REPORT OF THE 2020 ICCAT INTERSESSIONAL MEETING OF THE SUB-COMMITTEE ON ECOSYSTEMS
(Online, 4-6 May 2020)

"The results, conclusions and recommendations contained in this Report only reflect the view of the Sub-committee on Ecosystems. Therefore, these should be considered preliminary until the SCRS adopts them at its annual Plenary meeting and the Commission reviews them at its Annual meeting. Accordingly, ICCAT reserves the right to comment on, to object to and/or to endorse this Report, until it is finally adopted by the Commission."

1. Opening, adoption of agenda and meeting arrangements

The outbreak of Coronavirus (COVID-19) and its particular severity in Madrid obliged the ICCAT Secretariat to close since the 16th of March 2020. Therefore, it was decided to have the meeting on-line, from 4-6 May 2020.

Dr. Alex Hanke (Canada) and Dr. Andrés Doming (Uruguay), co-convenors for the Ecosystem and Bycatch components of the Sub-committee, respectively, chaired the meeting expressing their gratitude for the interest in the meeting. They reminded the Sub-committee that the meeting's objective was to review progress on indicators for the Ecosystem Report Card and to review and discuss key issues related to Bycatch. The SCRS chair (Dr. Gary Melvin) welcomed the participants as well, noting while the circumstances for the meeting were difficult, he had wanted to give the Sub-committee on Ecosystems a chance to advance any progress that they had made this year. On behalf of the Secretariat, the Assistant Executive Secretary welcomed the participants and thanked the coordination efforts made by the co-convenors and the Secretariat to hold the meeting. The Secretariat provided information on how to use the on-line platform for the meeting (Microsoft TEAMS).

The Agenda was reviewed, which was adopted with minor changes (**Appendix 1**). The List of Participants is included in **Appendix 2**. The List of Documents and Presentations provided to the meeting is attached as **Appendix 3**. The abstracts of all SCRS documents and presentations provided at the meeting are included in **Appendix 4**. The following served as rapporteurs:

Sections	Rapporteur
Items 1, 10	N.G. Taylor, M. Neves dos Santos
Item 2,3 and 4	A. Hanke, K. Gillespie
Item 5	A. Wolfhaardt
Item 6	J.C. Báez
Item 7	N.G. Taylor
Item 8	N.G. Taylor
Item 9	A. Hanke, A. Domingo

2. Review the progress on developing an Ecosystem Report Card for ICCAT including the development of status and pressure indicators and reference levels

2.1 Indicator: Retained and Assessed

SCRS/2020/35 provided updated indicators for ICCAT species that are retained and assessed. The update included new data from the most recent assessments, a separate category for stocks with undetermined status and a Kobe phase plot to show status in the terminal year of the assessment. A completed indicator checklist (**Table 1**) and the indicator values (**Table 2**) were provided as outlined in the Indicator Adoption Protocol.

The Sub-committee recommended relabeling the status of stocks from healthy, cautious, and critical to healthy, overfished/overfishing, and critical in order to remain consistent with the Commission's terminology.

2.2 Indicator: Marine mammals

SCRS/2020/036 provided a review of incidental cetacean bycatch reporting in European Union (EU) waters with the objective of finding sources of cetacean bycatch data or BPUE estimates. In addition, the International Whaling Commission (IWC) sponsored review of RFMO efforts in reducing cetacean bycatch that was also discussed.

Recognizing that there is paucity of cetacean bycatch data, the Sub-committee discussed why this was the case. It proposed that: it has not been a priority to collect this type of data; there is a perception of little impact by ICCAT fisheries; and/or there has been no strict requirement to collect and/or submit the data. It was also asked which ICCAT fisheries pose the greatest risk. It was noted that the U.S. is preparing a marine mammal ID and safe handling guideline for both the Interamerican Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fish Commission (WCPFC) so that data on cetacean interactions will be available for the Pacific Ocean in the near future. The results from the introduction of this may be available to share next year.

The IWC review of RFMOs efforts to reduce cetacean bycatch was thought not to accurately reflect ICCAT's efforts to reduce cetacean bycatch but members of the Sub-committee that had been involved in reviewing the IWC's draft report indicated that the final version would reflect the extensive comments that they had provided. The absence of any ICCAT recommendation on cetaceans was identified as an important shortcoming affecting ICCAT's overall score. Further to IWC review, it was indicated that the Bycatch Coordinator may attend a collaborative meeting between the IWC and other RFMOs in the spring of 2021 to discuss the monitoring of cetacean interactions in the ICCAT convention area.

2.3 Indicator: Trophic Relationships and Food Web

SCRS/2020/054 discussed the progress on developing an indicator for the food web and trophic relationships component of the ecosystem report card. Specifically, it revisited what the component means in the context of ICCAT species and fisheries and the importance of monitoring it. A list of candidate ecological indicators was proposed along with a discussion of the main challenges in developing an indicator for monitoring this ecosystem component.

Due shortage of time, discussion on this item was limited. So, it was suggested that the Group that had created this indicator work intersessionally including an informal meeting that could be held in July to review the proposal in more detail and present the conclusion of those discussions in the next meeting of the Sub-committee.

2.4 Indicator: Environment

SCRS/2020/044 provided an update to the environmental indicator describing environmental variability in three major tuna spawning grounds.

The Sub-committed noted that these indicators have been presented to the Mediterranean Albacore and Bluefin tuna Working Group. Researchers working on the Mediterranean albacore are testing the integrating this indicator in the stock recruitment relationship. Within the BFT Group, authors are also discussing including a more advance version of the SST indicator that aims to provide informing about larval survival for the assessment.

SCRS/P/2020/011 provided a proposal for advancing the work on the environmental indicators for the ecosystem report card. It was emphasized that indicators for this component can have direct relevance to a particular stocks and life cycles and can also range in scope to represent impacts on multiple stocks over large expanses of their ranges. Consequently, the scope for this component should cover both alternatives as well as reflect what is the current state of knowledge with respect to environmental indicators.

The Sub-committee supported the proposed change in scope but also recognized that the plan that was proposed was very ambitious given the capacity of the environmental indicator team. Consequently, it was suggested to request funds from the Commission to complete aspects of the plan. It was also discussed that the environmental indicator does not necessarily belong on its own but represents a pressure for many of the other components. The need to restructure the report card was suggested to address this concern.

Further it was considered that a Group could develop this concept for review at the next meeting.

2.5 Indicator: Fishing Pressure

SCRS/2020/055 proposed introducing a new ecosystem component into the ICCAT ecosystem report card to monitor the fishing impacts resulting from marine debris. Marine debris would be considered a "pressure" and different from the habitat component that would be considered a reflection of "state" as it was originally proposed. The importance of marine debris was presented in the context of ICCAT fisheries. Potential conceptual and operational management objectives were provided along with a list of candidate indicators shared by all ICCAT fisheries. Lastly the potential sources of marine debris associated with different fishery activities was identified and the availability and sources of data to support indicator development examined.

Upon review of the draft work plan, the Sub-committee recommended that the indicator quantify the contribution of ICCAT fisheries to the different types of marine litter and that the Group who created the indicator identify and promote the protocols that would reduce the ICCAT contribution. Thus, the marine debris component could consider the contribution of ICCAT fisheries to total marine litter. It was noted that ICCAT's FAD working Group has already made some progress in developing indicators of marine debris related to FAD stranding and the impact of FAD debris on the ecosystem. As well, there is widespread agreement by the FAD WG and the Commission that marine debris associated with the use and loss of FADs needs to be monitored and managed.

The Sub-committee asked what sources of marine debris exist and if marine debris data sources, like MARPOL were credible and what the potential was to obtain data from them. Lastly, there was concern regarding the possibility to demonstrate a link between the presence of marine debris and detrimental effects on ICCAT species.

2.6 Indicator: Marine Turtles

SCRS/2020/048 gave an overview of the data available to support marine turtle indicators and suggested that several would satisfy the operational objectives defined for this component.

The Sub-committee recognized the importance of having a marine turtle indicator from the standpoint of impacts by ICCAT fisheries however the monitoring of the bycatch of sea turtles in the artisanal fisheries was also considered to be important. It was noted that CPCs that are not flag states are required to report data on Tuna and Tuna-like species caught in artisanal fisheries and that sea turtle bycatch should be reported as well. Finally, the Sub-committee suggested reviewing the mitigation measures that would reduce incidental catches in artisanal fisheries.

It was also discussed that there are currently only recommendations in place attempting to reduce sea turtle interactions with purse seine and FADs. It was noted that measures to reduce interactions have been implemented independently by many CPCs in the absence of recommendations for other gear types and that it would be useful to catalogue and monitor their impact.

2.7 Indicator: Seabirds

Both SCRS/2020/050 and SCRS/2020/045 report on the development of seabird bycatch indicators for the ecosystem report card. SCRS/2020/050 summarizes the discussion held via email within the seabird indicator Group. This Group identified the need for two indicators, one to assess seabird bycatch mortality and the other for monitoring the effectiveness of management actions. Further discussion, including in-depth face to face technical consultation, is needed to finalize the details of indicator definitions and calculation procedure. SCRS/2020/045 indicated the need for data on the use of the ICCAT mitigation measures in order to evaluate effectiveness of measures and recommends the establishment of a template for CPCs to report the proportion of their fleets using different combinations of bycatch mitigation measures.

The Sub-committee questioned the availability of the required data and it was noted the contribution by Birdlife International of seabird density estimates as well as the contribution by CPCs of bycatch rates and mortality estimates would be sufficient to produce the indicators discussed within the seabird indicator Group in SCRS/2020/050. Related to the suggestion by SCRS/2020/045 to establish a reporting format of mitigation measure implementation as used in the WCPFC, the Secretariat explained that the ICCAT Domestic Observer Data form (ST09) contained the information related to the use of seabird mitigation measures by fleet and flag.

It was pointed out that an indicator monitoring the progress of ICCAT management measure implementation was kept as one of the options considered by the SCRS/2020/050. However, considering that the Ecosystem Report Card's aim is to provide an overall picture, the selected indicator would preferably take the form of an integrated index with time trends and not a table of CPC's reports on mitigation measure implementation such as the one adopted in the WCPFC. Such a table would be more suitable to discuss in the context of reporting requirements of ST09 or to the Compliance Committee. Noting that SCRS/2020/050 includes two suggested approaches for Indicator 2 (Progress of Management Actions), the Sub-committee suggested retaining both for now, at least to explore their potential application as indicators.

3. Review the progress on developing an Ecosystem Report Card for ICCAT including the development of status and pressure indicators and reference levels Methods in Support of Indicator Development

3.1 Review adequacy of existing indicators against proposed new ones

A set of presentations (SCRS/2020/029, SCRS/2020/030, SCRS/2020/034, SCRS/2020/037, SCRS/2020/041, SCRS/2020/047; "data-limited papers") provided examples of methods for screening and validating models and empirical indicators for assessed and unassessed stocks, and described how they could be linked to habitat. In addition, a new method was presented to impute total (reported and unreported) effort using ICCAT's Task II catch and effort data (SCRS/2020/046).

The data limited papers assessed a variety of methods (i.e. Catch Only Methods, COMs; Length-Based Indicators, LBIs; and Productivity Susceptibility Analysis, PSA) using a common set of approaches. Data-rich stocks were assessed with different levels of information and knowledge (a Value of Information approach). The data-rich datasets used were i) RAM legacy database https://www.ramlegacy.org; ii) ICCAT JABBA assessments; and iii) ICCAT Stock Synthesis assessments.

SCRS/2020/029 evaluated a spectrum of catch-only data-poor methods using stock reduction analysis using SRA+. This program is based on a biomass dynamic stock assessment model. The authors noted that catch-only methods performed poorly and were highly dependent on expert knowledge rather than the data. The authors recommended against the use of catch-only unless external sources of data are available to inform parameters.

SCRS/2020/030 presented a method to evaluate the Value of Information i.e. the improvement in performance derived from better quality data, life-history priors, and expert knowledge, for the family of data-poor methods based on biomass dynamics. This method provides an objective way to evaluate the impact of the different assumptions on estimates of stock trends and status and the Value of Information in the data, life-history parameters, and expert knowledge.

The authors noted that catch-only methods performed poorly for estimating absolute abundance unless paired with an index of abundance. Relative trends were less biased than absolute trends. These methods performed poorly for estimating biomass when only 10 years of data were available, although trends appeared to be well estimated. For the catch-only method where only 10 years of data were available, neither trends nor status were well estimated.

SCRS/2020/034 evaluated the ability of data-limited methods, fitted to total catch and indices of abundance, to determine stock trends and status using a Value of Information approach. Catch-only methods were unable to estimate absolute abundance. For long time series, estimates of final depletion from the catch-only methods, SRA+ with priors and catch MSY overlapped the true value but the credibility/confidence

intervals were large. For short time series, the catch and index methods were highly biased, however, the deterioration in performance of the catch-only method was less, possibly because the fits were poor. The SRA+ method performed well when informative data on abundance was available. Catch-only methods perform well in estimating relative trends if reliable life history priors are available.

The authors emphasized that this analysis illustrates the information quality of different data types, either better data on abundance, or better data on life history priors *r* and *K* as estimated through a production function.

SCRS/2020/037 assessed length-based indicators (LBI) that could be used to assess stock status. To do this, length compositions from data-rich stock assessments were used to derive LBIs and then compared to estimates of fishing mortality relative to F_{MSY}. The authors noted that even for data-rich stocks, not all LBIs were able to provide good estimates of trends or status. The performance of the LBIs are variable by stock and fleet which implies that some length distributions are not informing the integrated assessments or are potentially in conflict with other data sources. This means that careful screening should be conducted of data in the task II database before they are used as LBIs.

SCRS/2020/041 used stock assessments for bigeye and yellowfin tunas from the Atlantic, Indian, and Eastern Pacific Oceans to illustrate the use of diagnostics based on production functions and surplus production trajectories to explore changes in productivity (Walters *et al.*, 2008). It was noted that the presence of clockwise cycling due to recruitment anomalies, implies that future catches are driven by incoming year classes (possibly due to environmental drivers rather than a production function). This has consequences for management based on target and limit reference points, since it follows that future biomass trends cannot be predicted from current biomass based on setting total allowable catches (TACs).

The authors indicated that there is also the possibility of model misspecification, as some of the tRFMOs set steepness to be very high i.e. h=0.99, which may or may not be the case. It is important therefore as part of stock assessment to adopt quality control procedures to diagnose and facilitate the interpretation of model misspecification (Maunder and Piner, 2017).

SCRS/2020/047 evaluated estimates of and proxies for productivity for data-limited stocks. The authors evaluated potential methods using data-rich stocks as a benchmark. Empirical indicators appear to work well, particularly L_{50}:$L_{infinity}$ and k, and perform nearly as well as those based on r. It was noted that r appears to be a particularly robust proxy for productivity. It appeared that while it was possible to identify low productivity stocks, as productivity increased, estimates of r became less precise.

The Group acknowledged the contribution of this set of data-limited papers and supported their use to provide proxies for the status of ICCAT species. The Group noted that several of these data-limited methods are currently already in use among ICCAT's species Groups. The authors suggested that their use be further extended to assess status in more ICCAT species and noted that this set of analyses are helpful for identifying which methods are best suited to different life history traits. The authors emphasized that better quality data is required for improvement to outputs from these data-limited tools, as indicated by the Value of Information analysis and suggested greater collaboration between SCRS Groups to coordinate and improve their use of these methods.

SCRS/2020/046 summarized a new method to impute effort using ICCAT's Task II catch and effort data (T2CE). The methodology consists of raising reported effort using the coverage ratio (CovRatio) statistic reported by CPCs in their annual Task 2 catch and effort submissions. Missing values for the CovRatio statistic are imputed hierarchically using the most detailed data by spatial cell, year, and fleet resolution at the coarsest resolution to the coverage ratios averaged across years and CPCs. Future improvements to the estimation process could involve revision of several T2CE datasets from CPCs including those with inconsistent or missing coverage ratio statistics, and possibly, expanding the effort estimations using auxiliary information.

The Group noted that this was an important advance in effort estimation and commended the authors for improving and simplifying the previously developed Eff-dis method. The Group recommended that the authors work to validate the method using external data sources (e.g. via AIS data). There were concerns about the apparent periodicity in the effort series and recognition that it related to reporting of CPCs following adoption of ICCAT recs. The authors acknowledge a need to develop a model that shows

uncertainty in the effort for the historical portion of the time series. The authors noted that assessments currently work with the recent portion of the time series, in which there is a higher degree of confidence. The Group noted that the absence of good effort data will likely have large impacts on imputed values (e.g. Italy, Greece using non useable effort units). The Group recommended that this method be reviewed by WGSAM and sent to Sub-Com Stats for review and adoption.

3.2 Review development of case studies and ecoregions

SCRS/P/2020/009 relayed the outcomes of an Indian Ocean Tuna Commission (IOTC) workshop which had the objective to provide advice on the identification of draft ecoregions in the IOTC convention area and foster discussions on the operationalization of the ecosystem approach to fisheries management (EAFM).

The Sub-committee supported the methodology used to produce the ecoregions and ICCAT hosting a workshop with similar objectives. There were concerns about adopting the draft ecoregions proposed for the ICCAT convention area that were consistent with those expressed in discussions held during the 2019 meeting. Revisiting the concept of ecoregions for the convention area using the method described and reviewed in a workshop setting was recommended.

The set of presentations (regarding documents SCRS/2020/029, SCRS/2020/030, SCRS/2020/034, SCRS/2020/037, SCRS/2020/041, SCRS/2020/047; "data-limited papers") also provided an update on the case study based on the Sargasso Sea region. The key objectives of the case study are aligned with the recently amended ICCAT Convention (PLE_108/2019) i.e. to help apply the precautionary approach and an ecosystem approach to fisheries management in accordance with relevant internationally agreed standards and, as appropriate, recommended practices and procedures; use the best scientific evidence available; and protect biodiversity in the marine environment. For example, the use of validation, demonstrated above, where data-rich datasets are used to simulate data-poor datasets could be used to validate EFFDIS using AIS data. The habitat indicators could be used by collating data from electronic tags and remote sensing.

The Sub-committee recognized the contribution of the Sargasso Sea Commission in continuing to fund the case study and acknowledged the importance of the methods developed for the retained but unassessed species and habitat components of the ecosystem report card. The continued progress on the case study was encouraged.

4. Review feedback received from Species Groups regarding their needs and contributions towards incorporating/developing ecosystem

4.1 Discuss whether to continue to review information on the trophic ecology and habitat of pelagic ecosystems that are important and unique for ICCAT species in the Convention area (i.e. Res. 16-23)

The Sub-committee recognized that the resolution had expired and that there was no support to continue addressing this issue given the current commitment to develop indicators for the ecosystem report card. To some degree, the component reflecting ICCAT fishery impacts on food webs and trophic relationships would be characterizing these aspects of the ecosystem, so the work would continue.

4.2 Proposal to update the Sub-committee's short- and long-term objectives

SCRS/2020/049 reviewed Sub-committee's progress implementing an EBFM approach for ICCAT. It noted that despite the progress, they needed to operationalize EBFM as a formal mechanism to better integrate ecosystem considerations, or signals identified by ecosystem report cards and communicating these to the Commission for their inclusion into management decisions. A stepwise, adaptive process is emphasized to establish an ICCAT-specific operational EBFM focusing on limited ecosystem component(s) that are already identified, are of key importance and have adequate accumulated knowledge. In order to initiate the process, the document suggests establishing a small working Group with a participation of the SCRS Chairs for drafting a revision of the EBFM components of the SCRS strategic work plan for discussion and final adoption in 2021.

The Sub-committee recognized the importance of this proposal and noted that to date there has not been good integration of managers in these types of processes and there was a need for working-level integration of manager to facilitate their continuation. These concerns were reiterated by the SCRS Chair and it was suggested that a small working Group initiate and move this process forward.

5. Update of collaborative work on seabirds

5.1 *Discussion of results and implications regarding the current bycatch mitigation measures [Rec. 11-09]*

Presentation SCRS/P/2020/ 008 provided the results of collaborative work to assess seabird bycatch and the effectiveness of bycatch mitigation measures in a number of pelagic longline fleets operating in the South Atlantic and South Indian oceans (see also document SCRS/2020/066).

The Sub-Committee noted that the study included data from the pelagic longline fleets of Brazil, Portugal, South Africa, and Uruguay, as well as foreign charter vessels operating in the jurisdictional waters of South Africa and Uruguay, and covered the period 2002 to 2016. The Sub-committee welcomed the study, and the findings that bycatch levels within these fleets had declined steadily over the study period, coincident with the progressive implementation of bycatch mitigation measures. A number of temporal and spatial variables were found to significantly influence bycatch levels. Of the bycatch mitigation measures assessed, night-setting was found consistently to be associated with lower levels of seabird bycatch. In addition, tori lines in combination with night setting significantly reduced seabird bycatch.

The Sub-committee discussed the unexpected result that Tori Lines did not reduce bycatch levels during the daytime. The authors suggested a number of possible reasons for this unexpected finding. These included the fact that the Tori Line information was included in the models as binary information (only if it was used or not, rather than information on design specifications and correct use), problems associated with entanglements between the Tori Line and fishing gear, which may lead to increased incidents of bycatch, and the possible non-use of Tori-Lines when seabird abundance is very low.

The Sub-committee noted that branchline-weighting, which is one of the mitigation options in both ICCAT and IOTC, was not formally included in the study. The authors indicated that the reason for its omission was due to the inconsistent manner in which information and specifications of line weighting is used, collected, and reported. This was noted as an area that should be progressed in the future.

It was noted that the Common Oceans Tuna Project seabird bycatch assessment had also considered how to evaluate the effectiveness of the bycatch mitigation measures adopted by tuna RFMOs, and concluded that the data currently available did not allow estimations for individual year effects.

The Sub-committee considered that the results presented in SCRS/P/2020/008 show that if correctly applied, the combined use of tori lines and night setting bycatch mitigation measures can reduce seabird bycatch under a range of conditions and fishing operations, and encouraged further collaborative work to expand and improve the assessment of seabird bycatch and the effectiveness of bycatch mitigation measures.

6. Update of the advances in the collaborative work of sea turtles

The document SCRS/2020/040 report showed the main advances and preliminary results of the workshop on collaborative work to assess sea turtle bycatch held in Malaga the past month January. This collaborative work assessed the impact of pelagic longline and purse in fleets on sea turtles in the Atlantic and south Indian Ocean and Mediterranean Sea from an entirely scientific perspective. A short-term goal was defined as: determining the spatio-temporal patterns of the incidental catch of sea turtles in pelagic longline and purse seine fisheries. Data on incidental catch of sea turtles at the fishing set level were integrated (1998-2018). These data comprised a total of 33,370 (60,355,425 hooks) and 42,148 fishing sets observed on multiple pelagic longline and purse seine fleets, respectively. The distribution of the observed fishing effort and bycatch rate of sea turtles were explored.

During the discussion, the Sub-committee recognized that significant progress had been made and that the work could finally provide a response on the impact of pelagic longline and purse seine fisheries of participant CPCs on the bycatch of sea turtles.

This work could be further improved with the incorporation of data from additional fleets providing more coverage. To this end, some scientists (including Sierra Leone, France, United States, Canada) showed interest in joining work and collaborate with data from their fisheries and possibly also data from artisanal fisheries for ICCAT species.

7. Effect of the mitigation measures: intra and inter taxa

SCRS/2020/052 described progress of a meta-analysis for comparing hook, bait and leader effects on target, bycatch and vulnerable species, integrated in an EU Project "Evaluation of the effects of hooks' shape & size on the catchability, yields and mortality of target and by-catch species, in the Atlantic Ocean and adjacent seas surface longline fisheries".

The Group discussed the paper. It was noted that the study was excellent and that it largely supported what was already known about the effect of circle hooks. In response, the presenters noted that the advantage of the study was that as a meta-analysis, so it could synthesize across several studies across several taxa, as well as over various variables besides circle hooks. The Group further asked about the effect of so-called bite-offs (where large fish, mostly sharks, bite off the hook and leader and never make it to the vessel). It was noted that this issue was very important to consider for determining the efficacy of circle hooks as a mitigation measure for reducing overall mortality in bycatch, so the question was asked if there were any estimates of the bite-off rate for sharks. In response, it was noted that it was very difficult to assess the rate of bite-offs for sharks, and how many results in gut hooking. It is possible to have a general idea of the bite-off rates when using each hook type. Currently, it is not even possible to determine what species are responsible for such bite-offs, as they take place during the fishing operation often before haulback and without the possibility of identifying the responsible species. Given the above, assessing post-release mortality of specimens that bite-off is also very challenging.

SCRS/2020/056 was a literature review of the effect of hook type on the catchability, anatomical hooking location, and post-capture mortality of the shortfin mako.

The Group discussed the paper. One question was on the methodology used to exclude studies on the basis of sample size. The Sub-committee noted that there were some inconsistencies between the sample sizes of studies that were included and those that were excluded. The presenter responded that if the authors of the studies noted that the sample sizes for number of sharks captured was inadequate, the study was excluded but that while some authors considered their sample sizes inadequate other authors with similar sample sizes judged these adequate.

An additional question noted that the effect of circle hooks on the total mortality of shortfin mako shark is much larger than J-hooks effect based on the literature for this species. Because circle hooks (C-hooks) increases the catch rate of this species, they have much larger effect on the total mortality rather than the effect of the reduction of haul-back mortality of this species (Semba *et al.*, 2018). In response, the presenter noted that post-release survival was still likely to be higher for circle hooks was because once body condition was included then this effect offset the higher catch rates. The presenter also indicated the rates of post-capture mortality for bite-offs is unknown and may offset higher catch rates. The Group discussed handling practices in post-release mortality studies and how they may not reflect handling practices in the longline fisheries in practice. The presenter thanked the questioner and stated he would look more into the effects of this issue.

Moreover, it was noted that this paper and the preceding one were excellent additions to the ongoing discussion. A further question inquired about the effect of offset angles for each treatment. The presenter noted that the effect of offset was variable but that 10-degree offset were more likely to result in mouth hooking and that overall, the meta-analysis supports the conclusion that C hooks have higher catch rates for sharks.

The Group noted that the conclusion that the use of circle hooks could likely increase the recovery of the stock was overly strong. The presenter responded that given the Epperly *et al.* (2012) and Carruthers *et al.* (2009) concluded that some studies including their determined that mouth-hooking was more likely with circle hooks vs. J hooks. In addition, Epperly *et al.* (2012) concluded that foul hooking is 4.6 times more likely to be dead (Table 5 in Epperly *et al.*, 2012).

SCRS/2020/039 analyzed the effect of circle and J hooks on the at-haulback survival of swordfish, shortfin mako, blue and white marlin using US Longline observer data covering the normal operations of the fleet, showing that circle hooks, which were adopted as a sea turtle bycatch mitigation measure by the U.S. pelagic longline fleet in both the Pacific and Atlantic oceans, also increase the at-haulback survival of other species and, therefore, it addresses some of the research needs to develop and implement Ecosystem Based Fisheries Management.

The Sub-committee discussed the paper. One concern was that the analysis lacked the consideration of catch rates. A second concern was the appropriateness of discussing the matter at SC-ECO as opposed to in the Sharks species Working Group. The author responded that because of time limitation, the presentation did not include the issue of catch rates, but the document mentioned and discussed the issue of catch rates in depth. An additional comment was related to the methodology and the condition of the fish used in the analysis (i.e. defined explicitly as dead or alive) and what proportion of the total catch these fish represented: the answer was the sharks for which there was information consisted of a large proportion of the catch (i.e. more than 90%). Moreover, further clarification was requested about the exclusion of data from the experimental fishing operations. In response, for the subject of the paper, it made sense to omit the experimental fishing because it was examining the effect of both hook types under normal fishing operations.

Further questions were asked. It was noted that if similar gains in at-haulback survival could be achieved by shortening soak time alone. In response, the author noted that the magnitude of improvement was higher for circle hooks for shortfin mako than it was for soak time alone and that one additional problem was that in practice, it is difficult to enforce regulations with soak time. It was asked how soak time was measured: in response the author noted that the observer's record for that quantity was used, but that this number could be interpreted in a variety of ways because not all hooks in the longline spend the same amount of time in the water. Additional concerns included that the comparison of circle hooks and J hooks came from completely different periods and that different areas were compared. In response to this criticism, the authored noted that they didn´t consider this a concern without a hypothesis for underlying mechanisms for difference during the different periods. It was noted that circle hooks might not be answer to all the bycatch issues and that post-release mortality and catchability remain issues. In response it was noted that circle hooks were adopted by the US fleet to mitigate sea-turtle bycatch, but this paper also demonstrates that potential benefits are more widespread across different taxa.

The Sub-Committee discussed how to move forward to get a clear picture of net effect of mitigation measures, including circle hooks, across all taxa. The Sub-committee commented that an option to provide advice to the Commission on the adoption of mitigation measures could be to provide a range of options for the fleets to mitigate sea-turtle bycatch as is done in the Pacific, where the fleets have the possibility to implement either circle hooks or the use of fish bait. In response it was noted that this option had been provided to the Commission already. It was also noted that key issue is that there are trade-offs across species and that it will be important to illustrate the magnitude and direction of these trade-offs. It was noted that there were several obstacles to overcome to further refine the analysis on the effect of circle hooks. These include overcoming observer effect on the behavior of fishing crews and to develop technology to estimate what the post-release mortality is.

SCRS/P/2020/013 presented interaction with protected species with the artisanal fisheries in the Bay of Biscay.

There were several questions and comments. The Sub-committee asked what was known about survival following capture. In response, the presenter noted that there is no information and that birds could be tagged with satellite transmitters to estimate post-capture survival, which requires funding. A question was asked about safe handling protocols for birds, noting that these might help improve survival. The presenter noted that there do not currently exist safe handling protocols but that the research team was currently working on developing guidance to help and would be grateful for any existing guidelines. The Sub-

committee noted that ACAP has such guidelines, which are available on the ACAP website. It was asked what the population level effect of these fisheries on great shearwaters could be: in response, the author suggested that the population level impact was likely to be small because the percentage of animals released alive was high and the handling was minimal.

8. Other matters

Due to shortage of time a number of documents and presentations could not be reviewed by the Sub-committee and the decision was that the be presented at the next meeting of the Sub-Committee.

9. Recommendations

Regarding the Ecosystems component:

- Given the lack of data to support the monitoring of the impact of ICCAT fisheries on marine mammals, it is recommended that a definition of "marine mammal interactions" be discussed and adopted at the 2021 meeting of the Sub-Committee on Ecosystems. Based on this definition, CPCs should explore the availability of information on these interactions between marine mammals and ICCAT fisheries.

- Sub-committee recommends that the Commission develop an informal meeting format for the SCRS to work with managers to progress on SCRS-advisory processes that need more involved input from managers. the Sub-committee, currently developing the ecosystem report card, needs more working-level feedback from managers in order to provide the Commission with valuable strategic advice and continue developing advice on EBFM implementation options for ICCAT (i.e. in the development and implementation of assessments and management frameworks that incorporate species interactions, fleets interactions, habitats, environmental drivers and climate change into fisheries management). Specifically managers' feedback is needed on the identification of priorities among different ecosystem components aligned to management objectives, on the mechanisms for operationalizing signals identified from the report card into management decisions, and the types of trade-offs among objectives to be considered in the context of fisheries management.

  The key to this working Group being successful would be an informal structure, allowing more fluid back and forth discussions between all attendees. These types of discussions are not possible in the more formal panel and Standing Working Group on Dialogue between Fisheries Scientists and Managers (SWGSM) meetings. A more open meeting format with managers and scientists of different expertise would allow more nuanced information from both scientists and managers to be expressed, discussed, and built on; this would better inform managers on what can/could be delivered by SCRS and for scientists to better understand from managers what advice/information is needed to draft management decisions. The need for this type of Group is not unique to the Sub-committee, and the SCRS should consider including other functional uses of this requested informal SCRS-Managers working Group (for example this exact same Group could be used to advise on MSE processes).

Regarding the Bycatch component:

- New information presented to the Sub-committee indicates that the use of circle hooks in longline fisheries increases the at-haulback survival of shortfin mako shark, blue marlin, and swordfish. Under certain circumstances, shortfin mako shark, blue marlin and swordfish smaller than the adopted minimum size are required to be released (Recs. 19-06, 19-05 and 17-02, respectively). Therefore, to increase the effectiveness of those conservation measures, the Sub-committee reiterates its recommendation from 2019 that the Commission adopt the use of large circle hooks for shallow longline sets, but also recognized that: circle hooks decrease retention rates of some target species (e.g., swordfish); may increase retention rates of some sharks (e.g., shortfin mako); and that post-release mortality of discarded species is very difficult to assess.

- Three analyses presented to the Sub-committee indicates that at-haulback survival in shallow setting longline fisheries can be increased for blue marlin, SMA, SWO, and loggerhead turtles when circle hooks are used compared to traditional J hooks. The Sub-Committee recommends that national scientists collaborate and continue with these type of analyses and expand them to include other species and other variables that may influence catch rate, at-haulback survival and total mortality (e.g., hook size, bait type, etc.).

- The Sub-committee noted the relevant advances made by the collaborative research regarding interactions between ICCAT fisheries, seabirds, and sea turtles. To increase the value of this work to the SCRS and the Commission, the SC-ECO recommends more national scientists that hold relevant data on these interactions within ICCAT fisheries to join this collaborative research and make their data available.

Regarding general issues:

- In order for ICCAT to evaluate the effectiveness of its conservation measure in reducing seabird bycatch (Rec. 11-09), data on the use of these mitigation measures, and the combinations of measures used, should be collected, and made available. Both Recommendation 11-09 and 10-10 require such information to be collected and reported.

- The Sub-committee recommends that the SCRS develop improved mechanisms for SC-Eco to work across all species Groups of the SCRS on the issues related with multi-species (e.g. environmental impacts, multi-species trade-offs, integration of ecological considerations into management procedures) similar to the Working Group on Stock Assessment Methods or the Sub-committee on Statistics.

- The Sub-committee reviewed the progress made by the Secretariat in the development of the new EFFDIS and it concurred that the new estimation of total effort is a significant improvement over the previous methodology. Therefore, the Sub-committee recommends that the Secretariat present the results of the new EFFDIS estimation to the next meeting of the Sub-committee on Statistics for its review and potential approval.

Recommendations with financial implications

- The Sub-committee requested financial assistance to support the attendance of five to eight CPC scientists at a collaborative workshop to continue the evaluation of on sea turtles to continue the evaluation of ICCAT fisheries impact on sea turtles, with the use of detailed fishery observer data. This is in support of an ongoing process that will continue over the coming years.

- The Sub-committee requests financial assistance to support the attendance of five to seven CPC scientists at a collaborative workshop to discuss the relevance and the methodology used to delineate candidate ecoregions within the ICCAT convention area to foster discussion on operationalizing the EBFM. The SUBECO recommends that a report be prepared documenting their process and to present it in the 2021 meeting.

- The Sub-committee recommends that in response to ICCAT Rec. 19-05 on how CPCs estimate discards, the Secretariat in close coordination with the SCRS organize separate workshops with the goals of: a) characterizing the current state of discard estimation methodologies and the supporting data collection, b) evaluating if existing approaches are statistically sound and developing improvements if necessary, and/or recommending the implementation of discard estimation approaches, and c) if necessary, training national scientists in discard estimation techniques. The workshops should not be conducted as part of any regular species Group or Sub-committee meetings.

10. Adoption of the report and closure

The report was adopted during the meeting. The Co-convers and the Secretariat thanked all the participants for their efforts to work effectively and efficiently within a new framework of SCRS meetings. The online meeting was adjourned.

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Appendix 1

Agenda

1. Opening, adoption of the Agenda and meeting arrangements

Pertaining to Ecosystems

2. Review the progress that has been made in implementing ecosystem-based fisheries management and enhanced stock assessments

3. Review the progress on developing an Ecosystem Report Card for ICCAT including the development of status and pressure indicators and reference levels

    3.1. Review adequacy of existing indicators against proposed new ones
    3.2. Review development of ecoregions

4. Review feedback received from Species Groups regarding their needs and contributions towards incorporating/developing ecosystem

Pertaining to By-catch

5. Update of collaborative work on seabirds

    5.1. Discussion of results and implications regarding the current bycatch mitigation measures [Rec. 11-09]

6. Update of the advances in the collaborative work of sea turtles
7. Effect of the mitigation measures: intra and inter taxa
8. Support the development of indicators for the ecosystem report card
9. Other matters
10. Recommendations

    10.1. General recommendations
    10.2. Recommendations with financial implications

11. Adoption of the report and closure

Table 1. Indicator checklist responses for the Assessed Species component of the ecosystem report card.

Questions ***Component***	***Assessed***
Goal: What is the conceptual management objective to be reflected in the report	Ensuring long-term sustainability and optimum utilization of the retained stocks
Objective: What is the question that can be represented by an indicator(s)	Determine if the status of retained assessed stocks, based on biomass and fishing ratio indicators, is improving.
Status: (accepted, rejected, development)	The indicator has been accepted. Development continues on alternatives.
Updates • Frequency • Scripted/automatic	• Annually, provided there has been a stock assessment in the prior year. • The script creates the indicator plots from an Excel file but it is a manual exercise to request the data and convert to proper format for inclusion in the master data file.
Responsibility	Currently updated by the Assessed Species team.
Reference	Hanke, A.R., Juan-Jordá, M. J. and Coelho, R. 2028. Indicators for ICCAT species that are retained and assessed. Collect. Vol. Sci. Pap. ICCAT, 75(2): 285-293 (2018/069).
Indicator • What is the indicator? • Scientific basis? • Responsive to pressure? • Ecosystem relevance? • Does it achieve the objective? • Possible to set targets? • State alternative indicators?	• The indicator shows the fraction of assessed stocks over time that are in a healthy, cautious or critical state with respect to being overfished and overfishing. An additional indicator shows overfished and overfishing status for all stocks in the terminal year of the assessment. • The indicators are based on assessment outputs which have a scientific basis. • Indicator shows collective response of stocks to fishing pressure and management recommendations. • Achieving objective should promote a healthy ecosystem • It achieves objective. • Target is for all stocks to not be overfished or subject to overfishing. • Composite multi-stock B/B_{MSY} and F/F_{MSY} ratio indicators was proposed
Data • Does the data exist? • Where does it reside? • Is it readily accessible? • How to improve access?	• The data exists. • Data is on the ownCloud within separate analysis folders for each species and modeling platform or alternatively on the computer of the analysts that ran the models used for advice. • The data is not easily accessed. • Data should be available on the ICCAT website on the stock assessment page.
Capacity & Expertise • Level of participation • Knowledge of participants	• Updating the indicator is easy once the data has been collected. No special capacity issues. • Expertise of the participants is sufficient for interpreting the indicator.
Regions • Data conforms to ICCAT regions • Data conforms to Pelagic regions • Regionalize?	• The data conforms to ICCAT stock boundaries. • Not possible to conform to Pelagic regions. • It's possible to regionalize the indicator but the regions would need to be broad (North Atlantic, South Atlantic, Mediterranean). Indicator currently represents convention area wide performance.
Questions ***Component***	***Assessed***
Secretariat • Is support required? • Type?	• Yes • One-time Secretariat support required in establishing access to data. Ongoing support required to update data after a stock assessment.

Table 2. Raw indicator data for the assessed species where B_{ref} is the number of stocks with $B/B_{MSY}>=1$, F_{ref} is the number of stocks with $F/F_{MSY}<=1$ and N is the total number of stocks.

Year	B_{ref}	F_{ref}	N
1955	7	8	9
1956	9	11	12
1957	14	15	16
1958	14	15	16
1959	14	15	16
1960	14	15	16
1961	15	15	17
1962	15	14	17
1963	15	15	17
1964	14	13	17
1965	14	13	17
1966	14	15	17
1967	14	14	17
1968	14	14	17
1969	14	14	17
1970	14	16	18
1971	14	17	20
1972	14	17	20
1973	14	17	20
1974	14	16	20
1975	14	16	20
1976	14	16	20
1977	14	17	20
1978	14	15	20
1979	13	15	20
1980	13	16	20
1981	13	16	20
1982	13	15	20
1983	13	15	20
1984	12	16	21
1985	12	13	21
1986	11	13	21
1987	11	11	21
1988	11	13	21
1989	12	12	21
1990	11	11	21
1991	11	12	21
1992	10	10	21
1993	10	8	21
1994	10	9	21
1995	10	9	21
1996	10	9	21
1997	8	9	21
1998	8	9	21
1999	7	11	21
2000	7	8	21
2001	7	10	21
2002	7	10	21
2003	7	10	21
2004	8	9	21
2005	7	10	21
2006	8	10	21
2007	8	10	21
2008	7	13	21
2009	8	13	21
010	9	14	21
2011	10	14	21
2012	10	13	21
2013	10	15	21
2014	9	13	21
2015	9	14	21
2016	9	13	21
2017	9	14	21
2018	9	14	21
2019	9	14	21

Appendix 2

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Appendix 3

List of Papers and Presentations

Number	Title	Authors
SCRS/2020/029	An evaluation of data poor approaches for the evaluation of stock status in large ecosystems using only landings data	Kell L., Sharma R. and Winker H.
SCRS/2020/030	Evaluation of data poor approaches for evaluating stock status and trends: self-testing using biomass-based assessment models	Kell L., and Sharma R.
SCRS/2020/034	Evaluation of data poor approaches for evaluating stock status and trends: cross testing using integrated assessment models	Kell L.T., Sharma R., and Winker H.
SCRS/2020/035	Updated indicators for ICCAT species that are retained and assessed	Hanke A. R
SCRS/2020/036	A review of incidental cetacean bycatch reporting in EU waters	Hanke A.R., Kell LT., and Fortuna C.M.
SCRS/2020/037	Screening and validation of length-based indicators	Kell L.R., Luckhurst B., Kimoto A., and Minto C.
SCRS/2020/039	The effect of circle hooks vs J hooks on the at-haulback survival in the U.S. Atlantic pelagic longline fleet	Diaz G.
SCRS/2020/040	Report of the 2nd workshop on collaborative work to assess sea turtle bycatch in pelagic longline fleets (Atlantic and Indian Oceans and Mediterranean Sea)	Anonymous
SCRS/2020/041	Non-stationarity in productivity of tropical tuna and the implications for ecosystem-based fisheries management	Kell L.T., Sharma R., Winker H., Kitakado T., and Mosqueira I.
SCRS/2020/044	Environmental variability in three major Mediterranean tuna spawning grounds: updating SST indicators for the Ecosystem Report Card	Alvarez-Berastegui D.
SCRS/2020/045	The development of the seabird component of the ICCAT Ecosystem Report Card	Wolfaardt A., Bogle C., Debski I., Jiménez S., Misiak W., Prince S., Pon J.S., and Small C.
SCRS/2020/046	Reconstructing longline effort time series using reported coverage ratios	Taylor N.G., Palma C., Ortiz M., Kimoto A., and Beare D.
SCRS/2020/047	Validation of productivity analysis for data limited stocks	Kell L.T., Taylor N.G., and Palma C.
SCRS/2020/048	Suggestions for a feasible and simple ecosystem indicator of sea turtles and available data	Ochi D., Ueno S., Okamoto K. and Tsuji S.
SCRS/2020/049	Toward establishing ICCAT specific ecosystem-based approach to fisheries management	Tsuji S.
SCRS/2020/050	Progress report of development of ecocard indicator for seabird bycatch	Anonymous
SCRS/2020/052	Progress on a meta-analysis for comparing hook, bait and leader effects on target, bycatch and vulnerable fauna interactions	Santos C.C., Rosa D., and Coelho R.
SCRS/2020/054	In support of the ICCAT ecosystem report card: advances in monitoring the impacts on and the state of the "foodweb and trophic relationships" ecosystem component	Andonegi E., Juan-Jordá M.J., Murua H., Ruiz J., Ramos M.L., Sabarros P.S., Abascal F., Bach P., and MacKenzie B.
SCRS/2020/055	In support of the ICCAT ecosystem report card: indicators for marine debris	Zudaire I., Grande M., Murua H., Ruiz I., Basurko O.C., Murua J., Justel-Rubio A., Santiago J., Andonegi E., and Juan-Jordá M.J.

(Continued)

Number	Title	Authors
SCRS/2020/056	Review on the effect of hook type on the catchability, hooking location, and post-capture mortality of the shortfin mako, *Isurus oxyrinchus*	Keller B., Swimmer Y., and Brown C.
SCRS/2020/066	Report of the workshop III on collaborative work to assess seabird bycatch in pelagic longline fleets (south Atlantic and Indian Oceans)	Anonymous

SCRS/P/2020/008	Towards mitigation of seabird bycatch in pelagic longline fisheries: operational effectiveness of night setting and Tori lines across multiple fleets/wide spatial and temporal scales	Jiménez S., Domingo A., Winker H., Parker D., Gianuca D., Neves T., Coelho R., and Kerwath S.
SCRS/P/2020/009	IOTC workshop to identify regions in the IOTC convention area for informing the implementation of the ecosystem approach to fisheries management	Juan-Jordá M.J., Nieblas A.E., Murua H., De Bruyn P., Bonhommeau S., Collas M.D., DalleauM., Fiorellato F., Hayes D., Jatmiko I., Koya K.M., Kroese M., Marsac F., Pepin P., Shahid U., Thoya P., Tsuji S., and Wolfaardt A.
SCRS/P/2020/011	Proposal for advancing in Task 12 (Environmental Pressure) Ecosystem Report Card: From process specific to generic evaluation of the task	Alvarez-Berastegui D., Juan-Jorda M.J., Andonegi E., and Kell L.
SCRS/P/2020/013	Interaction of protected species with the artisanal tuna fishery of the Bay of Biscay: preliminary results	Louzao M., Oyarzabal I., Uriarte A., Onandia I., and Ruiz J.

Appendix 4

SCRS Documents and Presentations abstracts as provided by the authors

SCRS/2020/029 Ecosystem Based Fisheries Management is challenged by fishing impacts not just on the target stocks but also on by caught, threatened and endangered species, and the associated ecological communities. For example, in the case of ICCAT although more than a hundred species are recorded in the statistical database only 15 tuna and billfish stocks are formally assessed. We therefore evaluated a spectrum of data poor methods using SRA+. At the data limited end SRA+ approximates the behaviour of catch-MSY, sampling from prior distributions given a catch history do not crash the population and satisfy priors for initial and final depletion. At the data rich end SRA+ is fitted to abundance indices with priors for population growth rate (r) and current and initial depletion. We used the RAM Legacy database, to simulate data poor datasets by removing information. This allowed the Value of the Information in the dataset and priors to be evaluated. For example, are results determined by the data or expert knowledge? We showed that catch only methods performed poorly and were highly dependent on expert knowledge rather than the data.

SCRS/2020/030 Ecosystem Based Fisheries Management is challenged by fishing impacts not just on the main target stocks but also on by caught, threatened and endangered species, and the associated ecological communities. For example, although ICCAT has more than a hundred species in its statistical database only 15 Tuna and billfish stocks have been formally assessed. This is due either to lack of data, capacity or management recommendations. The lack of formal assessments may hamper progress towards Ecosystem Based Fisheries Management, we therefore evaluate the ability of data poor methods to provide robust advice on stock status and trends. We do this by conducting a cross-test using integrated stock assessments conducted by the SCRS to simulate pseudo data. These are then used to fit models based on biomass dynamics for scenarios related to quality, and priors and heuristics based on expert knowledge. Although this approach ignores many sources of uncertainty comparing the performance of data poor methods to estimates from assessment model used to provide actual advice, allows the value-of -information to be evaluated.

SCRS/2020/034 Ecosystem Based Fisheries Management is challenged by fishing impacts not just on the main target stocks but also on by caught, threatened and endangered species, and the associated ecological communities. Although ICCAT's statistical database includes more than a hundred stocks, only 15 teleost stocks are formally assessed. This is due either to lack of data, capacity or management recommendations. We therefore evaluate the ability of data poor methods, fitted to total catch and indices of abundance, to determine stock trends and status. To do this, we conduct a self-test based on assessments conducted by the SCRS to evaluate the Value-of-Information. In a self-test a model is first fitted to data and then used to simulate-pseudo data. We then refit the model for scenarios where data or expert knowledge are omitted and compare the estimates obtained to the original estimates. Although this approach ignores many sources of uncertainty, if the methods do not perform well when the assessment model assumptions are the same as the original assessment, then they are unlikely to perform well in more complex situations.

SCRS/2020/035 An update of the assessed species indicator is provided. This indicator tracks the status (B/B_{MSY} and F/F_{MSY}) of all assessed stocks over time. Additionally, the status of all stocks is shown for the terminal year assessed and a completed indicator checklist is included.

SCRS/2020/036 This review determines the state of cetacean bycatch reporting in EU waters as reflected in a 2019 European Union report. The objective was to determine the extent to which cetacean bycatch data and methods could inform the development of an indicator of ICCAT fisheries impacts on cetaceans. The report suggests the need for ICCAT to work with other RFMOs to jointly develop a sampling framework that will provide the data required to identify status indicators and thresholds that will allow risks to be managed. The experiences conveyed in the report also show the importance of coordination of efforts between scientists, managers and fishing entities.

SCRS/2020/037. Regional Fisheries Management Organizations have the responsibility to manage not just the main commercial stocks but also by caught species that may be endangered, threatened or protected and the associated communities. Although ICCAT has over hundred species in its database only 15 stocks have been formally assessed. This is due either to lack of data, capacity or management recommendations. The lack of formal assessments may hamper progress towards Ecosystem Based Fisheries Management. We

therefore evaluate Length Based Indicators that could be used to assess stock status for stock where data are limited. To do this we use length compositions from data rich stock assessments to derive Length Based Indicators and then compare them to estimate of fishing mortality relative to F_{MSY}.

SCRS/2020/039 Observer data from the U.S. pelagic longline fleet was used to analyze the effect of circle and J hooks on the at-haulback survival of swordfish, shortfin mako, blue and white marlin. The probabilities of survival were estimated from odd ratios. Full models included water temperature, soak time, and fish length as continuous covariates. When only the effect of hook type is taken into consideration, circle hooks resulted in a significantly higher probability of survival for all species except for white marlin where the difference was not significant. Temperature, soak time, and fish length were significant depending on the species. When significant, in general these covariates had a negative effect on survival (i.e., higher values resulted in lower survival). The results show that circle hooks, which were adopted as a sea turtle bycatch mitigation measure by the U.S. pelagic longline fleet in both the Pacific and Atlantic oceans, also increase the at-haulback survival of other species and, therefore, it addresses some of the research needs to develop and implement Ecosystem Based Fisheries Management.

SCRS/2020/040 A collaborative work to assess the impact of pelagic longline fleets on sea turtles in the Atlantic Ocean from an entirely scientific perspective was initiated in 2018. This report details the results obtained in Workshop II (January 2020, Malaga, Spain). Researchers from Brazil, Japan, Spain, and Uruguay, as well as the Coordinator of ICCAT's GBYP attended the workshop. Scientists from France, Portugal and South Africa also sent data on their fisheries to contribute to the process. The possibility of including the Mediterranean and extending the assessment to purse seine fisheries was explored. A short-term goal was defined: Determine the spatio-temporal patterns of the incidental catch of sea turtles in pelagic longline and purse seine fisheries in the Atlantic Ocean and southern Indian Ocean. Data on incidental catch of sea turtles at the fishing set level were integrated (1998-2018). These data comprised a total of 33,370 (60,355,425 hooks) and 42,148 fishing sets observed on multiple pelagic longline and purse seine fleets, respectively. The distribution of the observed fishing effort and bycatch rate of sea turtles were explored. Next steps are discussed.

SCRS/2020/041 The Ecosystem Report Card of the Sub-Committee on Ecosystems includes indicators for assessed species based on productivity, i.e. trends of biomass or spawning stock biomass relative and fishing mortality or harvest rate relative to Maximum Sustainable Yield reference points. The objective is to assess whether the main target stocks are in a healthy, cautious or critical state and how this has changed over time. Productivity, however, depends on a variety of physical and biological processes. We therefore use the stock assessments for bigeye and yellowfin tunas from the Atlantic, Indian and Eastern Pacific Oceans, to illustrate the use of diagnostics based on production functions and surplus production trajectories to explore changes in productivity.

SCRS/2020/044 In 2018, the sub Committee on Ecosystem decided to include in the Ecosystem Report Card a new component of pressure focused on environmental variability. This new component should provide indicators informing on the variability of environmental processes having an effect on the ecology of tuna populations. The unique indicators included in this pressure component up till now are the temperature variability in the main tuna spawning grounds in the Mediterranean covering from May to August. Here we update these indicators and propose a slight modification for its calculation (from temperature at 10.5 meters to temperature at 1.5m) to be more representative about the potential effects of sea temperature in the ecology of early life stages of tunas in the study areas.

SCRS/2020/045 This paper serves as a contribution to the development of the ICCAT Ecosystem Report We highlight that bycatch is considered one of the main impacts of ICCAT fisheries on seabirds and emphasise the importance of monitoring seabird bycatch associated with ICCAT fisheries. We propose two high-level indicators (bycatch rates per unit effort, and an estimate of the total number of seabirds killed), together with a third indicator (use and effectiveness of bycatch mitigation measures) to facilitate the interpretation of trends in the other two, and to help inform an adaptive approach to the management of seabird bycatch in ICCAT fisheries. We outline the uncertainties and limitations associated with the suite of indicators, most of which relate to the availability of appropriately collected and reported data. Improvements in the quantity and quality of data will lead to enhancements in the indicator system and its usefulness for informing management decisions. Even with imperfect data, the indicators and ecosystem report card will help highlight data gaps and priorities for further monitoring, and thus strengthen the report card tool over time.

SCRS/2020/046 Here we summarize a new method to impute effort using ICCAT's Task II catch and effort data (T2CE). The basic methodology consists of raising reported effort using the coverage ratio (CovRatio) statistic reported by CPCs in their annual Task II submissions. Missing values for the CovRatio statistic are imputed hierarchically using the most detailed data by spatial cell, year, and fleet resolution at the coarsest resolution to the coverage ratios averaged across years and CPCs. Over modelling approaches this improves the transparency of effort imputation methods. This method inflates effort more than other methods employed at ICCAT for this purpose. A key matter to determine for future research is to characterize the uncertainty in the effort estimates. The effort reconstruction reveals that future improvements to the estimation process could involve the revision of several T2CE datasets from CPCs including those ones with inconsistent or missing coverage ratio statistics, and possibly, expanding the effort estimations using auxiliary information such as the ICCAT Task I fleet characteristics data (T1FC, fishing days by vessel and year) to validate and also capture the effort that was applied but did not result in any catches.

SCRS/2020/047 Regional Fisheries Management Organisations have the responsibility to manage not just the main commercial stocks but also by caught species that may be endangered, threatened or protected and the associated communities. Although ICCAT has over hundred species in its database only 15 stocks have been formally assessed. This is due either to lack of data, capacity or management recommendations. The lack of formal assessments may hamper progress towards Ecosystem Based Fisheries Management. We therefore evaluate estimates of and proxies for productivity for data limited stocks. We do this by evaluating potential methods using data rich stocks as a benchmark.

SCRS/2020/048 With regard to the indicator for sea turtle bycatch in the Ecosystem Report Card, the SC-ECO has been discussing the method of creating the indicator, but currently there is no consensus on the indicator values. Therefore, this document attempts to organize the conditions necessary for an appropriate sea turtle indicator and the data necessary for the development of the indicator in order to facilitate the discussion. The most important thing is to be clear on the targets of the indicators you will be updating on an ongoing basis—how can the pressure of fishing on the sea turtle population be measured? Since many CPCs are regularly involved in the calculation of indicators, it is desirable to use data that is as simple as possible and does not require additional data collection efforts to calculate indicators. The document presents and discusses candidate management targets targeted by the sea turtle indicator and the data currently available.

SCRS/2020/049 The current round of SC-ECO work for incorporating ecosystem-based approach to the ICCAT fishery management (EBFM) followed the 2015-2020 SCRS Science Strategic Plan established at 2014 SCRS. The plan originally intended the development of integrated ecosystem model together with monitoring of all components of ecosystem including socio-economic component. The SC-ECO decided in 2016 its short and medium-term work plan after reviewing the various procedures and experiences incorporating ecosystem consideration in assessment and fisheries management advices, and feasibility of integrated ecosystem modelling corresponding to the existing data availability. The short-term work plan contained three components, i) development of an Ecosystem Report Card, ii) communication with the Commission through Dialogue Meeting between Scientists and Managers, and iii) enhanced coordination and communication of ecosystem-relevant research across the SCRS Working Groups. For Ecosystem Report Card, draft ecosystem components together with the corresponding Goals and Questions (Objectives) plan and road map were agreed in 2017. Repeating the process that the SC-ECO reviewed the candidate indicators prepared by small working group established for each component with volunteers in 2018 and 2019, currently 4 out of 11 ecosystem components (retained assessed species, mammals, non-retained sharks, and socio-economic) already established candidate indicators and the remaining ones have relatively clear idea on direction other than trophic relationships. Progress on an EBFM plan was presented to the 2018 Dialogue with Science and Manager Meeting and a meeting with the SCRS Working Group chairs was made at the 2017 Sub-Committee on Statistics, which was modified for bycatch coordinator attending all Species Group in order to capture ecosystem relevant research, though feedbacks were rather limited in both cases. After finalizing the first prototype of ecosystem report card in 2020 as planned, the work plan indicates to develop Ecosystem Considerations Report (or Ecosystem Synthesis Report) and Ecosystem Risk Assessment with the input and participation from the Commission. While the plan was based on the guideline developed for the cases required whole ecosystem management in a certain area, data paucity of many ecosystem components and difficulty to define common eco-region across key ecosystem components would constrain a capacity for the former and the Commission already made clear indication for the latter by a range of Resolutions. The ICCAT already/or has a capacity to incorporate some ecosystem consideration. The component missing to be operational EBFM is a formal mechanism to better integrate

ecosystem considerations, or signals identified by ecosystem report cards, into management decisions and communicating them to the Commission. Up to now, the EBFM development emphasized more improving conceptual aspects. On the other hand, implementation of EBFM is step-wise adaptive process. Moving toward establishing ICCAT-specific operational EBFM focusing on limited ecosystem component(s) that are already identified of key importance with adequate accumulated knowledge/ experience of the issue (e.g. non-retained species) may have advantage, though this would require active participation and commitment from the whole SCRS and the Commission. In order to initiate the process, the document suggests establishing a small working group with a participation of the SCRS Chairs for drafting a revision of EBFM component of the SCRS strategic work plan for discussion and final adoption in 2021.

SCRS/2020/050 The paper summarizes the discussion held via email between 26 March 2020 and 23 April 2020 for the purpose of developing the Ecosystem report card indicators for seabird bycatch. The Group identified the need of two indicators, one to assess seabird bycatch mortality and the other for monitoring a progress of management actions, though further discussion, including in-depth face to face technical consultation, is needed to finalize the details of indicator definitions and calculation procedure. The seabird density information, essential input data, is made available to the ICCAT thanks to the effort of Birdlife International. The discussion so far is limited to the seabird bycatch associated with tuna longliners

SCRS/2020/052 This paper describes the progress of an EU Project "Evaluation of the effects of hooks' shape & size on the catchability, yields and mortality of target and by-catch species, in the Atlantic Ocean and adjacent seas surface longline fisheries". At this stage, a meta-analysis of 36 publications totaling 55 experiments was conducted to assess effects of hook, bait and leader type on retention and at-haulback mortality rates of target, bycatch and vulnerable species of the pelagic longline fishery. Specifically for this progress paper, we provide one example of each group, namely swordfish as a main target species, blue shark as one main bycatch species usually retained if captured, and the loggerhead sea-turtle as one vulnerable species. The use of circle hooks significantly lowers retention rates of loggerhead sea-turtles and also swordfish. Using fish bait significantly reduces the retention of loggerhead sea-turtles, but does not significantly affect the retention of swordfish or blue shark. The effects of using wire leaders could not be assessed for the loggerhead turtle and significantly increased retention of blue sharks. As for at-haulback mortality, the use of circle hooks significantly reduced at-haulback mortality for swordfish and was not significant for blue shark or loggerhead sea-turtle. Using fish bait increased at-haulback mortality of blue shark and was not significant for the other taxa. The effects of using wire leaders on at-haulback mortality was only possible to calculate for blue shark and was not significant. The results presented here are part of an ongoing project, with final results expected in July 2020. Future work will consider expanded information on the other species captured in pelagic longlines, as well as other fishery characteristics.

SCRS/2020/054 In support of the development of the ICCAT Ecosystem Report Card, this paper addresses the "foodweb/trophic relationships" ecosystem component. Specifically, it contributes towards developing the following elements: (1) we describe what this component means in the context of ICCAT species and fisheries and the importance of monitoring it; (2) we describe the role of ecological indicators and ecosystem models in monitoring this ecosystem component; (3) we present a list of candidate ecological indicators that could be estimated to monitor this component; (4) we discuss the main challenges in monitoring this ecosystem component and indicator development; and finally (5), we draft a work plan to guide our future work. We invite the ICCAT community and others to contribute towards the development of ecological indicators and ecosystem models to monitor this ecosystem component. If interested, contact the corresponding authors to find out how you can contribute to this initiative.

SCRS/2020/055 This document proposes to include "Marine debris" as an ecosystem component into the ICCAT Ecosystem Report Card. The addition of this pressure component will allow to highlight the importance of identifying marine debris produced by the fishing activities of the major ICCAT fisheries and its potential impact on the marine ecosystem in the Atlantic Ocean. Specifically this contribution provides the following four elements: (1) we describe what the marine debris ecosystem component means in the context of ICCAT fisheries and the importance of monitoring as well as we make a proposal of a conceptual and an operational objective to measure progress towards the management of this component; (2) we present a list of candidate indicators, which are shared by all fishing gears, that could be measured to monitor the extent of marine debris both on the open ocean and coastal ecosystems produced by ICCAT fisheries; (3) we identify the potential sources of marine debris associated to different fishery activities, and we examine data availability and sources to support indicator development; and (4) we draft a work plan to guide future work.

SCRS/2020/056 Due to the assessed vulnerability for the North Atlantic shortfin mako, *Isurus oxyrinchus*, ICCAT has identified the need to better understand the use of circle hooks as a potential mitigation measure in longline fisheries. We conducted a literature review related to the effect of hook type on the catchability, anatomical hooking location, and post-capture mortality of this species. We found twenty-eight papers related to these topics, yet many were limited in interpretation due to small sample sizes and lack of statistical analysis. In regard to catchability, our results were inconclusive, suggesting no clear trend in catch rates by hook type. The use of circle hooks was shown to either decrease or have no effect on at-haulback mortality. Three papers documented post-release mortality, ranging from 23-31%. The use of circle hooks significantly increased the likelihood of mouth hooking, which is associated with lower rates of post-release mortality. Overall, our review suggests minimal differences in catchability of shortfin mako between hook types, but suggests that use of circle hooks likely results in higher post-release survival that may assist population recovery efforts.

SCRS/2020/066 A collaborative workshop to assess seabird bycatch in the pelagic longline fleets operating in the South Atlantic (SAO) and Indian (IO) Oceans from an entirely scientific perspective was conceived in September 2016. Three workshops have been celebrated, two (I and II in 2017-2018) in Montevideo, Uruguay and one (workshop III, June 2019) in Cape Town, South Africa. This report summarizes the results of Workshop III. A database ready to be analyzed was finally available, which included observer data collected aboard the fleets of Brazil (SAO), Portugal (SAO and IO), South Africa (SAO and IO) and Uruguay (SAO). In order to respond to ICCAT, the main objective of the workshop was: 1) to determine the effectiveness of the mitigation measures adopted by the commission in reducing seabird bycatch. The final dataset comprised 15,779 fishing sets and 36.4 million hooks observed during 583 trips aboard 132 vessels (SAO and IO; 2002-2016). The main workshop outputs included a scientific paper submitted to a pair-reviewed journal and a document presented at the IOTC-2019-WPEB15. The work will be presented at ICCAT-2020- SCECO for discussion.

SCRS/P/2020/009 The IOTC WPEB14 recommended to convene a workshop in 2019 to provide advice on the identification of draft ecoregions to foster discussions on the operationalization of the ecosystem approach to fisheries management (EAFM) in the Indian Ocean Tuna Commission (IOTC) convention area. This workshop took place the 30th, 31stof August and 1stof September in La Reunion Island and gather 17 participants with a wide range of expertise in IOTC species, fisheries and oceanography in the Indian Ocean. Prior to the workshop, a consultant was hired to prepare a baseline draft proposal of ecoregions to be presented and discussed at the workshop by all the participants. During the workshop, the group discussed the potential benefits and uses of ecoregions in the context of IOTC species and fisheries. The group also provided feedback on the technical aspects, data and methods used in the derivation of draft ecoregions. Three baseline ecoregion classifications were reviewed by the group, which in combination with expert knowledge, were used to derive draft ecoregions within the IOTC convention area. The draft ecoregions are not intended to be used for management purposes. At this stage, the WPEB15 has endorsed the draft ecoregions for further development as a tool to progress EAFM implementation (e.g. develop ecosystem report card, ecosystem overviews, fisheries overviews) and to test its benefits and potential uses in the context of IOTC species and fisheries.