conduct projections for SMA based on the 2017 stock assessment, but incorporating projections with Stock Synthesis. Projections can include several of the provisions contemplated in Rec. 17-08 (100 t intervals, 2 generation times; effectiveness of circle hooks, effect of minimum sizes with SS3)

2. Initiate the review of data available for a stock assessment of POR in the future, including:

   - Catch data available at the Secretariat
   - National scientists to identify data available (catch, indices of abundance, length compositions, life history)
   - Life history
   - Review of SRDCP activities (e.g., reproductive biology, satellite tagging) that can be of use to provide future advice
   - The ABNJ POR assessment for the Southern Hemisphere

3. Review of the SRDCP activities and progress

Working Group on Stock Assessment Methods Work Plan (WGSAM)

Primary

1. Localized CPUE study
2. Refine the SWO habitat model via the Species Distribution Model (SDM)
3. Add a second fleet to LLSIM
4. Application of Data Limited Methods to small tuna

Secondary

1. Add addition species to SDM/LLSIM as available (i.e. YFT, BFT)
2. Attempt a study design for how to best address species targeting within CPUE data
3. Attempt a study design to complete LLSIM/GLM matrix “best practices”

Sub-committee on Ecosystems and By-Catch Work Plan

Pertaining to Ecosystems:

Consistent with the ongoing exercise of developing an Ecosystem report card the Sub-committee drafted the following work plan. The plan indicates specific tasks to be completed by the ecosystem report card working groups prior to the 2019 Sub-committee on Ecosystems meeting.

In general, all operational state indicators require a threshold value and the definition of an acceptable range of values within which variation will not initiate a reaction. Further, all groups must determine if detailed reporting to regions within the Convention area would be possible and necessary. Each component will have specific tasks that must be addressed.

Date	*Component*	*Task*	*Who*
2018 SCRS meeting		Report Card for Annual Report.	Sub-committee
Nov 2018 to April 2019		Update prototype report card and define thresholds and limits for state indicators. Also determine if regionalizing indicator is beneficial.	
	Retained Species: Assessed	Update Bratio and/or Fratio values from recent assessments and deal with F0.1 issue.	Committee participants Secretariat
	Retained Species: Not assessed	Catch biomass of unassessed retained species in the Convention overtime relative to total retained catch biomass in the Convention.	Committee participants By-catch Coordinator
	Non Retained Sharks	Create indicator based on silky shark BPUE from PS and bigeye thresher BPUE from LL.	Committee participants
	Turtles	Provide additional indicator based on the BPUE for loggerhead and leatherback turtles. Develop indicators for other areas.	Committee participants
	Seabirds	Create indicator based on the total interactions, total mortality or alternatives.	Committee participants
	Mammals	Interaction rates for other regions and based on PS as well as LL fleets. Investigate possibility of including gillnet impacts.	Committee participants
	Trophic structure, Community and diversity indicators	Create diversity indicator. Create indicator reflective of the trophic restructuring using size based indicators. Seek possibility of using external and internal observer data.	Committee participants

	Habitat	Create an indicator based on the number of FADs lost and in use.	Committee participants and By-catch Coordinator
	Socio eco	Proportion of CPCs with decreasing year on year cash earned and production value. Develop Call for tenders to develop indicators.	Committee participants
	Fishing Pressure	Number of active PS vessels per category. LL Number of hooks deployed (Effdis) over time and spawning habitat quality.	By-catch Coordinator
	Environmental Pressure	Develop indicators.	Committee participants
2019		Review updated report card at Sub-com Eco.	Sub-committee
2019		Report Card for Annual Report.	Sub-committee

Pertaining to by-catch:

1. Continue the ongoing collaborative work related to seabirds and marine turtles.
2. Develop a list of bycatch 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.

Sub-committee on Statistics Work Plan

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.

The most important project the Secretariat has been working on since 2017 is the Statistical Online Reporting System web application, for which a preliminary prototype was deployed on the web in April 2018 covering statistical forms of Task I and II. The SCRS and the Commission Online Technical Working Group has supported and recommended to continue with this project, extending to all compliance and statistical data submission requirements of CPCs.

Other Secretariat tasks and projects that will be extended over 2019, include:

- The ICCAT RDMBS server migration from MS-SQL 2008-R2 to MSQ-SQL 2016, and

- Replacement of the stand-alone MS-ACCESS Task II databases on the Web by SQLite equivalent ones.

In addition, other ongoing tasks represent continuous improvements that will continue during 2019 and beyond. The tasks that are a priority for 2019 are as follows:

- Improvements to the applications that work with the various databases;

- Ongoing work on the tagging database including the revision of the database structure for electronic tagging data, TG forms standardization, and automatic reading of TG forms;

- Standardization of electronic forms of compliance and statistics for automatic data integration, and;

- Adaption of all the databases of ICCAT-DB to the foreseeing future "ICCAT Online Reporting" strategy.

Appendix 13

Prototype Ecosystem Report Card

Introduction

In 2017, the ICCAT Sub-committee on Ecosystems developed a work plan that included a proposal to develop a prototype Ecosystem Report Card to be reviewed by the Commission in 2018 in accordance with Resolution 15-11. The Sub-committee recognized that the Ecosystem Report Card would: a) provide to the Commission and stakeholders a succinct summary of the state of select ecosystem components; b) increase the visibility and usefulness of important ecosystem data and research; c) strengthen ties between ecosystem research and fisheries management; d) provide the context that will allow the Commission to incorporate ecosystem considerations into their management decisions; e) represent the progress of management actions in achieving Ecosystem-Based Fisheries Management (EBFM) objectives; and f) encourage a more holistic and integrated approach to the management of ICCAT fisheries.

The development of the prototype Ecosystem Report Card was conducted as an inter-sessional exercise that required the Sub-committee to assess the status of 10 ecosystem components: Assessed Retained Species, Non-Assessed Retained Species, Seabirds, Marine Turtles, Marine Mammals, Non-Retained Sharks, Trophic Relationships, Socio Economic, Fishing Pressure and Habitat. Following review of the exercise outcomes by the Sub-committee, the list was expanded to include an Environment component. Candidate indicators were proposed to represent the state of each ecosystem component in the prototype Ecosystem Report Card. The details of this process can be found in the individual assessment documents and the meeting report.

This Ecosystem Report Card demonstrates, through the use of status indicators, the potential for assessing the impacts of ICCAT fisheries and management decisions on different components of the ecosystem. It should be noted, that interpretation of the indicators may be subject to caveats and these have been identified where applicable. Furthermore, this report card represents a first step in an iterative process to develop a tool in consultation with managers that will support informed fisheries management decisions in ICCAT.

Scope

The initial scope of the reporting is for the entire ICCAT Convention area; however, the Sub-committee recognizes that future iterations of this report card will provide a more regional perspective on the impacts of ICCAT fisheries and management actions but how these regions will be defined is still to be determined. That being said, some ecosystem components considered here have a distinctly regional focus which is largely a function of data limitations and/or time constraints.

In the future, this section will provide a brief overview of the major physical and biological attributes of the area in addition to the major pressures on the ecosystem services that the area provides.

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 healthy, cautious or critical states is improving over time.

The data for all currently ICCAT assessed stocks/species supported the estimation of B over B_{MSY} (B ratio) and F over F_{MSY} (F ratio) back to 1975 (**Figure 1**). At that time, most stocks were in the healthy zone on the basis of both the B- and F-based reference points. After 1975, overfishing increased until the mid-1990s resulting in many stocks reaching a critical state (F/F_{MSY} <= 1.4). The overfishing corresponds with a subsequent decline in biomass such that by the early 2000s, half of all assessed stocks are in the cautious or critical zone (B/B_{MSY} < 1 or < .4). By 2017, management actions reduced the number of stocks subjected to overfishing to near the 1975 levels. However, biomass increases have been slow resulting in a lower fraction of stocks reaching a healthy state (B/B_{MSY} >= 1).

Future work will involve, developing B and F ratio proxies for those stock assessments that adopted an $F_{0.1}$ strategy (e.g., bluefin tuna). Furthermore, the definition of the "cautious" and "critical" zones for the B and F ratios (see Hanke *et al.* 2018) will be reviewed and consideration will be given on how to represent the underlying uncertainties in the models that provide the ratio estimates.

Retained unassessed species

Objective: Determine if the catch biomass of unassessed retained species in the Convention area relative to total retained catch biomass of species in the Convention area is increasing over time.

Trends in this recommended indicator (**Figure 2**) do not suggest that any unassessed retained species has become an increasingly more important component of the catch. Recent increases in the catch biomass of retained assessed species correspond with retained unassessed species remaining a relatively constant fraction of the total catch biomass. However, one must be cautious because the interpretation is affected by increases in the number of new species being reported to ICCAT and improvements in the reported catches, as well as the trends in the catch biomass of the assessed species.

Further development of the indicators will depend on a review of the list of species considered to be part of the ICCAT Convention and development of a model-based approach to account for the effect of trends in catch biomass and increases in the number of species reported to ICCAT.

Seabirds

Objective: Determine if the interaction rates and/or total estimated mortality are being reduced over time.

This indicator is still under development and the Sub-committee expects that the ongoing activity under the seabird component of the Common Oceans Tuna project will succeed in delivering the eco-card indicators for 2019. Additionally, the collaborative work being done by ICCAT CPCs on seabirds will also support this deliverable.

Mammals

Objective: Determine if interaction rates are being reduced over time.

The interaction rate (BPUE) estimates for mammals in the Northwest Atlantic (**Figure 3**) have been declining over the last 4 years and for the past 5 years have been within one standard deviation of the mean. The trend is based on the combined dolphin, small whale and seal capture data from a small fraction of the Convention area. The fate of marine mammals that were released after interacting with different fishing gears is currently unknown (i.e. post-release mortality).

Future versions of this indicator will cover an extended area and possibly become more species specific.

Sea turtles

Objective: Determine if the BPUE estimates for loggerhead and leatherback turtles are decreasing over time.

The U.S. NED (northeast distant fishing area) BPUE estimates for loggerhead (TTL) and leatherback (DKK) turtle capture rates are at historic lows despite increasing fishing effort (**Figure 4**). Capture rates after gear restrictions (mandatory use of circle hooks and finfish bait) were implemented in 2004 are generally lower than pre 2004 and exhibit regular fluctuations. Increasing nest counts for each species suggest that sea turtle populations might be increasing which might result in increasing capture rates in the coming years (Hanke, 2018). The current indicator reflects the capture for 2 species caught in the Northwest Atlantic by a single fleet and offers no estimate of the mortality.

Future versions will involve more fleets and a greater spatial extent.

Non-retained sharks

Objective: Determine if the number of interactions and/or total mortality is reduced.

This indicator is still under development. The Sub-committee requested that the SCRS Sharks Species Group initially develop indicators for bigeye thresher caught by longline fleets and silky sharks caught by purse seine fleets. Particularly, the Sharks Species Group has been asked to consider the methodology of Tolotti *et al*., 2016 for developing an abundance indicator for silky shark from purse seine fisheries.

Trophic relationships/structure

Objective: Determine if trophic interactions and inter dependencies involving species that are affected by fishing are being maintained.

This indicator is still under development. The Sub-committee reviewed candidate indicators and suggested developing a diversity-based indicator and an indicator reflective of trophic restructuring using size data. The Task II catch at size data set will be examined for its utility in developing the size-based indicators at the community level, possibly disaggregated by region, species and fleet. It is expected that trophic indicators will be useful for providing key information for strategic management, since they reflect changes in ecosystems' (or the food web) dynamics that might affect the dynamics of each of the individual species in the long term.

Habitat

Objective: Determine if ICCAT fisheries impact the critical habitat of ICCAT species.

This indicator is still under development. The initial management goal under the habitat component was to ensure that ICCAT fisheries have minimal impact on critical habitats such as spawning, nursery and foraging grounds or areas where a large number of species aggregate forming high biodiversity hotspots. Critical habitats can be impacted by abandoned and lost gear such as drifting FADs and GPS buoys. Relative to that, it was determined that creating an indicator based on the number of FADs and buoys lost and in use would support the component objective.

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 Convention area and b) the cash value earned through export of tuna and sharks and their processed commodities. Summary indicators (**Figure 5**) were developed for the period from 1980 to 2015 with colours red, yellow and green reflecting a greater than 10% decline in both, a decline in one and no decline in either measure of economic benefit, respectively. The proportion of red, yellow, and green has remained relatively consistent, with some periodic fluctuation, 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.

This indicator is sensitive to a change in economic benefit of individual ICCAT Contracting Parties regardless of the size of their production. It aims to monitor status in accordance with the EBFM objectives without any direct linkage with ICCAT management considerations. However, given that one would expect a link between ICCAT tuna catch quantity and the periodic fluctuations of the indicator, future work could determine the degree to which the various ICCAT resolutions are driving this process.

Fishing pressure

Objective: Determine if overall effort and fishing pressure are increasing over time.

Two candidate indicators were chosen namely, the number of active purse seine vessels per vessel size category and the total number of hooks deployed by longline vessels. These indicators are still under development. Though various components have provided indicators of fishing effort (e.g. **Figures 3** and **4**), the Sub-committee concluded that estimation of total fishing pressure is highly complex and requires a detailed analysis and knowledge of the fleets, including the nature of the fishing operations and gear characteristics. Interpretation of trends is confounded by differences in how fleet characteristics were recorded and reported to ICCAT over time and mischaracterization of the fishing capacity in 2014/15.

Environment

Objective: Determine if environmental pressures are impacting the state of the different ecosystem components.

Three preliminary indicators based on temperature data (**Figure 6**) provide information on the potential effects of environmental variability on bluefin tuna (*Thunnus thynnus*) and albacore tuna *(Thunnus alalunga*) eggs and larval survival and growth (Reglero *et al*., 2018) in three Mediterranean spawning grounds (higher values = higher recruitment potential). In the Balearic Sea, annual temperature is highly variable with three years (2003, 2011 and 2015) exhibiting high recruitment potential (84 percentile). During the last five years of the studied period (2012-2016), the trend remains highly variable with no clear trend. For Tunisia, the pattern is also variable around the mean, but there is a consistent negative trend during the last five years, indicating declining potential larval growth and survival. Annual temperatures in the Cyprus spawning grounds are the least variable of the three areas and show clear positive trends with three high recruitment potential years (2013, 2014 and 2016) in the most recent five year period.

In the future, a more robust indicator will be developed directly reflecting retention/dispersion potential in the Mediterranean Sea as well as the Atlantic Ocean and adjacent water masses.

Outlook

A comprehensive evaluation of the impact of ICCAT fisheries and management actions on the ecosystem represented by 9 of the report card components is not possible at this stage given the preliminary nature of the reporting. However, the report card can provide information on the state of the main species (retained assessed and retained unassessed) as well as the economic trends. Broadly speaking, ICCAT has taken measures to reduce the impacts on the assessed species but recovery of the biomass to levels consistent with the Convention objectives is yet to be realized for several stocks. Significantly, there is no evidence to suggest that there have been increases in the harvest of any other retained fish species which would require it to be assessed. Economically, there are indications that a consistent proportion of Contracting Parties (~60%) are regularly experiencing year over year declines in economic benefit derived from ICCAT tuna resources which could result in new pressures on the ecosystem and social impacts as fleets diversify.

Impacts of fisheries on non-retained species remain unquantified for the short term, but progress on indicator development is expected to provide these perspectives in the near future. Quantifying the impacts on the trophic relationships/structure and habitat requires longer time horizons but informative indicators are likely to be developed. Characterizing the pressures from fishing on the ecosystem and the environment is essential to provide the context needed to evaluate the future potential impact of management measures. This characterization will progress at a rate commensurate with the degree of external collaboration.

Effect of current regulations

The declines in leatherback and loggerhead interaction rates in the northwest Atlantic since 2004 are consistent with the implementation of gear changes (large circle hook and the use of whole finfish bait) designed to reduce incidental captures. These measures were part of a domestic management measure adopted by one Contracting Party and are not part of mitigation measures adopted by ICCAT. ICCAT also benefits from unilateral actions taken by Contracting Parties to reduce mammal interactions with longline vessels. The degree to which species or taxa specific mitigation measures have a consistently positive impact on those species or taxa and all other species of concern is yet to be quantified and depends on an awareness of all measures currently in force.

Management recommendations

Currently, no management actions are recommended.

Research recommendations

- Various collaborative efforts to assemble and analyze observer shark, seabird and sea turtle bycatch data are currently underway. The Sub-committee encourages 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.
- The Sub-committee recommends a further review of investigations into the best way to regionalize the components of the ecosystem report card. It also recommends reviewing regional case studies that demonstrate the implementation of EBFM principles.
- The Sub-committee recommends that Terms of Reference be developed for a call for tenders aimed at developing and supporting the implementation of an ecosystem-based fishery management plan for ICCAT, as indicated in the SCRS Science Strategic plan.
- The Sub-committee recommends investigating the development of fisheries independent and model-based indicators.

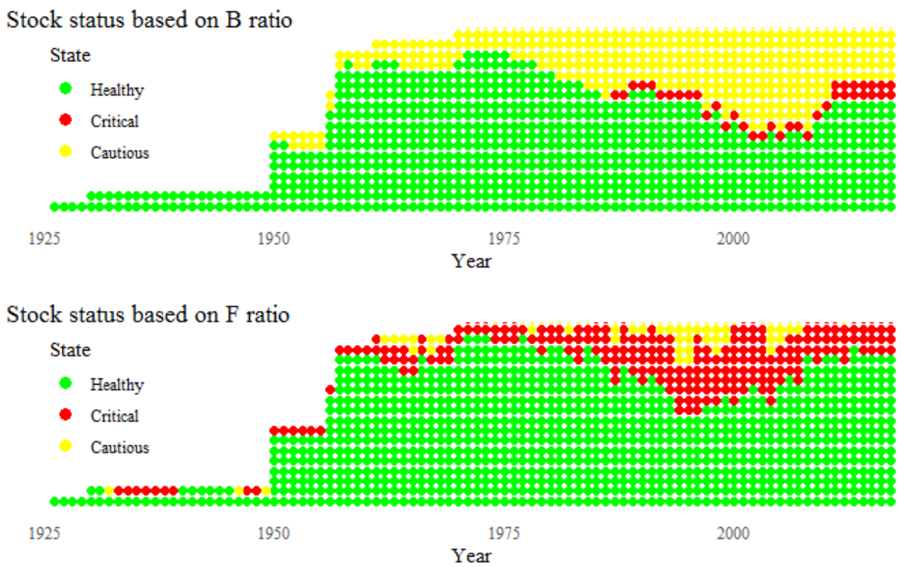


Figure 1. Stock status of all assessed ICCAT species based on B/B_{MSY} and F/F_{MSY}. Refer to the text for the definition of the states. Note that the status of the stocks was projected forward to 2017 from the last assessment.

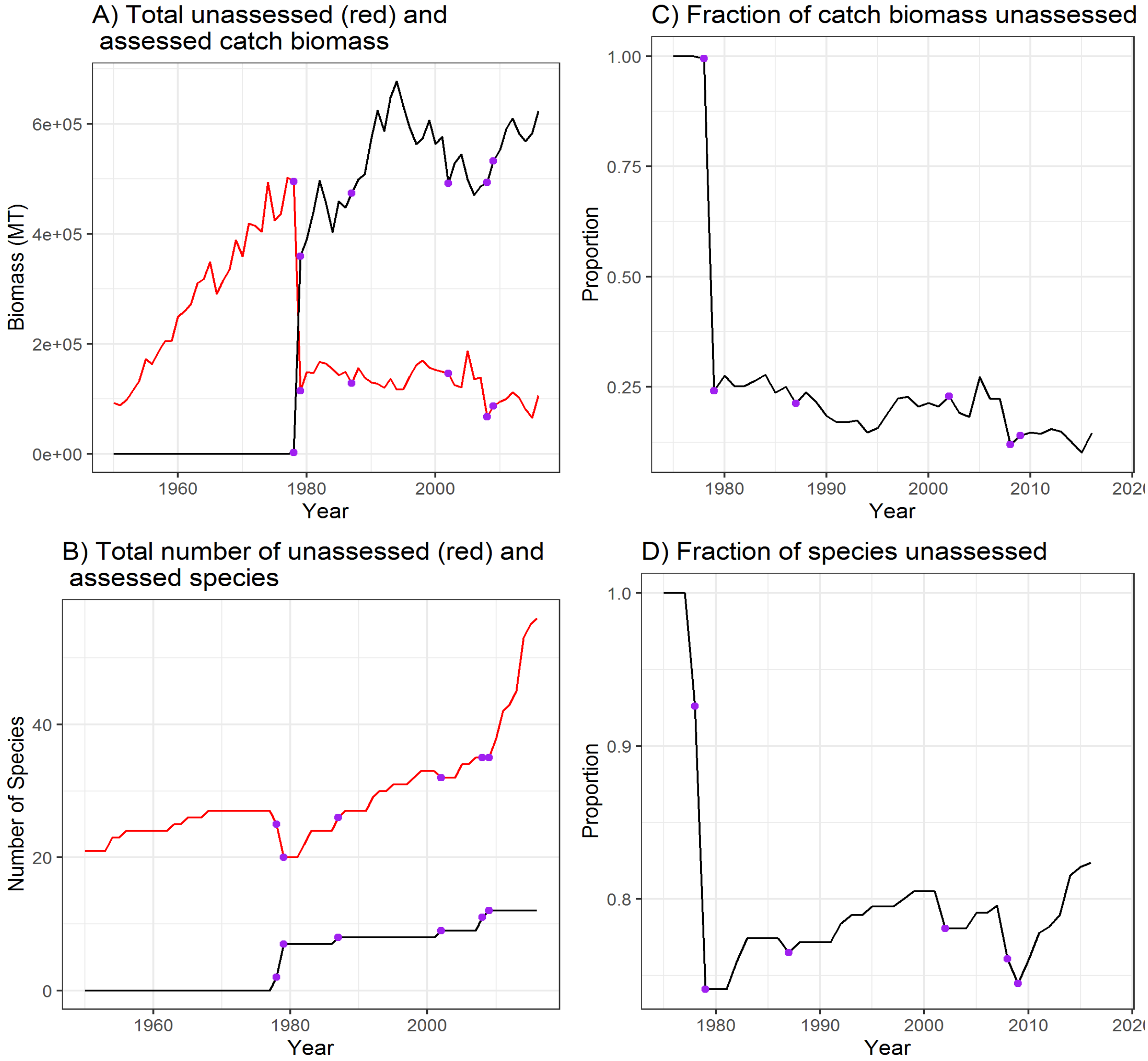


Figure 2. Indicators used to assess the status of only the retained, unassessed species within the ICCAT Convention. In the terminal year there are a maximum of 68 species with 12 being assessed. Years of first assessment are indicated using a purple point.

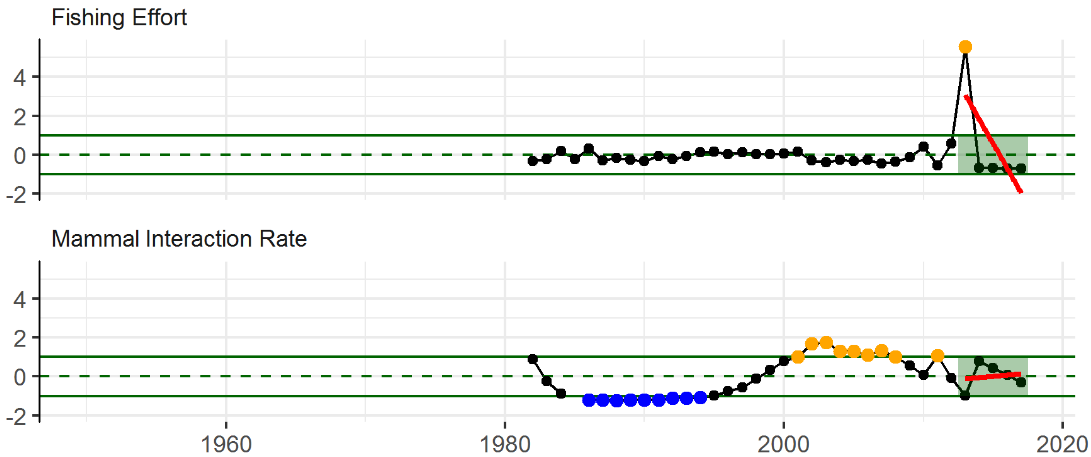


Figure 3. Standardized indicators of fishing effort and interaction rate for the north Atlantic Ocean north of 15° north latitude. Values in the top 16% of the data are orange and values in the bottom 16% are blue. Red trend lines are for the last 5 years and were fit with a linear model.

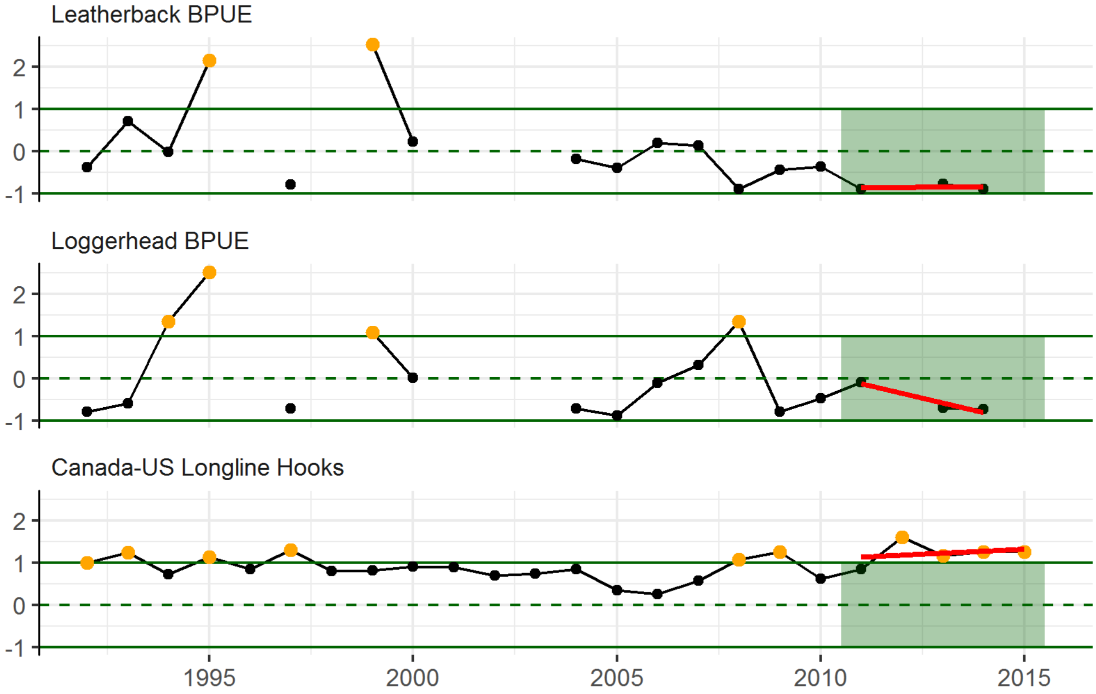
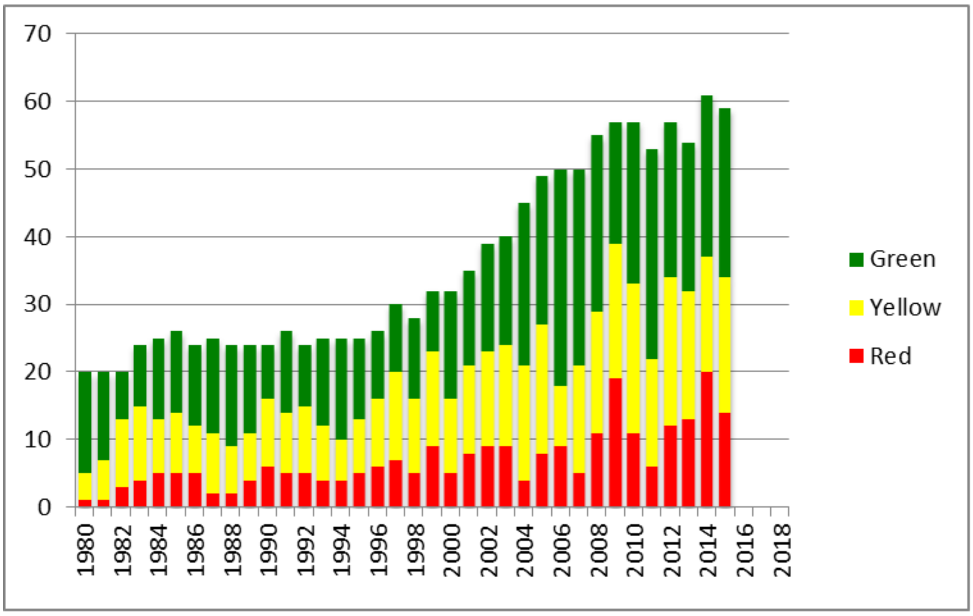


Figure 4. Indicators of marine turtle bycatch rates scaled and centered on 0 and effort scaled and centered on 5000 hooks. Values in the top 16% of the data are orange and values in the bottom 16% are blue. Red trend lines are for the last 5 years and were fit with a linear model.



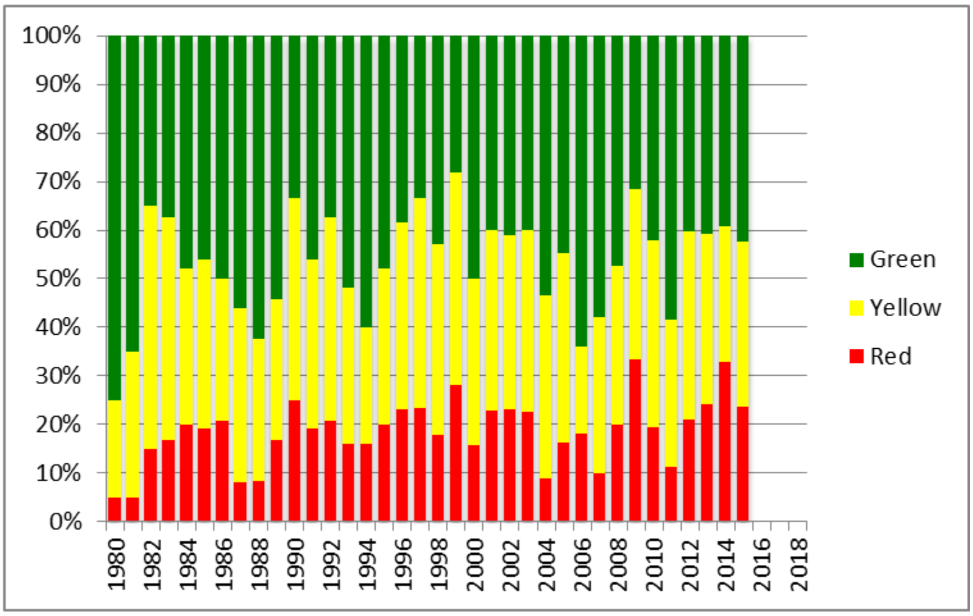


Figure 5. Economic indicators that show the number (top) and proportion (bottom) of ICCAT Contracting Parties experiencing a greater than 10% decline in production value of tuna catch from the ICCAT Convention area and the cash value earned through export of tuna and sharks and their processed commodities. Green indicates neither cash value earned or production value declined while red indicates both did. Yellow indicates that one of the two declined.

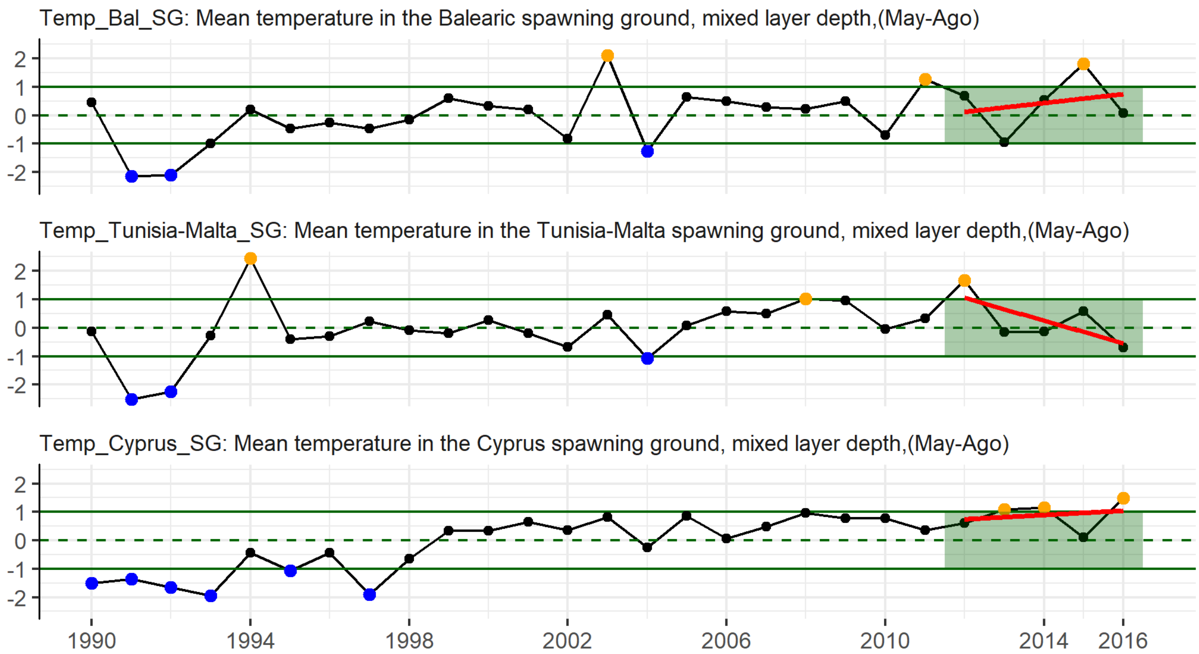


Figure 6. Mean temperature in the western Mediterranean spawning ground (Balearic Sea); Central Mediterranean (Tunisia; South Sicily) and Eastern Mediterranean (Cyprus). Data from the Copernicus MEDSEA hydrodynamic model. Values in the top 16% of the data are orange and values in the bottom 16% are blue. Red trend lines are for the last 5 years and were fit with a linear model.

Appendix 14

SUMMARY NOTE ON THE FAO COMMON OCEANS/ABNJ TUNA PROJECT

At its meeting in November 2012 in Agadir, the Commission gave its consent for the Secretariat to take the necessary steps to become a partner of the ABNJ/GEF programme. For this purpose, the Secretariat wrote a letter addressed to the FAO and the GEF to inform that ICCAT would join the programme provided that ICCAT benefited from the activities envisaged. During the 2017 Annual meeting, the Commission continued participation in the FAO Common Oceans/ABNJ Tuna Project was discussed and it was agreed that ICCAT would continue to participate in the projects underway. Several CPCs noted the value of this cooperation, as pointed out by the SCRS Chair, and there was general agreement that engagement in this project should continue in the future, in order to complement and strengthen related scientific and management initiatives within ICCAT.

Since implementation of this programme, the Secretariat has participated actively in various technical and administrative meetings. It has contributed efficiently to the work of the Steering Committee and to the discussion of the different work plans. To this end, since the previous SCRS Plenary, the ICCAT Secretariat has participated in ABNJ Common Oceans initiatives. These include participation in the following meetings that were funded or partially funded by the Project:

- FAO Coordinating Working Party on Fisheries Statistics (CWP) technical workshop on global harmonization of tuna fisheries statistics, that was held in Rome, 19-22 March 2018;
- Joint tuna RFMO MSE Working Group meeting held at University of Washington in Seattle, 13-15 June 2018;
- Fifth project Steering Committee (PSC) of the Common Oceans ABNJ tuna project held in Rome, 16-18 July 2018;
- 2nd meeting of the ICCAT Expert Port Inspection Group for Capacity and Assistance, Madrid, 18-19 September 2018.

In addition, the ICCAT Executive Secretary and his Assistant informally met the Common Oceans ABNJ tuna project coordinator during the last COFI meeting in Rome.

ICCAT coordinated and concluded in late 2017, together with the Common Oceans ABNJ Tuna Project, a *Feasibility study on the development of an Online Reporting System* (FORS). This includes both a feasibility study to determine the resources, costs, technologies required to implement an online reporting system, as well as the production of a demo online reporting tool. During 2018, various "outcomes" of the FORS study (technology, development model, concepts, recommendations, etc.) were used by the Secretariat aimed at improving the SCRS statistical online validation system. Furthermore, this prototype tool went into a testing phase during 2018. Following the objectives of the Common Oceans ABNJ Tuna project, the FORS tool and study results are generic and can potentially be applied across multiple tuna RFMOs.

The Steering Committee of the FAO Common Oceans/ABNJ Tuna Project met at the FAO headquarters in Rome in July 2018 and overviewed the activities carried out through the four components of the project, as well as of the other projects being carried out under the Common Oceans Programme. The draft work plan and budget for year six was reviewed, and some discussion was held on the future process for developing a project proposal for GEF 7. A 12 month no cost extension has been approved for the project in order to finish those activities which were still ongoing. Among the funding approved are the financing for the:

- 2rd joint t-RFMOs Working Group on FADs;
- 3rd meeting of the joint t-RFMOs MSE Working Group, if requested, which can include funding for the establishment of a *github*;
- participants from developing countries to attend the next meeting of the ICCAT Standing Working Group on Dialogue between Fisheries Scientists and Managers, if held before end June 2019;
- 2rd meeting of the joint t-RFMOs Ecosystems Working Group;
- On-line reporting (limited funding).

During the last Annual meeting, the Commission has expressed its wish not only to follow, but to be heavily involved in, the development of proposals for phase 2, to ensure that ICCAT can be in the vanguard of innovative activities, which will help to strengthen and complement (but not replace) the activities being undertaken by ICCAT. During the Steering Committee of the FAO Common Oceans/ABNJ Tuna Project meeting, the GEF officer at FAO suggested that partners suggest as early as possible that partner countries be requested to allocate STAR funding for biodiversity to ABNJ related activities, particularly those relevant to ecosystems and by-catch mitigation. Following closely the progress and activities of the UN BBNJ process would also help to ensure that the requests made by ICCAT are in line with the overall philosophy of the programme. More details on the process to be followed are available in the report of the 5th Steering Committee meeting. It is envisaged that all proposed activities will start with the theory of change and the identification of specific outcomes. Activities will be selected in accordance with their suitability. FAO will compile the activities into a single project.

During the above mentioned Steering Committee meeting, the Secretariat put forward a list of potential project proposals, which are listed below (and contained in the **Addendum 1 to Appendix 14**).

1. Port Inspection Capacity Building

Objective: To equip developing CPCs with the skills and equipment needed to carry out Port Inspections and report appropriately.

2. Compliance Capacity Building Missions

Objective: To assist developing CPCs to better understand and be able to report on all ICCAT reporting requirements and improve compliance with ICCAT conservation and management measures.

3. Online reporting

Objective: To develop an online reporting system for both statistical and compliance-related data/information in a modular form and which could be shared, in part and as required, with other organisations.

4. MSE

Objective: Support the work of the joint t-RFMO MSE Working Group.

5. Improve global communication of t-RFMO scientific advice and information of joint interest to tRFMOs

Objective: To develop a more dynamic platform (revised tuna.org web site currently hosted in the ICCAT website) for information sharing and improve communication.

6. Ecosystem Report Cards

Objective: To increase capacity of tRFMOs to provide advice on ecosystem-based fishery management.

7. FAD – Joint t-RFMO Working Group meetings

Objective: To further the work already carried out jointly by tRFMOs.

8. Development of global standards for scientific observers

Objective: Consultant to carry out initial draft for global standards for scientific observers.

9. Field species ID cards

Objective: To develop new field species ID cards "bank" for target and commonly by-catch species from tuna fisheries for all t-RFMOs, as although a few species are specific to individual oceans, many are common to more than one t-RFMO Convention area.

In addition to the above potential projects, there are other non-ICCAT led initiatives which are supported by ICCAT and linked to above, such as:

10. CLAV

Under the previous project, FAO funded an expert to improve data quality of the CLAV. This has proved very useful to RFMOs in detecting duplicates, possible inconsistencies etc.

11. Tuna Compliance Network

ICCAT would support the continued funding of the Tuna Compliance Network over the next project period.

Addendum 1 to Appendix 14

Activities proposed by ICCAT for the work plan and budget for project year four
Common Oceans ABNJ Tuna Project (Phase 2)

1. Port Inspection Capacity Building

Objective: To equip developing CPCs with the skills and equipment needed to carry out Port Inspections and report appropriately.

Seven ICCAT Contracting Parties have submitted pre-assessment forms in order to request assistance with the implementation of ICCAT Port Inspection Measures. The Expert Group had agreed in 2017 that on the basis of the pre-assessment, a full assessment should be carried out in person by the Working Group, the Secretariat and/or an external consultant.

It is expected that some progress on this will be made at the forthcoming Expert Group in September, but travel to some of the seven CPCs may be required to analyse further. Following a determination of needs, training and/or other assistance will be developed. Such assistance will also be dependent on the availability of funds; the fund held at ICCAT at present for this purpose is very limited, and significant voluntary contributions are not foreseen in the short term.

Funding from ABNJ phase two for these activities is sought. To date, small amounts to fund the Expert meetings have been (gratefully) received, but more significant funding would be required to adapt and impart training courses on site. Approval was tentatively given in 2015, but it is recognised that there have been some delays in ICCAT processes, so this funding was not taken up.

Based on IOTC experience and available estimates, it is foreseen that the process would cost approximately €1,200,000 to be spread over the entire period of the project.

2. Compliance Capacity Building Missions

Objective: To assist developing CPCs to better understand and be able to report on all ICCAT reporting requirements and improve compliance with ICCAT conservation and management measures.

This is an area which needs serious development in ICCAT. To date, ICCAT capacity building activities have concentrated on meeting attendance, statistical data collection, and stock assessment related courses. While ICCAT needs to maintain efforts on the aforementioned three areas, it also needs to develop capacity building for compliance with the increasingly complex ICCAT Recommendations.

Given the number of ICCAT Contracting Parties (52, of which around 40 would be eligible for assistance), on-site assistance to all parties may not be feasible, given the small number of staff which the compliance department currently comprises. A two-pronged approach is therefore suggested; the first, initially, workshops could be held either at the ICCAT Secretariat or in conjunction with intersessional meetings for a limited number of representatives from each CPC. The second would be to determine priority CPCs in conjunction with the Compliance Committee where a continuous and serious lack of compliance with reporting obligations has been noted, and carry out missions to those CPCs.

Although only a limited number of missions could be carried out each year, funding for these would be required to cover the workshop expenses, Secretariat travel, and CPC participant travel.

Costs will depend much on the number of participants and number of workshops, which for practical reasons may be limited. A very rough estimate would be in the region of €1,000,000 spread over the entire period of the project.

3. Online reporting

Objective: To develop an online reporting system for both statistical and compliance-related data/information in a modular form and which could be shared, in part and as required, with other organisations.

The Online Reporting Working Group is currently developing the plan for executing this task, but in general there is agreement that this will need to be done on a modular basis. The overall development of this will be quite expensive, and CPC training may also be required. At this stage, ICCAT requests clarification as to whether such development could be covered by the Project, and if so, that funding be made available. See **Attachment 1 to Addendum 1 to Appendix 14** below.

Approximate estimated costs €1,500,000, details to be developed later in the year.

4. MSE

Objective: Support the work of the joint t-RFMO MSE Technical Working Group.

ICCAT has been leading work on this over the last few years, and is happy to continue to do so. Work at present advances slowly, being limited mainly to one meeting a year. Since its creation the t-RFMO technical Group on MSE has mostly worked through correspondence and relied on the willingness of participants to invest their time to reach the Group goals. All previous Group Chairs have had to shoulder the responsibility of chairing with many other responsibilities. The same can be said about the members of the Group. For most of them the responsibility of spending time on their own t-RFMO MSE process has precluded them from contributing more time to the tRFMO Technical Group. Moreover, there are only relatively few people with expertise on MSE in tRFMOs. This state of affairs has resulted in slow progress for many of the activities of the MSE Working Group. The main activity to date has been to be a forum for discussion on critical MSE-related issues. ICCAT suggests that funding be made available for one lead scientist from the MSE Group to dedicate 2-3 months per year to this, with a set of deliverables agreed in advance, in addition to keep financial support for the attendance of experts to the meetings. The deliverables would then be discussed by the wider group before any agreement, but work could advance at a speedier pace then heretofore.

Proposed activities:

(a) Dedicated Chair of the tRFMO Working Group. To have a chair which dedicates at least two months a year to coordinate and advance the work of the MSE Working Group.
(b) Support the creation and maintenance of *github* site dedicated to serve as repository of MSE Code from all t-RFMOs.
(c) Produce a review of approaches for the development and implementation of technical criteria to be used in the evaluation of the presence of exceptional circumstances.
(d) Testing of optional visualization approaches for MSE results by applying such approaches to a global representative set of tuna stocks. This set should include both, model-based and empirical management procedures.
(e) Develop a process and provide the resources required for the independent review of MSE processes in tRFMOs.

It is estimated that approximately €350,000 could cover the needs of the MSE leader and meetings over the project period.

5. Improve global communication of t-RFMO scientific advice and information of joint interest to t-RFMOs

Objective: to develop a more dynamic platform (revised tuna.org web site currently hosted in the ICCAT website) for information sharing and improve communication.

In recent years, the tuna.org web site has been less dynamic than would be desirable. ICCAT is happy to continue to host this site, but has some ideas for its development, including automatic updates from links to the tRFMO site, as well as establishing designated contacts for period updating and improvement. The site currently links to the CLAV, and could also be used to publicise activities by the Tuna Compliance Network as well as other initiatives common to all t RFMOs.

This project would also benefit from the development of the on-line reporting system implementation, by including all the final “products” (information) available in each one of the five t-RFMOs OR systems. The potential is enormous and updates can be made in real time, by combining meetings calendar, slightly more complex standard global executive reports (data requirement summaries, production summaries, etc.), dynamic world map fishing activity (catches, effort, fishing power, etc.), etc.

Individual t-RFMOs communicate scientific advice in the form and through the means that are more appropriate for each organization. Such individualized communication does not easily allow global assessments of the status of tuna stocks. Furthermore, countries that are members of more than one tRFMO, face the challenge of having to deal with information in different forms.

Proposed activities

(a) Improvement of the tuna-org.org web portal by developing and maintaining a dedicated web page on MSE including links to MSE pages for each t-RFMO, and maintaining multilingual versions of such webpage;
(b) Providing web access to learning tools about MSE (shiny apps, training modules, MSE related media).

Estimated development costs: €200,000

6. Ecosystem Report Cards

Objective: To increase capacity of tRFMOs to provide advice on ecosystem-based fishery management.

The report cards would be relevant to Atlantic, Indian and Pacific Oceans. As noted by the 2016 ABNJ report on EBFM most t-RFMOs have had trouble operationalizing initiatives related to EBFM. Most of the progress in operationalizing has been at the national level.

Proposed activities:

(a) Develop an agreement on ecosystem units to be used by t-RFMOs especially in the geographical areas of overlap between tRFMOs: southern oceans vs all other oceans, eastern vs Central Pacific Ocean, southern Indian Ocean vs southern Atlantic Ocean, eastern Indian Ocean vs western Pacific Ocean.

(b) Choose two ecosystem units where there is overlap between t-RFMOs and:

(c) Develop and obtain agreement from the corresponding t-RFMOs on an initial set of operational objectives related to EBFM for such two units.

(d) Develop an ecosystem report card for such two units.

Estimated development costs: €400,000.

7. FAD – Joint t-RFMO Working Group meetings

Objective: To further the work already carried out jointly by t-RFMOs.

ICCAT hosted the First joint t-RFMO FAD Working Group meeting in 2017. Although there was general agreement that further joint meetings could be beneficial, a Technical Working Group (TWG) is being established, as work has to be carried out previous to future joint meetings. Funding will be necessary for the TWC to carry out their work and for ICCAT to hold two more joint meetings during the project period, requiring approximate funding of €250,000.

8. Development of global standards for scientific observes

Objective: Consultant to carry out initial draft for global standards for scientific observers.

A consultant to carry out initial draft and three meetings of experts during the project period would entail approximate costs of €200,000.

9. Field species ID cards

Objective: To developed new field species ID cards "bank" for target and commonly by-catch species from tuna fisheries for all t-RFMOs, as although a few species are specific to individual oceans, many are common to more than one t-RFMO Convention area.

The ICCAT Manual continues to be developed, and ICCAT has also developed several species ID Sheets. The current format of this information is more useful for desk work that for field work, and it has been suggested that a comprehensive set of tuna, shark and other by-catch species laminated sheets be developed for field work by scientists, port inspectors, etc. A few species are specific to individual oceans, but many would be common to more than one t-RFMO Convention area. The ID sheet "bank" would be available to all RFMOs interested in using them. This could also be linked to Port Inspection, as the sheets would be made available to inspectors and used for training. Initial costs would be linked to the development of the sheets; actual production costs will depend on number required of each.

Estimated development costs: €100,000.

Non-ICCAT led initiatives but supported by ICCAT and linked to above:

10. CLAV

Under the previous project, FAO funded an expert to improve data quality of the CLAV. This has proved very useful to RFMOs in detecting duplicates, possible inconsistencies, etc. ICCAT would support the continuance of this function, which benefits all t-RFMOs. It is expected that this work could be carried out by an expert on a part-time basis (cost to be estimated by FAO – €250,000 over the five years?).

11. Tuna Compliance Network

ICCAT would support the continued funding of the Tuna Compliance Network over the next project period. Most t-RFMOs are unlikely to be in a position to make significant contribution to this, but all involved agree on its utility. The estimated costs are around €600,000 over the project period.

Attachment 1 to Addendum 1 to Appendix 14

The ICCAT Integrated Online Management System (IOMS): Short notes on common aspects shared by t-RFMOs on Online reporting systems in development

All the five t-RFMOs (CCSBT, IATTC, ICCAT, IOTC, WCPFC) have been working (studying, planning, first development phases) in recent years on the development of online reporting/management (OR) systems, aimed at handling both structured and non-structured information in accordance with data requirements created to fulfil each t-RFMOs' mandate. This approach is a strategic "movement" towards more efficient data handling systems (provision of effective validation, real time responses, etc.). It is in fact, a complete change in the data management paradigm of the fisheries management domain, which has great potential to reduce decades of the technological gap (effective convergence) between the fisheries domain and other "high-tech" scientific domains.

The level of complexity of each t-RFMO OR system varies depending on their own specificities. However, a large portion of "elements" (data requirements, data structures, coding systems, business rules, etc.) that will comprise part of each OR system, are common and should share similar designs (allowing code re-use, shorten learning curves, sharing development experiences, promote data harmonization, etc.). This approach will also benefit (indirectly and in the long-run) all the t-RFMO parties in general.

The ICCAT Online Reporting Technology Working Group (WG-ORT), at its last intersessional meeting (for report see ANNEX 4.2 of the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 1*) defined the main characteristics (development strategy, design model, technologies adopted, modular design pattern approach, Progressive Web Application (PWA) - development, etc.) and established a strategic plan to initiate (and progress over time) the development of the IOMS.

Among others, a fundamental aspect of the IOMS development was the adoption of an open source development approach (licensing, copyright, and terms of use, to be decided in the future). In addition, the development should also be based, as far as possible, on open source technologies (operating systems, databases, programming languages, web frameworks, etc.). This approach can benefit in several ways all the t-RFMOs. For example, when looking at IOMS first development phase (for details see the WG-ORT report) only, all the t-RFMO's can since the beginning, benefit (follow, learn, contribute, utilise) from:

- The IOMS database design model (core component of the main web-app platform, which will manage all web application modules, user profiles, data requirements, etc.);
- The IOMS standard components (message handler, data logger, data validators, versioning, etc.);
- The work on harmonised data structures and coding systems;
- Reduced learning curves on various development aspects;
- Adopting code examples (promotion of code re-use).

In general, the adoption of open source design approaches always promotes active development, higher participation, richer experiences, which often lead to more efficient and optimized results.

In the long-run (after OR systems implementations), if carefully planned, one of the great beneficiaries can also be TUNA-ORG (www.tuna.org) as a final consumer (moving from a static to a dynamic web page) of all the final "products" (information) available in each one of the five t-RFMOs OR systems. The potential is enormous. It can consume/present in real time, a simple combined tuna-org meetings calendar, slightly more complex standard global executive reports (data requirement summaries, production summaries, etc.), dynamic world map fishing activity (catches, effort, fishing power, etc.).

A final aspect that has to be studied (not yet discussed by ICCAT) in the future is: "what to do with the enormous amount of valuable information generated by OR automatic processes (threads, messages, validators, etc.). This work fits well in the "big-data" field (pattern search algorithms).

Appendix 15

BFT MSE ROADMAP TEXT [Section 15.2]

2018 (remainder)

SCRS *(October)*

Review progress on the MSE and recommend revisions.

Commission *(November)*

Ideally the Commission would continue developing the conceptual management objectives proposed at SWGSM. This would be assisted by a presentation from the SCRS Chair.

2019

BMSE TT[1] *(January)*

Propose final reference set of OMs[2] with acceptable conditioning, and review progress on CMP[3]. Development. Initially propose key performance statistics[4].

BFT SG[5] *(February/March)*

Approve final set of OMs and review progress to provide advice on CMP development. Provide input to SCRS Chair on content of MSE presentation to Panel 2.

Panel 2 *(March)*

Receive update on MSE and structure of CMPs so that they can provide feedback and suggest refinements.

Develop initial operational Management Objectives for Commission approval.

BMSE TT *(May/June)*

Review further development of CMPs refined to take account of Panel 2 inputs.

BMSE TT *(September – 1-day pre-meeting)*

Compile summary of updated CMP results to facilitate Bluefin tuna Working Group discussion.

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[1] The Bluefin MSE Technical Group, consisting of core members and CMP developers, but open to attendance by other members of the BFT WG.

[2] 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.

[3] 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).

[4] A performance statistic relates to a quantity (e.g. average catch over projection period) evaluated in a simulation trial of one CMP under one OM.

[5] The Bluefin Species Group, being the group that regularly meets each year in the week before the SCRS meeting.

BFT SG *(September)*[6]

Review progress including inputs from Panel 2 for possible comment. Review current proposed CMPs, and then recommend CMPs to be retained for further refinement in the light of subsequent Commission-approved operational objectives. Provide feedback on possible operational Management Objectives. Initiate discussion on Exceptional Circumstances[7] provisions.

SCRS *(October)*

Endorse final set of OMs for the MSE and recommended CMPs to be further explored. Provide feedback on possible operational Management Objectives.

Panel 2 *(November 1-day before Commission meeting)*

Prepare draft operational Management Objectives for consideration by Commission, taking account of input from SCRS.

Commission *(November)*

Commission to be updated on CMP structures, including projected performance of CMPs to provide feedback to SCRS and its subgroups. Finalize operational Management Objectives.

2020

BMSE TT *(January)*

Review further development of CMPs refined to take account of Commission inputs.

BFT SG *(February/March)*

Review progress to provide advice on CMP development. Provide input to SCRS Chair on content of MSE presentation to Panel 2. Develop proposals for Exceptional Circumstances provisions. Consideration of an independent review of the MSE process.

Panel 2 *(March)*

Receive update on MSE and structure of CMPs and on Exceptional Circumstances provisions, so that they can provide feedback and suggest refinements.

BMSE TT *(July)*

Review further development of CMPs refined to take account of Panel 2 inputs.

BFT SG *(September)*

Compile list of final CMP options for consideration for adoption, together with providing draft Exceptional Circumstances text. Make preparations to compute TAC recommendations for the options put forward.

SCRS *(October)*

Review and finalize proposals from Bluefin tuna Working Group for CMP options to be considered for adoption, and for Exceptional Circumstances text.

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[6] If MSE progress inadequate, develop workplan to provide assessment-based TAC advice for 2021 during Sept 2020 BFT SG meeting.
[7] These are specifications of circumstances (primarily related to future monitoring data falling outside the range covered by simulation testing) where overriding of the output from a Management Procedure should be considered, together with broad principles to govern the action to take in such an event.

Panel 2 (*November 1-day before Commission meeting*)

Prepare final proposals to the Commission for CMP options to consider and Exceptional Circumstances text. The CMP options put forward by the SCRS may be reduced in number, possibly to a single option.

Commission *(November)*

Adopt a MP together with the period for which this will apply before revision and associated Exceptional Circumstances provisions. Consider adoption of TAC recommendations provided by that MP.

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.

	NALB	*BFT*	*NSWO*	*Tropicals*
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

	NALB	*BFT*	*NSWO*	*Tropicals*
2018	- Call for Tenders issued for peer review - SCRS to develop criteria for the identification of exceptional circumstances - SCRS to continue testing variations of the HCR, as requested by 17-04 - Independent expert completed peer review of code	- SCRS conducted joint meeting on BFT/SWO MSE - SCRS reviewed reference set of operating models - SCRS begins testing candidate management procedures - 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 - [SCRS to conduct stock assessment for bigeye tuna] - SWGSM/Panel 1* to consider qualitative management objectives
2019	- Commission may refine the interim HCR - Commission (through SWGSM/Panel 2) to develop guidance on a range of appropriate management responses should exceptional circumstances occur	- BFT MSE Technical Group meeting - Initiate independent peer review of MSE code - Finalize development of OM reference set - SCRS to evaluate additional management procedures[1] **- SWGSM/Panel 2 meeting** to agree operational management objectives and performance indicators for adoption by the Commission	- SWO Species Group meeting with MSE Session - Finalize reference set of OM and complete their conditioning - Begin testing candidate management procedures[2] - Conduct independent peer review of MSE code	- Stock assessment of yellowfin tuna - Continue development of MSE framework, and start development of candidate management procedures -TROP MSE session during species group week
2020	- ALB Species Group session at SCRS MSE meeting **Commission to adopt a long-term management procedure**	- BFT MSE Technical meeting - SCRS to finalize evaluation of CMPs and proposal for determination of exceptional circumstances develop final advice to Commission[3] **- Commission to adopt an interim management procedure**	-SWO Species Group meeting with MSE Session[4]	- Stock 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

[1] If progress is not appropriate start planning for a stock assessment of BFT in 2020.
[2] If progress is not appropriate start planning for a stock assessment of SWO N in 2020.
[3] If MSE not completed as planned SCRS to conduct stock assessment for BFT 2020.
[4] If MSE not completed as planned SCRS to conduct stock assessment for SWO N in 2020.

	NALB	*BFT*	*NSWO*	*Tropicals*
			- **SWGSM/Panel 4* meeting** to agree on operational management objectives and performance indicators for adoption by the Commission SCRS to finalize evaluation of CMPs and proposal for determination of exceptional circumstances	-TROP MSE session during species group week
2021	Stock assessment for northern albacore		- SWO MSE Technical Group meeting - Conduct final independent review of SWO MSE process and develop final advice for the Commission **- Commission to adopt an interim management procedure**	- 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[5]
2022		Stock assessment of BFT	Stock assessment of N SWO	- 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**[6]
2023				- Stock assessment of BET and YFT

* Panels may meet intersessionally, as appropriate.

[5] If progress is not appropriate start planning for stock assessments of YFT and BET in 2022.
[6] If progress is not appropriate conduct stock assessments of YFT and BET in 2022.

Appendix 17

DRAFT RECOMMENDATION BY ICCAT ON SPECIES CONSIDERED TO BE TUNA AND TUNA-LIKE SPECIES OR OCEANIC, PELAGIC, AND HIGHLY MIGRATORY ELASMOBRANCHS

(Proposal by the Chair of the WG of the Convention Amendment)
(New proposal, discussed previously as CONV_10/2015 and not adopted)

RECALLING the work of the Working Group on Convention Amendment to clarify the scope of the Convention through the development of proposed amendments to the Convention;

FURTHER RECALLING that the proposed amendments developed by the Working Group on Convention Amendment included defining "ICCAT species" to include tuna and tuna-like species and elasmobranchs that are oceanic, pelagic, and highly migratory;

NOTING the work of the Standing Committee on Research and Statistics (SCRS) to determine which modern taxonomic groupings correspond to the definition of "tuna and tuna-like fishes" in Article IV of the Convention, and which elasmobranch species would be considered "oceanic, pelagic, and highly migratory";

THE INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS (ICCAT) RECOMMENDS THAT:

1. Upon the entry into force of the amendments to the Convention as developed by the Working Group on Convention Amendment, the term "tuna and tuna-like species" shall be understood to include the species of the family *Scombridae*, with the exception of the genus *Scomber*, and the sub-order *Xiphioidei* as follows:

Scombrid

Acanthocybium solandri (Cuvier 1832) – Wahoo, Thazard Bâtard, Peto
Auxis rochei rochei (Risso 1810) – Bullet tuna, Bonitou, Melvera
Auxis thazard thazard (Lacepède 1800) – Frigate tuna, Auxide, Melva
Euthynnus alletteratus (Rafinesque 1810) – Little tunny, Thonine commune, Bacoreta
Katsuwonus pelamis (Linnaeus 1858) – Skipjack tuna, Listao, Listado
Orcynopsis unicolor (Geoffrey St. Hilaire 1817) – Plain Bonito, Palomette, Tasarte
Sarda sarda (Bloch 1793) – Atlantic Bonito, Bonite à dos rayé, Bonito del Atlántico
Scomberomorus maculatus (Mitchill 1815) – Spanish Mackerel, Thazard atlantique, Carite Atlántico
Scomberomorus regalis (Bloch 1793) – Cero, Thazard franc, Carite chinigua
Scomberomorus tritor (Cuvier in Cuvier & Valenciennes 1832) – West African Spanish Mackerel, Thazard blanc, Carite lusitánico
Gasterochisma melampus (Richardson 1845) – Butterfly Kingfish, Thon papillon, Atún chauchera
Allothunnus fallai (Serventy 1948) – Slender tuna, Thon élégant, Atún lanzón
Thunnus alalunga (Bonnaterre 1788) – Albacore, Germon, Atún blanco
Thunnus albacares (Bonnaterre 1788) – Yellowfin tuna, Albacore, Rabil
Thunnus atlanticus (Lesson 1831) – Blackfin tuna, Thon à nageoires noires, Atún de aletas negras
Thunnus obesus (Lowe 1839) – Bigeye tuna, Thon obèse, Patudo
Thunnus thynnus (Linnaeus 1758) – Atlantic Bluefin tuna, Thon rouge du Nord, Atún rojo
Thunnus maccoyii (Castelnau 1872) – Southern Bluefin tuna, Thon rouge du Sud, Atún del Sur

Istiophoridae

Istiompax indica (Cuvier 1832) – Black Marlin, Makaire noir, Aguja negra
Istiophorus platypterus (Shaw 1792) – Sailfish, Voilier de l'Atlantique, Pez vela del Atlántico
Kajikia albida (Poey 1860) (currently known as *Tetrapturus albidus* in FAO and other CPCs species list that use FAO species names as reference) – White Marlin, Makaire blanc de l'Atlantique, Aguja blanca del Atlántico

Makaira nigricans (Lacepède 1802) – Blue Marlin, Makaire bleu de l'Atlantique, Aguja azul del Atlántico
Tetrapturus belone (Rafinesque 1810) – Mediterranean Spearfish, Marlin de la Méditerranée, Marlín del Mediterráneo
Tetrapturus georgii (Lowe 1841) – Roundscale Spearfish, Makaire épée, Marlín peto
Tetrapturus pfluegeri (Robins & de Sylva 1963) – Longbill Spearfish, Makaire bécune, Aguja picuda

Xiphiidae

Xiphias gladius (Linnaeus 1758) – Swordfish, Espadon, Pez espada

2. Upon the entry into force of the amendments to the Convention as developed by the Working Group on Convention Amendment, the term “elasmobranchs that are oceanic, pelagic, and highly migratory” shall be understood to include the species as follows:

Order	*Family*	*Genus*	*Species*	*Authorship*	*Common names*
Orectolobiformes	Rhincodontidae	*Rhincodon*	*typus*	Smith 1828	Whale shark, Requin baleine, Tiburón ballena
Lamniformes	Pseudocarchariidae	*Pseudocarcharias*	*kamoharai*	Matsubara 1936	Crocodile shark, Requin crocodile, Tiburón cocodrilo
Lamniformes	Lamnidae	*Carcharodon*	*carcharias*	Linnaeus 1758	Great white shark, Grand requin blanc, Jaquetón blanco
Lamniformes	Lamnidae	*Isurus*	*oxyrinchus*	Rafinesque 1810	Shortfin mako, Taupe bleue, Marrajo dientuso
Lamniformes	Lamnidae	*Isurus*	*paucus*	Guitart Manday 1966	Longfin mako, Petite taupe, Marrajo carite
Lamniformes	Lamnidae	*Lamna*	*nasus*	Bonnaterre 1788	Porbeagle, Requin-taupe commun, Marrajo sardinero
Lamniformes	Cetorhinidae	*Cetorhinus*	*maximus*	Gunnerus 1765	Basking shark, Pélerin, Peregrino
Lamniformes	Alopiidae	*Alopias*	*superciliosus*	Lowe 1841	Bigeye thresher, Renard à gros yeux, Zorro ojón
Lamniformes	Alopiidae	*Alopias*	*vulpinus*	Bonnaterre 1788	Thresher, Renard, Zorro
Carcharhiniformes	Carcharhinidae	*Carcharhinus*	*falciformis*	Müller & Henle 1839	Silky shark, Requin soyeux, Tiburón jaquetón
Carcharhiniformes	Carcharhinidae	*Carcharhinus*	*galapagensis*	Snodgrass & Heller 1905	Galapagos shark, Requin des Galapagos, Tiburón de Galápagos
Carcharhiniformes	Carcharhinidae	*Carcharhinus*	*longimanus*	Poey 1861	Oceanic whitetip shark, Requin océanique, Tiburón oceánico
Carcharhiniformes	Carcharhinidae	*Prionace*	*glauca*	Linnaeus 1758	Blue shark, Peau bleue, Tiburón azul
Carcharhiniformes	Sphyrnidae	*Sphyrna*	*lewini*	Griffith & Smith 1834	Scalloped hammerhead, Requin marteau halicorne, Cornuda común
Carcharhiniformes	Sphyrnidae	*Sphyrna*	*mokarran*	Rüppell 1837	Great hammerhead, Grand requin Marteau, Cornuda gigante
Carcharhiniformes	Sphyrnidae	*Sphyrna*	*zygaena*	Linnaeus 1758	Smooth hammerhead, Requin marteau commun, Cornuda cruz
Myliobatiformes	Dasyatidae	*Pteroplatytrygon*	*violacea*	Bonaparte 1832	Pelagic stingray, Pastenague violette, Raya-látigo violeta
Myliobatiformes	Mobulidae	*Manta*	*alfredi*	Krefft 1868	*NA*, *NA*, *NA*
Myliobatiformes	Mobulidae	*Manta*	*birostris*	Walbaum 1792	Giant manta, Mante géante, Manta gigante
Myliobatiformes	Mobulidae	*Mobula*	*hypostoma*	Bancroft 1839	Lesser devil ray, Mante diable, Manta del Golfo
Myliobatiformes	Mobulidae	*Mobula*	*japanica*	Müller & Henle 1841	*NA*, *NA*, *NA*
Myliobatiformes	Mobulidae	*Mobula*	*mobular*	Bonnaterre 1788	Devil fish, Diable de mer méditerranéen, Manta mobula
Myliobatiformes	Mobulidae	*Mobula*	*tarapacana*	Philippi 1892	Chilean devil ray, *NA*, *NA*
Myliobatiformes	Mobulidae	*Mobula*	*thurstoni*	Lloyd 1908	Smoothtail mobula, Mante vampire, Diablo chupasangre

NA – not available

3. The lists of species set forth in paragraphs 1 and 2 above will be reviewed periodically and may be amended, as appropriate, upon the receipt of advice from the SCRS.

Appendix 18

Opening Address by Mr. Camille Jean Pierre Manel, ICCAT Executive Secretary

Welcome all,

I am extremely pleased to be among you and to participate for the first time in this important meeting of the ICCAT Standing Committee on Research and Statistics (SCRS), an exceptional space for discussion.

First, allow me to take this opportunity to pay my great respects for the immense work accomplished by my predecessor Mr. Driss Meski as well as to the excellent team at the Secretariat who I have come to know over the past few months.

I would also like to sincerely thank the SCRS Chair, Dr David Die, as well as all the Co-Coveners and Rapporteurs of the Species Groups for their productiveness, which is a reflection of the quality of the work undertaken in the Groups.

The pursuit of ICCAT objectives makes for a dynamic environment that is marked, among others, by increasingly complex issues, ever greater expectations, and limited financial resources that are difficult to mobilise. In addition, this environment imposes on us the need for continuous adaptation. Consequently, the SCRS is confronted by numerous urgent requests that can only be satisfied swiftly with the assistance of other bodies of the Commission.

As a result, the Secretariat faces an increasing workload. However, I am sure that whatever these new challenges may be, we will meet them together, through our different contributions, so as to achieve ICCAT objectives.

For my part, I will do everything in my power and will commit the Secretariat further to improve our contribution to the work of this important Committee for the Commission.

You can rest assured of our full availability and support.

I wish you great success in your work.

Thank you very much.

Appendix 19

List of acronyms

ABNJ	Areas Beyond National Jurisdiction
ACAP	Agreement on the Conservation of Albatrosses and Petrels
ALK	Age length key
ALR	Aquatic Living Resources
AOTTP	Atlantic Ocean Tropical tuna Tagging Program
AS	Age structured
ASPIC	A Stock Production Model Incorporating Covariates
ASPM	Age-Structured Production Model
AZTI	Centro Tecnológico Experto en Innovación Marina y Alimentaria
B	Biomass
BOT	British Overseas Territory
BMSE TT	Bluefin MSE Technical Group
BSP	Bayesian Surplus Production model
BTRP	NOAA Bluefin Tuna Research Program
CARICOM	Caribbean Community
CATDIS	Catch 5x5 distribution
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CEFAS	Centre for Environment Fisheries and Aquaculture Science
CFASPM	Catch-Free Age-Structured Production Model
CI	Confidence Interval
CIPs	Centres de Recherches de Pêches (Angola)
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
CK	Cleithrum to keel
CKMR	Close Kin Mark Recapture
CLAV	Consolidated List of Authorized Vessels
CMMs	Conservation and Management Measures
CMG	GBYP Core Modelling MSE Group
CMP	Candidate Management Procedure
CPCs	Contracting Parties and Cooperating Contracting Parties, Entities or Fishing Entities
CONAPESCA	Comisión Nacional de Acuacultura y Pesca
CPUE	Catch-per-unit effort
CRO	Centre de Recherches Océanologiques (France)
CRO-CI	Centre Recherches Océanologiques (Côte d'Ivoire)
CRODT	Centre de Recherche Océanographique de Dakar-Thiaroye (Senegal)
CV	Coefficient of variation
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CMSY	Catch at MSY
CWP	Coordinating Working Party on Fishery Statistics
DAFF	Department of Agriculture Forestry and Fisheries (South Africa)
DG-MARE	Directorate General for Maritime Affairs and Fisheries
DINARA	Dirección Nacional de Recursos Acuáticos (Uruguay)
DNPA	Direction Nationale de la Pêche et de l'Aquaculture (Angola)
DP	Data Preparatory
DST	Decision Support Tool
EBFM	Ecosystem Based Fisheries Management
EBRP	Enhanced Billfish Research Programme
EEZ	Exclusive Economic Zone
EFFDIS	Fishing effort 5x5 distribution
EMS	Electronic Monitoring System
ERAs	Ecological Risk Assessments
EU	European Union
F	Fishing mortality
FADs	Fish Aggregating Devices
FADURPE	Fundaçao Apolonio Salles de Desenvolvimento Educacional

FAJ	Fisheries Agency of Japan
FMAP	Federation of Maltese Aquaculture Producers
FAO	Food & Agriculture Organization of the United Nations
FIRMS	Fishery Resources Monitoring System
FL	Fork length
FMC	Fisheries Monitoring Center
FOBs	Floating Objects
FSSD	Fisheries Scientific Survey Division (Ghana)
FORS	Fisheries Online Reporting System
GBYP	ICCAT Atlantic-Wide Bluefin Tuna Research Programme
GBYP SC	GBYP Steering Committee
GFCM	General Fisheries Commission for the Mediterranean
GEPE	Cabinet d'Études de Plans et Statistiques (Angola)
GO	Gene Ontology
GRT	Gross Registered Tonnage
HCRs	Harvest Control Rules
IATTC	Inter-American Tropical Tuna Commission
ICES	International Council on the Exploration of the Sea
IEO	Instituto Español de Oceanografía
IFAN	Institute fondamental Afrique noire Cheikh Anto Diop
INAPESCA	Instituto Nacional de Pesca y Acuacultura
INDP	Instituto Nacional para Desenvolvimento das Pescas (Cabo Verde)
INRH	Institut National de Recherche Halieutique (Morocco)
IOMS	Integrated Online Management System
IOTC	Indian Ocean Tuna Commission
IPA	Institut de Pêche Artisanale (Angola)
ISSF	International Seafood Sustainability Foundation
JABBA	Just Another Bayesian Biomass Assessment
JAGS	Just Another Gibbs Sampler
JCAP	ICCAT-Japan Capacity-Building Assistance Project
JDMIP	Japan Project for the Improvement of Data and Management of Tuna Fisheries
K2SM	Kobe II Strategy Matrix
LFI	Large Fish Indicator
LJFL	Lower jaw fork length
LOA	Length overall
LPRC	Large Pelagic Research Center (USA)
LSTFVs	Large-scale tuna fishing vessels
MEDAC	Mediterranean Advisory Council
MFADs	Moored Fish Aggregating Devices
MFRD	Marine Fisheries Research Division (Ghana)
MOU	Memorandum of Understanding
MP	Management Procedure
MRAG	Marine Resources and Fisheries Consultants
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
NEI	Not Elsewhere Included
NOAA	National Oceanic and Atmospheric Administration
Multifan-CL	Length-based, age structured assessment model
MIST	Maximum impact sustainable threshold
OMs	Operating Models
PSC	Project Steering Committee
PSAT	Pop-up satellite archival tag
PWA	Progressive Web Application
Rad-seq	Restriction site Associated DNA Sequencing
RMA	Research Mortality Allowance
ROP	Regional Observers Program
RFMOs	Regional Fisheries Management Organizations
RV	Research Vessel

SA	Stock Assessment
SAM	Stock Assessment Model
SC	Steering Committee
SCRS	Standing Committee on Research and Statistics
SC-ECO	Sub-committee on Ecosystems
SDGs	Sustainable Development Goals
SEAP	Secretary of Aquaculture and Fisheries
SEAPODYM	Spatial Ecosystem and Populations Dynamics Model
SEFRA	Spatially Explicit Fisheries Risk Assessment
SFPA	Sustainable Fisheries Partnership Agreement
SMTYP	Small Tunas Year Programme
SNPs	Single Nucleotide Polymorphisms
SPR	Spawning potential/spawner recruit ratio
SRDCP	Shark Research and Data Collection Programme
sPATs	Survivorship Popup Satellite Archival Transmitting Tags
SS3	Stock Synthesis III
SSB	Spawning stock biomass
SS-BSP	State-Space Bayesian Surplus Production
SSG	Shark Species Group
SSPAC	Système de Suivi de la Pêche Artisanale et Côtière
SRDCP	Shark Research and Data Collection Programme
SWGSM	Standing Working Group on Dialogue between Fisheries Scientists and Managers
TAC	Total Allowable Catch
TWG	Technical Working Group
T-RFMO	Tuna Regional Fisheries Management Organization
VBGF	Von Bertalanffy growth function
VMS	Vessel Monitoring System
VPA	Virtual Population Analysis
WGSAM	ICCAT Working Group on Stock Assessment Methods
WCPFC	Western Central Pacific Fisheries Commission
WWF	World Wildlife Fund
YOY	Young of the Year
YPR	Yield per recruit

Appendix 20

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