

**REPORT OF THE 2022 ICCAT INTERSESSINAL MEETING
OF THE SUBCOMMITTEE ON ECOSYSTEMS AND BYCATCH**
(Online, 31 May - 3 June 2022)

1. Opening, adoption of the Agenda and meeting arrangements

The Conveners opened the meeting welcoming the participants (the “Subcommittee”). The Executive Secretary greeted the participants noting his special thanks for the attendance of the Secretariat of the [Inter-American Convention for the Protection and Conservation of the Sea Turtles](#) (IAC). He noted that ICCAT and the IAC has recently signed a Memorandum of Understanding and that he looked forward to fruitful collaboration with them in the future.

The Agenda is attached in **Appendix 1**, the list of participants in **Appendix 2**, the list of presentations and papers in **Appendix 3**, and the abstracts provided by the authors in **Appendix 4**. Rapporteurs were assigned as follows:

Item 1, 20.	N.G. Taylor
Item 2.	N.G. Taylor, L. Kell, Q. Huynh, E. Andonegi, S. Tsuji, D. Alvarez
Item 3.	A. Hanke
Item 4., 5.	M.J. Juan-Jordá
Item 6.	R. Forselledo, S. Jiménez Cardozo
Item 7.	C. Santos, R. Forselledo
Item 8.	N.G. Taylor
Item 9-11.	A. Domingo, N.G. Taylor
Item 12.	S. Jiménez Cardozo
Item 13-14.	A. Domingo, N.G. Taylor
Item 15.	M. Santos
Item 16.	C. Palma, C. Mayor, N.G. Taylor
Item 17.	A. Hanke, A. Domingo
Item 18.	A. Hanke, A. Domingo, N.G. Taylor, M.J. Juan-Jordá
Item 19.	M. Santos

Pertaining to Ecosystems

2. Review the progress on developing status indicators, pressure indicators and reference levels for the components of the Ecosystem Report Card

The Subcommittee reviewed the progress of the teams tasked with developing and updating the indicators for the components of the Ecosystem Report Card. It was noted that none of the teams were able to progress on the tasks outlined in the 2021 workplan. It was recognized that the pandemic and the demands associated with the increased number of meetings were partially to blame.

The Subcommittee reviewed SCRS/P/2022/037 that provided a framework for assessing and developing indicators to reflect the status of data-poor species which are often endangered, threatened and protected species or are found in vulnerable marine ecosystems. A first step in assessing these stocks could be to conduct a risk assessment of all stocks and species of concern based on a productivity susceptibility analysis (e.g. Arrizabalaga *et al.*, 2015, Lucena-Fredou *et al.*, 2017), then to decide on the species that require management actions, using the support tool for implementation of the ecosystem based approach to fisheries management detailed in SCRS/2022/109 or via an elicitation exercise (e.g. Leach *et al.*, 2014).

The Subcommittee recognized that the implementation of the Ecosystem Approach to Fisheries Management (EAFM) requires assessments of fish stocks on both regional and global scales (Hilborn *et al.*, 2020) of both bycaught as well as target stocks and species, and that data-limited approaches offer a mechanism for developing indicators in situations where data and resources are limited (e.g. Dowling *et al.*, 2015, Kell *et al.*, 2022). It was also noted that these approaches allow for an assessment of the state of both predator and prey species, a requirement for EAFM implementation (SCRS/2022/107). For example, monitoring squids, which are increasingly being targeted by fisheries and are an important element of the

food web and are both predators and prey, will provide information on how their distribution and abundance affect ICCAT species. Another question was, how do changes in the abundance of top-level predators such as sharks affect ICCAT species? These concerns relate to the increasing global demand for small fish to produce aquaculture and agriculture feed, and myctophids which may be subject to fishing pressure in the future. The Subcommittee observed that length-based approaches could provide indicators of the main stocks/species of concern and support the development of the Ecosystem Report Card.

2.1 Review progress on the development of methods for prioritizing risks and screening and validating indicators

SCRS/2022/106 reported the progress in the development of a tool which is a management strategy evaluation framework called “EcoTest”. This is an extension to [openMSE](#) software, used for single-species modeling, which simulates multi-species fisheries dynamics. The paper demonstrates the use of EcoTest using the Atlantic longline fishery as a case study with two fleets targeting bigeye tuna (BET) and North Atlantic swordfish (SWO) respectively, and capturing blue shark (BSH), North Atlantic shortfin mako shark (SMA), white marlin (WHM), and blue marlin (BUM) in addition to target species. The Operating Models (OMs) were based on recent Stock Synthesis 3 assessments produced by the respective Species Working Groups. Hypothetical interactions between the primary target species and secondary species were parameterized by the relationships in the fishing mortality between them.

The Subcommittee expressed their appreciation for the work, asking if the work could be expanded to look at hypotheses that included spatial distribution of species, and/or with vulnerable species covered under the agenda item 7.1. The Subcommittee also inquired if predator-prey interactions could be considered and how structural errors across OMs could be considered. It was responded that i) no ecological interactions were currently included in the model and ii) a suit of OMs could use alternative more complicated spatial stock assessments for conditioning. The Subcommittee also noted that while developing and using indices like bycatch-per-unit-effort for seabirds had been problematic in the past, in contrast, count data for many seabirds populations was of reasonably high quality.

SCRS/2022/109 reported the progress made during the intersessional period on the development of the EBFM communication support tool presented in the 2021 Intersessional Meeting of the Subcommittee on Ecosystems and Bycatch (*online, 5-7 May 2021*) (Tsuji, 2021). The tool aims to screen species that may have a relevance to ICCAT EAFM and to show relative importance among those screened species once conservation priority is determined. The majority of the effort dedicated to improving the tool was on further improvement to the supporting habitat database. This is now mostly completed for fish species and planned to be completed during 2023 for seabirds and sea turtles. Data mining on habitat information for crustaceans, cephalopods, and ctenophores that was supported with ICCAT funds was delayed. Two modifications were introduced: the first was to separate the definition of “ICCAT relevance” into two different components, one for potential fisheries-specific susceptibility; and the second was for biological interrelationship with tuna and tuna-like species, including prey-predator relations, cohabitants, and commensal species. The project intended to shift towards using a machine learning approach and currently examined the feasibility on random forest model. The author requested further collaboration and support from the SC-ECO as well as emphasizing the need to improve interactions with the Commission to ensure that the tool development was on the right track.

The Subcommittee had a few questions. First, it asked what the relationship of this work was with the existing ecological risk assessment at ICCAT. In response, it was explained that the tool aimed to identify the list of species that may interact with tuna and tuna fisheries and that the results and experiences of existing ecological risk assessment would be incorporated into the second step of the tool that will estimate the relative importance of species in the context of ICCAT EAFM. It was also indicated that the main focus of the tool was to assess the relevance to ICCAT for those taxonomic groups for which there is little information available.

The Subcommittee further asked how this work would fit with other analytical initiatives. The response was that the tool would work as a set of filtering criteria for screening the species of interest, based on biological, ecological, and habitat characteristics, rather than the current process which has a tendency to be driven by richness of data and evidence. Objective screening would be beneficial for claiming the implementation of more systematic ecological considerations in the science supporting ICCAT fisheries. In addition, it was noted that the EAFM implementation would require a wide range of supporting tools and that the tool proposed here would supplement those currently under development within the Subcommittee. The

Subcommittee further inquired about what taxonomic groups would be considered and how different regions for the assessment and management would be considered. In response, it was explained that the tool intended to capture all species groups that may interact with tunas and tuna fisheries, but in particular those for which very little or nothing is known. This may include those species used as bait, and/or those with strong association with floating sargassum seaweed. With respect to regional differences, it was explained that the tool is currently only applying filtering on species groups occurring in the Atlantic and adjacent seas as well as some areas with known exchanges, e.g., off South Africa, and Red Seas.

2.2 Review development of case studies and ecoregions

2.2.1 Sargasso Sea case study

The Subcommittee reviewed the two projects supporting the Sargasso Sea case study. The SARGADOM Project funded by Le Fonds Français pour l'Environnement Mondial (FFEM) that is “contributing to hybrid governance to protect and manage two remarkable areas of the high seas: The Thermal Dome and the Sargasso Sea”, and the project under the Global Environment Facility (GEF) Common Oceans Sustainable Utilization and Conservation of Biodiversity in Areas beyond National Jurisdiction Program, entitled “Strengthening the Stewardship of an Economically and Biologically Significant High Seas Area”. Specific tasks under the FFEM project include i) Socio-ecosystem analysis-diagnosis: Defining the socio-ecosystem, Identifying sustainability issues; Characterizing the pressures and their impacts and the proposal of strategies to improve the sustainability of the socio-ecosystem, ii) Governance models for ecosystem based management: Diagnosis to build a hybrid and participatory governance model through participatory and multi-sectoral discussions, and iii) Capacity building and communication: Lessons learned from the results achieved in the two sites, both in terms of knowledge and governance, development of a program of capacity building and dissemination of know-how. The Global Environment Fund (GEF) project will conduct an Ecosystem Diagnostic Analysis (EDA) for the entire Sargasso Sea ecosystem providing a baseline for monitoring and adaptive management/stewardship of the Sargasso Sea. Prepare a roadmap and budget for the adoption of an Ecosystem Based Approach to governance and conservation and develop a Strategic Action Program defining the management or stewardship measures and associated priority actions Knowledge Management, Monitoring and Evaluation.

During the presentation of the Sargasso study case, researchers involved in that project explained that the project is in the status of developing an ecosystem diagnostic analysis under a Driving Forces–Pressures–State–Impacts–Responses (DPSIR) framework, defining the different sources of impacts and defining a strategic plan. The activities conducted are in part founded by Oceana’s Open Ocean program and it is specifically focused on assessing how the different elements of the DIPSIR interact, with some specific study cases like the mako shark. Most discussions regarding the Sargasso Sea case studies were conducted under this part of the agenda. The Subcommittee recognized the efforts carried out in the Sargasso study case and the wide perspective of the studies conducted. The researchers involved in the project suggested summarizing the main potential outcomes for the Subcommittee.

2.2.2 Subtropical Atlantic Case Study

The Subcommittee reviewed SCRS/P/2022/041 which described a pilot study for the tropical ecoregion focused on trophic ecology and the development of end-to-end ecosystem models (e.g. ECOPATH with ECOSIM). The current objectives and activities are focused on the integration of stomach content data, habitat models, and climate variability into ecosystem models. The activities are supported by different funding sources and a PhD student.

The Subcommittee asked about the developmental status of the initiative and its level of implementation in fisheries assessments. In response it was noted that stomachs are sampled from the 3 targeted species but that they are trying to get stomachs from bycatch species if possible. Samples are mostly received from European purse seiners. Samples come predominantly from canneries in Vigo, in the form of frozen samples at the moment. They are trying to get samples from other fleets too. There were possibilities for sampling stomachs (Brazil) and there were also references to the TRIATLAS H2020 project. The speaker also indicated that there will be an ecosystem model workshop in the future.

2.2.3 Western Mediterranean Sea case study

The Subcommittee reviewed and was updated on the Western Mediterranean (WMED) case study described in SCRS/P/2022/035. This presentation described a framework of various research projects over the last decade. The primary objective is to explore the effects of environmental variability on tuna species in the Mediterranean, design novel tools for monitoring that environmental variability, and to identify effective ways to integrate that information for tuna species assessment and management (e.g. improve CPUEs, model environmental drivers for survival and develop recruitment simulations).

The Subcommittee recognized and acknowledged the work carried on by this initiative during the last decade as an EAFM case study in the Mediterranean, focused on the exploration and monitoring of environmental variability in key tuna areas, its effects on tuna species ecology, and how these effects translate into effects on the main species groups (e.g. bluefin tuna and albacore). The Subcommittee also encouraged reinforcing the activities currently conducted in the framework for the environmental component of the ecosystem report card. It supported specific actions proposed by the researchers involved in that initiative, directed at achieving the following objectives: improving existing environmental variability indicators at Mediterranean scale meaningful for tuna species; the practical integration of those indicators in the current fisheries assessment processing; connecting with other Mediterranean initiatives and institutions; as well as bridging the gap between conservation and fisheries approaches.

The Subcommittee considered that the specific actions proposed by the researchers involved in this Mediterranean scale pilot project are of interest:

1. Develop tools (e.g. web-based) for monitoring marine extreme events (and other relevant marine extreme events with impact on tuna ecology) in key tuna areas of the Mediterranean
2. Explore the integration of environmental recruitment spatial models into assessment (fisheries and conservation perspectives)
3. Propel eco-region reports for the environmental component of the ecosystem report card (biannual)
4. Outreach activities through the tuna dedicated education platform “planetuna.Com”
5. Conduct workshops at Mediterranean scale to find ways to align general objectives of ICCAT in this ecoregion with institutions in charge of i) ocean observation (e.g. The Mediterranean Ocean Network, MONGOOS) and ii) the implementation of the new objectives of the Barcelona Convention and the 2030 biodiversity strategy of the European Union (e.g. The United Nations Environmental Program).

3. Review the intersessional work of the sub-group working on the applicability and functionality of the Ecosystem Report Card (EcoCard) as a tool for monitoring the impacts of ICCAT fisheries

The Subcommittee reviewed SCRS/2022/104 that was produced by the Sub-group on the Ecosystem Report Card (EcoCard), which is a tool for monitoring and communicating the ICCAT fishery impacts on ecosystem components.

The Subcommittee acknowledged that the tool’s development would benefit from feedback from the Commission and SCRS Species Groups. It was further noted that, given the concerns identified by the sub-group, major achievements on the EcoCard would not be possible until these concerns were addressed, and once an open and direct dialogue was possible. It was suggested that the best avenue to achieve this dialogue was by requesting that a meeting of the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers (SWGSM) occur in 2023. This meeting could serve as a mechanism to consult with the Commission on the value of the EcoCard as well as the benefits of implementing an EAFM framework within ICCAT.

It was emphasized that the EcoCard was a good tool for providing a very high-level perspective on the impact of ICCAT fisheries on the ecosystem and the effect of climate variability on ICCAT species. It was also noted that it was not specifically designed for providing specific management advice. Consequently, more meticulous perspectives on impacts may be required. The Subcommittee encouraged the EcoCard developers to get feedback from the Commission and SCRS Species Groups that would guide EcoCard development and that this feedback could be received through an elicitation process. It was further

suggested using all available channels to communicate the usefulness of the EcoCard and to put emphasis on education and awareness before engaging in consultations.

The Subcommittee was reminded that not all attempts to communicate with the Commission go as well as initially hoped. This is especially the case when discussions on EAFM or the EcoCard are relegated to Other Matters in a meeting agenda whose principal objective is unrelated to EAFM. The Subcommittee was reminded that in order to be effective, communications with the Commission must be concise, identify what it wanted, why it was needed, and to demonstrate how it benefits the Commission.

A discussion on the purpose of EAFM and the EcoCard in ICCAT noted that, while the principal concern was with managing and responding to the impact of ICCAT fisheries on the ecosystem, management would have to take into consideration the influence of climate variability. The significance of the influence of climate variability on these decisions could be addressed in an MSE context. Further it was voiced that the Subcommittee had a responsibility to represent the influence of environmental variability at the ecosystem level because the Species Groups only consider the importance of environmental variability with respect to their particular species of interest.

A discussion of future work for the Sub-group included the relative merits of the particular order of conducting a scoping exercise and elicitation process. The Subcommittee considered that a scoping exercise conducted for each ecosystem component by the relevant teams would help to inform the elicitation process and that the elicitation process might also borrow content from a similar exercise being conducted in the Sargasso Sea case study. The contribution of case studies in general to the overall implementation of EAFM and development of the EcoCard was also suggested as an important item to address at the next Sub-group meeting

4. Review the progress of the workshop convened to advance the identification of draft ecoregions and foster discussions on their potential use to facilitate the implementation and operationalization of EAFM within ICCAT

SCRS/2022/062 provided an ecoregion proposal of eight candidate ecoregions within the ICCAT Convention area. Ecoregions are geographically defined areas exhibiting relatively homogeneous ecosystems and are designed to be units of analysis to support ecosystem planning, incentivized ecosystem research, integrated ecosystem assessments, and decision-making for the integrated management of fisheries. These ecoregions could be used to develop concrete examples of ecosystem advisory products, as an additional and complementary tool to strengthen current practices in the Subcommittee and the SCRS for the provision of integrated advice to the Commission.

The Subcommittee thanked the presenter and the ecoregion team for the work carried out in developing the proposal of candidate ecoregions. The Subcommittee noted the importance of developing pilot products to test the usefulness of the proposed ecoregions and to communicate their potential use to the SCRS/Commission. The pilot products could help provide concrete examples of the use of ecoregions and the benefits in providing regional integrated advice. Therefore, the Subcommittee endorsed the proposed candidate ecoregions to develop pilot products to test their utility as a tool to advance EAFM implementation at ICCAT.

The Subcommittee expressed interest in continuing the work for refining the ecoregion delineation process based on the suggestions received in the first ecoregion workshop as well as any suggestion that may be received from the SCRS and proposed to have a second ecoregion workshop to refine the process. The Subcommittee discussed the timing of the second workshop and whether it should be run in parallel or not with the development of the pilot products. The Subcommittee favoured prioritizing the development of pilot projects as concrete examples to test their usefulness and leave the organization of the second ecoregions workshop to towards the end of 2023, where the pilot products could also be presented and discussed.

The Subcommittee wondered how the different thematic factors in the criteria (oceanography, core species distributions of target species and core fishing grounds of ICCAT fisheries) were treated and weighted for informing ecoregion delineation. They suggested that distribution of species should be given more weight over the other criteria, because the fleet dynamics which give rise to core fishing grounds were very dynamic. It was explained that during the workshop, the Subcommittee had discussions about what thematic factors in the criteria should be given more weight and that in principle all three were given equal

weight. Yet, because of the classification methods used for deriving a proposal (where biogeographic provinces were clustered based on their species and fisheries composition), it was explained that in the end it was the oceanography, followed by species, and then fisheries that had the largest impact in the resultant baseline ecoregion proposal boundaries. In the end, the final ecoregion product was the result of modifying the candidate baseline ecoregions based on expert judgment.

The Subcommittee also noted the regional management units for turtles and the ongoing work of sharks defining stock areas and movement (for porbeagle, shortfin mako) may not overlap well with the boundaries of the candidate ecoregions. The Subcommittee also wondered how to treat those species like bluefin tuna that are distributed across and move among several ecoregions. It was explained that the ecoregion will not accommodate the species distribution of every species in ICCAT. Instead, the ecoregions are trying to capture the core distribution of different species as well as distinct regional oceanographic features (e.g. Gulf stream ecosystem).

The Subcommittee wondered why bycatch species were not used to inform ecoregion boundaries. It was explained that bycatch species are intended to be the main focus of the ecoregion tool, as the ecoregions are meant to be used as the spatial framework to develop more integrated advisory products including integrated assessments for bycatch species.

The Subcommittee wondered what species and years in the CATDIS dataset were used in the ecoregion analysis. It was explained that the last 15 years were used and that this was only available for eight species of tunas and billfishes (major ICCAT species). The Secretariat informed the Subcommittee that soon three shark species will be included in the CATDIS dataset, so they might be considered for future analyses. Similarly, it was suggested trying to use the data available for the small tunas in future analyses since the data quality has improved for some of the small tunas in the recent years. The Subcommittee encouraged CPC scientists involved in the Small Tuna Species Group to participate in the next ecoregion workshop to account better for the small tuna species distribution and their fisheries in future ecoregion refinements.

The Subcommittee requested making the shapefiles delineating the final candidate ecoregions derived in the first workshop available to the Subcommittee and they were placed in the meeting's Owncloud.

5. Review how the terms EAFM and EBFM are being used and clarify which will be used by the Subcommittee

SCRS/P/2022/040 argued that to be consistent with the language employed by the Commission in [Rec. 15-11](#), the [SCRS Strategic Plan](#), and the amended [ICCAT Convention text](#) the Subcommittee should adopt the term Ecosystem Approach to Fisheries Management (EAFM) instead of Ecosystem Based Fisheries Management (EBFM).

In reference to the definition of EAFM as defined by the FAO EAF guidelines, it was noted the Subcommittee could at this stage only suggest that the Commission consider using the FAO EAFM ([García et al., 2003](#)) definition to guide the work of the SCRS in operationalizing EAFM in ICCAT.

Pertaining to Bycatch

6. Sea turtles

6.1 Review progress of the collaborative work on sea turtles and presentation of the next steps

SCRS/P/2022/033 presented an update on the collaborative work to assess the impact of tuna fisheries in the Atlantic and Indian Oceans and Mediterranean Sea. Fine scale bycatch data from several longline and purse seine fleets, covering about 20 years are being analyzed. In addition, bibliographical revisions on the status of sea turtle populations and their interactions with tuna fisheries other than those operating in the Atlantic and Indian Oceans and Mediterranean Sea, are being conducted to enable contextualization of the impact of tuna fisheries more globally.

Current available data include about 135,000 fishing sets. Preliminary analyses have been conducted for the main three bycatch species, loggerhead, leatherback, and olive ridley. Until now, random forest and GAM models considering several environmental covariates have been made for each species and by fishery. In addition, a revision of the status of sea turtle populations, and the interaction of sea turtles with ICCAT and non-ICCAT fisheries in the Mediterranean Sea is being conducted.

Given that in part the objectives were to determine catch rates and that the use of circle hooks has a proven effect on such rates, the Subcommittee questioned if the effect of circle hooks was being considered. Authors mentioned that this information was not available for all the fleets and/or all the data in the analysis, so it would be very difficult to include this factor in this analysis. However, as it was recognized as an important point, it could be considered in the future.

Regarding the review of the impact of other non-ICCAT fisheries, the Subcommittee discussed if this was important issue to analyze in the context of the impact of these fisheries on sea turtles, and if there was any intention to somehow reduce the importance of the impact of ICCAT fisheries. The inclusion of target species as a variable in the analysis was mentioned as an important component that should be considered. The authors noted that this information is not available, nevertheless a variable that considers the depth of operation of the longline was used. Depth can be considered as a proxy of the target species, as deep longlines commonly target tunas and shallow longlines target swordfish. The hypothesis for including this variable is that the setting depth influences sea turtles' bycatch.

Another comment was about the separation of fisheries (longline and purse seine) in the analysis, and the importance of having a result that integrated the effects of all fisheries. This has been considered and will probably be incorporated, but for the moment, the preliminary analyses have been done by fleet. Information and access to data providers for updated and other environmental variables was offered during the discussion. Participants in the meeting interested in this study were invited to participate.

Regarding the Mediterranean as a case study, the Subcommittee asked if it was possible to identify sea turtles at a species level during the aerial surveys from the Atlantic Wide Research Programme for Bluefin tuna (GBYP). According to scientist leading this part of the study, it was possible to identify species and that is why this information was offered from the GBYP and will be included. The importance of this study was highlighted, and it was noted that it might be important to share these results with the Indian Ocean Tuna Commission (IOTC) as part of the Indian Ocean is included in the study. The representative of the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) congratulated those involved in the initiative being carried out by this Subcommittee and the importance of these kinds of studies. The representative also offered collaborating with any available information and also with the participation of experts involved in the IAC.

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

7.1 *Factors affecting bycatch and interactions*

Document SCRS/2022/108 presented the advances of a collaborative work related to the development of bycatch reduction devices (BRDs) in tropical tuna purse seine fisheries. Some of the prototypes that are being tested to minimize bycatch, save time and improve crew safety include shark velcros, mobulid sorting grids, release ramps and hoppers with ramps. Authors noted that the use of these tools has shown promising results in terms of shark survival. It was also noted that the implementation of some of these BRDs may require adaptations in the vessels.

The Subcommittee requested clarification regarding the use of shark velcros since it would involve lifting the shark by the tail and this practice has been linked with potential injuries in the spinal column and internal organs of sharks. In response, authors noted that there is no scientific evidence showing that lifting a shark by the tail is harmful to the animal.

Document SCRS/2022/111 presented an update of a previous work on the effect of terminal gear modifications on the catchability and at-haulback mortality of shortfin mako shark. Two meta-analyses were updated as one of the referenced studies was found to have a confounding variable that resulted in interpreting a bait effect as a hook effect. Results showed that there is no significant difference in the catchability of shortfin mako sharks attributable to circle hooks.

As it was seen in the presentation, the review and update in the meta-analyses resulted in differences with the results previously reported by the authors. As such, the Subcommittee mentioned that in order to evaluate the effect of hook type on the catchability and at-haulback mortality rates, it would be important to apply the same update in the meta-analyses of other target and bycatch species. Even though it might be difficult to incorporate into the meta-analysis, the importance of other variables that have a proven effect on the at-haulback mortality like specimen size and temperature was also mentioned. These two variables might be associated with the type of fishery and the area of operation. The authors noted this important issue and commented that it is difficult to solve, sometimes due to the lack of information reported, and that this is an issue that applies to other meta-analysis studies. The importance of post-release mortality studies was highlighted in order to confirm the effectiveness of different hook types in reducing the mortality of the species.

SCRS/P/2022/032 presented an update of the meta-analysis on the effects of hook, bait, and leader type on retention and at-haulback mortality rates of target and bycatch species captured in pelagic longline fisheries. It showed that circle hooks significantly reduce retention rates of loggerhead, leatherback, and olive ridley sea turtles, with even lower retention rates than with fish baited hooks. Additionally, the use of circle hooks was demonstrated to significantly reduce retention rates of swordfish. Circle hooks were also associated with lower at-haulback mortality rates of some species, including blue shark, shortfin mako, and scalloped-hammerhead shark.

The Subcommittee supported the study update of separating studies that used squid and fish as bait into two experiments in order to eliminate confounding effects. The Subcommittee noted that despite causing a reduction in swordfish catches, the use of circle hooks seems to significantly increase retention of other targeted species specifically albacore and bluefin tuna.

The Subcommittee also discussed why there were such differences in at-haulback mortality rates when comparing bait type, and particularly for shortfin mako shark. In response, the authors noted that this was probably due to confounding effects like leader material and other variables including soaking time and environmental variables. The Subcommittee discussed that incorporating other variables, such as those mentioned above to the meta-analysis is difficult as sometimes the information is not available or splitting information in many variables results in a smaller number to analyze.

Additionally, the Subcommittee highlighted that the available information on post-release survival of non-target species is still limited and that this information is crucial to evaluate the effectiveness of different hook types in reducing mortalities of non-target species. The Subcommittee further noted the importance of sharing this type of analysis with the Sub-group on Technical Gear Changes, as well as with the Shark Species Group. The importance of this issue for [Rec. 21-09](#) and the Shark Research and Data Collection Program (SRDCP) was noted.

Document SCRS/2022/113 presented an overview of the mobulids tagging programs that are being conducted in the Atlantic Ocean. The main objective of these programs is to assess post-release survival of mobulids released from tuna purse seiners and identify the most effective handling practices in reducing mobulids mortality. To date, 9 pop-up tags have been deployed. Additionally, there are 17 tags that are planned to be deployed during 2022.

The Subcommittee noted its appreciation for the work developed and suggested that it should be presented to the Sharks Species Group during the SCRS Species Groups Meeting in September 2022.

8. Presentation of the progress made by the Sub-group on Technical Gear Changes (technical changes to the terminal gear)

The Subcommittee reviewed a short presentation on the progress in the course of five online meetings made by the Sub-group on Technical Gear Changes which is examining how potential technical changes to the terminal gear could affect catch rates, retention rates, at-haulback mortality, and post-release mortality.

The Sub-group is exploring the effects of terminal gear modification to address [Rec. 19-05](#) (paragraph 21) pertaining to billfishes but the work was subsequently expanded to consider sharks and focused specifically

on shortfin mako shark. The Sub-group is working on three main tasks as follows: 1) to collect, review and summarize past studies (e.g. reports and documents) for refining experimental study designs, with the main purpose to help inform design of Task 2 and Task 3; 2) to design experimental studies to assess the effects of terminal gear modifications (such as hook shape and size, leader type, etc. on catch rates, retention rates, at-haulback mortality and post-release mortality and 3) to design a study on the effects of fishing practices (including timing, soaking time, bait, depths, areas) that could reduce bycatch and bycatch mortality.

The Subcommittee inquired why the focus had been on SMA. In response, it was noted that while originally motivated by billfish, the effects of terminal gear modifications were of a broad interest on the subject in the SCRS community but that this interest was especially pronounced for SMA. In the future, any species could be considered. Further to this, the Subcommittee inquired if a call for tenders will be issued to implement the experimental design. But in response, it was noted that i) the Sub-group was not yet ready to implement an experiment in part because they still needed to synthesize the particular questions that the study would have to address; ii) it still needed to finalize the experimental design to address them; and iii) to determine the mechanism by which such a set of studies would be implemented. It was noted that in the Indian Ocean there was ongoing study looking at the effects of hook type, soak time, and other factors that might help with the design and implementation of such a study in the Atlantic Ocean. The Subcommittee was reminded that the Sub-group was open to anybody in the ICCAT community and would welcome information from other initiatives.

The Subcommittee discussed what the role of the Subcommittee was in discussing changes to the terminal gear. It noted that given that the concern being addressed by the Sub-group was the concern of virtually all working groups, the work of the Sub-group could expand to consume a large proportion of the Subcommittee's time. In response it was noted that the issues addressed by the SCRS have become more and more complex from year to year. Therefore, there should be a broader involvement of all Species Groups and Subcommittees in addressing these broader issues.

The Subcommittee agreed that the Sub-group continue to meet intersessionally in the course of 2022 and 2023 to advance the progress made to date. Moreover, it was reiterated that the Sub-group should continue to report on whatever progress had been made and continue to be revised by Subcommittee.

9. Revise the list of bycatch species that are found in the ICCAT database, in conjunction with the Secretariat and national scientists for the purposes of validating those species for ultimate use in research and reports (e.g. ecosystem components)

The Subcommittee co-convenor presented a revised list of bycatch species. He asked that members of the Subcommittee review the list to make sure that species on the list reflect species that have been reported and stored in the ICCAT database system. The Secretariat agreed to cross check the list of bycatch species against the list of species reported in Task 1.

There were questions about how to update the list of species currently on the FAO list of species that are captured but are not on the ICCAT list. The Secretariat described the process as follows: Create/collate a list of species without ASFIS code (last list: https://www.fao.org/fishery/static/ASFIS/ASFIS_sp.zip) and then for each, define the following:

- The scientific name, common names (EN, FR, ES), basic taxonomy, author(s)
- The Secretariat will confirm if they do not have ASFIS (alfa 3) codes issued (latest version)
- The Secretariat will send to FAO a request for inclusion of those new species in the ASFIS list
- Await feedback (and inform on possible requests)

10. Explore the use of scientific reference points as a tool for assessing and managing ICCAT fisheries with respect to bycatch species

There were no updates on this agenda item.

11. Investigate available information on hotspots and/or areas with high BPUE to aid in the management of ICCAT fisheries with respect to bycatch species

There were no updates on this agenda item.

12. Seabirds: future actions

Document SCRS/2022/058 proposed that a multi-year seabird strategy and action plan be developed to help guide and evaluate efforts to reduce seabird bycatch in ICCAT fisheries. The objectives and actions might include, but not be limited to, contribute to a formal review of the recommendations in Rec. 11-09, on reducing bycatch of seabirds, a review of Rec. 16-14, on minimum standards for observer programs, and Rec. 18-09, on port inspection. Such a strategy could align any recommended changes to Rec. 16-14 with concurrent updates to ICCAT reporting under Rec. 10-10, seabird incidental catch. An additional part of this strategy could be to review the Convention for the Conservation of Southern Bluefin Tuna's (CCSBT) multi-year seabird strategy, aspects of which could be considered in developing an ICCAT-specific strategy.

The participants of the CCSBT multi-year seabird strategy development informed the Subcommittee that the process to agree on the multi-year strategy took more than three years. Although the agreed-to strategy could not be shared before final approval at the CCSBT Commission, the Subcommittee was informed that according to the strategy included in its workplan it would conduct a global evaluation of effectiveness of introduction of seabird bycatch mitigation measures by tuna-RFMOs, including ICCAT. The intention is to invite relevant t-RFMOs scientists to participate. The Subcommittee was also informed that the second Areas Beyond National Jurisdiction (ABNJ) project planned to conduct the global assessment of seabird bycatch, similar to the one concluded in 2019, under the lead of Birdlife International together with the CCSBT. The Subcommittee proposed waiting to see the progress in the CCSBT before committing to new activities, noting the limitation of coverage by ICCAT on overall seabird bycatch occurrences and heavy workload expected for the inter-sessional period at the Subcommittee.

The Subcommittee noted that some aspects of the CCSBT plan could be considered in developing an ICCAT-specific strategy, but due to differences, including areas of operation of its fisheries and jurisdictional issues, ICCAT would have to consider its own experience. The Subcommittee recognized the importance of taking actions to address the bycatch of seabirds and specifically recalled that the review of Rec. 11-09 is still pending. The importance of starting to discuss a strategy was highlighted by the Subcommittee.

The Subcommittee recognized that seabird bycatch and its mitigation in longline tuna fisheries have historically been an important part of the meeting agenda. The Subcommittee discussed if allocating more agenda time to it in the 2023 meeting of the Subcommittee was needed.

Pertaining to Ecosystem and Bycatch

13. Review feedback received from Species Groups regarding their needs and contributions towards incorporating/developing ecosystem including bycatch considerations and discuss additional mechanisms to effectively coordinate, integrate and communicate ecosystem-relevant research across the ICCAT Species Groups and within the SCRS

The Subcommittee did not receive any feedback from any of the Species Groups on their needs or contributions pertaining to this agenda item. The Subcommittee discussed the need to insist on receiving this feedback and to find the appropriate mechanisms to procure this feedback.

14. Review 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 WGSAM or the Subcommittee on Statistics

This item generated a broad discussion that covered aspects related to the mandate and scope of the Subcommittee, as well as those related to the general functioning of the SCRS and the integration of

activities across all groups. It was understood that this debate should be carried out in the SCRS plenary meeting, since it involves all the groups and subcommittees. It is hoped that the SCRS convene a broad discussion on this topic at its annual meeting.

15. Contractor's report on the Quasi-Quantitative Risk Assessment Approach

The Subcommittee reviewed and approved a term of reference to be used in the call for tenders for work on the quasi-quantitative risk assessment approach.

16. Other matters

16.1 Update on status of EFFDIS

The EFFDIS (EFFort DIStribution) is a gear based (currently only longline) estimate of total effort made by the ICCAT Secretariat, resultant from raising the partial effort (with coverages of yearly fishing activity ranging from 10% to 100%) of Task 2 catch and effort (T2CE) reported by ICCAT CPCs, to the total effort of a given flag and gear within a year using the reported Task 1 nominal catches. The total estimated effort should be consistent with the total catches of the ten major tuna and tuna-like species, as well as the three major shark species that are reported in Task 1 nominal catches (T1NC). Some attempts were made in the past to validate the yearly T2CE coverage ratios reported, by comparing the total annual catches of the thirteen major ICCAT species reported in T2CE against its equivalent in T1NC. The Secretariat continues this study to improve the EFFDIS in the future.

On the follow-up of the Subcommittee of Ecosystems and Bycatch and the Subcommittee on Statistics in 2021, there was a recommendation to review the gaps of T2CE available in the ICCAT-DB. The Secretariat provided a brief study of the T2CE limitations (presentation SCRS/P/2022/030) which included the data-gap analyses that were focused on the identification of missing T2CE datasets for those records where an equivalent T1NC exists (total catches of the thirteen major species). The study compared two geographical regions (ATL, Atlantic Ocean and the MED, Mediterranean Sea). This was to contrast the poor and inconsistent T2CE datasets from the MED, with the more complete datasets of ATL. Only the longline T2CE datasets reported by month and 5x5 (or higher resolution) were considered. There are cases where more than one T2CE dataset per flag/gear/year was reported to ICCAT (each with different species catch compositions but reflecting the same effort). These have not yet been fully eliminated. This could double count the number of hooks estimated.

For the period 1950-2020 each T2CE longline dataset (flag, year, gear, effort, effort measure, group) was cross joined with its equivalent T1NC dataset (catches of the 13 major ICCAT species by flag, gear, and year). Each combination was then classified into five categories (scores in brackets):

- | | |
|---|------|
| a) T2CE without equivalent T1NC | (-1) |
| b) T1NC only (T2CE missing) | (1) |
| c) T1NC and T2CE reported without effort (only catches) | (2) |
| d) T1NC and T2CE reported without hooks (other effort measures) | (3) |
| e) T1NC and T2CE reported with hooks | (4) |

Only the category (e) is qualified to be used in the EFFDIS estimations. The remainder T2CE datasets classified in the other 4 categories need to be corrected (a), recovered (b), and fully revised (c and d) by ICCAT CPCs.

16.2 Estimate the fraction of the total longline catches that do not have sufficient effort information in T2CE and estimate the impact of those datasets on the estimates of EFFDIS

The results for the MED, with an average of 14 flags with LL activity between 1990 and 2020, show that only 4 to 5 flags (~33%) reported consistently over time, so that they would qualify according to the category e criterion (above) to be used in EFFDIS (**Figure 1**). In terms of catches of the 13 major ICCAT species (**Figure 2**) the T1NC coverage increased to around 50% on average (1990-2020) with large oscillations (between 20% and 85%) within that period.

The results for the ATL, with an average of 31 flags with LL activities between 1990 and 2020 (increasing from 23 flags in 1990 to 39 flags in 2006 and then decreasing to 30 flags in 2020), show that about 15 to 16 flags reported consistently over time to qualify for use in EFFDIS according to the category e rating criterion (**Figure 3**). In terms of catches of the 13 major ICCAT species (**Figure 4**), T1NC coverage increased to about 90% on average (1990-2020), with the average coverages of about 80% in the 1990's growing to more than 90% in 2000s.

The Group welcomed the Secretariat's preliminary work on the completeness of T2CE reporting. After some clarifications requested by the Group on the methodology used (criteria used in classification of categories, process used to cross-join T2CE and T1NC, and the filtering rules used to screen/eliminate T2CE datasets), the Group reiterated the continued need to improve T2CE using this report on the degree of T2CE completeness as a way to identify where gaps needed to be fixed. The Secretariat noted that the expected improvements in T2CE will also greatly benefit CATDIS estimates in the future. This could address the reiterated recommendation of the Subcommittee on Statistics proposed by the Sharks Species Group to include the three major shark species in the CATDIS.

The T2CE data from 2000 onwards included approximately 90% of T1NC catches of the 13 major species. The benchmark used by the Group for publishing EFFDIS would be to use those yearly T2CE datasets classified as category e (as explained above) that cover at least 90% of T1NC catches for the 13 major species.

Future improvements to T2CE made by CPCs to both regions (ATL and MED) will allow producing EFFDIS for years prior to 2000. In addition, other important gears fishing for ICCAT species (purse seine, baitboat, gillnets, etc.) may also be included in the future in EFFDIS with similar studies.

16.3 Preview of the Global Environmental Fund ECOTEST project

This information is provided in section 2.1.

17. Recommendations

17.1 Regarding the Ecosystems component

In addition to endorsing case studies related to the EAFM (Tropical Atlantic, Sargasso Sea, and Mediterranean), the Subcommittee recommends pursuing a Memorandum of Understanding (MoU) with the Sargasso Sea Commission (SSC) as well as with other relevant organizations as this will strengthen linkages and collaboration with bodies required to implement EAFM.

17.2 Related to the EcoCard work

The Subcommittee recommends that the Sub-group on the Ecosystem Report Card meet intersessionally to continue reviewing the applicability and functionality of the Ecosystem Report Card as outlined in the report SCRS/2022/104.

17.3 Related to the Ecoregion work

The Subcommittee recommends that the SCRS review and comment on the ecoregion delineation process as well as on the proposed candidate ecoregions within the ICCAT Convention area. It further invites the SCRS to provide future directions and report back to the Subcommittee.

17.4 Related to the EAFM/EBFM terminology

The Subcommittee recommends that the different SCRS species groups and subcommittees adopt the use of the acronym EAFM (Ecosystem Approach to Fisheries Management) instead of the acronym EBFM (Ecosystem Based Fisheries Management) to be consistent with the terms used by the Commission and the SCRS Strategic Plan.

17.5 Regarding Bycatch component

The Subcommittee recommends that the Secretariat, in collaboration with the SCRS and national scientists, continue to review and update the list of bycatch species in the ICCAT database.

- The Subcommittee noted the relevant advances made by the collaborative research regarding interactions between ICCAT fisheries and marine turtles. To increase the value of this work to the SCRS and the Commission, the Subcommittee recommends more national scientists holding relevant data on these interactions within ICCAT fisheries to join this collaborative research and make their data available.
- The Subcommittee recommends that the SCRS continue collaborating with the Inter-American Convention for the Protection and Conservation of Sea Turtles and that the existing collaboration be enhanced.
- Updated meta-data analyses reviewed by the Subcommittee continue to support that the use of large circle hooks is an effective mitigation measure to reduce sea turtle bycatch. While recognizing that circle hooks have varying effects on other target and bycatch species, the Subcommittee continues to recommend the use of circle hooks for shallow longline sets to increase the effectiveness of conservation measures for sea turtles. The Subcommittee also recommends continued research of the efficacy of terminal gears including circle hooks and the trade-offs across species throughout the ongoing work of the Sub-group on Technical Gear Changes.
- The Subcommittee recommends that the Sub-group on Technical Gear Changes continue to meet intersessionally to continue advancing its important work.

17.6 Regarding on Ecosystems and Bycatch component

- The Subcommittee recommends that national scientists review their historical T2CE data using the SCRS report card and submit any missing information. This task is required to improve the current estimation of the EFFDIS and CATDIS.
- The Subcommittee recommends that the EFFDIS estimates for the Atlantic region for 2000 onwards be posted for use on the ICCAT website.

17.7 Recommendations with Financial Implications

17.7.1 Regarding the Ecosystem component

- The Subcommittee endorses the proposed preliminary candidate ecoregions derived from the first ICCAT ecoregion workshop to develop pilot products to test their usefulness and utility as a tool to progress on EAFM implementation in ICCAT. The pilot products will provide some concrete examples of the use of ecoregions to operationalize EAFM in ICCAT. They will also show their potential uses and benefits to the SCRS/Commission. The Subcommittee requests financial assistance to support the work to develop a case study project (integrated bycatch assessment for two selected ecoregions) to test usefulness and utility of the ecoregions as a tool to progress on EAFM implementation in ICCAT [€15,000].
- The Subcommittee recommends that the SCRS supports further refinements of the ecoregion process and proposed candidate ecoregions based on the suggestions described in the report (SCRS/2022/107) as well any suggestion received from the SCRS. The Subcommittee recommends a second ICCAT ecoregion workshop in 2023 to refine the ecoregion delineation process based on the expert advice and feedback received in the first ICCAT ecoregion workshop as well as feedback received by the SCRS. For this, the Subcommittee requests financial assistance to organize this second ecoregion workshop (online). Financial assistance will be used to support the preparatory work [€15,000].
- The Subcommittee recommends that financial support be given to assist with development of the risk screening and management prioritization tool [€15,000].

17.7.2 Regarding the Bycatch component

- The Subcommittee requests financial assistance to support the attendance of five to eight CPC scientists at a collaborative workshop to continue the evaluation of ICCAT fisheries impact on marine turtles in the Mediterranean Sea, with the use of detailed fishery observer data. This is in support of an ongoing process that will continue over the coming years [€20,000].

The table below contains the overall funding requests made by the Subcommittee for 2022:

<i>Subcommittee on Ecosystems and Bycatch</i>	2023
Workshops/meetings	
Support the work to develop a case study project	€15,000
Collaborative workshop to discuss the relevance and the methodology used to delineate candidate ecoregions	€15,000
Workshop on evaluation of impact of ICCAT fisheries on marine turtles in the Mediterranean Sea	€20,000
Support for development of risk screening and management prioritization tool	€15,000
TOTAL	€65,000

18. Workplan

Consistent with the ongoing exercise of developing an Ecosystem report card and implementing an EAFM framework for ICCAT, the Subcommittee drafted the following workplan. The plan indicates specific tasks to be completed and organizes them by priority (from highest to lowest) for the coming year.

18.1 Pertaining to the work of the Sub-group on the Ecosystem Report Card

The Subcommittee recommended that the Sub-group on the Ecosystem Report Card continue to do intersessional work related to the ToRs provided in Appendix 5 of the Report of the 2021 Intersessional Meeting of the Sub-Committee of Ecosystems (Anon., 2021) and the Report of the First Meeting of the Sub-group on the Ecosystem Report Card (SCRS/2022/104).

Date	Component	Proposed tasks	Who
December 2022, 3 days, online,	Sub-group	<ol style="list-style-type: none"> 1. Review progress on the regular production and communication of the EcoCard to the SCRS (i.e. assessments updating pilot EcoCard). 2. Plan specific activities to obtain feedback from the Commission, including creating a questionnaire targeting the ICCAT community to support a scoping exercise. 3. Discuss how the ongoing case studies (e.g. Sargasso Sea, Tropical Atlantic, Mediterranean Sea) contribute to EcoCard development; 	Convenor: Participants: national scientists and observers

		<p>4. Review a draft of the “guideline document” shared prior to the next Sub-group meeting;</p> <p>5. Identify and discuss potential synergies and collaborations with outside international projects and initiatives to support indicator and EcoCard development;</p> <p>6. Undertake a scoping exercise to:</p> <ul style="list-style-type: none"> – Review the objectives of each ecosystem component, – Review objectives of EcoCard and each of the ecosystem components relative to the conceptual DPSIR model, – Identify the attributes each component monitors, – Identify synergies and overlapping among the ecosystem components. 	
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18.2 Pertaining to the workshop on ecoregion development:

The Subcommittee proposes:

- To develop pilot products to test their utility and be presented at the next meeting of the Subcommittee on Ecosystems and Bycatch;
- To conduct a second ICCAT ecoregion workshop to refine the ecoregions following the delineation process. This includes every step of the process from objectives to methods used to derive them, to refining of boundaries, to testing their usefulness. The pilot projects finished by the time of the second workshop can be presented there to facilitate discussion with concrete examples.

<i>Date</i>	<i>Component</i>	<i>Task</i>	<i>Who</i>
Intersessional work starting June 2022 and ends December 2023	Pilot Product development	Test the relevance of the ecoregions	Sub-group participants
December 2023, 3 days	Second Ecoregion Workshop	Review and update ecoregions	Sub-group participants

18.3 Pertaining to the development of a Risk Screening and Management Prioritization Tool

The steps required for development of the tool include:

- Establish supporting database containing ecological and habitat characteristics of species, and characteristics of fishing operations of individual gears, in particular, including a list of species used as baits, list of species observed to interact with ICCAT fisheries, depth of gears, and any attracting devices (e.g., FADs, bait, light sticks).
- Develop a risk screening tool with machine learning, based on susceptibility determined by the ecological and habitat characteristics of species. Observed occurrences of interactions will be

used as the cases showing positive susceptibility when training the machine learning process. The results of the risk screening tool will be tabled at the 2023 meeting of the Subcommittee.

- Develop a management prioritization tool as a further extension of machine learning model, once a range of risk species identified and judgment criteria to determine management priority are given.

<i>Date</i>	<i>Component</i>	<i>Task</i>	<i>Who</i>
June 2022 to June 2023	Further development of supporting database	Operational characteristics of fleets; interaction observed between any species with ICCAT fisheries; habitat characteristics for non-fish species, including seabirds, sea turtles, sea mammals; data mining of habitat characteristics information for crustaceans, cephalopods, and ctenophores to be done with automated data acquisition.	Sachiko Tsuji/Contractor Contract must complete prior to the end of December 2022
June 2022 to June 2023	Develop AI modeling for risk screening	Explore and choose proper model structure for risk screening, test model, provide screening results at the 2023 meeting of the Subcommittee	Laurie Kell, Sachiko Tsuji
2023 to June 2024	Develop AI modeling for management prioritization	Develop model to identify additional species of concern, depending on an assessment of their conservation priority. First trial to be tabled for review of 2023 meeting of the Subcommittee and final model to be presented at the 2024 meeting of the Subcommittee.	Modeling team/ Contractor?

18.4 Pertaining to the progress on case studies

While the Subcommittee endorses objectives of the various case studies, it is not currently engaged in ensuring their completion.

<i>June 2022 to June 2023</i>	<i>Sargasso Sea Case Study</i>	<i>Extend DPSIR approach to more components in the NW Atlantic Ocean (i.e. Habitat, Environmental Pressures, Fishing Pressure)</i>	<i>Provide full names</i> <i>Laurence Kell</i>
	Tropical Ecoregion Case Study	Advance existing knowledge on the biological interactions between different ecosystem components in the Atlantic tropical ecosystem as follows: 1. Undertaking trophic analysis using stomach contents, stable isotope analysis, fatty acid analysis, and genetics	Eider Andonegi

		<p>2. Developing ecosystem models (Ecopath with Ecosim (EwE))</p> <p>3. Developing model-derived indicators to inform several components of the ICCAT EcoCard</p>	
	Western Mediterranean Sea Case Study	<p>1. Develop tools (e.g., web based) for monitoring marine extreme events with an impact on tuna ecology in key areas of the Mediterranean</p> <p>2. Explore the integration of environmental recruitment spatial models into assessments to provide new fisheries and conservation perspectives.</p> <p>3. Provide updates for the environmental component of the ecosystem report card</p> <p>4. Explore outreach activities through the tuna dedicated education platform planettuna.com</p> <p>5. Conduct workshops at Mediterranean scale to find ways to align general objectives of ICCAT in this ecoregion with institutions in charge of i) ocean observation (e.g., The Mediterranean Ocean Network, MONGOOS) and ii) the implementation of the new objectives of the Barcelona Convention and the 2030 biodiversity strategy of the European Union (e.g., The United Nations Environmental Program)</p>	Diego Alvarez

18.5 Pertaining to Ecosystems Report Card Development

The tasks outlined here are somewhat contingent on the outcomes of an elicitation process and a review by the Sub-group on the Ecosystem Report Card. No updates are expected before the 2023 meeting of the Subcommittee. There is no obligation, but teams are welcome to continue their work.

<i>Component</i>	<i>Task</i>
	Update prototype report card components with new indicators
Retained species: Assessed	Update B_{RATIO} and/or F_{RATIO} values from recent assessments and deal with $F_{0.1}$ issue
Retained species: Not assessed	Perform PSA to select retained unassessed species
Non retained sharks	Increase the scope of the data used in the analysis. Include other gear types
Turtles	Perform risk assessment for loggerhead and leatherback turtles and indicator development
Seabirds	Create indicator based on the total interactions, total mortality or alternatives
Mammals	Discuss collaborations with IWC and ICES
Trophic structure, community and diversity indicators	Continue work developing indicators to monitor the biomass structure, size structure and trophodynamics of the ecological communities in response to fishing pressure and environment (detail workplan in Andonegi <i>et al.</i> , 2020)
Habitat	Create indicators to monitor climate-induced and fishing-induced habitat changes in ICCAT species
Socio economic	Develop a process to extract the socio-economic data

Fishing pressure	Develop an indicator based on fishing effort or capacity. Develop indicator based on marine debris
Environmental pressure	Develop indicators that are generic
Marine debris, food webs and trophic relationship	Informal discussion of the elements of the plans and potential indicators

18.6 Pertaining to other ecosystem items

It was recommended that the Subcommittee Co-convenors, in cooperation with the SCRS Chair and Vice Chair, continue their revisions to the EAFM components of the SCRS strategic workplan.

<i>Date</i>	<i>Component</i>	<i>Task</i>	<i>Who</i>
May 2022 – June 2023	SCRS Strategic workplan	Review and propose updates to the components of the plan that relate to EAFM and Bycatch	Bycatch and ecosystem convenors
June 2023, 5 days	2023 meeting of the Subcommittee on Ecosystems and Bycatch		

Pertaining to bycatch

- ECOTEST development will continue through 2022, expanding it to include other species
- Continue the collaborative work on sea turtles
- Conduct a 5-day workshop focussed on sea turtle (including leatherback) bycatch in the Mediterranean Sea
- Continue the collaborative work with the Sharks Species Group on bycatch
- Continue work on Sub-group on Technical Gear Changes
- Continue to review and clean the list of bycatch species
- Discuss and continue to make progress on seabird bycatch issues
- Explore the use of reference points for the management of bycatch species

19. Responses to the Commission

19.1 Explore potential technical changes to the terminal gear and fishing practices that could reduce bycatch and bycatch mortality (at-vessel and post-release). Design and implement a study(ies) to compare the effects of hook shape and size on catch rates. Rec. 19-05, para 21

Background: The SCRS shall, in collaboration with CPCs, explore potential technical changes to the terminal gear (such as hook shape, hook size, leader type, etc.) and fishing practices (e.g. timing, soaking time, bait, depths, areas) that could reduce bycatch and bycatch mortality (at-vessel and post-release). As part of this process, the SCRS in collaboration with CPCs shall design and implement a study (or studies) to compare the effects of hook shape and size on catch rates (considering both hooking and retention rates), at-haulback mortality, and post-release mortality. The experimental design should account for the influence of leader material types and consider potential operational differences among regions and fleets.

As indicated in the 2021 response to the Commission, a Sub-group was created to explore potential technical changes to the terminal gear changes. This Sub-group was expanded beyond the Billfish Species Group to include participants from other SCRS Species Groups and subcommittees. The Sub-group continued to work intersessionally during 2022 and it made significant progress in completing the following tasks:

- Compiling a preliminary list of operational longline fleet characteristics in the ICCAT Convention area.

- Making a preliminary review of available scientific literature regarding catch rates and retention rates, at-haulback mortality and post-release mortality in ICCAT longline fisheries.
- Conducting a power analysis for some ICCAT longline fleets to establish the required fishing effort to be able to detect the effects of the technical gear changes.

While the Subcommittee acknowledges that important work has been conducted to address the Commission's request, it also indicated that more work is still needed in order to provide advice to the Commission. Therefore, the Sub-group will continue to meet intersessionally in 2023 and report its findings to the Subcommittee on Ecosystems and Bycatch.

20. Adoption of the report and closure

The report was adopted, and the meeting was closed.

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Table 1. Tasks to be completed by the Ecosystem Report Card working groups prior to the 2022 Meeting Subcommittee on Ecosystems and Bycatch.

<i>Date</i>	<i>Component</i>	<i>Task</i>	<i>Who</i>
May 2021 to April 2022		Update prototype report card components with new indicators	
	Retained Species: Assessed	Update B_{RATIO} and/or F_{RATIO} values from recent assessments and deal with $F_{0.1}$ issue	Subcommittee participants
	Retained Species: Not assessed	Perform PSA for select retained unassessed species	Subcommittee participants
	Non Retained Sharks	Increase the scope of the data used in the analysis. Include other gear types	Subcommittee participants
	Turtles	Perform risk assessment for loggerhead and leatherback turtles and indicator development	Subcommittee participants
	Seabirds	Create indicator based on the total interactions, total mortality, or alternatives	Subcommittee participants
	Mammals	Discuss collaborations with IWC and ICES	Subcommittee participants
	Food web and trophic relationships	Continue work developing indicators to monitor the biomass structure, size structure and trophodynamics of the ecological communities in response to fishing pressure and environment (detailed workplan in Andonegi <i>et al.</i> 2020).	Subcommittee participants
	Habitat	Create indicators to monitor climate-induced and fishing-induced habitat changes in ICCAT species	Subcommittee participants
	Socio economic	Develop a process to extract the socio-economic data	Subcommittee participants By-catch Coordinator
	Fishing Pressure	Develop an indicator based on fishing effort or capacity. Develop indicator based on Marine debris	Subcommittee participants Secretariat
	Environmental Pressure	Develop indicators that are generic.	Subcommittee participants
	Case Studies	Extend DIPSIR approach to more components in the NW Atlantic Ocean (i.e. habitat, environmental pressures, fishing pressure). Tropical ecoregion case study (test EAFM tools including Ecosystem Overview Report, Ecosystem Risk assessment, Ecosystem models).	Subcommittee participants

Table 2. Proposed update to form ST09. Depth Range and Hooks between Floats are now required to be reported separately for each set using one of the 3 categories indicated for each metric. Optionally, the estimated depth of fishing may also be reported when known.

<i>FOpDepthCode</i>	<i>Hooks between Floats (HBF)</i>	<i>Estimated depth range value in 10m increments (optional)</i>
Shallow	1-5 h/f	
Medium	6-12 h/f	
Deep	12+ h/f	

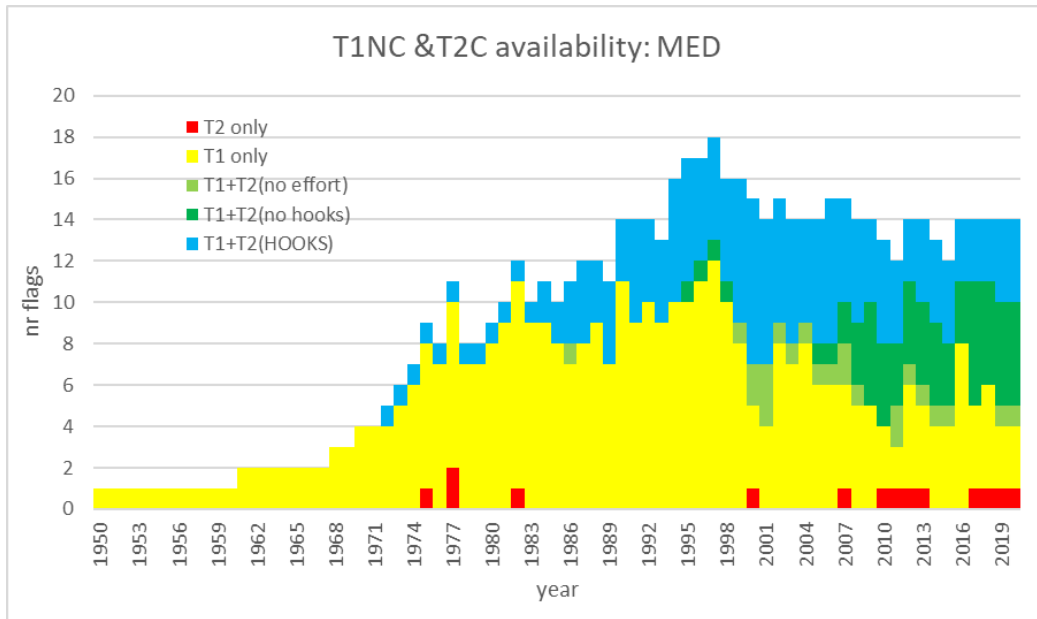


Figure 1. Number of flags with longline fishing activity reporting T2CE and T1NC by year and T2CE category, in the Mediterranean Sea. Only the “light blue” series can be used in EFFDIS estimations.

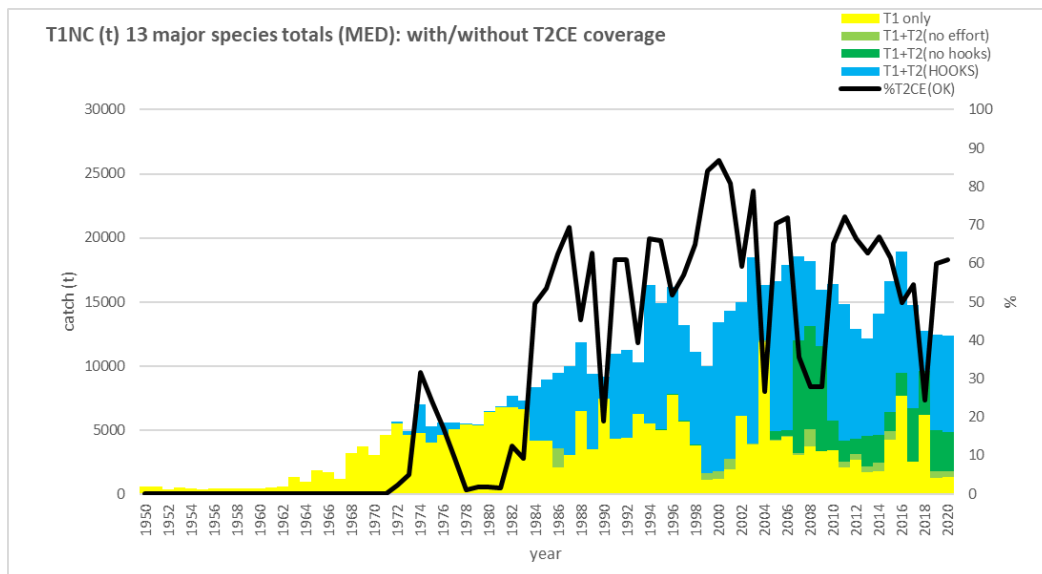


Figure 2. Total longline catches (t) of T1NC (13 major species) classified by T2CE categories and year, in the Mediterranean Sea. The coverage ratio of T1NC classified under “T2CE category e)” (shaded in “light blue”) against the T1NC longline catches is shown on the right axis.

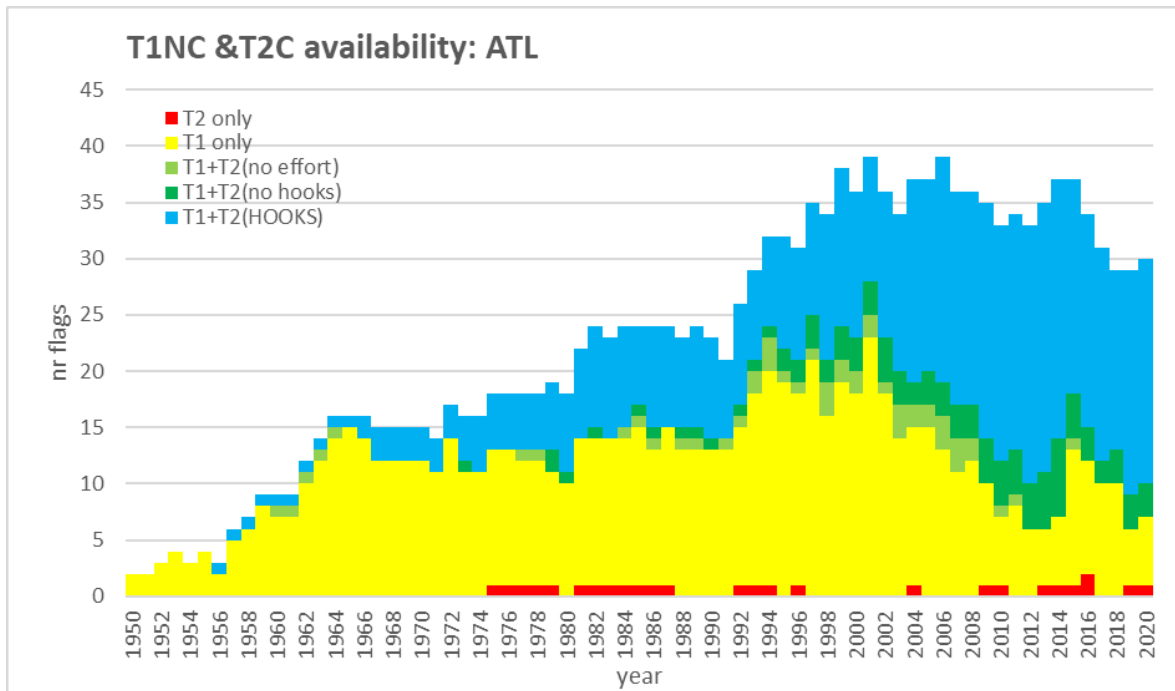


Figure 3. Number of flags with longline fishing activity reporting T2CE and T1NC by year and T2CE category, in the Atlantic Ocean. Only the light blue series can be used in EFFDIS estimations.

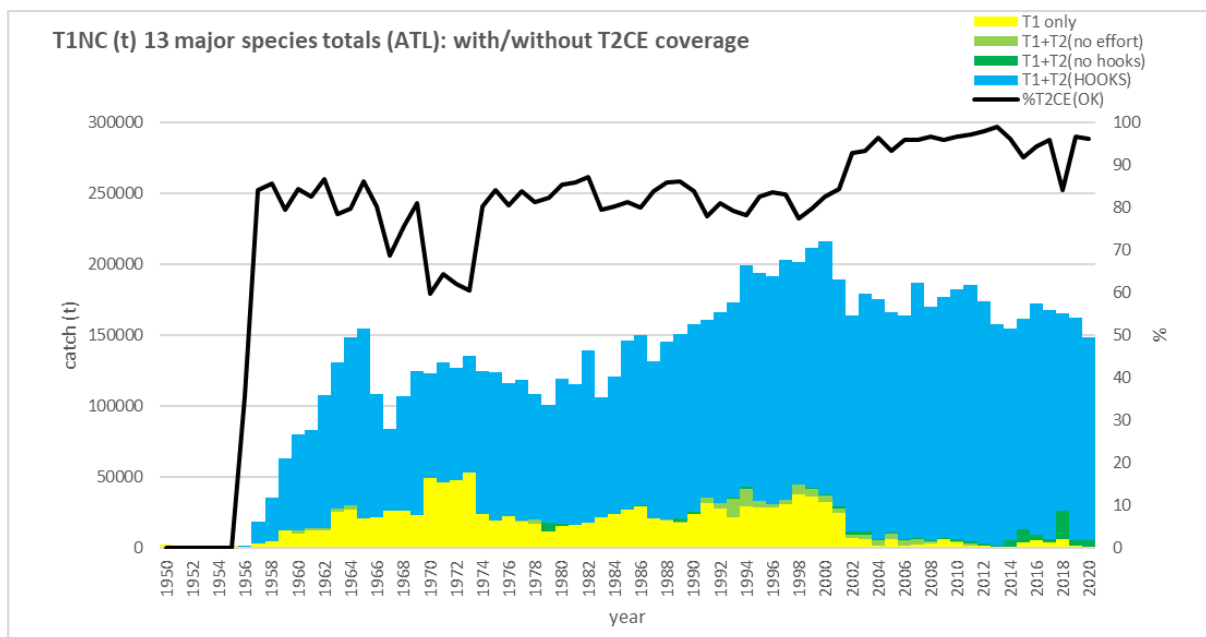


Figure 4. Total longline catches (t) of T1NC (13 major species) classified by T2CE categories and year, in the Atlantic Ocean. The coverage ratio of T1NC classified under “T2CE category e)” (shaded in “light blue”) against the T1NC longline catches is shown on the right axis.

Agenda

1. Opening, adoption of the Agenda and meeting arrangements

Pertaining to Ecosystems

2. Review the progress on developing status indicators, pressure indicators and reference levels for the components of the Ecosystem Report Card
 - 2.1 Review progress on the development of methods for prioritizing risks and screening and validating indicators
 - 2.2 Review development of case studies and ecoregions
3. Review the intersessional work of the sub-group working on the applicability and functionality of the Ecosystem Report Card (EcoCard) as a tool for monitoring the impacts of ICCAT fisheries
4. Review the progress of the workshop convened to advance the identification of draft ecoregions and foster discussions on their potential use to facilitate the implementation and operationalization of EBFM within ICCAT
5. Review how the terms EAFM and EBFM are being used and clarify which will be used by the Subcommittee.

Pertaining to Bycatch

6. Sea turtles
 - 6.1 Review progress of the collaborative work on sea turtles and presentation of the next steps
7. Effect of the mitigation measures: intra and inter taxa
 - 7.1 Factors affecting bycatch and interactions
8. Presentation of the progress made by the Sub-group on Technical Gear Changes (technical changes to the terminal gear)
9. Revise the list of bycatch species that are found in the ICCAT database, in conjunction with the Secretariat and national scientists for the purposes of validating those species for ultimate use in research and reports (e.g., ecosystem components)
10. Explore the use of scientific reference points as a tool for assessing and managing ICCAT fisheries with respect to bycatch species
11. Investigate available information on hotspots and/or areas with high BPUE to aid in the management of ICCAT fisheries with respect to bycatch species
12. Seabirds: future actions

Pertaining to Ecosystem and By-catch

13. Review feedback received from Species Groups regarding their needs and contributions towards incorporating/developing ecosystem including bycatch considerations and discuss additional mechanisms to effectively coordinate, integrate and communicate ecosystem-relevant research across the ICCAT Species Groups and within the SCRS

14. Review 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 WGSAM or the Subcommittee on Statistics
15. Contractor's report on the Quasi-Quantitative Risk Assessment Approach
16. Other matters
 - 16.1 Update on status of EFFDIS: CPCs identified as having reported T2CE datasets with incomplete information on effort (catches without effort), report revisions to ICCAT with the missing effort included and whenever possible the catches of the three major shark species (POR, BSH, SMA)
 - 16.2 Estimate the fractions of the total longline catches that do not have sufficient effort information in T2CE and estimate the impact of those datasets on the estimates of EFFDIS
 - 16.3 Preview of the Global Environmental Fund ECOTEST project
17. Recommendations
18. Workplan
19. Responses to the Commission
20. Adoption of the report and closure

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Appendix 3

List of Papers and Presentations

	<i>Title</i>	<i>Authors</i>
SCRS/2022/058	Proposal to develop an ICCAT seabird work plan	Wolfaardt A., Prince S., Yates O., Jimenez S., Gianuca D.,
SCRS/2022/062	Pre-workshop analysis in preparation for the 2022 ICCAT Ecoregion Workshop: Identification of regions in the ICCAT Convention area for supporting the implementation of ecosystem-based fisheries management	Nieblas A.E., Murua H., Juan Jordá, M.J.
SCRS/2022/104	Report of the 1st Meeting of the Sub-group on the Ecosystem Report Card	Juan-Jorda M., Murua H., Diaz G., Obregon P., Kell L., Alvarez-Berastegui D., Eider A., Coelho R., Sachiko T., Ochi D., Domingo A., Die D., Yates O., Tai I., Bell J., Tugores P., and Hanke A.
SCRS/2022/106	ECOTEST, a proof of concept for evaluating ecological indicators in multispecies fisheries, with the Atlantic longline fishery case study	Huynh Q., Carruthers T., and Taylor N.G.
SCRS/2022/107	Report of the ICCAT workshop on identification of regions in the ICCAT Convention area for supporting the implementation of ecosystem-based fisheries management	Juan-Jorda M., Nieblas A., Hanke A., Tsuji S., Andonegi E., Di Natale A., Kell L., Diaz G., Alvarez Berastegui D., Brown C., Die D., Arrizabalaga H., Yates O., Gianuca D., Niemeyer Fiedler F., Luckhurst B., Coelho R., Zador S., Dickey-Collas M., Pepin P., and Murua H.
SCRS/2022/108	Developing bycatch reduction devices in tropical tuna purse seine fisheries to improve elasmobranch release	Murua J., Ferarios J.M., Grande M., Onandia I., Moreno G., Murua H., and Santiago, J.
SCRS/2022/109	Progress report of development of communication support tool for implementation of ecosystem-based approach to fisheries management	Tsuji S.
SCRS/2022/110	2nd Report of the Sub-group on technical gear changes	Anonymous
SCRS/2022/111	The effect of terminal gear modifications on the total mortality of the shortfin mako, <i>Isurus oxyrinchus</i>	Keller B., Reinhardt J., Swimmer Y. and Brown C.
SCRS/2022/113	Tagging programs of mobulids in the Atlantic Ocean	Grande M., Onandia I., Murua J., Maria J., Ruiz J., Lezama-Ochoa N. and Santiago J.
SCRS/P/2022/030	Improving EFFDIS: cross-validation of catch and effort data to identify weaknesses	Palma C., Taylor N.G., and Major C.
SCRS/P/2022/032	Update of the meta-analysis on the effects of hook, bait, and leader type on retention and at-haulback mortality rates of target and bycatch species	Santos C., Rosa D., and Coelho R.
SCRS/P/2022/033	Advances on the collaborative work to assess sea turtle bycatch in pelagic longline and purse seine fleets (Atlantic and Indian Oceans and Mediterranean Sea)	Domingo A.
SCRS/P/2022/035	Study case for Ecosystem Based Management (EBM) in the Mediterranean EcoRegion: an initiative for monitoring the environmental variability of tuna related marine ecosystems and transference for effective EBM	Alvarez-Berastegui D., Reglero P., Carlos-Baez J., Macias D., Ortiz-de Urbina J., Cabanellas M., Juza M., Mourre B., Hernandez I., Diaz-Barroso L., Tintoré J., Amengual-Ramis J., Cardin V., and Gloria-Lazaro, A.

SCRS/P/2022/037	Risk assessment framework for targeted, bycaught, endangered, threatened, protected, predator and prey species	Kell L.T.
SCRS/P/2022/040	EAFM or EBFM in ICCAT: terminology and definitions	Juan-Jorda M.
SCRS/P/2022/041	Trophic ecology in the ICCAT tropical ecoregion	Andonegi E.

Appendix 4

SCRS documents and presentations abstracts as provided by the authors

SCRS/2022/058 - The development and adoption of a seabird strategy and action plan is proposed. This strategy should be informed by relevant ICCAT Recommendations and actions to reduce levels of seabird bycatch across its fisheries, and the large volume of work presented at the Sub-committee on Ecosystems plus other relevant information on seabird bycatch. This will facilitate a strategic and coordinated approach to seabird bycatch management in ICCAT.

SCRS/2022/062 - The overall aim of the workshop is to advance in the identification of candidates for ecologically meaningful regions (ecoregions) that can serve as a basis to produce more integrated ecosystem-based advice, and thereby support the operationalization of ecosystem-based fisheries management (EBFM) in the International Commission for the Conservation of Atlantic Tunas (ICCAT) convention area. Ideally, the candidate ecoregions should have boundaries that make ecological sense but should also be practical for facilitating the provision of integrated advice at the regional level. This report summarizes a pre-workshop analysis following the Terms of References agreed upon by the SC-ECO which will be presented at the workshop to inform group discussions. The expected outputs of this workshop are: (1) a better understanding of the role and purpose of ecoregions as a tool to support EBFM implementation in ICCAT; (2) decision criteria including the major thematic factors to guide the development of draft ecoregions; (3) an understanding of the data layers and analytical methods proposed for deriving the ecoregions with their strengths and weaknesses; and (4) a proposal of candidate draft ecoregions within the ICCAT convention area. The workshop will gather CPC national scientists and external experts from different scientific disciplines (e.g., biogeography, oceanography, ecology, fisheries and fisheries management in the ICCAT area) to develop an iterative and consultative process for broad-scale regionalization of the ICCAT Convention area.

SCRS/2022/104 - A Sub-group of the SC-ECO met to review the applicability and functionality of the Ecosystem Report Card (EcoCard) to be applied in ICCAT. The first meeting focused on understanding the process underway for developing and reporting the indicator based EcoCard in ICCAT. Progress was compared against the five main stages recommended for indicator development, reporting and use. The discussions and recommendations of the Sub-group have been structured in terms of (1) progress and best practices, (2) challenges and actions that need further refinement, (3) gaps, and (4) opportunities and potential solutions, relative to each of the five stages.

SCRS/2022/106 - There is a need for rigorous science to inform decision makers for Ecosystem Based Fisheries Management (EBFM). It is important to establish challenging and plausible scenarios for ecosystem dynamics and then test whether current and potential indicators can reflect stock status. Without the validation of indicators and the testing of relevant policy guidance to mitigate ecosystem impacts, there is a credibility gap between scientific practitioners of ecosystem science and decision makers that need to defend their actions in large multi-party negotiations. A multi-species framework that supports tactical decision making can make significant progress towards the essential goals of EBFM. We present a management strategy evaluation framework called "EcoTest". This is an extension to openMSE software, used for single-species modeling, which simulates multi-species fisheries dynamics. A range of features are possible in EcoTest, such as the ability to evaluate current indicators as well as design new indicators and identify the conditions under which indicators operate reliably. Here we demonstrate the use of EcoTest using the Atlantic longline fishery as a case study.

SCRS/2022/107 - In 2020 the Subcommittee on Ecosystems (SubEco) recommended convening a workshop to advance the identification of ecologically meaningful regions (ecoregions) in the ICCAT convention area to support the implementation of ecosystem-based fisheries management (EBFM). Ecoregions may provide a spatial framework to support regional ecosystem planning and prioritization, incentivized ecosystem research and the development of integrated advice products for informing fisheries management-decisions. This online workshop took place the 15-17th of March 2022 and gathered 32 participants with a wide range of expertise in ICCAT species, fisheries and oceanography in the Atlantic Ocean. Prior to the workshop, a consultant was hired to prepare a baseline ecoregion proposal to be presented and discussed at the workshop. During the workshop, the Group discussed the potential benefits and potential uses of ecoregions in the context of ICCAT species and fisheries. The Group also provided feedback on the technical aspects, the data and methodologies used in the derivation of the baseline ecoregions proposal. Using their expert knowledge, the Group refined the baseline ecoregion proposal which resulted in a proposal of eight candidate ecoregions within the ICCAT convention area. The Group recommends that (i) the SubEco review and comment on the ecoregion delineation process and the proposed candidate ecoregions within the ICCAT convention area and (ii) invites the SubEco to provide future directions. The Group also recommends that the SubEco endorses the proposed candidate ecoregions to develop pilot projects to assess the usefulness and utility of the ecoregions as a tool to progress on EBFM implementation in ICCAT.

SCRS/2022/108 - Today most on deck bycatch releases in tuna purse seiners are conducted by hand or simple aids (e.g., canvases, cargo nets). New developments in bycatch reduction devices (BRDs) can assist to decrease impacts on vulnerable bycatch species, including sharks and mobulid rays. Collaborative work with fishers is helping advance in the construction of functional BRD prototypes, which improve crew safety and speed up bycatch release times. New options such as shark velcros, mobulid sorting grids, release ramps, and hoppers with ramps can enhance current release standards. Practical aspects such as low cost, durability, easy handling, and storage can favor their adoption. Designs for some BRDs need to be adapted around individual vessels, and sometimes are limited by available deck spaces and configurations. However, for future purse seiners these selective BRDs should be integrated from the start in the boat design to maximize their efficiency and integration. Finally, we encourage tuna RFMOs to support research and adoption of BRDs for endangered, threatened and protected (ETP) species, incorporating them in their conservation measures and best release practice guidelines.

SCRS/2022/109 - The paper reported the progress in the development of a tool to facilitate prioritization in implementation of ecosystem-based approach to the fisheries management (EBFM) presented as SCRS/2021/071 (revised). Although the database on habitat characteristics has made several improvements on fish species, in data coverage, database structure and codes management, no progress has been made in further expansion of habitat characteristics database to cover other taxonomic groups. The way to define potential extent of the ICCAT relevance of individual species was modified to assess fisheries-specific susceptibility for three gear groups (i.e. longline, purse seine and other coastal gears), separating from the extent of distribution overlap that would be determined by the extent of biological relationships with tuna and tuna-like species, including prey-predator relations, cohabitants, and commensal species. It is also intended to shift toward the utilization of machine learning approach and currently its feasibility was under examination mainly based on random forest model. Based on lessons learnt so far, the paper further collaboration and support from the SC-ECO.

SCRS/2022/110 - This report reflects the work that was conducted intersessionally by the Sub-group on Technical Gear Changes after the 2021 SCRS plenary and the 2022 SC-ECO meeting. When created, the Sub-group was tasked with 3 main tasks, namely: 1) Collect, review and summarize past studies for refining experimental study designs, 2) Designing experimental studies to assess the effects of terminal gear modifications (such as hook shape and size, leader type, etc.) on catch rates, retention rates, at-haulback mortality and post-release mortality, and 3) Designing a study on the effects of fishing practices (e.g., timing, soaking time, bait, depths, areas) that could reduce bycatch and bycatch mortality. In this report we provide details on the process and work conducted since the last 2021 SCRS plenary (and until the present date). Most of the work has focused Task 1 and 2 described above., namely preparing tables of fisheries descriptions, carrying out power analysis to identify the minimum effort required to detect specific % changes for gear effects in experimental studies on hook types for various species and fleets, and summarizing past studies. We also provide the plans for continuing the work throughout 2022.

SCRS/2022/111 - Due to the overfished status of the North Atlantic shortfin mako, *Isurus oxyrinchus*, ICCAT has identified the need to better understand the effect of terminal gear modification as a mitigation measure in longline fisheries. Here we update two meta-analyses as one of the referenced studies was found to have a confounding variable that resulted in interpreting a bait effect as a hook effect. In both cases, significant differences in catchability are lost between hook types. For at-haulback mortality, the cited sources from the two meta-analyses were combined to maximize sample size; an updated model demonstrates a significant reduction of 10% in at-haulback mortality due to circle hook use. In review of additional publications, shortfin mako caught with circle hooks vs. J-hooks were twice as likely to be mouth hooked vs. foul or gut hooked, with the latter two being at least 4.5 times more lethal than mouth hooking. Overall, our paper demonstrates circle hook use is effective for reducing total mortality of the species and improves the probability of survival of shortfin mako incidentally captured in longlining fishing operations.

SCRS/2022/113 - Tagging programs are key to evaluate post-release mortality of Endangered, Threatened, and Protected species that are caught incidentally in fishing operations, such as mobulids. This document presents the tagging programs conducted on purse seiners under OPAGAC and ANABAC, aimed at assessing post-release survival of mobulids caught in association with tuna schools in the Atlantic Ocean, and released according to the Code of Good Practices. Tagging started in 2019 and will continue until the 26 POP-UP tags are deployed. The preliminary results show that the low occurrence of these individuals on purse seine sets, has delayed implementation of the programs, with only 9 specimens tagged on twelve fishing trips (300 days-at-sea). Deployment of the remaining 17 TAGs is planned before the end of 2022. The programs will enable to identify differences in the probability of survival depending on the releasing method used and the state of the animal following its capture. MINI-PAT tags will allow to collect information for the study of the species' habitat and migratory pattern, which can be instrumental in the identification of complementary mitigation measures, where required.