REPORT OF THE 2017 INTERSESSIONAL MEETING OF THE SUB-COMMITTEE ON ECOSYSTEMS
(Madrid, Spain, 10-14 July 2017)

1 Opening, adoption of Agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat, Madrid, 10-14 July 2017. Dr. Miguel Neves dos Santos, ICCAT Assistant Executive Secretary, opened the meeting on behalf of the Executive Secretary and welcomed participants. The Sub-Committee on Ecosystems convener, Dr. Alex Hanke (Canada) and interim By-Catch convener Dr. Andres Domingo reiterated the Secretariats welcome. The Conveners then described the objectives and logistics of the meeting. The Agenda was adopted with several changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The List of Documents presented at the meeting is attached as **Appendix 3**. All the abstracts for the presented documents and presentations are provided in **Appendix 4**. The following participants served as rapporteurs:

Section	*Rapporteurs*
Item 1	P. de Bruyn
Item 2	M-J. Juan Jordá, D. Álvarez, R. Coelho
Item 3	B. Luckhurst, A. Hanke
Item 4	G. Diaz, P. de Bruyn
Item 5	K. Okamoto, J. Swimmer,
Item 6	Y. Inoue, K. Oshima, A. Wolfaardt, B- Mulligan, J-C, Baez
Item 7	F. Poisson, P. de Bruyn
Item 8	A. Hanke, A. Domingo, S. Tsuji
Item 9	A. Hanke, A. Domingo
Item 10	P. de Bruyn

2 EBFM

2.1 Review the progress on developing an Ecosystem Report Card for ICCAT and review potential status and pressure indicators, reference levels and management actions for elements of ICCAT's EBFM framework and any progress on developing new indicators for all ecological components of ICCAT's EBFM framework (i.e. target species, by-catch, habitat and trophic relationships)

Document SCRS/2017/140, Part 1 had two main objectives, first to initiate a discussion for the need and usefulness of an indicator-based ecosystem report card, and second, to provide a potential template for an ecosystem report card to contribute on the process towards its full development and use.

It was clarified to the Sub-Committee that monitoring and updating the state of the target species component will be based on the stock status that are routinely provided by Species Working Groups. Challenges remain for the by-catch components where few formal assessments exist and the total number of interactions and mortalities of some of these species with tuna fisheries remain unknown or poorly known. The Sub-Committee noted that information for the trophic relationship component is presently insufficient to advance the work on this component.

It was noted that environmental indices and related information are already being used and incorporated in the fisheries stock assessment process for some of the main target species, either as part of the CPUE standardizations or in the actual assessments.

The Sub-Committee noted that the main focus of the ecosystem report card is currently the ecological dimension, but the socio-economic and human dimensions are also fundamental and should be taken into account when implementing an ecosystem approach. While the incorporation of socio-economic information is important, at this stage ICCAT does not collect socio-economic data. It was commented that there is socio-economic information routinely collected outside ICCAT by other organizations, for example by FAO, but not in a way that can be immediately used by ICCAT. It was also noted that there is socio-economic information collected at national levels but the challenges remain to scale this information up to the RFMO level. However, the Sub-Committee encouraged that this type of information be presented by national scientists.

The study presented a series of activities and the development of several products to support the development and refinement of the ecosystem report card such as an ecosystem synthesis report, an integrated ecosystem assessment and an ecosystem plan. The Sub-Committee inquired who would be responsible and the timeline for implementation of these activities. It was discussed that it would undoubtedly increase the work load for the Sub-Committee including the scientists and the Secretariat, and that the development of these proposed activities might need to continue relying on the inputs of the CPC scientists and funding from national projects such as a recently funded EU project (see below). As the proposed work to complete the ecosystem report cards is substantial there will be a need to prioritize the work.

It was also noted that the traffic light approach (i.e. the use of red, yellow and green colours) is a very powerful tool to communicate information that should be considered when the indicators are presented. It was also recommended to frame the main goals and questions for each ecosystem component that needs to be monitored (target species, by-catch species, trophic relationships and habitats) as part of an ecosystem approach. The temporal and spatial scales are also important considerations as various indicators may be relevant at different scales. It was recommended that before defining indicators it is necessary to identify at which scales they should be applied.

SCRS/P/2017/024 provided an overview of the issues related to developing ecoregions and representative indicators for an Ecosystem Report Card for ICCAT using Task I and II data.

The Sub-Committee discussed that numerous indicators were provided and these can likely not all be accommodated in the report card. By disaggregating the indicators to lower levels (e.g. by fleets and stocks) it might make the report card too complex for management purposes. The Sub-Committee agreed that the ultimate goal should be to find simple indicators to communicate the state of each main ecosystem component in simple ways. It was highlighted that the Commission is ultimately interested in the sustainable management of the main target species of tunas and tuna-like species. It is essential that the main purpose of the ecosystem report card and its ecosystem indicators is to have a clear link with the Commission objectives. It was proposed that for each ecosystem component, (e.g. the target species component) the Species Working Groups should provide input about the identification of potential indicators and participate in their development.

The Sub-Committee reiterated the need to have a discussion on defining what would be the ideal vs practical spatial scales for the choice of potential ecoregions. While some ecosystem areas make ecological sense, it was recognized that the optimum or practical spatial scale is dependent on the type of indicator and the management questions.

It was discussed that many of the current data sets in the ICCAT website and scientific products created by the Working Groups have the potential to be used to develop some of the proposed ecosystem indicators.

Document SCRS/2017/140, Part 2, presented an integrated multispecies B/B_{MSY} and F/F_{MSY} ratio, which have been used by some organizations to diagnose the state of the fished and assessed part of an ecosystem. These multispecies B/B_{MSY} and F/F_{MSY} ratios were calculated at several spatial and taxonomic scales, and they were estimated using hierarchical models to account for the several runs and models used by the SCRS to provide management advice for each assessed stock. These indicators should be treated as preliminary since they need to be further tested and developed.

The Sub-Committee asked for clarifications on how the single species ratios of B/B_{MSY} and F/F_{MSY} were extrapolated both backwards and forward in time. It was noted that there is a reason why stock assessments have a starting year and there might be an issue to extrapolate.

The Sub-Committee asked how the uncertainty of the single B/B_{MSY} and F/F_{MSY} ratios was accounted for in the estimation of the integrated ratios. The assessment of the different stocks contains uncertainties in the input data quality and the assessment methodology; therefore the aggregation process may introduce bias making it difficult to interpret the indicators. It was discussed that there are plans to explore different ways to account for uncertainty as this is an important issue.

The Sub-Committee also noted that the integrated B/B_{MSY} and F/F_{MSY} ratios for the ecoregions had no appropriate reference level. It was also highlighted that the integrated ratio calculated for different taxonomic groups and spatial scales must be interpreted with caution.

The Sub-Committee noted that by combining assessment results for the 21 assessed ICCAT stocks, the integrated ratios are a mix of data-rich and data-limited stocks with different levels of uncertainty. The Sub-Committee also noted that the integrated ratios combine stocks with different productivities and biomass levels, even when the ratios are combined by major taxonomic groups, and that it might not be appropriate to combine those in the same indicator. These integrations also ignore species interactions.

The Sub-Committee discussed that the estimation of multispecies integrated indicators to represent the overall status of the assessed part of the ecosystem is still an approach to be further explored. However, it was acknowledged that these indicators might be too complicated to be interpreted and it may be difficult to link them with management actions. The Sub-Committee suggested to further investigate why and how this integrated indicator is used within other organisations. It was also highlighted that it is essential to have specific objectives before an indicator is developed, to ensure that they can answer specific questions relevant to the sustainable management of ICCAT tuna and tuna-like species.

SCRS/P/2017/030 presented the main objectives and expected outcomes of the Specific Contract No. 2 under the Framework Contract EASME/EMFF/2016/008 which provides scientific advice for fisheries beyond EU waters to the European Commission. This project will be addressing some of the current impediments and will provide solutions that shall support the implementation of an Ecosystem Approach to Fisheries Management through collaboration and consultation with the key tuna RFMOs, specifically ICCAT and IOTC.

The Sub-Committee inquired what was the link between the presented EU project and the current activities being carried out by the Sub-Committee. The author clarified that this project is funding several activities that will be generating products that are intended to assist and support the current work of the Sub-Committee. The Sub-Committee indicated that it would like to collaborate in the activities of the project and be informed of the progresses made. The author clarified that there are plans to present and share the results and main findings of the project in the next Sub-Committee meeting with the objective to get feedback from the Sub-Committee and find ways that the products can better assist the ongoing work of the Sub-Committee.

SCRS/P/2017/028 presented the current advances from a multidisciplinary joint research initiative linking tuna species ecology and operational oceanography. The analytical approach of this initiative is based on three main tasks, 1) investigate tuna environmentally driven traits, 2) develop indicators for identified environmental processes (operational oceanography tools) and 3) apply the developed indicators to improve assessment of tuna species. The operational products developed provide information on variability of oceanographic processes driving tuna ecology traits, distribution of spawning and larval habitats, larval abundance indices and survival.

The Sub-Committee discussed several examples of how environmental indicators could be developed. It was not clear how and what environmental indicators could be used as inputs in the ecosystem report card if generated for the entire Convention area. There is a need to clarify what specific questions are intended to be addressed with the ecosystem report card and whether the report card can be divided into smaller spatial scales or regions where it would be easier to identify the environmental drivers. It was highlighted that it is important to identify the right hypotheses, before developing the indicators.

It was noted that it is difficult to interpret ecosystem indicators which may respond to both fishing pressure and environmental variation. In these cases, the development of appropriate environmental indicators is important and needed to disentangle the effect of fishing from the environment at the right spatial scales. It was also noted that the use of environmental and oceanographic data could help to inform the definition of ecoregions within the ICCAT Convention area.

It was clarified that the operational oceanographic platform described in the study focuses on producing environmental products for the western Mediterranean, but the main methods and derived knowledge on the processes linking oceanography and the ecology of tunas and tuna-like species can be transferred to other areas of the Mediterranean Sea or the Atlantic Ocean. It was also clarified that several environmental indicators produced by this study are already being used by the bluefin tuna and albacore Working Groups in the assessment.

The Sub-Committee requested that the author make a summary table of potential indicators that could be used by the Sub-Committee (**Table 1**).

SCRS/P/2017/034 presented an analysis of the current status, required time for rebuilding, future catch, and future profitability for 397 European fish stocks (Mediterranean, Black Sea, and North-East Atlantic stocks).

The Sub-Committee noted that not all stocks may be fished optimally relative to MSY and this was not taken into account in the study. The author clarified that this is an issue in such types of meta-analysis and that predicting all the interactions would be very complex. The author explained that the meta-analysis of many stocks can still provide indicators of the overall status of stocks in a region and that this study mainly highlights the poor status and the many challenges faced by fisheries in the Mediterranean Sea. Since it would be difficult to achieve MSY for all stocks, there will be a need to decide if the management should ensure the most vulnerable stocks are not fished below safe biological limits. There were also some discussions on the use of economic indicators in the analysis.

The Sub-Committee suggested extending the work to contrast the status of prey versus predators, and examine the different responses. The profitability of fisheries on top predators may be linked to the level of exploitation on the prey species (e.g. sardines, anchovies). It was clarified that it is difficult to model the complex interactions between top predators and prey species. It is, however, important to monitor such interactions which may potentially impact the fisheries.

Draft Ecosystem Report Card

The Sub-Committee discussed the proposal to develop a prototype Ecosystem Report Card which could be presented to the SCRS in 2018. A preliminary prototype of the Report Card including the purpose, audience and structure was reviewed along with a proposal for a road map. Both the road map and the general structure of the report are given below.

It was discussed the possibility of meeting with the SCRS Working Group chairs at the 2017 Working Group Meetings and it was noted that a proposal could be provided at the meeting of the SCRS officers or at the conclusion of the meeting of the Sub-Committee on Statistics. The Sub-Committee discussed how the prototype would be completed in the absence of expert support and it was indicated that components with no input would simply be left blank.

Road Map

2017 SWG meeting
A Proposal will be presented to the chairs of the Species Working Groups. The Proposal will include the Preliminary prototype Report Card with rationale and a proposal for implementation. Further, the chairs will be requested to provide inputs for the report in accordance with the guidelines provided below.

2018 SC-Eco Meeting
A prototype of the Report Card will be developed inter-sessionally and presented to the Sub-Committee for review and the implementation plan will be updated. The report will be populated using the inputs provided by the Working Groups and relevant experts.

2018 Commission Meetings
The proposal to implement an ecosystem Report Card will be introduced in order to attract feedback and achieve agreement in principle to implement this tool.

Purpose
The Sub-Committee agreed that the purpose of the report card is to assist the Commission advance the implementation of EBFM by monitoring the state of the ecosystem components supporting ICCAT fisheries.

Regions
The Sub-Committee noted that the exact boundaries for the regions and their number have not yet been defined but interim options are to choose the whole Convention area, to use the definitions proposed in SCRS/2017/P/024 or some combination of the two options.

Ecosystem Components
The proposed structure for the Ecosystem report card includes the components listed below. Retained species (tuna, billfish, sharks):

- Non retained species
    - Seabirds
    - Turtles
    - Mammals
    - Sharks

- Trophic relationship
- Habitat
- Socio-economic
- Fishing pressure

Retained Species (tuna, billfish, sharks)
Goal: Ensuring long-term sustainability and optimum utilization of the retained stocks
Questions: Whether the harvest level of all retained stocks is maintained over agreed biomass target levels
Potential indicators:
Proportion of stocks for which $F/F_{MSY} > 1$
F/F_{MSY} of a reference stock(s) (that which has the highest sensitivity to exploitation pressure)
Proportion of retained stocks that are assessed

Non Retained Species (seabirds, sea turtles, sharks and mammals)
Goal: Minimizing the interactions and mortality as practically as possible
Questions: Whether the number of interactions and/or total mortality is reduced
Potential indicators:
Total mortality estimates of seabirds/sharks/mammals/sea turtles (possibly select a sensitive species)
Total interaction estimates by group (possibly select a sensitive species)

Trophic Relationships
Goal: Ensuring that ICCAT fisheries will not cause adverse impacts on the structure and function of the communities.
Questions: Whether trophic interactions and inter dependencies involving species that are affected by fishing are maintained
Potential indicators:
Trophic level indicator of catches taken by tuna fisheries (e.g. estimated based on observer data)
Diversity indicators of catches taken by tuna fisheries (e.g. estimated based on observer data)

Habitat
Goal: Ensuring that the tuna fisheries will not cause adverse impacts on critical habitat
Questions: Whether ICCAT fisheries impact on critical habitat
Potential indicators:
Proportion of lost/abandoned gears to total gears used (possible?)
The number of FADs lost
The cumulative biomass of species that are caught in bait fisheries

Socio economic
Goal: Maximise social well-being or quality of life of fishing communities
Questions: Whether ICCAT fisheries reduce the quality of life in fishing communities
Potential indicators:
The employment rate of people working in ICCAT fisheries
The median annual income of fishermen working in ICCAT fisheries

Fishing Pressure
Controlling indicators:
Total catch
Total effort

2.2 Review the proceedings of the Joint meeting between tRFMOs on the implementation of the EBFM approach

SCRS/2017/P/025 provided a report of the Joint Meeting of Tuna RFMOs on the Implementation of the Ecosystem Approach to Fisheries Management. The meeting was held on December 12 to 14, 2016 at the FAO headquarters in Rome, Italy and the complete report can be accessed here: http://www.fao.org/fileadmin/user_upload/common_oceans/docs/JointTunaRFMO_EBFM_Meeting.pdf

This information was also presented to the SWGSM meeting held in Madrid from June 29 to 30, 2017 and was well received by managers. The Sub-Committee acknowledged that ICCAT is already implementing some of the elements of EBFM. However, there is a need to continue and deepen the dialogue with managers to further advance this process. It was noted that to implement Ecosystem Based Management (EBM), sources of impact to the ecosystem other than fisheries need to be taken into consideration. However, the Sub-Committee agreed that at the present time it is not in a position to do so.

The Sub-Committee also discussed the difficulties to implement EBFM at the RFMO level. In other words, it is easier to advance and implement this concept at a national level where different sources of impact can be more easily managed than doing it at an international level. This is due to the fact that RFMOs often adopt management measures by consensus.

Furthermore, ICCAT can only control the impact of tuna fishery operations but it doesn't have the authority to somehow manage impacts unrelated to fishing (e.g. oil exploration). The Sub-Committee discussed if EBFM is already part of the tRFMOs mandate, and it was agreed that the situation is different among all these organizations. The Sub-Committee also warned about comparing the advancements in implementing EBFM among the different RFMOs. For example, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has the mandate to conserve all marine living resources, while ICCAT has the mandate to manage tuna and tuna-like species.

3 Ecology and Habitat

3.1 Review information on the trophic ecology and habitat of pelagic ecosystems that are important and unique for ICCAT species in the Convention area

SCRS/2017/148 provided information on aspects of the ecology of squid and their importance in the pelagic trophic web of the northwest Atlantic including the Sargasso Sea. In the northwest Atlantic, two species of squids are commercially exploited: Northern shortfin squid *Illex illecebrosus* (Ommastrephidae) which is an oceanic species and the longfin squid *Doryteuthis (Loligo) pealeii* (Loliginidae) which is a neritic species. The populations of both of these species are strongly influenced by the Gulf Stream, a powerful western boundary current system. Most squid species have life spans of a year or less and, as a consequence, their populations often display irregular annual fluctuations in abundance. As squids function as both predator and prey, they play an important role in the trophic web of pelagic ecosystems. Ommastrephidae are major contributors to the diets of large pelagic fishes in the central north Atlantic and all five tuna species (Thunnidae) plus swordfish (*Xiphius gladius*) managed by ICCAT have squid as an integral prey group in their diets. Squids are essentially "annual" species and are highly responsive to changes in their environment. Due to the importance of squid species in pelagic ecosystems, there is a need to incorporate data on these species into any ecosystem-based fisheries management (EBFM) model for tuna and tuna-like species.

The Sub-Committee was interested to know if there was data available to support the development of an abundance indicator for squid and queried if any t-RFMO collected stomach content data as part of a regular sampling programme. It was noted that the IATTC does collect stomachs as part of their sampling programmes but no further details were available. Analyses of stomach contents generally do not contain whole squid because they are quickly digested, however their beaks remain and can yield information on species, abundance and size estimates. Quantitative assessments are conducted for some species of squid and these data can be obtained from FAO. It was also stated that the Republic of South Africa conducts squid stock assessments. Given that squid are so short- lived the ecosystem indicator would largely be a function of recruitment success which is heavily influenced by environmental factors. It was noted that squid are also an important food source for seabirds as well as a source of bait in longline fisheries resulting in further fishery-related linkages. It was encouraged by the Sub-Committee that the fraction of the diet composed of squid be determined for the major ICCAT species.

SCRS/2017/160 provided a single Ecological Niche model for skipjack tuna (SKJ) in the eastern Central Atlantic Ocean (AO) and western Indian Ocean (IO) using data from the European purse seine fleet. Chlorophyll-a fronts were used as a proxy for food availability while selected physical variables defined the abiotic preferences. Skipjack feeding habitat spanned from latitudinal occurrence of eddy-type productive features at mesoscale in the IO to large-scale upwelling systems that seasonally shrink and swell in the AO. About 83% of FAD free sets and 75% of FAD sets were within 25 km of the estimated preferred habitat while in the AO, 34% of FAD sets occurred at distances greater than 100 km, in the relatively food-poor Guinea Current which may correspond with favourable spawning and larvae habitat. Results emphasized higher skipjack accessibility to purse seiners in months when the habitat is reduced. Moreover, the positive correlation found in the IO between the annual size of preferred habitat, and in recent years for the AO, with both the annual nominal catch rates and total catches of skipjack suggests interpreting the habitat size as an indicator of the carrying capacity of this fast-reproducing species.

The mechanistic relationship between estimated habitat size and catch rates was questioned by the Sub-Committee and it was suggested that the population concentration of skipjack increases as habitat size decreases. Further, given the closer proximity of the FAD sets to the estimated preferred habitat it was suggested that FAD location also be a covariate in the model. This was attempted but gave inconsistent results. The Sub-Committee recognized that the model did not predict the area of high catches in the AO as well as the IO and wondered if it was possible to characterize the environmental conditions of the preferred habitat in the AO better. Although improving the fit was a future objective it was noted that the current model was still reasonably accurate for the AO. Lastly, the Sub-Committee observed that the habitat variables were equally weighted in the model and it was suggested that an alternative weighting scheme which favoured the more important determinants of presence should be considered.

Document SCRS/2017/133 presented a species distribution model (SDM) for swordfish using a habitat suitability framework. Currently, the model integrates ocean depth, annual average estimated total chlorophyll, temperature and oxygen. Model predictions and general distributions of North Atlantic swordfish catches are used as criteria for the inclusion and treatment of variables. Initial trials demonstrated that the habitat cannot be predicted using temperature and oxygen alone. The inclusion of the spatial annual average productivity via chlorophyll markedly improved distribution predictions. The current formulation predicts the north-south seasonal migration in the North Atlantic but also predicts high abundance in areas of low swordfish catch. Better, time-varying data for ecosystem productivity relevant to swordfish might resolve this problem, but important habitat features may also be missing.

The Sub-Committee questioned the lack of agreement of the preferred habitat with the location of high catches of swordfish in the tropical South Atlantic and it was clarified that the poleward migration of swordfish from the tropics occurs at the same time in both hemispheres and correspond to different seasons in the different hemispheres. For this reason, catch rates of swordfish in the Republic of South Africa EEZ are typically higher in the winter and it was suggested that the relationship between the CPUE deviates and habitat volume be determined for this region. Future improvements to the model included incorporating zooplankton and micro nekton covariates and examining the annual variability in the habitat volume relative to the spatial variation in catch rates. Other explanatory variables suggested by the Sub-Committee related to the presence of horizontal temperature or salinity gradients and the number of fronts. Some factors that were suggested to inform the model like reactions to vertical gradients of temperature and salinity or the habits of this endothermic species are reflected in the PSAT data. A discussion on the mismatch between catches and the estimated habitat in some areas was thought to be a function of how

male and female swordfish are distributed and/or variability in the distribution by age. Though including this variability in the model was considered to be dependent on good PSAT data, which is currently not available, it was recommended that the Task II size data could be used to determine if these hypotheses were plausible. Lastly, there was interest by the Sub-Committee to generate products from the model such as annual indicator of habitat volume by area and/or indicators of the relative location of the optimal habitat. Further it was noted that this information could help to define the regions of the Ecosystem Report Cards

4 Data used for by-catch analyses

4.1 Revision and update of ST09 forms

In 2016, both the Sub-Committee on Ecosystems and the Sub-Committee on Statistics recommended that the existing ST09 observer data submission forms be revised to simplify the reporting requirements with the expectation that the revision will help to increase the submission rate of observer data. This work was to be conducted intersessionally through collaboration between CPC scientists and the Secretariat with a preliminary version to be presented to the Sub-Committee on Ecosystems and the Sub-Committee on Statistics, and for potential adoption by the SCRS in 2017. As such, the Secretariat received feedback from several CPC scientists and presented the revised reduced forms. The Secretariat removed most of the fields that had previously been developed for operational (set-by-set) data submission, maintaining those for aggregated submissions. The Secretariat also noted that the forms needed to be flexible enough to facilitate data submission for a variety of different Species Groups which are caught as by-catch in ICCAT fisheries.

The Sub-Committee discussed that regardless of the work that SCRS might be able to conduct with the reported observer data, the SCRS and the Secretariat have been mandated by the Commission to develop the forms to submit observer data and for CPCs to report such data.

The Sub-Committee discussed if the revised version of the ST09 form was oversimplified as all requested information was at the trip level and detailed information at the set level was lost. There was a general agreement that some information at the set level should be maintained in the form. More specifically the 'number of hooks between floats' that helps to identify shallow and deep sets which could be used as a proxy for targeting. The Sub-Committee agreed that a revised version of the form should include a field to report the number of hooks between floats in ranges and a field with a qualitative definition of the fishing depth (i.e., shallow, medium, deep). It was discussed that the more limited the data is reported, the more limited the utility of these data for the SCRS will be. However, the Sub-Committee reiterated that detailed analyses of the observer data should be conducted by national scientists, who know all the details and caveats of the data, and not by SCRS. As such, the Sub-Committee understood that the need to report very detailed observer information might not be warranted. SCRS could use more aggregated observer data to routinely monitor by-catch levels, and conduct more detailed impact assessment using additional data sources when it considers necessary.

The Sub-Committee endorsed the latest version of the ST09 form that incorporated some of the comments provided to the Secretariat (the fields are presented in **Appendix 5**). These forms will be presented to the Sub-Committee on Statistics before being presented to the SCRS plenary for final approval.

Document SCRS/2017/157 proposed new fields to be added to the Port State Measures forms. The Sub-Committee indicated that issues related to Port State Measures are the competence of the ICCAT Compliance Committee and not the SCRS. It was noted that the information that is proposed to be collected can help to assess compliance with the use of mitigation measures adopted by ICCAT.

4.2 Status of ST09 observer data received by the Secretariat (report cards)

In 2016, the Sub-Committee on Ecosystems and Statistics discussed that compliance with the submission of observer data using the ST09 forms was very low. As such, the Secretariat was requested to develop "report cards" on submission of this information such as those develop for the other Task I and Task II data. It was noted that this is not as simple a task as the development of report cards for Task I and II data, as observer data is extremely complex and contains multiple dimensions. As a result, submission of an ST09 form may not represent the submission of full observer data. However, the Secretariat cross referenced the

submission of ST09 forms, with the submission of the previously developed CP45 meta-data forms. The purpose of this was to determine which CPCs had stated in their CP45 forms that they collect by-catch data in observer programmes, but did not submit ST09 information. This is also not an ideal process, as it only highlights CPCs that duly submitted CP45 forms, and not those who have submitted no information at all. This new report card is provided in **Appendix 6**.

The Sub-Committee commended the Secretariat for advancing the work related to the mentioned report cards. The Sub-Committee discussed the difficulties in assessing the quality of the reported data using the report cards, but it was also pointed out that this difficulty is also found when assessing other Task II data. The Sub-Committee provided the Secretariat with additional advice that can help to improve the report cards.

4.3 Update on EFFDIS estimations

An update to the EFFDIS database was requested by the Sub-Committee on Ecosystems in early 2017. The request was made because general updates in the Task I and II data had become available, and particularly because Japanese historical Task II data had been revised. The Secretariat presented an update of the EFFDIS estimations (SCRS/P/2017/032) with the same methodology previously used (Beare *et al.* 2016). EFFDIS data are made available by the ICCAT Secretariat as the number of hooks reported by the CPCs in the Task II 'Catch-and-Effort' data submission (HooksObs) and the estimated total effort (HooksEst). The estimated total effort is obtained by using Task I (nominal catches) and the Task II 'Catch-and-Effort' data.

The nomenclature used in the final version of EFFDIS has caused some confusion and the Sub-Committee recommended that HooksObs be named HooksReported. It was also noted that in certain cases, the catch available in the Task II data is higher than that in Task I. It was agreed that the Task I catches should always be used for the scaling of the effort as it is the official total catch submission and is likely more accurate than the Task II catches. The current model used to estimate total effort is a GAM from the Poisson family which models -using Generalized Cross Validation- the frequency of hooks (count data). Dependence on time is estimated using 'harmonics'; and on space using (2D-spline) smooth functions. Currently 'variance' is estimated from the Standard Errors of the GAMs. The Sub-Committee recommended using other techniques or strategies to help model-selection (cross validation) and estimate variance (bootstrapping). The code (effdisR) is all written up as a documented R-package, available on request from the ICCAT Secretariat. The Sub-Committee recommended that cross validation of the regression model be conducted. That is because GAMs can over-fit the data. When this happens, the ability of the model to be used as a predicting tool is diminished.

5 Sea turtles

SCRS/2017/155 reviewed the historical information on the incidental catch of sea turtle by the Japanese pelagic longline fisheries within the International Commission for the Conservation of Atlantic Tunas (ICCAT) Convention area collected by the Japanese scientific observers. A total of 681 sea turtles were caught on 28 million hooks from eleven thousand fishing operations (sets) observed from 1997 to 2015. The most common species occurred was leatherback (N=312, 45.8%), followed by loggerhead (N=144, 21.1%), and olive ridley (N=76, 11.2%). Species of 149 individuals were unidentified, accounting for 21.9% of total sea turtle by-catch observed. Most of the turtles were caught in the tropical to temperate Atlantic area (10º S to 25º N, area 2) and northern Atlantic (North of 25º N, area 1). In areas 1 and 2, leatherback was the most common species, while olive ridley was the most common in the southern area (10º S to 35º S, area 3). No turtle was recorded from far southern area (South of 35°S, area 4). The areas are also further divided indicating that area 1 and area 4 have vessels fishing "shallow", with 7-13 hooks between floats, and area 2 generally fishing deeper (greater than 14 hooks).

The Sub-Committee inquired why the number of hooks between floats was not included in the results. It was only used to characterize the regions, but it'll be included in the future analyses. The Sub-Committee suggested that the GAMM analysis be conducted for each species separately. It was explained that the analysis was only for leatherback at this time. The Sub-Committee inquired regarding the reason for higher by-catch rate of leatherback recorded in area 1. It was explained that the gear configuration of hooks observed in area 1 was only shallow-set and was only deep-set in area 2, therefore it was unclear whether the area or gear depth effect on the by-catch rate of leatherback. It was also asked which types of bait and

hook were used. This information was not available at this time although the observers record this information. The authors indicated that they have problems regarding species identification for hard shelled turtles in their observer data and this may be the case for other fleets as well. There is a document to identify the species, therefore it may be helpful to solve the problem. The Sub-Committee suggested that the length of the line between floats may be a better proxy for gear depth than the number of hooks per basket, which influences sea turtle by-catch. The Sub-Committee discussed the importance of investigating numerous factors including SST which affect by-catch.

SCRS/2017/141, refers to an ICCAT earlier request from its Standing Committee on Research and Statistics (SCRS) to conduct an assessment of the impact of ICCAT fisheries on sea turtles (ICCAT 2009). Information on the area of operation and estimated fishing effort of 15 longline fleets fishing in the Atlantic in 2012 and 16 fleets in 2013-2014 was obtained from the ICCAT EFFDIS (fishing effort in number of hooks by time-area strata) database. Sea turtle by-catch rates were identified for six fleets operating within the ICCAT Convention area through a comprehensive literature review. For the remaining nine fleets for which data were not available, by-catch rates were assigned based on spatial overlap of fleets with published rates. The total number of sea turtle interactions was estimated using the reported and assigned sea turtle by-catch rates per fleet and multiplied by the estimated total fishing effort deployed by the fleets. The methodology was similar to the one used to estimate the number of seabird interactions with pelagic longlines in ICCAT fisheries (Klaer *et al.* 2009). The total number of sea turtle interactions (all species combined) with pelagic longline gear in the ICCAT Convention area ranged from 30,612 to 47,315 (depending on the by-catch rates used) during 2012-2014. This study is meant to complete the previous work presented in Mckee Gray and Diaz (2017). There was a figure indicating the capture rate of some sea turtle species exceeded that of target species.

The Sub-Committee questioned the high CPUE values for EU-Spain listed in **Table 3** from one of the published CPUE studies and used in the estimates. It was explained that in cases when a range of CPUEs was available, the maximum CPUE was used. The Sub-Committee noted that the numbers would then result in the maximum possible estimations in each case. The Sub-Committee asked how this work would continue, and it was answered that the idea is to insert new data into the current model to get revised estimates. Subsequently it was reminded that large circle hooks and/or the use of fish bait are effective by-catch mitigation measures to reduce sea turtle by-catch and increase post release survivorship, and this information is supported by a large body of literature. The Sub-Committee noted the concern that there is a resulting increase in shark by-catches and reduction of some target species catches (e.g. swordfish). It was also reminded that the SCRS was asked to evaluate the impact on the sea turtle populations and to recommend mitigation measures. The Sub-Committee asked to share scientific papers regarding the effects of large circle hooks and other mitigation measures in order to reduce the knowledge gap. It was also mentioned that circle hook experiments conducted on a deep set bigeye tuna fishery showed no difference in sea turtle by-catch rates between J hooks and large circle hooks, however, since circle hooks caught more tuna, some fisheries have voluntarily adopted their use.

SCRS/2017/150 presented observer records from EU-Spain purse seiners targeting tropical tunas that indicate by-catch of six different sea turtles species in the Atlantic Ocean. Incidental catch rate of sea turtles from the purse seine fisheries occur, but the mortality is very low, and not statistically significant. However, the incidental catch of sea turtles could provide relevant information about the species' distribution. The North Atlantic Oscillation (NAO) is the principal atmospheric oscillation that modulates the trade winds in the North Atlantic Ocean. The principal aim of the present study is to understand the effect of the NAO in the interannual pattern distribution of sea turtle incidental catch by this fishery. The number of total sea turtle records in years with positive NAO phases is significantly higher that the number of sea turtle interactions in years with negative NAO phases.

The Sub-Committee noted that the same individuals may be repeatedly recaptured. It was suggested to conduct mark recapture programmes.

SCRS/P/2017/029 presented a brief overview of sea turtle conservation measures adopted by some other RFMOs. The first measure that was adopted in ICCAT was in 2003. Currently, most include implementation/requirement of a combination of following "FAO Guidelines" for safe handling and release of sea turtles, continued research into mitigation techniques, provision of educational information to fishers, and reporting interaction data to scientific committees. However, few measures mandate specific actions to mitigate sea turtle interactions. The IOTC encourages annual reviews of data, use of finfish as bait

and a reporting requirement for turtle interaction in net fisheries. In the WCPFC, conservation measures for longline vessels that fish for swordfish in a shallow-set are required to employ or implement at least one of the following three methods to mitigate the capture of sea turtles:

1) Use only large circle hooks, which are fishing hooks that are generally circular or oval in shape and originally designed and manufactured so that the point is turned perpendicularly back to the shank. These hooks shall have an offset not to exceed 10 degrees; 2) use only whole finfish for bait; or 3) use any other measure, mitigation plan or activity that has been reviewed by the Scientific Committee and the Technical and Compliance Committee.

A discussion included clarification on the situation about IOTC, which has a significant problem regarding sea turtle by-catch in gillnet and driftnet fisheries. In addition, the Sub-Committee reviewed the *Recommendation by ICCAT on Management Measures for the Conservation of Atlantic Sailfish* [Rec. 16-11], regarding marlins and sailfish, which recommended encouraging or requiring the use of circle hooks. The Sub-Committee discussed that any recommendation should include flexibility with regards to choice of mitigation method (e.g. select from some options) similar to WCPFC.

6 Seabirds

6.1 Feedback on GEF-ABNJ seabird mitigation meeting and ICCAT collaborative work meeting

SCRS/2017/158 provided an update on the seabird component of the Common Oceans Tuna Project and was presented on behalf of participants of two regional pre-assessment workshops on seabird by-catch.

The need to continue to maintain linkages and share information between this work and the Sub-Committee was noted, as was the capacity building element of the project. The Sub-Committee was informed that for the upcoming pre-assessment data meeting (20-24 February 2018, Mexico) by-catch data will be compiled and then basic data analysis will be conducted to begin the process of aligning datasets and understanding commonalities.

SCRS/P/2017/033 reported on collaborative work to assess seabird by-catch in the pelagic longline fleets operating in the South Atlantic and Indian Oceans.

Given the similarity of the ultimate objectives of the two above mentioned concurrent processes, the Sub-Committee emphasized the importance of harmonising efforts and linkages between these complimentary processes.

6.2 Review of progress on seabird interaction estimations and mitigation

Document SCRS/2017/152 presented results of Japanese research investigating the effect of longline setting time on the catches of target and by-catch species. The study made use of data collected by the Japanese Observer Programme from vessels fishing South of 25°S from 2011 to 2013.

The Sub-Committee noted that setting lines during the darkness of night significantly reduces seabird by-catch, and thus represents an effective by-catch mitigation measure. The daily pattern of by-catch rate varied between species. The patterns of catch rate of target fish species among setting times varied among species. However, it was noted that the study did not consider soak time, and for some species catches were low, and so this aspect of the study should be considered preliminary. The Sub-Committee suggested to present the result in relation to nautical dawn, rather than sunrise, as the night setting conservation measure for seabirds requires setting to be started and finished during the hours of darkness, between nautical dusk and nautical dawn and the author explained that the time was adjusted to sunrise rather than nautical dawn for biological reasons. The Sub-Committee noted that the study highlighted the value of using set-by-set operational data, and suggested that the authors consider using a GAMM analysis to investigate further the effect of moon phase on the catch rates of seabirds.

Document SCRS/2017/167 presented a preliminary estimation of seabird bycatch numbers by Chinese Taipei longline vessels in the southern Atlantic Ocean from 2002 to 2016. The paper updates a previous analysis, and makes use of observer data collected from 60 Chinese Taipei–tuna longline vessel trips operating in the South Atlantic during this period. By-catch estimates were higher South of 35°S, especially in the southwest and southeast Atlantic, and between February and July.

The Sub-Committee noted that by-catch estimates of total mortality peaked in 2008, and have decreased since 2013. The possible reasons for the decreasing trends in by-catch estimates need to be further explored, but may be influenced by decreasing effort, levels of observer coverage, experience of observers and captains, and the use of mitigation measures, amongst other factors. The Sub-Committee welcomed the report that there has been an improvement in recent years in the quality of the data collected and reported by the observer programme, and agreed that this should lead to a better understanding of by-catch associated with this fleet. The Sub-Committee provided some suggestions for further investigations, including how the proportion of fishing effort has changed over time in relation to the area South of 35°S, an assessment of the effectiveness of mitigation measures and other factors that contribute to by-catch and by-catch reduction.

Document SCRS/2017/154 presented Japanese research efforts which aimed to understand the effectiveness of seabird by-catch mitigation techniques. The study presented results of at-sea trials conducted during April and May in 2014 and 2015 in the North Pacific to assess the effectiveness of the following measures: i) hybrid tori line, ii) 40g Lumo lead placed at the hook, iii) 34g blinking weight placed at the hook and iv) 34g blinking weight placed 30cm from the hook. In total, 27 longline fishing operations were observed in the study, and the seabird attack rates of the baited hooks and by-catch events for the two major by-catch species, Laysan albatross *Diomedea immutabilis* and the black-footed albatross *Diomedea nigripes*, were recorded.

The Sub-Committee noted that the attack and by-catch rates of these species did not differ significantly across the four mitigation gears. The Sub-Committee noted the high seabird by-catch rate observed in the study. The author explained that at-sea trials were done in areas where seabirds were abundant in order to maximise the likelihood that the experiment would detect differences among mitigation measures. It was suggested that the researchers investigate further the reasons for the number of birds caught, and how this might be addressed.

Document SCRS/2017/156 presented an analysis of tracking data for four procellariform seabirds from South Georgia (wandering albatross, black-browed albatross, grey-headed albatross and white-chinned petrel), and the calculated overlap of tracked birds with pelagic longline fisheries in the southern Ocean for the period 1990-2009. The analysis made use of an extensive tracking dataset, which includes all major life-history stages, as well as long-term demographic data from Bird Island, South Georgia.

The Sub-Committee noted the importance of the southern portion of the ICCAT Convention area for South Georgia albatrosses. The Sub-Committee discussed the methodology used in the study, including the different life history categories used and the representativeness of counts of breeding pairs as a proxy for total population abundance. The Sub-Committee noted that all four populations have experienced long-term declines and that there was a high degree of inter-annual variability in the numbers of birds breeding at Bird Island, especially for grey-headed albatrosses. The author explained that this variability was due largely to the biennial breeding pattern of this species (where birds breed every other year), compared to the annual breeding pattern of black-browed albatrosses. Given the lack of evidence for any land-based threats (such as introduced predators and human disturbance) and disease, these declines have been attributed to factors affecting birds at sea, and in particular by-catch associated with commercial fishing operations.

It was noted that historically high by-catch of seabirds in fisheries operating around South Georgia have been reduced to negligible levels following the introduction and use of a suite of by-catch mitigation measures. The residual threat is considered to be from more distant fisheries, particularly during the non-breeding period when birds range more widely. It was also noted that work is underway to understand the respective roles of by-catch and climate change in driving these population trends. The Sub-Committee recognised that because of the long-lived nature of albatrosses, populations may not show rapid recovery following a reduction in threats. Counts of breeding birds at colonies provide an assessment of only one component of the population. Consequently, links between population trends and threats, such as by-catch,

and the efficacy of by-catch mitigation measures, should be interpreted with caution. The Sub-Committee noted that large-scale overlap of average seabird distribution with fishing effort doesn't necessarily equate to seabird mortality. In addition, the risk of by-catch depends on how each species and life-history stage behaves or interacts with the vessel. The overlap analysis highlights areas of potential risk, and should be complemented by fine-scale tracking and by-catch data to better understand the nature and extent of by-catch.

Document SCRS/2017/151 presented results of research which investigated whether bill length can be used to distinguish species in the wandering albatross complex: *Diomedea exulans*, *D. dabbenena*, *D. antipodensis gibsoni* and *D. antipodensis antipodensis*. The identification of species based on bill length measurements were compared with those using molecular approaches (DNA analysis), and were found to be in complete agreement. Based on this result, the Japanese observer programme has introduced bill length measurements protocols to facilitate species identification.

The Sub-Committee agreed that the outcomes of the research provide a valuable tool to help overcome seabird identification challenges. The Sub-Committee commended Japan for its efforts to address this issue, and for including the tool into their observer programme.

SCRS/P/2017/035 provided information on a scientific survey to assess seabird abundance in Mauritanian waters.

The Sub-Committee noted that the majority of species of seabirds are migratory coming from European waters and that there is a significant concentration in the vicinity of Cape Blanc. As there is also a great deal of fishing activity in the region this would justify the need to initiate by-catch mitigation measures. It also appears that there is by-catch of birds by foreign vessels in Mauritanian waters and it was noticed that a vessel was found to have frozen seabirds on board for reasons that were unclear.

6.3 Seabird by-catch and mitigation in the Mediterranean

Document SCRS/P/2017/018 summarized the data on seabird by-catch obtained from the onboard observer programme of the *Instituto Español de Oceanografía* (IEO) between 2000 and 2016.

The Sub-Committee noted that the increasing trend of by-catch reported may be explained by increasing observer coverage. The Sub-Committee noted that estimates of total seabird by-catch based only on nominal BPUEs should be treated with caution due to the combination of high zero catch sets and very few sets with high seabirds catches. The Sub-Committee discussed the methods to improve these estimates, using similar approaches that were presented for other fleets.

The Sub-Committee was informed of a planned new phase of ACCOBAMS-MAVA-GFCM by-catch work from 2017-2020, which includes: a Mediterranean-wide by-catch database to be held by GFCM; trials of mitigation gear for reducing multi-taxa by-catch for gillnets, trawl and demersal longlines; the creation of a by-catch advisory group; and the development of a Mediterranean-wide gap analysis and an associated strategy for by-catch work.

Document SCRS/P/2017/019 summarized the data on seabird direct mortality from the onboard observer programme of IEO from 2009 to 2016.

The Sub-Committee considered the short time series of data available, thereby limiting interpretation. The authors propose to continue with the ringing programme.

The Sub-Committee recalled the recommendation from this Sub-Committee in 2016 to conduct a regional workshop with the goal of recovering catch and by-catch information in gillnet fisheries. This has been approved by the Commission so funds are available and dates and details need to be confirmed to conduct the workshop.

6.4 Response on the effectiveness of seabird mitigation measures as per Rec. [11-09]

The Sub-Committee recalled that the paucity of seabird by-catch data submitted to the ICCAT Secretariat after the implementation of mitigation measures has prevented the assessment required by Rec. 11-09. Nevertheless, the Sub-Committee acknowledged that several intersessional initiatives have been advanced (as reported in section 6.1) to address this Rec. [11-09]. Collaborative work is currently being undertaken by ICCAT CPC national scientists who have started to analyze seabird by-catch data from detailed operational level observer data, which should facilitate the advancement of the required assessment. Additionally, the Common Oceans Tuna project has an ongoing global seabird assessment that can also provide additional information for the ICCAT Convention area. It is expected that more national scientists with knowledge of longline fisheries operating in areas South of 25°S will participate in the collaborative initiative undertaken by ICCAT CPC scientists.

7 Fish species caught as by-catch but not considered by other Species Groups

SCRS/P/2017/031 provided information on the by-catch issues in the French Mediterranean longline fisheries and in particular the first output of a collaborative research project.

The Sub-Committee asked why the fishermen were unwilling to use tori lines during the trial. It was expressed that the fishermen in the study use mostly small boats, and the use of tori lines is not practical. Also, as the interactions with birds are highly seasonal, the fishermen did not want this equipment on the boat.

SCRS/P/2017/036 provided information on the Namibian large-pelagic sampling programme and possible seismic impacts.

The Sub-Committee welcomed the work being conducted by Namibia. It was noted that the spatial information provided for by-catch would need to be corrected using the original logsheet data, as the sign and decimals in the spatial information presented were not included, resulting in erroneous plots of the catch data.

A presentation on an update on post-release survival of tagged whale shark encircled by tuna purse-seiner was provided in document SCRS/2017/147.

There was no confirmed post release mortalities. The Sub-Committee noted that most of the tags deployed in 2016 detached after a week or less, whereas those deployed in 2014 stayed on longer. It was queried whether this could have been due to tag failure. It was clarified that it was due to animal behaviour (deep diving) as the data from the tags are intact and clearly indicate this behaviour.

SCRS/2017/159 provided a study on elasmobranch by-catch in the French tropical purse-seine fishery of the eastern Atlantic Ocean.

The authors stated their willingness to collaborate with other CPCs to improve this study, especially with their EU-Spain colleagues due to the similarity in fishing operations and areas. The Sub-Committee welcomed this study particularly in light of the fact that few by-catch studies on purse seine fisheries have been presented to the Sub-Committee. It was encouraged that this presentation be made again at the next meeting of the Sharks Working Group.

SCRS/2017/165 provided a study on using FADS to estimate a population trend for the oceanic whitetip shark in the Atlantic Ocean.

The Sub-Committee made some technical suggestions to improve the estimations in the study, including to remove spatial cells where no encounters have ever been recorded, as this will reduce the zero-inflation problem and the corresponding variance. This would need to be tested to see if it is justifiable. It was observed by the Sub-Committee that as the effort of the fishery expanded South, the encounters with OCS appear to decrease. The Sub-Committee discussed whether there is currently enough confidence in the results to make conclusions about the decline of the oceanic whitetip shark population. It was suggested that the declining trend in encounters could be due to a spreading of effort across an expanding fishing area or other factors that were not considered, rather than an actual population decrease. There were differing opinions on this issue and further studies are required to clarify this problem.

The Secretariat presented **Table 2** containing the Task I catches of non-target species often not taken into consideration. The list was comprised largely of teleost species not categorised under the main/small tuna or shark categories. It was noted that several of these species have a relatively high economic value and are thus desirable for retention. The Sub-Committee considered that it is important to collect the catch data of these non-target species and then review their roles in the pelagic ecosystem. CPCs are therefore strongly encouraged to continue or initiate the submission of Task I information for these species.

8 Other matters

8.1 Review mechanisms to integrate the activities of the Sub-Committee on Ecosystems with those of the Species Working Groups. Consider the Committee's role within the SCRS and how to effectively coordinate, integrate and communicate ecosystem-relevant research across the ICCAT Species Working Groups and within the SCRS

The Sub-Committee discussed its role and its relationship to the Species Groups. It was recognized that the Sub-Committee has a broad mandate and no established mechanism to communicate and engage the Species Groups on which it relies. It was noted that a positive move towards resolving these issues would be to have annual meetings of the officers of the SCRS during the week of Species Working Group meetings, and develop an executive summary to include in the SCRS annual report on the state of the ecosystem components supporting ICCAT fisheries.

8.2 Discuss the information required to evaluate mitigation efforts for by-catch species

A presentation was provided entitled "Statistical consideration on sea-bird mitigation measure evaluation''. This presentation was previously introduced at CCSBT (CCSBT-ERS/1703/27).

The Sub-Committee noted the statistical challenges and problems associated with interpreting rare occurrence events such as seabird by-catch. The Sub-Committee recognised that it is important to account for non-independence of set by set data within the same trip. Differences in seabird by-catch rates among vessels may assist to assess the effectiveness of mitigation measure implementation. The Sub-Committee recalled the relevance of Domingo *et al.* (2015) on the species richness encountered by pelagic longliners, and noted that there may be examples from other taxa and fields where analyses account for rare or other extreme/infrequent events. The Sub-Committee agreed that the challenges associated with using Birds-Per-Unit-Effort to estimate total mortality should be further investigated. The presenter reported that the Vietnam regional pre-assessment workshop of the Common Oceans Tuna Project discussed the statistical issues, and intend to consider it further during the course of the Project. It is hoped that this process will help to develop a better analytical approach to overcome these challenges.

9 Recommendations

9.1 General recommendations

By-catch

- The Sub-Committee requests that CPCs continue or initiate the submission of Task I information for non-target teleost species not categorised under the main/small tuna or shark categories (e.g. oilfish, escolar, Atlantic pomfret, etc.).

- The Sub-Committee acknowledges that large circle hooks are proven to be effective in reducing sea turtle by-catch and might also increase post-release survival. The Sub-Committee also acknowledges that circle hooks have different impacts on both target and by-catch species. While they decrease marlin by-catch and swordfish catch rates, they increase tropical tuna and sharks catch rates.

  Taking into consideration the above scientific information, and that most sea turtle by-catch occurs on shallow longline sets, the Sub-Committee recommends the Commission to consider adopting for longline fisheries targeting swordfish and sharks at least one of the following mitigation measures:

1. the use of large circle hooks
2. the use of finfish bait
3. other measures considered effective by the SCRS.

- The Sub-Committee encourages national scientists to evaluate the overall impact of adopting mitigations measures on the management of the large pelagic fish community.

- The Sub-Committee recommends that the Working Group on Stock Assessment Methods review the method used to update the EFFDIS estimates and provide advice on potential improvements.

Ecosystems

- It is recommended that the next meeting of the Dialogue between Scientists and Managers Working Group (SWGSM) include an agenda item on the development of Ecosystem Report Cards to support the implementation of an EBFM framework for ICCAT.

- It is recommended that in future Species Working Group meetings there be a meeting between the Working Group chairs and the Ecosystem Sub-Committee Conveners in order to discuss ecosystem related issues.

- Given the need to communicate the status of the unassessed and non-retained species caught by ICCAT fisheries as well as other components of the ecosystem that play a role in supporting the fisheries, the Sub-Committee recommends that the SCRS include an Executive Summary of the outcomes of the ecosystem assessments in the annual report of the SCRS.

9.2 Recommendations with financial implications

By-catch

- The Sub-Committee requests financial assistance to support the attendance of three to five CPC scientists during the seabird assessment process of ICCAT.

Ecosystems

- Given the large amount of work involved in implementing ecosystem based fisheries management in ICCAT and implementing related products such as Ecosystem Overviews, Ecosystem Assessment Reports and Ecosystem Report Cards, the Sub-Committee recommends that 20,000 Euros of financial assistance be provided to support an external contractor to expedite this process.

10. Adoption of the report and closure

The report was adopted during the meeting. The Conveners thanked all the participants and the Secretariat for their hard work.

The meeting was adjourned.

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Table 1. Potential Ecosystem indicators for use in EBFM by the SCECO.

Group	1 - Hydrographic scenarios affecting Tuna species traits						2- Species habitats		3- Species population trends		
Indicator id	1.1.1	1.1.2	1.2.1	1.2.1	1.3.1	1.4.1	2.1	2.2	3.1	3.2	3.3
indicator name (S.T.M.= spatial temporal mean)	S.T.M. temperature in the mixed layer depth	S.T.M. temporal increment (15 days) in the mixed layer depth	S.T.M. salinity in the mixed layer depth	S.T. Mean salinity spatial gradients in the mixed layer depth	S.T.M. retention-dispersion ratios	S.T.M. surface chl-a	Bluefin tuna spawning habitat quality index	Albacore adult habitat distribution	Bluefin tuna larval abundance index	Bluefin tuna larval survival index	Albacore larval abundance index
Nature of the indicator	Inter annual changes on the oceanographic scenario	Inter annual changes on the oceanographic scenario	Inter annual changes on the oceanographic scenario (changes on water masses distribution)	Inter annual changes on the oceanographic scenario (changes on water masses distribution)	Inter annual changes on the oceanographic scenario (mesoscale activity)	inter annual changes on the biological scenarios	Spatial temporal distribution of bluefin tuna spawning habitats in the Western and Central Mediterranean	Spatial temporal distribution of albacore habitats in the Western Mediterranean	standardized abundances of bluefin tuna larvae	Larval survival	Standardized abundances of albacore larvae
Target process monitored	Spawning ecology of tunas in the Mediterranean	Spawning ecology of tunas in the Mediterranean	Spawning ecology of tunas in the Mediterranean	Spawning ecology of tunas in the Mediterranean	Larval ecology of tunas in the Mediterranean	spawning ecology of bluefin tuna	Spawning ecology of tunas in the Mediterranean	Spatial distribution of albacore potential habitats during the spawning season	Spawning stock biomass in the Western Mediterranean	Recruitment to juvenile stages	Spawning stock biomass in the Western Mediterranean
Target species	Tunids	Tunids	Tunids	Tunids	Tunids	Bluefin tuna	Tunids	Albacore	Bluefin tuna	Bluefin tuna	Albacore

Status	Developed	Developed	Developed	Developed	in development	Developed	Developed (v1)	in development	Developed	Developed	Developed
Input data	Water temperature from hydrodynamic models in the MLD	Water temperature from hydrodynamic models in the MLD	Water salinity from hydrodynamic models in the MLD	Water salinity from hydrodynamic models in the MLD	Water surface currents from altimetry and hydrodynamic models	Sea surface Chl-a from satellite	Hydrographic scenarios from remote sensing and hydrodynamic models	Hydrographic scenarios from remote sensing and hydrodynamic models	Ichthyoplankton and oceanographic data	IBM models and oceanographic data	ichthyoplankton and oceanographic data
Definition	Mean water temperature in the mixed layer depth in tuna reproductive areas along the species reproductive seasonality	Mean temporal gradients of water temperature in the mixed layer depth in tuna reproductive areas along the species reproductive seasonality	Mean water salinity in the mixed layer depth in tuna reproductive areas along the species reproductive seasonality	Mean water salinity gradients in the mixed layer depth in tuna reproductive areas along the species reproductive seasonality	cumulative retention of drift particles along specific spatial/temporal scale	Mean Chl-a in the Belearic Sea during species reproductive season	Mean value of daily spawning habitat quality index in reproductive areas	Mean value of daily potential habitat quality index	Inter annual changes larval abundances	Inter annual trends of environmental effects on larval mortalities till the juvenile developmental stages	Inter annual changes larval abundances
Areas	Tuna reproductive areas in the Mediterranean	Tuna reproductive areas in the Mediterranean	Tuna reproductive areas in the Mediterranean	Tuna reproductive areas in the Mediterranean	Tuna reproductive areas in the Mediterranean	Western Mediterranean	Tuna reproductive areas in the Western Mediterranean	Fishing areas in the western Mediterranean	Western Mediterranean	Western Mediterranean	Western Mediterranean
Scientific background	Alemany et al. 2010; Alvarez-Berastegui et al. 2016; Reglero et al. 2012	Alvarez-Berastegui et al. 2016	Alemany et al. 2010; Alvarez-Berastegui et al. 2016; Reglero et al. 2012	Alvarez-Berastegui et al. 2016	Barroso et al. (in prep), Reglero et al (in prep)	Alvarez-Berastegui et al. 2016	Alvarez-Berastegui et al. 2016; Reglero et al. 2017	Saber et al. 2016	Alvarez-Berastegui 2016, Ingram et al 2017,	Reglero et al. 2016	Alvarez-Berastegui 2017

Table 2. Task I catches (t) of species not included in the main or small tuna categories, nor in the main shark species category.

Species	Common	2007	2008	2009	2010	2011	2012	2013	2014	2015	Grand Tota
Aluterus monoceros	Unicorn leatherjacket filefish									0.69	0.69
Balistes carolinensis	Grey triggerfish									0.26	0.26
Balistidae	Triggerfishes, durgons nei								0.00	0.09	0.09
Belone belone	Garfish								21.42	1.05	22.47
Brama brama	Atlantic pomfret					4.22	70.66	35.24	269.68	38.33	418.13
Canthidermis maculata	Rough triggerfish									75.33	75.33
Caranx crysos	Blue runner									55.81	55.81
Caranx hippos	Crevalle jack					20.56				0.21	20.77
Coryphaena equiselis	Pompano dolphinfish									0.01	0.01
Diodon hystrix	Spot-fin porcupinefish									0.02	0.02
Elagatis bipinnulata	Rainbow runner									53.96	53.96
Exocoetidae	Flyingfishes nei									0.04	0.04
Lampris guttatus	#N/A					2.04	8.94			0.83	11.81
Lepidocybium flavobrunneum	Escolar				427.71	401.30	515.77	400.70	313.86	404.39	2463.73
Lichia amia	Leerfish								96.66	3.67	100.32
Masturus lanceolatus	Sharptail mola									0.99	0.99
Mola mola	Ocean sunfish								0.02	0.38	0.39
Naucrates ductor	Pilotfish								68.69	0.00	68.69
Ranzania laevis	Slender sunfish									1.58	1.58
Ruvettus pretiosus	Oilfish	30.90	2.69	10.28	8.78	109.86	393.76	34.83	139.63	34.61	765.33
Scomberesox saurus	Atlantic saury						2.32				2.32
Seriola dumerili	Greater amberjack					0.03			7.21	4.83	12.07
Seriola lalandi	Yellowtail amberjack					25.90					25.90
Seriola rivoliana	Longfin yellowtail									0.43	0.43
Seriola spp	Amberjacks nei					0.02					0.02
Sphyraena barracuda	Great barracuda					18.48		0.89	0.81	1.68	21.87
Taractes rubescens	Dagger pomfret									0.81	0.81
Taractichthys steindachneri	Sickle pomfret									0.72	0.72
Uraspis secunda	Cottonmouth jack									0.03	0.03

Appendix 1

Agenda

1. Opening, adoption of Agenda and meeting arrangements

2. EBFM

   2.1 Review the progress on developing an Ecosystem Report Card for ICCAT and review potential status and pressure indicators, reference levels and management actions for elements of ICCAT's EBFM framework and any progress on developing new indicators for all ecological components of ICCAT's EBFM framework (i.e. target species, by-catch, habitat and trophic relationships)

   2.2 Review the proceedings of the joint meeting between tRFMOs on the implementation of the EBFM approach

3. Ecology and Habitat

   3.1 Review information on the trophic ecology and habitat of pelagic ecosystems that are important and unique for ICCAT species in the Convention area.

4. Data used for by-catch analyses

   4.1 Revision and update of ST09 forms

   4.2 Status of ST09 observer data received by the Secretariat (Report cards)

   4.3 Update on Effdis estimations

5. Sea Turtles

6. Seabirds

   6.1 Feedback on GEF-ABNJ seabird mitigation meeting and ICCAT collaborative work meeting

   6.2 Review of progress on seabird interaction estimations and mitigation

   6.3 Seabird by-catch and mitigation in the Mediterranean

   6.4 Response on the effectiveness of seabird mitigation measures as per Rec [11-09]

7. Fish species caught as by-catch but not considered by other species groups

8. Other matters

   8.1 Review mechanisms to integrate the activities of the Sub-committee on Ecosystems with those of the species Working Groups. Consider the committee's role within the SCRS and how to effectively coordinate, integrate and communicate ecosystem-relevant research across the ICCAT Species Working Groups and within the SCRS.

   8.2 Discuss the information required to evaluate mitigation efforts for by-catch species.

9. Recommendations

   9.1 General recommendations

   9.2 Recommendations with financial implications

10. Adoption of the report and closure

Appendix 2

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Appendix 3

List of Papers and Presentations

Reference	Title	Authors
SCRS/2017/140	A template for an indicator-based ecosystem report card for ICCAT	Juan-Jordá, M-J. Murua, H., Arrizabalaga, H. and Hanke, A.
SCRS/2017/141	Estimated number of sea turtle interactions with pelagic longline gear in the ICCAT Convention area for the period 2012-2014	Gray C.M. and Diaz G.A.
SCRS/2017/147	Update on post-release survival of tagged whale shark encircled by tuna purse-seiner	Escalle L., Amandé J.M., Filmalter J.D., Forget F., Gaertner D., Dagorn L. and Mérigot B.
SCRS/2017/148	A preliminary assessment of the ecological role and importance of squid in the pelagic trophic web of the northwest Atlantic Ocean including the Sargasso Sea	Luckhurst B.E.
SCRS/2017/150	North Atlantic oscillation leads to the differential interannual pattern distribution of sea turtles from tropical Atlantic Ocean	Báez J.C., Pascual-Alayón P., Ramos M.L. and Abascal F.J.
SCRS/2017/151	Genetic validation of the use of bill length measurements for identifying species in the wondering albatross species complex: introduction of a new identification method to the Japanese observer program	Inoue Y., Kitamura T., Kanda N., Schofield P., Ryan P.G., Phillips R.A., Burg T.M. and Oshima K.
SCRS/2017/152	New aspects of catch rate: estimating catch and bycatch rate in fish and seabirds at each setting time from sunrise and sunset	Inoue Y., Yokawa K., Ito T. and Oshima K.
SCRS/2017/154	An at-sea trial of seabird mitigation gears including three weighted branch line specifications for tuna longline fisheries	Ochi D., Katsumata N. and Oshima K.
SCRS/2017/155	Review of sea turtle bycatch data in the ICCAT Convention area obtained through Japanese scientific observer program	Okamoto, Ochi D. and Oshima K.
SCRS/2017/156	Identifying areas, seasons and fleets of potential highest bycatch risk to South Georgia Albatrosses and Petrels	Clay T.A., Small C., Carneiro A.P.B., Mulligan B., Pardo D., Wood A.G. and Phillips R.A.
SCRS/2017/157	Opportunities in ports to improve data in order to review the effectiveness of seabird measures	Mulligan B. and Small C.
SCRS/2017/158	Update on the seabird component of the common oceans tuna project – seabird bycatch assessment workshops	Maree B.
SCRS/2017/159	Elasmobranches bycatch in the French tropical purse-seine fishery of the eastern Atlantic ocean: spatio-temporal distributions, life stages, sex-ratio and mortality rates	Clavareau L., Sabarros P.S., Escalle L., Bach P. and Mérigot B.
SCRS/2017/160	Skipjack tuna (*Katsuwonus pelamis*) feeding habitat dynamics and accessibility to purse seine fisheries in the Atlantic and Indian Oceans	Druon *et al*.
SCRS/2017/165	Using FADs to estimate a population trend for the oceanic whitetip shark in the Atlantic Ocean	Tolotti M.T., Capello M., Bach P., Murua H., Pascual-Alayón P., Rojo-Mendez V. and Dagorn L.
SCRS/2017/167	Preliminary Estimation of seabird bycatch numbers by Taiwanese longline vessels in the Southern Atlantic Ocean between 2002 and 2016	Huang H. and Yeh Y.

Reference	Title	Authors
SCRS/P/2017/018	Updating seabirds bycatch estimates in the Spanish Mediterranean drifting longline fishery: years 2000–2016	García-Barcelona S., Pauly Salinas M. and Macías D.
SCRS/P/2017/019	Ringing on board the Spanish Mediterranean longline fleet: first step to know the survival rates of accidentally caught seabirds	García-Barcelona S., Pauly Salinas M. and Macías D.
SCRS/P/2017/024	On developing an Ecosystem Report card for ICCAT	Hanke A.
SCRS/P/2017/025	Report of the Joint Meeting of Tuna RFMOs on the Implementation of the Ecosystem Approach to Fisheries Management	Hanke A.
SCRS/P/2017/028	Operational oceanography for assessing tuna environmentally driven ecology traits	Alvarez-Berastegui *et al.*
SCRS/P/2017/029	RFMOs and Sea Turtles	Swimmer Y. and Gutierrez A.
SCRS/P/2017/030	Selecting ecosystem indicators for fisheries targeting highly migratory species	Juan-Jorda *et al*.
SCRS/P/2017/031	Bycatch monitoring in the French Mediterranean longline fisheries – First output of a collaborative research project	Poisson F., Métral L. , Brisset B., Cornella D., Wendling B. , Arnaud-Hond S.
SCRS/P/2017/032	EFFDIS: a modelling approach to estimate overall Atlantic fishing effort by time-area strata (update May 2017)	ICCAT Secretariat
SCRS/P/2017/033	Collaborative work to assess seabird bycatch in pelagic longline fleets (South Atlantic and Indian Oceans)	Inoue Y. and Domingo A.
SCRS/P/2017/034	Rebuilding European Fisheries	Winker H.
SCRS/P/2017/035	Abundance of sea birds in Mauritania	Khallahi B.
SCRS/P/2017/036	The Namibian Large-Pelagic Sampling Programme and possible Seismic impacts	Uanivi U.

Appendix 4

SCRS Documents and Presentations Abstracts – as provided by the authors

SCRS/2017/140 - To facilitate the implementation of Ecosystem-Based Fisheries Management in the ICCAT Convention area, the Sub-Committee on Ecosystems recommended the development of an indicator-based ecosystem report card. The main purpose of the ecosystem report card is to improve the link between ecosystem science and management and increase the awareness, communication and reporting of the state of ICCAT's different ecosystem components to the Commission. Here, we first aim to initiate a discussion and make the case for the need and usefulness of an indicator-based ecosystem report card. Second, we provide a potential template of an ecosystem report card to contribute on the process towards its full development and use. Third, we calculate several ecosystem indicators to test its utility and identify potential challenges and opportunities for their development. We calculated an integrated multispecies B/BMSY and F/FMSY ratio, which we use to monitor the status of ICCAT assessed stocks at several spatial and taxonomic scales. Continuing the development and refinement of the report card with the involvement of a diverse group of experts including scientist, managers and other key stakeholders will be pivotal to improve its utility and relevance to the management of tuna and tuna-like species and associated ecosystems in the Atlantic Ocean.

SCRS/2017/141 - In 2010, the International Commission for the Conservation of Atlantic Tunas (ICCAT) requested its Standing Committee on Research and Statistics to conduct an assessment of the impact of ICCAT fisheries on sea turtles (ICCAT 2009). Information on the area of operation and estimated fishing effort of 15 longline fleets fishing in the Atlantic in 2012 and 16 fleets in 2013-2014 was obtained from the ICCAT EFFDIS (fishing effort in number of hooks by time-area strata) database. Sea turtle bycatch rates were identified for 6 fleets operating within the ICCAT Convention area through a comprehensive literature review. For the remaining 9 fleets for which data were not available, bycatch rates were assigned based on spatial overlap of fleets with published rates. The total number of sea turtle interactions was estimated using the reported and assigned sea turtle bycatch rates per fleet and multiplied by the estimated total fishing effort deployed by the fleets. The total number of sea turtle interactions (all species combined) with pelagic longline gear in the ICCAT Convention area ranged from 30,612 to 47,315 (depending on the bycatch rates used) during 2012-2014. This study completes the previous work presented in document SCRS/2016/125.

SCRS/2017/147 - In the tropical eastern Atlantic Ocean, whale sharks are sometimes encircled by nets of tropical tuna purse-seiners. In order to estimate the post-release survival of encircled individuals, a post release survival experiment, using pop-up satellite tags, was conducted in this ocean in 2014. This study presents updated results from this experiment. In addition to the six (five included in the study and an individual from Murua et al. 2014) whale sharks tagged in June–July 2014, five other individuals were tagged in June 2016. Among these 11 tags, seven individuals survived at least 21 days after release, three tags detached after 3 and 7 days and the fate of these individuals remains unknown, and one tag failed to report. Although the sample size remains limited, the results indicate a post release mortality rate following encirclement of large whale shark of 0%. Nevertheless, there remains an urgent need to increase post-release tagging experiments of whale shark encircled by purse-seine nets to estimate the survival rate and to define, if needed, regulatory measures to protect this shark species..

SCRS/2017/148 - This paper provides information on aspects of the ecology of squid and their importance in the pelagic trophic web of the northwest Atlantic including the Sargasso Sea. The majority of the global squid catch comprises species from two families, the Ommastrephidae and Loliginidae. In the northwest Atlantic, two species of squids are commercially exploited: Northern shortfin squid *I. illecebrosus* (Ommastrephidae) which is an oceanic species and the longfin squid *Doryteuthis* (*Loligo*) *pealeii* (Loliginidae) which is a neritic species. The populations of both of these species are strongly influenced by the Gulf Stream, a powerful western boundary current system. Most squid species have life spans of a year or less and, as a consequence, their populations often display irregular annual fluctuations in abundance as opposed to cyclical patterns. Squids are considered to be sensitive to environmental factors and these factors may strongly influence recruitment and early growth. As squids function as both predator and prey, they play an important role in the trophic web of pelagic ecosystems. Studies of stomach contents demonstrate that Ommastrephidae are major contributors to the diets of large pelagic fishes in the central north Atlantic and all five tuna species (Thunnidae) plus swordfish (*Xiphias gladius*) managed by ICCAT have squid as an integral prey group in their diets. As squids are essentially "annual" species and are highly

responsive to changes in their environment, it may be possible to use squids as a "sentinel" group with respect to climate change. The evidence presented here shows the importance of squid species in pelagic ecosystems and the need to incorporate data on these species into any ecosystem-based fisheries management (EBFM) model for tuna and tuna-like species in the northwest Atlantic including the Sargasso Sea.

SCRS/2017/150 - Observer records from Spanish purse seiners targeting tropical tunas indicate by-catch of six different sea turtles species in the Atlantic Ocean. Incidental catch of sea turtle from the purse seiners fisheries targeting tropical tunas occur, but the mortality is very low, and not significant. However, the incidental catch of sea turtles could provide relevant information about the species' distribution. The North Atlantic Oscillation (NAO) is the principal atmospheric oscillation that module the trade winds in the North Atlantic Ocean. The principal aim of present study is understanding the effect of the NAO in the interannual pattern distribution of sea turtle incidental catch by this fishery. The number of total sea turtle records in years with positive NAO phases is significantly higher that the number of sea turtle interactions in years with negative NAO phases.

SCRS/2017/151 - To understand the potential impacts of bycatch on populations, it is important to identify animals to species level. This includes individuals within the wandering albatross species group, *Diomedea exulans*, *D. dabbenena*, *D. antipodensis gibsoni* and *D. antipodensis antipodensis*, which overlap in their at-sea distributions. In our study, species was determined initially for bycaught birds in this group from bill length measured in the lab. These identifications were then compared with those from molecular methods (DNA analysis). Results were in complete agreement, and it was suggested that the bill length method has the potential for application in the Japanese and, by inference, other observer programs. Indeed, we report this method has now been introduced as standard in the Japan Observer Program.

SCRS/2017/152 - Hourly catch rate pattern of seabirds, tuna, shark and other fish species were estimated by the data collected by longline observers in relation to the time of sunrise, to investigate the effect of time zone of longline gear setting the relative timing of gear setting to the sunrise on the catches of target and bycatch species. Catch rates of seabirds caught by hooks deployed before the sunrise were in rather low level or zero. The setting time from sunrise affected to seabird bycatch occurrence rate and that effect was stronger than those of area and lunar phase effect. As a result, the night setting would very effective for seabird mitigation. The results obtained from catch rate of fish species indicated that efficient setting operation timing varied between target species.

SCRS/2017/154 - In this study, seabird attacking behavior toward branchline bait and bycatch rate under use of three weighted branchline designs (LUMO leads, and Blinking weights fixed at 30cm apart from hooks and Blinking weights fixed just upon hooks) were compared with that of a hybrid tori-line by the experimental longline operations to evaluate effectiveness of these gears as seabird bycatch mitigation gears. During research cruises in 2014 and 2015, 27 longline had been set around the Northwest Pacific and 50 albatrosses had been caught. All branchline designs had exhibited similar effect to tori-lines about reduction of attacking rate and bycatch rate but blinking weight tended to be less effective when it placed apart from hook.

SCRS/2017/155 - The document reviewed the historical information on the incidental catch of sea turtle by the Japanese pelagic longline fisheries within the ICCAT Convention area collected by the Japanese scientific observers. A total of 681 sea turtles were caught with the 28 million hooks of eleven thousand fishing operations observed from 1997 to 2015. The most common species occurred was leatherback (N=312, 45.8%), followed by loggerhead (N=144, 21.1%), and olive ridley (N=76, 11.2%). Species of 149 individuals were unidentified, accounting for 21.9% of total sea turtle bycatch observed. Most of the turtles were caught in the tropical to temperate Atlantic (10o S to 25o N, area 2) and northern Atlantic (North of 25o N, area 1). In the areas 1 and 2, leatherback was the most common species, while olive ridley was the most common in the Southern area (10o S to 35o S, area 3). No turtle was recorded from far southern area (South of 35o S, area 4).

SCRS/2017/156 - This paper presents an analysis of tracking data for 4 procellariiform seabirds from South Georgia, and calculates overlap with pelagic longline fisheries in the Southern Ocean for the period 1990-2009. We used an unusually comprehensive tracking dataset from all major life-history stages (including juvenile stages), weighted according to the proportion of the population they represented (based on demographic models), in order to generate population-level distributions by month. This analysis confirms that the ICCAT area is important for all species, with hotspots of overlap with fisheries in the Brazil-Falklands Confluence region and in the southeast Atlantic, from Tristan da Cunha east to the Benguela Upwelling. Overlaps were particularly high for Japan and Chinese Taipei, and to a lesser extent South Korea, Namibia and Brazil. Black-browed albatrosses had the highest index of overlap with fisheries in the Atlantic, and for all species, overlap was highest during winter months (May–September; when fishing effort south of 30°S is greatest). The areas identified here largely match areas where high rates of bycatch have been recorded, emphasizing the need for use of bycatch mitigation measures.

SCRS/2017/157 - This paper highlights the importance of expanding the sources of data on implementation of seabird bycatch mitigation measures via port inspection. The planned review of the effectiveness of Rec. 11-09 on seabird bycatch has been severely hampered by a lack of data, and the requirement to conduct an update assessment of the effectiveness of the mitigation measures by 2015 has not been met. Recognising that ICCAT has an ICCAT scheme for minimum standards for inspection in port (Rec. 12-07), the addition of elements relevant to seabird bycatch to this scheme would provide a valuable supplementary data source on the nature and extent of the use of various measures mandated under Rec. 11-09, through limited additional effort. Such an approach would be complementary to existing data sources and would not replace them. We make suggestions of the data fields that could be used in ICCAT port inspection forms, and highlight the need for inspector training and materials to support such an approach.

SCRS/2017/158 - This paper provides the outcomes of two Regional Seabird Bycatch Pre-assessment Workshops held in early 2017, together with some explanatory background. An agreed next step is that a data preparation workshop, along the lines of stock assessment workshops and CPUE standardisation processes, should be held in February 2018. Further, intersessional work before and after the data preparation workshop is highly desirable. The scale of this evaluation effort will be limited to the Southern Hemisphere.

SCRS/2017/159 - Marine megafauna, especially sharks and rays, are caught as bycatch by the tropical tuna purse-seine fishery. We studied their spatio-temporal distribution patterns by species and by the diversity of assemblages, as well as by differentiating juveniles and adults in the eastern Atlantic Ocean. We also studied sex-ratios and mortality rates at release. The data analyzed were collected by scientific observers onboard French purse-seiners between 2005 and 2017. Among the 18 species of elasmobranches caught, 85.4% of the individuals were silky sharks.. Distributions of catch per unit of effort (CPUE) by species, sex-ratios and diversity indices varied with life stages, areas, seasons and fishing modes (fish aggregating device vs. free-swimming tuna school sets). These differences appear to be linked to specific environmental conditions occurring in some areas and seasons. Higher elasmobranches catch rates in FAD sets (40%) compared to FSC sets (17%) were detected. Overall, this study highlights high elasmobranches bycatch rates, high mortality rates for most species (12.76–56.93%; average 45.8%), and high proportion of juveniles caught for the large majority of species (21.27–100%; average 87.4%).

SCRS/2017/160 - A single Ecological Niche model was developed for skipjack tuna (SKJ) in the Eastern Central Atlantic Ocean (AO) and Western Indian Ocean (IO) using data from the European purse seine fleet (fig. 1). Chlorophyll-a fronts were used as proxy for food availability while selected physical variables defined the abiotic preferences. SKJ feeding habitat spanned from latitudinal occurrence of eddy-type productive features at mesoscale in the IO to large-scale upwelling systems that seasonally shrink and swell in the AO (fig. 2). About 83% of FSC sets and 75% of dFAD sets were done within 25 km distance of preferred habitat while, in the AO, 34% of dFAD sets occurred at distances greater than 100 km (fig. 2a), mostly in the relatively food-poor Guinea Current, which is questioned to correspond to a spawning and larvae favourable area. Results emphasized higher SKJ accessibility to purse seiners in months when the habitat is reduced (fig. 3). Moreover, the positive correlation found in the IO between the annual size of preferred habitat and both the annual nominal catch rates and total catches of SKJ (fig. 4) i) agrees with the near full exploitation since the 2000s for the IO and in recent years for the AO, and ii) suggests interpreting the habitat size as an indicator of the carrying capacity of this fast-reproducing species.

SCRS/2017/165 - Count data of oceanic whitetip sharks (*Carcharhinus longimanus*) associated with Fish Aggregating Devices (FADs) were used to derive a population trend for the species in the eastern Atlantic Ocean. Observer data from the French and Spanish purse seine fleets were used in the analyses. The combined time series spanned from 1995 to 2015 and was divided into historic (1995-2003) and recent years (2004-2015). The time series division was based on the evolution of the FAD fishery in the Atlantic Ocean and the substantial increase of the number of FAD sets as from 2004 was considered a key factor. The estimated population abundance index (λ) for the historic period was approximately two times higher than the recent, dropping from 0.5674 to 0.2935. Results indicate a declining population trend for the oceanic whitetip shark in the eastern Atlantic Ocean.

SCRS/2017/167 - Bycatch by longline fisheries is one of the major threats to some species of seabirds and albatross. This research collected observer data from 60 Taiwanese tuna longline vessel trips operating in the Southern Atlantic Oceans between 2002 and 2016. In total, two thousand and ninety nine seabirds were incidentally caught. Among them, 57.9% were albatrosses, including black-browed, yellow-nosed, wandering, and sooty albatrosses. Other seabird included white-chinned petrel, great shearwater and others. There were limited seabird bycatch in the north of 25° S. The bycatch number ranged from 0 to 68 birds per set. The bycatch rates were higher in the south of 35° S, between 2008 and 2013, and during major fishing seasons (February to July). The estimated seabirds mortality was higher in 2008 and decreased in recent years.

SCRS/P/2017/018 - This presentation summarized the data on seabird bycatch obtained from the on board observer programme of the Instituto Español de Oceanografía (IEO) between 2000 and 2016. During this period five seabird species dominated the catches, four breeding species and one species wintering in the area. The catches occured mainly along the continental shelf, with a major incidence in the Ebro delta and around the Balearic Islands. Most of the catches occur during breeding and migratory seasons, and 95% of seabird bycatch occurs in home based longline targeting swordfish (LLHB) and drifting longline targeting albacore (LLALB)

SCRS/P/2017/019 - This presentation summarized the data on seabird direct mortality from the onboard observer programme of IEO from 2009 to 2016. The document presents a pilot program for banding/ringing seabirds captured by the Spanish longline fishery in order to estimate post-release mortality. Since 2009, 1068 seabirds have been reported as bycatch in drifting longline fishery by the IEO-Observer programme. About 52% of those seabirds died, 37% were released alive and the fate of the remaining 11% were unknown. The 2016 ringing program began in December, since then 6 seabirds have been ringed and released alive, and one bird was recaptured.

SCRS/P/2017/024 - A method for developing distinct geographical subunits using the existing spatial of the Task I and Task II data was described. This led to the creation of 5 areas for which it was shown that indicators could be developed. It is noted that much of the content is available on which to base both Ecosystem Assessments and Report Cards for these regions and that much of the data is online allowing some of the work to be programmed. These documents are expected to provide a useful context for the single species stock assessment and can yield an overall view of management performance. Furthermore, regular ecosystem reports will help to improve the accessibility and quality of the data on which they are based. In the short term it will be necessary to agree on a format and the content for the report cards, consistent with EBFM framework, and to engage managers in developing the content they feel would be relevant.

SCRS/P/2017/025 - No abstract available

SCRS/P/2017/028 - Advancing towards ecosystem base management requires linking species ecology and environment. Fluctuations in oceanographic conditions have a wide range of effects on species ecology that should be consider during both assessment and management. Here we present current advances from a multidisciplinary joint research initiative linking tuna species ecology and operational oceanography. The analytical approach of this initiative is based on three main tasks: 1) Investigate tuna environmentally driven traits, 2) develop indicators for identified environmental processes (operational oceanography tools) and 3) apply the developed indicators to improve assessment of tuna species. The different studies developed are supported by the combination of biological data (larval surveys, fisheries data and rearing experiments) and operational oceanography products coming from hydrodynamic models, remote sensing and in situ data (CTD; gliders; lagrangian platforms; fixed stations). The operational products develop provide information on variability of oceanographic processes driving tuna ecology traits, distribution of spawning and larval habitats, larval abundance indices and survival.

SCRS/P/2017/029 - presented a brief overview of sea turtle conservation measures adopted by some other RFMOs. The first measure that was adopted in ICCAT was in 2003. Currently, most include implementation/requirement of a combination of following "FAO Guidelines" for safe handling and release of sea turtles, continued research into mitigation techniques, provision of educational information to fishers, and reporting interaction data to scientific committees. However, few measures mandate specific actions to mitigate sea turtle interactions. The IOTC encourages annual reviews of data, use of finfish as bait and a reporting requirement for turtle interaction in net fisheries. In the WCPFC, conservation measures for longline vessels that fish for swordfish in a shallow-set (not prescribed) are required to employ or implement at least one of the following three methods to mitigate the capture of sea turtles:

1) Use only large circle hooks, which are fishing hooks that are generally circular or oval in shape and originally designed and manufactured so that the point is turned perpendicularly back to the shank. These hooks shall have an offset not to exceed 10 degrees; 2) use only whole finfish for bait; or 3) use any other measure, mitigation plan or activity that has been reviewed by the Scientific Committee and the Technical and Compliance Committee.

SCRS/P/2017/030 - Several international instruments have set the minimum standards and key principles to guide the implementation of an ecosystem approach for the management and conservation of marine living resources. The ICCAT resolution 15-11 and the 2015-2020 SCRS Science Strategic Plan have also established the main objective of advancing ecosystem based fisheries management to provide advice to the Commission. Yet these aspirations have not provided practical guidance on how to make operational an EAFM within ICCAT. The Specific Contract N0 2 under the Framework Contract EASME/EMFF/2016/008 provisions of Scientific Advice for Fisheries Beyond EU Waters addresses the current impediments and provides solutions that shall support the implementation of an Ecosystem Approach to Fisheries Management (EAFM) through collaboration and consultation with the key tuna RFMOs. This Specific Contract has three main objectives: (1) Provide a list of ecosystem indicators (and guidance for associated reference points) to monitor impacts of fisheries targeting Highly Migratory Species (HMS); (2) Provide criteria and guidelines to choose ecological regions with meaningful ecological boundaries for HMS and its fisheries in order to facilitate the operationalization an EAFM in marine pelagic ecosystems; and (3) Provide guidelines for an EAFM plan using two ecoregions as case studies within ICCAT and IOTC Convention areas. The results of this contract will be imbedded in the EAFM process that ICCAT is carrying out through a close collaboration and communication with ICCAT SCRS. Ultimately, the products created throughout this contract will aim to facilitate the linkage between ecosystem science and fisheries management to foster the operationalization of an EAFM.

SCRS/P/2017/031 - The reduction of bycatch mortality is an objective of the ecosystem approach to fisheries and is also important for consumers of fisheries products. Along the French Mediterranean coast, two longline fishers associations allowed scientists to monitor the impact of their activities on various taxa. Partnerships with commercial fishermen were developed to enable them to participate in this study and to integrate their information, experience, and expertise. In order to decrease bycatch mortality rates of bycaught animals, a manual on best practices was developed. The manual provides appropriate handling practices to ensure crew safety and increase the odds of survival for elasmobranchs, sea turtles, and sea birds released to sea. The manual provides a description and basic information on the biology of the most common species encountered. It also includes fishing regulations. A leaflet derived from it was also edited and both documents have been disseminated to various fishing communities. Additionally, in order to reduce the incidence of unwanted catch, a bycatch iphone application called "EchoSea", was developed for fishers to report their bycatch data in real-time while at sea. The app uses a device's built-in GPS to fill in location coordinates on the data form. The bycatch reports are sent to a central server that is accessible to scientists in order to create taxa-specific abundance or "risk" maps by for fishers to avoid bycatch "hotspots". Finally, this work also includes the creation of a dedicated website geared for the fishing community with updates on on the project and includes live tracks of blue sharks (*Prionace glauca*), loggerhead sea turtles (*Caretta caretta*), pelagic stingray (*Pteroplatytrygon violacea*) and swordfish (*Xiphias gladius*) tagged with archival satellite tags (www.amop-selpal.com). Current goals are to prepare "a tool kit" comprised of a dehooker, line cutter, adapted to the fisheries for easy and safe releasing of unwanted catches.

SCRS/P/2017/032 - An update to the EFFDIS effort database was requested by the Sub-Committee on Ecosystems in early 2017. The request was made because general updates had become available, and particularly because Japanese historical data had been revised. The ICCAT Secretariat updated the database in May 2017 using the latest data and the overall output will be presented. Details of the calculation, which combines information from Task 1 and 2 data will also be described.

SCRS/P/2017/033 - reported on collaborative work to assess seabird bycatch in the pelagic longline fleets operating in the South Atlantic and Indian Oceans. Objectives of this work are i) to determine the spatio-temporal patterns of seabird bycatch, ii) to estimate the seabird bycatch (at the lowest possible taxonomic level), and iii) gain knowledge on the performance of mitigation measures. To progress, scientists from Japan, Brazil and Uruguay participated in a workshop in Montevideo, Uruguay (20th-23rd June, 2017) and Portugal contributed fine scale data. The meeting reviewed the data from each country to discuss the spatial/temporal resolution for analysis, the required data, as well as the possible alternatives for the data analysis. Other scientists have also been invited to collaborate in this work and share information. This analysis is expected to begin within approximately three months.

SCRS/P/2017/034 - presented an analysis of the current status, required time for rebuilding, future catch, and future profitability for 397 European fish stocks (Mediterranean, Black Sea, and North-East Atlantic stocks). All stocks were assessed using the CMSY software in R with the implemented Catch-Only Monte-Carlo method CMSY and a full Bayesian State-Space Surplus Production Model. Four metrics were presented for future projections: (1) percentage of stocks that can produce MSY (B > BMSY), (2) percentage of stock below safe biological levels (B < 0.5 BMSY), (3) total catch (% change) and (4) a measure of change in profitability. Sustainable exploitation by 2015 has been achieved for only 1/3 of the stocks with overfishing still widespread, particularly in the Mediterranean Sea. The future projections show that the current target of F = 0.95 Fmsy would fail to rebuild depleted stocks and result in poor overall profitability. Fastest rebuilding is achieved with F = 0.5 FMSY. Highest profitability could be achieved with F = 0.6 - 0.8 FMSY, associated low risk of stocks falling outside safe biological limits.

SCRS/P/2017/035 - This work on the assessment of the abundance of birds in Mauritanian waters is part of the study of marine and coastal biodiversity of Mauritanian waters. It focuses on the results of a campaign on the assessment of the abundance of sea birds/megafauna in the Mauritanian oceanic waters. The campaign that took place from 1 to 12th November, 2016 covered parts of continental shelf and slope from 15 to 1800 m deep from the north to the south. During this campaign, 26000 birds were observed for 41 bird species. The majority of these birds are migratory species from the Mediterranean, North Sea or Arctic to south. Eight species accounted for 96% of the total number of individuals observed. These are: Northern Gannet (Morus bassanus), Cory's Shearwater (Calonectris borealis), Pomarine Skua (Stercorarius pomarinus), Leach's Storm Petrel (Oceanodroma leucorhoa), Black Tern (Chidonias niger), Common Thern (Sterna hirundo), Sandwich Tern (Thalasseus sandvicensis) et Grey Phalarope (Phalaropus fulicarius). The northern Mauritanian area, located in front of the permanent upwelling of the cap Blanc, known for its richness, groups together a large part of these birds. The importance of fishing activity in this area suggests the need to take measures to protect these species.

SCRS/P/2017/036 - The Namibian Large pelagics sampling programme involves industry skippers who record daily catches on logsheets and fisheries observers who record fish lengths on specifically designed sampling forms. This study was aimed at providing insights on the sampling programme and to evaluate the extent to which the catches of the Namibian pole and line fisheries were affected by seismic exploration activities in or close to fishing grounds. Data exploration was carried out and it was found that there were three versions of the logsheet being used. The coordinates of catch positions were unrealistic as catches made west of the 0o longitude could not be distinguished from those made east of that longitude. Only bycatch for which provision has been made on the logsheet were recorded, while all other bycatch were lumped as 'other'. Similarly, observers only recorded the species that were provided for on the logsheet. A new logsheet is being designed that will provide for the recording of seabirds and turtle bycatch. Seismic data was not obtained as the process for obtaining the data from the custodians proved too challenging.

CCSBT-ERS/1703/27 - The document examined the statistical characteristics of the occurrence of seabird bycatch in the longline fisheries using the data collected through the Japan's onboard observer program in the period of 1997 to 2015. Only the data on the operations conducted in the south of 35S was utilized. The distribution of occurrence of seabird bycatch, both by operations as well as at the level of cruises, indicated a strong skewedness toward lower values with a long tail in the upper end. Around 10 percent of efforts with high seabird bycatch accounted for about half of the total bycatch. The variability in average bycatch rate among the cruises was considered to reflect a range of effectiveness of the mitigation measures that the fishers had applied. The shape of distribution indicated that a substantial portion of fishers succeeded to suppress an extent of seabird bycatch under a certain level. The analysis revealed a positive relation between the BPUE and the amount of hooks observed. It considered the average seabird captured per operation, showing more consistency that the BPUE against the number of hooks observed, to be more preferable as a standard indicator of referring the bycatch rate.

Appendix 5

Updated ST09 observer data form fields. Note this is based on an excel sheet, and in many cases pull down menus are provided to limit the responses possible. These options are not provided here, but will be made available in the final version of the forms.

ST09A-Vessels_Sets

Vessels information				Trip Information				Set Information										
Fish. oper. ID	Flag code	Gear group	Number of vessels	Total trips (observed)	Time period	Task-I Areas	South of 20 degrees S	No of sets	No. hooks	% total effort represented	No. sets observed	No. hooks observed	Hook type	Set depth (hooks per basket)	School t. (cod)	Seabird Mitigation measures	Other Mitigation measures	Notes

ST09B-Catch_SamplingDetails

Catch composition by fishing operation							**Sampling by fishing operation**									
		Catches		**discards (number)**		**Number sampled**	**Landing information**		**Release information**			**Sampling**				
Fish. operation ID	Species code	Number	Weight (kg)	Alive (DL)	Dead (DD)		Condition at landing	% landed in provided condition	% Released	Condition at release	% released in provided condition	Genetics (Y/N)	Otoliths (Y/N)	Stomach (Y/N)	Gonads (Y/N)	Notes

Appendix 6

Observer data Report Card

CP45 - observer programme information								ST09 reports received	
Notes	CPC	Start year	Reporting year	Other by-catch species - catch estimates	Sea turtles monitored	Seabirds monitored	Mammals monitored	2015	2016
	Canada	1978	2012	Yes	Yes	Yes	Yes	Yes	Yes
	Chinese Taipei	2002	2012	Yes	Yes	Yes	Yes	Yes	Yes
	EU.France	2005	2012	Yes	Yes	No	Yes	Yes	Yes
	EU.Malta	2008	2012	Yes	Yes	Yes	Yes	Yes	Yes
	EU.Portugal	1998	2012	Yes	Yes	Yes	Yes		Yes
	Mexico	1993	2012	Yes	Yes	No	No		
	Peoples Republic of China	2008	2012	Yes	Yes	Yes	Yes	Yes	Yes
	Russian federation	2006	2012	Yes	No	No	No		
	Tunisia	2011	2012	Yes	Yes	No	Yes		
	Turkey	2011	2012	Yes	Yes	No	Yes		Yes
	Uruguay	1998	2012	Yes	Yes	Yes	Yes		
	USA	1992	2012	Yes	Yes	Yes	Yes	Yes	Yes
	ChinaPR.	2008	2013	Yes	Yes	Yes	Yes	Yes	Yes
	Chinese Taipei	2002	2013	Yes	Yes	Yes	Yes	Yes	Yes
	EU.France	2005	2013	Yes	Yes	No	Yes	Yes	Yes
BFT	EU.Italy	2013	2013	Yes	No	No	No		
SWO	EU.Malta	2009	2013	Yes	Yes	Yes	Yes	Yes	Yes
DOL	EU.Malta	2008	2013	Yes	Yes	Yes	Yes	Yes	Yes

BFT	EU.Malta	2008	2013	Yes	Yes	Yes	Yes	Yes	Yes
BFT	EU.Portugal	2012	2013	No	No	No	No	Yes	Yes
	Iceland	2010	2013	Yes	No	Yes	No		Yes
	Japan	1992	2013	Yes	Yes	Yes	Yes	Yes	Yes
	Korea	2005	2013	Yes	Yes	Yes	No	Yes	Yes
	Tunisia	2011	2013	Yes	Yes	No	Yes		
	Turkey	2012	2013	Yes	Yes	No	Yes		Yes
	Uruguay	1998	2013	Yes	Yes	Yes	Yes		
	Venezuela	2012	2013	Yes	Yes	Yes	Yes		
	Chinese Taipei	2002	2014	Yes	Yes	Yes	Yes	Yes	Yes
	Cote d'Ivoire	2012	2014	Yes	Yes	No	Yes		
	El Salvador	0	2014	NA	NA	NA	NA		
BFT	EU.Croatia	2011	2014	No	No	No	No	Yes	Yes
	EU.Cyprus	2013	2014	Yes	No	No	No		Yes
Tropical	EU.France	2005	2014	Yes	Yes	No	Yes	Yes	Yes
Obsmer	EU.France	2003	2014	Yes	Yes	No	Yes	Yes	Yes
	EU.Ireland	2002	2014	Yes	Yes	Yes	Yes		
BFT	EU.Italy	2014	2014	Yes	No	No	No		
	EU.Malta	2008	2014	Yes	Yes	Yes	Yes	Yes	Yes
Azores	EU.Portugal	1998	2014	No	Yes	Yes	Yes	Yes	Yes
Mainland	EU.Portugal	2003	2014	No	Yes	Yes	Yes	Yes	Yes
Mediterranean	EU.Spain	1997	2014	Yes	Yes	Yes	Yes		Yes
	Ghana	2013	2014	Yes	Yes	No	No		
	Iceland	NA	2014	Yes	Yes	Yes	Yes		Yes
	Japan	1992	2014	No	Yes	Yes	Yes	Yes	Yes
	Korea	2005	2014	Yes	Yes	Yes	Yes	Yes	Yes
	Phillipines	0	2014	NA	NA	NA	NA		
	Suriname	0	2014	NA	NA	NA	NA		

	Tunisia	2011	2014	Yes	Yes	No	Yes		
	Turkey	2012	2014	Yes	Yes	No	Yes		Yes
	Venezuela	2012	2014	Yes	Yes	Yes	Yes		
	EU. Croatia	2011	2015	No	No	No	No	Yes	Yes
	EU.Italy	2015	2015	Yes	No	No	No		
BFT, dolphinfish and SWO	EU.Malta	2008	2015	Yes	Yes	Yes	Yes	Yes	Yes
	Ghana	2014	2015	Yes	Yes	No	No		
	Japan	1992	2015	No	Yes	Yes	Yes	Yes	Yes
	Korea	2005	2015	Yes	Yes	Yes	Yes	Yes	Yes
	Belize	2015	2016	Yes	Yes	Yes	Yes		Yes
	Turkey	2012	2016	Yes	Yes	Yes	Yes		Yes

CPCs without CP45 submissions

Bolivia	Yes (blank)	
Honduras	Yes (blank)	
St Lucia	Yes (blank)	Yes (blank)
UKOT	Yes (blank)	Yes (blank)
Algeria		Yes (BFT only)