REPORT OF THE 2016 INTER-SESSIONAL MEETING OF THE SUB-COMMITTEE ON ECOSYSTEMS
(Madrid, Spain, 5-9 September 2016)

1. Opening, adoption of Agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat, Madrid, from September 5 to 9, 2016. Mr. Driss Meski, ICCAT Executive Secretary, opened the meeting and welcomed participants. The Sub-Committee on Ecosystems Co-conveners, Dr. Kotaro Yokawa (Japan) and Dr. Alex Hanke (Canada) reiterated the ICCAT Executive Secretary's welcome. The Conveners then described the objectives and logistics of the meeting. The Agenda was adopted with several changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The List of Documents presented at the meeting is attached as **Appendix 3**. The following participants served as rapporteurs:

Section	*Rapporteurs*
Items 1, 6, 9	P. de Bruyn
Item 2	M-J. Juan Jorda
Item 3, 5.	A. Hanke
Item 4, 7	G. Diaz
Item 8	A. Wolfaardt, B. Mulligan
Item 10	K. Yokawa, A. Hanke

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

Document SCRS/P/2016/046, entitled "Evaluation of Methods of Incorporating Oceanographic Indicators into Indices of Abundance for Stock Assessment: Project Overview and Progress" provided the progress on the building and use of the longline simulator model LLSIM. LLSIM is a computer programme to simulate longline catch data for highly migratory species. The spatial detail of the current version is for the Atlantic Ocean but other spatial features could be accommodated. The data simulations are designed to facilitate the analysis of the precision and accuracy of methods used to estimate population abundance from catch and effort data in fisheries assessments. The basic rationale is to generate controlled random data with sufficient realism so that strengths and weaknesses of alternative methods can be judged using known true values as a standard. The general case is that the number of hooks fished, other gear features, catch and general location of each set are known from real data. Population abundance and its distribution in space are unknown, and an accurate time series of abundance is the objective of the analysis. This model is being used to address the need for testing and validating various methods of including oceanographic data into the standardization of CPUE data as recommended by the Working Group on Stock Assessment Methods. It also addresses the recommendation made by the Sub- Committee on Ecosystems on how best to include environmental indicators into CPUE standardization. Progress was demonstrated on how temperature and dissolved oxygen data from the Community Earth System Model, version 1– Biogeochemistry [CESM1(BGC)] has now been incorporated into the model. This data was able to reproduce often used oceanographic indicators such as the Atlantic Multidecadal Oscillation (AMO), the Tropical North Atlantic Index (TNA) and the Atlantic Warm Pool (AWP). Progress was also demonstrated in building the gear and effort layers of the LLSIM model. A simulated fishery has been developed based loosely on the US longline fleet logbook data 1986-2010. At this stage of development the catchability of each of 131 gear types is being developed. Once this task is completed the Group should be able to distribute a simulated data set to one or more analysis groups for testing of various standardization methods. The results of this exercise will hopefully be ready for presentation at the 2017 Working Group on Stock Assessment Methods (WGSAM) meeting.

The author shared with the Sub-Committee a CPUE standardization exercise planned to be conducted in the 2017 WGSAM meeting. The exercise consists in providing to several groups of people with a set of CPUE time series that need to be standardized using environmental data and other factors, and post evaluating the different group approaches and methods and their effect on the CPUE standardization. During the CPUE standardization exercise, the different groups will not know in advance the time series of true abundance corresponding to the CPUE time series being analyzed. The objective is to evaluate whether current CPUE standardization practices used in ICCAT result in products that are close to the true abundance trends or not. The Sub-Committee raised several questions about the CPUE standardization exercise. The Sub-Committee wondered whether the assessment teams would be given the same starting environmental data sets or if instead they would need to compile them themselves since

the different starting points could have an impact on the standardization exercise. The author pointed out that the whole exercise was not totally defined yet, but that the main objective was to provide to a group of people with CPUE time series that needed to be standardized together with environmental data and other common factors to evaluate the impact of the different standardization techniques and methods currently used. For example SST will be provided, which is a common environmental variable used in CPUE standardization exercises, yet the author pointed out that just because it is commonly available does not mean it should be the standard environmental parameter always used. There is a need to evaluate whether the common standard use of SST is good enough. The author highlighted that there is a clear need to evaluate whether the current practices in ICCAT of CPUE standardization without incorporation environmental information are working right or if there is value in adding environmental information to improve the CPUE standardization process. Perhaps the current practices and their outputs are close enough to the true abundance trends of the populations being analyzed and there is no need to complicate and extend the CPUE standardization process. To reiterate, the first thing is to test the performance of current practices and then move on from there.

It was also pointed out that the objective of the exercise is to define a standard practice for CPUE standardization, in this case, blue marlin is being used as an example, but any of the species could be used. The author reiterated that the objective of the study is not trying to reproduce the actual CPUEs of any species, that is not needed. The point is to create CPUE time series for which we know the true abundance trend of the studied population, and use it to test the performance of methods. We could also extend this tool to explore the effect of changing catchability over time due to technological improvements and measure the effect on the CPUEs.

The Sub-Committee noted that the study missed salinity as an important environmental variable to determine species distributions, and highlighted it could also be used to determine the habitat suitability index of species. It was raised by the author that an important future step is to validate the habitat suitability model predicted with the real distribution of the species.

The Sub-Committee discussed the overall value of using environmental data to standardize CPUE time series, and how often this type of analyses is used in the Species Working Groups. It was expressed that it is a current practice, perhaps not common enough. However, it was highlighted that it should be considered a priority and worth pursuing further.

Document SCRS/2016/175 entitled “Modelling the oceanic habitats of silky shark (*Carcharhinus falciformis*), implications for conservation and management” aimed to provide the first insights into the environmental preferences of silky sharks by modelling their abundance from observer data with a set of biotic and abiotic oceanographic factors, spatial-temporal terms and fishing operation variables. Investigating the relationship between abundance and environmental conditions is of primary importance for the correct management of marine species, especially highly migratory large pelagic species like silky sharks (*Carcharhinus falciformis*), a species that is currently ranked by the IUCN as near threatened or vulnerable, depending on the region. Tropical tuna purse seine vessels annually deploy thousands of drifting fish aggregating devices (FADs) to facilitate catching tuna. However, using these devices increases the by-catch rate compared with fishing free swimming schools, as well as other potential impacts on the ecosystem. This work considers Spanish observer data (IEO and AZTI database) from 2003 to 2015, and comprising ~7500 fishing sets for the Atlantic Ocean. Oceanographic data (SST, SST gradient, salinity, SSH, CHL, CHL gradient, oxygen, and current information such as speed, direction and kinetic energy) were downloaded and processed for the study period and area from the MyOcean- Copernicus EU consortium. Results provide information on the dynamics and hotspots of silky shark abundances as well as the most significant habitat preferences of the species. Models detected a significant relationship between seasonal upwelling events, mesoscale features and shark abundance and suggested strong interaction between productive systems and the spatial-temporal dynamics of sharks. This information could be used to assist t-RFMOs in the conservation and management of this vulnerable non-target species.

The Sub-Committee questioned how far away we are from using this type modeling approaches, prediction maps of habitat preferences and hotspots for species of by-catch to assist in fisheries management decisions. The Author pointed out that once the validation of the model is complete, it will be possible to provide annual prediction maps of habitat preferences for silky sharks which potentially could be more useful to provide management advice. The Sub-Committee discussed alternative ways of using the current data and suggested to explore the effect of inter-annual variability or other time frames on the habitat preferences of silky shark. Additionally, it was noted that very little is known about this species migrations and their feeding and reproductive areas which should clearly be linked to the distribution maps of the species. The Sub-Committee agreed there should be more work to link environmental data with the behaviour, ecological and habitat preferences of this species. The collection of biological samples and gonad data could complement the habitat preference study to elucidate if species are there for feeding and/or reproduction.

The Sub-Committee also highlighted the fact that the habitat preference maps are based on fishery dependent data which can have an impact on the resulting interpretation of the habitat preference maps. Yet, the author pointed that by collapsing all the fisheries observer data into one time frame and estimating habitat preferences by quarters, the fishing effort was relatively well distributed spatially and by quarter. Additionally, the author is exploring several methods to evaluate if fishing effort distribution is having an effect on the results. The author is also planning to expand these types of analyses to other by-catch species, and focus first on those species that are threatened, as well as including other by-catch and target species, with the objective of identifying habitat overlaps of species spatially and temporally and identify hotspot areas that can be predictable in space and time.

The Sub-Committee also discussed the fact that FADs might be modifying the natural habitat of silky sharks. Additionally, there might be several characteristics about the FAD operations such as their speed and location that might be changing the natural conditions, distribution and behavior of sharks. The study is currently accounting for some of these factors and it is encouraging that it was able to find a link between the spatial presence of sharks and major oceanographic features.

Document SCRS/2016/160 entitled "Aspects of The Migration, Seasonality and Habitat Use of Two Mid-Trophic Level Predators, Dolphinfish (*Coryphaena Hippurus*) and Wahoo (*Acanthocybium Solandri*). In The Pelagic Ecosystem of the Western Atlantic including the Sargasso Sea "provided information on aspects of the ecology of two mid-trophic level predators, dolphinfish *Coryphaena hippurus* and wahoo, *Acanthocybium solandri* in the western Atlantic including the Sargasso Sea. Both species are included in the ICCAT Small Tunas category and are taken principally as by-catch species by longline fisheries. However, they support important commercial and recreational line fisheries in the western Atlantic including the United States and the Caribbean. Both species play an important role in the pelagic ecosystem of the western Atlantic but both have been relatively little studied until recently. Studies show that there is a linkage between oceanography and the seasonality of fisheries landings of these two species and data from Bermuda, in the central Sargasso Sea, are provided as an example. Electronic (PSAT) tagging data has provided evidence of possible migration routes and lengthy residence times of dolphinfish in the Sargasso Sea. These PSAT data also provide important insights into habitat use and diel patterns of feeding in the water column. The evidence presented here shows both the importance of these two species in the overall ecosystem and the need to incorporate these and other species into any ecosystem-based management system for tuna and tuna-like species in the Sargasso Sea.

The Sub-Committee discussed whether there is enough knowledge to affirm that high sea pelagic ecosystems in the Atlantic Ocean are top-down or bottom up driven, and noted how little is known about the trophic ecology of apex predators and how climate and fishing affect the structure and function of the pelagic food web. A preliminary trophic web of the Sargasso Sea was presented to demonstrate the trophic positions in this pelagic ecosystem. It was pointed out that dolphin fish are food competitors with Yellowfin and Albacore tuna in the northern part of their range. The Sub-Committee affirmed that there is relatively little known about the trophic ecology of these species.

The Sub-Committee pointed out a recent paper by Olson *et al.* 2016 (Bioenergetics, trophic ecology and niche separation of tunas, advances in Marine Biology, in press) which discusses how the trophic ecology research of tunas in the Atlantic Ocean is much behind and has yet to provide much of the detail and knowledge that exists in the Pacific and Indian Oceans.

It was also recalled that currently the ICCAT Atlantic Tuna Tropical Tagging Program has a plan to tag wahoo in the Western Atlantic as recommended by the ICCAT Small tuna Working Group.

Additionally, the stock structure of these two species was briefly discussed. The literature suggests that Wahoo appear to comprise a single circumglobal population with little genetic differentiation between oceans and genetic studies of dolphinfish in the North Atlantic Ocean also indicate little population differentiation.

Document SCRS/P/2016/044 evaluates the progress of the five tuna RFMOs (tRFMO) in implementing Ecosystem-Based Fisheries Management (EBFM). Specifically it focuses on reviewing the ecological component, rather than the socio-economic and governance components of an EBFM approach. First it develops a benchmark Conceptual Ecological Model for what could be considered a "role model" of EBFM implementation in a tRFMO. Second, it develops a criteria to evaluate progress in applying EBFM against this benchmark role model. The evaluation assesses the progress of the following four ecological components: targeted species, by-catch species, ecosystem properties and trophic relationships, and habitats, and review 20 elements that ideally would make EBFM more operational. The review finds that many of the elements necessary for an operational EBFM are already present, yet they have been implemented in a patchy way, without a long term vision of what is to be

achieved and a formalized plan implementation. In global terms, tuna RFMOs have made considerable progress within the ecological component of target species, moderate progress in the ecological component of by-catch, and little progress in the components of ecosystem properties and trophic relationships and habitats, although their overall performance varies across the ecological components. All the tuna RFMOs share the same challenges of coordinating effectively all ecosystem research activities and developing a formal mechanism to better integrate ecosystem considerations into management decisions and communicating them to the Commission. While tuna RFMOs are at the early stages of implementing EBFM, it is believed implementation should be seen as a step-wise adaptive process which should be supported with the best ecosystem science and an operational plan as a tool to set the path to advance towards its full implementation. With this comparative review of progress it is hoped to create discussion across the tuna RFMOs to inform the much needed development of operational EBFM plans.

The Sub-Committee was supportive of the assessment of the progress of tRFMOs to apply the principles of EBFM. It was emphasized that the intent was not to compare the progress among tRFMOs but to provide the feedback necessary to focus progress within each. Direct comparisons are also difficult because progress will vary due to the specific nature of the problems each tRFMO faces. Some tRFMOs were established before ecosystem principles were addressed in major international treaties and agreements, so more recently establish tRFMOs may have the advantage of having accommodated ecosystem considerations into their basic texts and throughout their administrative structure.

The list of specific actions that a tRFMO must respond to was large and it was recommended that the Sub-Committee prioritize these actions and review them against what has already been included in the SCRS Strategic Science Plan to see if any need to be included in the Groups workplan. It was noted that tRFMOs should collaborate on addressing the prioritized list so that there would be less duplication of effort and to coordinate mechanisms for communication within and between tRFMOs.

Consideration was given to the fact that certain goals of a tRFMO may not be within its capacity to achieve so expecting compliance with some minimum standard might not be possible. Thus mechanisms to increase work capacity within each RFMO are needed. In addition, collaboration with the other tRFMOs and intergovernmental organizations would facilitate progress.

There was some concern expressed over reference points for by-catch species because of their use in an assessment context suggested that many species would be without one. It was however noted that the term reference point has a different meaning and might require different estimation methods for each taxomic groups.

With respect to the reporting of results, there was a request that the success of the measures was represented to show progress relative to some starting point (within the current time period) rather than with an ideal tRFMO. It was noted that this was considered but too difficult to implement. It was noted that the role model RFMO might be difficult to achieve and instead it was highlighted that implementation should be seen as a step-wise adaptive process, evolutionary and not revolutionary, which should be supported with the best ecosystem science

3. Develop proposals for obtaining common Oceans ABNJ tuna project funding to support a joint meeting between tRFMOs on the implementation of the EBFM approach.

The Sub-committee reviewed an invitation sent to the five tRFMOs regarding their interest in participating in a joint meeting on the implementation of the EBFM approach. The invitation included the proposed agenda developed at the 2015 Sub-committee on Ecosystems meeting.

All invitees agreed to participate in a meeting scheduled for 12-14 December 2016 at FAO headquarters in Rome, Italy. A maximum of two attendees were identified by each tRFMO with ICCAT being represented by the SCRS Chair and a representative of the Secretariat.

4. Establish clear EBFM goals and objectives to be discussed and considered by the Commission.

An ecosystem based fisheries management framework was developed for the ICCAT convention area and populated using data sourced from Task II size data, Task II catch effort data, the ICCAT manual, FishBase and peer reviewed literature (SCRS/P/2016/047). The framework included 4 components from the Ecological dimension of the generic EBFM framework defined by Lodge *et al.* 2007. To this was added a monitoring component of the support system. A total of 27 species/stock elements were included in the Target Species

component and 13 species plus generic seabird and sea turtle elements were included in the By-catch Species component. Only two habitat elements have been defined for the Habitat Component and one element within the Monitoring and Trophic Relationship components. The framework reveals both the potential to report on the status of the ecosystem within the ICCAT Convention area and problems that must be overcome to make the reporting complete, current, accurate and informative. Ideally, the framework requires a standardized reporting format for all Species Working Groups with database support for biomass and fishing mortality data as well as reference points and life history parameters. Continued efforts to populate the framework will involve work on data inputs, indicators, reference levels and management response for each element of the framework. Lastly, some thought must be given to how the framework's content should be reported and an effort must be initiated to hold workshops, engage experts, start a dialogue with the Species Working Groups, Commission and other tRFMOs with a view to advancing progress on the framework.

The Sub-committee discussed the appropriateness of the data sources proposed to develop the length and weight based indicators, such as the Task II data. Concern was expressed that these might not be the most appropriate data sources in all cases and that other sources of data should be investigated. For example, series of average weights are estimated by the Secretariat for some stocks for which assessments are conducted and those average weights are more representative than those estimated from the Task II Catch-and-Effort data. The Sub-committee recognized the difficulties in obtaining the time series of biomass and fishing mortality estimated in the course of stock assessments used as indicators in the EBFM framework because this information is rarely included in the stock assessment reports. It was pointed out that in the past the WGSAM recommended that time series of estimated B and F be included in the assessment reports. This recommendation from the WGSAM was adopted by the SCRS, but it has been mostly ignored by the Species Working Groups. However, the Sub-committee also recognized the difficulties that might arise providing this information when multiple model runs are performed during the stock assessments and there is no clear favorite. In these cases, the Species Working Groups are expected to select just one series of B and F to use as an ecosystem indicator with the caveat that these indicators were not considered to be optimal representatives of the status of a particular stock. The Sub-committee indicated that the proposed framework in its current format includes extensive fishery information in the Target species component of the framework, but limited elements in the Monitoring and Trophic relationships components. It was discussed that fishery information is already provided in stock assessment reports and Executive Summaries and the Sub-committee wondered if including such information in the framework is a duplication of effort. It was explained that indicators other than B and F could be provided for the target species to reduce the redundancy and that it was necessary to have these elements in place to be able to develop elements in the trophic relationships component. It was also discussed the need to clearly identify the target audience of the ecosystem report cards derived from this framework. The detailed content of the framework was thought to be useful for use by the SCRS to identify data and research needs and to measure progress. It was noted that the framework itself identifies the relationship between conceptual management objectives and the operational objective useful to science and that a more synthesized reporting of the framework would be more accessible to the Commission and other constituents. It was suggested that ecosystem report cards are an excellent tool to provide information and they are already being used by other RFMOs. These report cards can be updated on a regular basis to inform the Commission.

Other available tools are Ecosystem Risk Assessments that help to identify and quantify the importance of the different components of the ecosystem and their interactions where you can estimate the likelihood of an interaction occurring and their potential ecological and economic impact. Ecosystem Risk Assessments can also be used to identify what ecological and socioeconomic components should be tracked and to prioritize work. It was discussed that even though the Commission had embraced EBFM for ICCAT, the Commission still finds that it is challenging to understand the concept and the requirements for its implementation and that the SCRS should continue to work with the Commission to achieve a better understanding of EBFM. Similarly, the concept of EBFM has not been deeply discussed at the Species Working Groups. As such, the Sub-committee agreed that the Sub-committee on Ecosystems should reach out to the Species Working Groups and provide guidance on the best way to collaborate with this effort. The Sub-committee agreed that the framework will be helpful to develop products for the Commission to advance and better understand EBFM. It was discussed the need to develop some of these products in the near future as it is preferable to provide information to the Commission as we advance in our efforts rather than inform the Commission later in the process. The Sub-committee discussed that one approach to move forward is to develop a case study for a particular stock instead of for a particular ecosystem. In other words, it would be easier and perhaps faster to inform the Commission to conduct an assessment of a particular stock incorporating different aspects of the ecosystem (e.g., trophic relationships, environmental data) rather than developing a case study for the Gulf of Mexico or the Sargasso Sea. At the same time, the Sub-committee agreed on the difficulties and limitations associated to advancing this work when the Sub-committee on Ecosystems only meets once a year.

5. Assess research needs and prioritize research activities in order to develop a long term research plan

The Sub-committee reviewed SCRS/2016/170 which provided a long term work plan based on the elements of the SCRS Strategic Science Plan that pertained to Ecosystems. Discussion was then held in regard to the short term and long term objectives and the best way forward.

In a classic EBFM implementation framework, such as that proposed by Levin *et al.* (2009), the first step is to identify the goals and objectives, as these objectives are used to identify data gaps and guide the development of indicators, reference points and management actions. Consideration was given to involving the Commission in the process, however involving management bodies was recommended only once a clear vision of the EBFM framework and reporting format was available. Thus, given that the Sub-committee was also provided with an EBFM framework during the meeting (SCRS/P/2016/047), it was concluded that the most feasible path forward would be to focus on producing an Ecosystem Report Card based on the framework.

The Report Card and framework could be presented at the next Dialogue between Science and Managers Meeting in order to receive feedback on the proposed goals and objectives. The involvement of Species Working Groups in the design and support of the Report Card was also considered an important short term objective. Additional measures for engaging the Commission involved constructing a questionnaire where the responses would be the basis of an ecosystem risk assessment that would identify the Commissions management objectives.

The Sub-Committee determined that the following ecosystem related activities would be important to complete in the coming years with the full awareness of the other SCRS Working Groups:

Short Term

1. To develop an **Ecosystem Report Card** that will be reviewed by the Sub-committee on Ecosystems in 2017

   The purpose is:

   a) Synthesize and summarize multiple and complex information into a smaller number of grades and distinct ecosystem components.

   b) Effectively communicate the status and trends of several ecosystem components to the Commission and other stakeholders.

   c) Engage the Commission and other stakeholders

2. To request the Commission to include an agenda item in the next Dialogue Meeting between Scientists and Managers, regarding a continued discussion on EBFM.

   The purpose is:

   a) Present the Ecosystem Report Card and Ecosystem framework.

   b) Engage the Commission in the development of Ecosystem Report Card and Ecosystem framework.

   c) Increase awareness of the need to account for ecosystem consideration in fisheries management.

3. To implement new mechanisms or improve current mechanisms to effectively coordinate, integrate and communicate ecosystem-relevant research across the SCRS Working Groups.

   The process might include:

   a) Start discussions with other SCRS Species WG about providing those stock assessment data outputs in a standardized format in order to generate the indicators required for the EBFM framework.

b) At each intersessional meeting of the Sub-committee on Ecosystems provide a report of the main outcomes from the previous year. For example:

i. Summary of the main outcomes of the last Commission meeting relevant to the activities of the Sub-committee on Ecosystems. [Secretariat]

ii. Summary of the main outcomes of the last annual SCRS meeting relevant to the activities of the Sub-committee on Ecosystems. [Chair]

iii. Summary of relevant activities, outputs, initiatives derived from the other Working Groups relevant to the activities of the Sub-committee on Ecosystems. […]

Medium Term

1. Develop an **Ecosystem Considerations Report** (or Ecosystem Synthesis Report) and include it as part of the ICCAT Manual in a section on Ecosystems Based Fisheries Management.

   The purpose is:

   a) Synthesize and integrate information of the main ecosystem components, processes and interactions in the ICCAT ecosystem using existing analysis and reports to provide an understanding of the ecosystem context in which ICCAT fisheries operate.

   b) Provide a guidance document for the Sub-committee on Ecosystems, and ultimately a guidance document for the Commission to provide an ecosystem context for fisheries management decisions.

   c) Provide a living document where ecosystem research, research priorities (long and short), and data gaps are raised and used to updated the work programme on a year schedule.

2. Conduct an **Ecosystem Risk Assessment (ERA)** with the input and participation from the Commission.

   The purpose is:

   a) Use the ERA as a tool to (a) define potential relevant ecological, human and institutional interactions and (b) assess their likelihood of occurrence and magnitude of their impact (ecological or economic impact), in order to provide general guidance to the Commission about the interactions on which to focus further research and attention.

   b) Provide guidance to the Commission from the ERA results, inform the Commission about what it is already doing to address the impacts and rank the risks identified.

   c) Engage the Commission and increase awareness of the need to incorporate ecosystem consideration into decision making process.

6. Total effort estimates by fishery

6.1 Longline

6.1.1 Review Task II longline catch and effort data coverage

The Secretariat provided a brief overview of the availability of Task II data for use in the Effdis data estimations (**Table 1**). It was noted that only data provided in $1x1^{O}$ resolution and by month are suitable for the Effdis estimation. It was clear that many important/significant fishing fleets have not reported effort information at a sufficient resolution to facilitate Effdis estimation. The Sub-committee therefore recommended as a priority that this Task II data be recovered, especially for more recent years.

The importance of these data was highlighted by the fact that at least 70% of the total effort should be available in order to provide reliable extrapolations for the missing data. The Secretariat clarified that it is likely that less than 70% coverage has been obtained although this would need to be confirmed.

6.1.2 Review the methodology to be used to update the longline EFFDIS data

The contractor who produced the updated EFFDIS estimates in 2015 provided the Sub-committee with a brief summary of the assumptions and data used to conduct the estimation exercise. The full details of this work is provided in document Beare *et al.* 2016. The Sub-committee was then invited to request clarifications on several of the assumptions and issues with the data.

The Sub-committee acknowledged the utility of this information as well as its importance to the continued seabird and sea turtle work. The author noted several caveats with the data used for the estimations. In some cases the summed Task II data is higher than the Task I nominal catches. The Sub-committee clarified that in all cases the Task I data is considered more reliable and so should be the scaling factor. It was noted, however that where these types of conflicts exist, they should be flagged for future clarification with CPCs.

The Secretariat also clarified that there have been substantial revisions by some CPCs to the Task II CE database. These changes may have a significant impact on the Effdis estimations. The revision of the Task II data will be conducted prior to the 2016 SCRS plenary meeting at which stage these data can be provided to the author of the Effdis document in order to revise the estimations. It was also requested that the author provide estimates of error and uncertainty around the final Effdis estimates. In the short term this may be in the form of CVs around the estimates, but more complex solutions will be sought to provide a clearer picture of the uncertainty around these estimates. CPC scientists were encouraged to become involved in this process to ensure the best possible estimates of Effdis are obtained. It was stressed however, that the ongoing work using the Effdis data should not wait for the updated estimates and that the current available information is sufficient to advance the sea turtle and seabird evaluations. Once the new data is available, this can be incorporated in the future.

It was also suggested that there is a need to differentiate between the different types of longline fisheries in order to improve the Effdis estimations, but this will be conducted at a later stage.

6.2 Other gears

The Sub-committee was made aware of an ongoing EU effort to re-estimate and improve their purse seine effort data. This updated information should be used in future PS Effdis estimations. It was also suggested that future efforts should seek to separate free school and FAD fishing effort in order to improve the estimations.

The Sub-committee was reminded of a past recommendation to estimate Effdis for gillnet fisheries. The Secretariat clarified that there is insufficient Task II CE data to conduct this task. As such the Sub-committee recommended that regional workshops be held with the goal of recovering these data from the relevant CPCs directly.

7. Sea Turtles

SCRS/P/2016/045 showed that while ways to reduce sea turtle by-catch have been found, the other effective way of reducing the impact of such by-catch is reducing post-release mortality. This can be achieved by improving on-board handling, hook-removal and release techniques of captured animals. Since 2007 around 1,500 longline fishers, observers and fishery technicians have been trained in these techniques mainly in America and the Mediterranean Sea. Two factors are important when training fishermen: 1) the trainer must have ample experience working on board fishing vessels with turtles – someone who can answer fishermen's doubts and questions, who understands the variety of situations on board a fishing vessel and knows how to adapt to them. Only then will the trainer get the fishermen's attention and respect, and will they feel respected; 2) simply telling fishermen what to do or not to do is not enough; the reasons behind need to be explained – this type of training is about providing fishermen with knowledge to be able to decide what to do in each situation and to gain responsibility over their acts and decisions.

The following link provides a list of available training videos in the different languages:
www.youtube.com/playlist?list=PLvFm4k9xS1jpIpuWI-jltwRDrAC215x6C

In addition, very recently a new syndrome was diagnosed in the Mediterranean Sea in loggerhead and leatherback sea turtles captured by fishing nets (trawling, gill-net, trammel-net), which could greatly alter what we previously knew on post-release mortality of animals released by these fisheries, potentially increasing it by a large %: decompression sickness (DCS).

DCS happens when sea turtles diving at depth get stressed, which changes the normal metabolism of diving and allow nitrogen to be incorporated into the blood supply, and are forced to the surface by the fishing gear. It is still unknown at what minimum depth the animal has to be to suffer DCS, or for how long, but the problem probably arises from a combination of both, plus the degree of stress of the animal. Diagnosis so far has only been done at rescue centres, with a combination of clinical exam (animals arrive very depressed and after some hours become hyperactive, and suddenly die), US scan, radiography, CT scan and response to treatment (decompression chamber), or on freshly dead animals, and it seems that at least 50% of animals brought from trawlers in the Mediterranean during the winter present with this sickness.

The Sub-committee inquired how the effectiveness of training fishers in safe handling techniques can be assessed. There is no direct way to do so, but stranding data could help to make such assessment in some areas. The presenter indicated that attendance to the training sessions was voluntary and the fishers that attended these sessions were very interested in the issue and very willing to learn the safe handling techniques. The Sub-committee discussed the merits of ICCAT developing a poster with 'safe handling' techniques similar to what was produced for sea birds. Although there was discussion that not all techniques work in all fisheries or in all situations, there was a general agreement that there are some minimum standards that can be applied across all ICCAT longline fisheries (e.g., using a net to board sea turtles, cutting the line as close as the hook as possible).

The first of two joint-analysis workshop on the effectiveness of sea turtle mitigation measures in Pacific longline fisheries was held in Honolulu in February 2016 (www.wcpfc.int/node/27494 as WCPFC-2016-SC12/EB-WP-11). This ABNJ (Common Oceans) Tuna project sponsored workshop was attended by 31 participants from 14 countries from all three oceans, as well as invited IGOs and NGOs. The first workshop characterized current sea turtle interaction and mortality rates under existing fishing operations using observer data from a variety of sources representing over 2,300 turtles caught by 31 fleets between 1989-2015. There were three types of analyses undertaken for leatherback, loggerhead, green and olive ridley turtles: 1) estimating the effects of various operational variables on interaction rates at the set level; 2) estimating how turtle interaction rates vary by hook position within baskets; and 3) estimating the effects of various operational variables on turtle at-vessel mortality rates. Post-release mortality rates were not considered due to a lack of available information. In the first analysis, hook category (shape and size), bait species, hooks per basket, and soak time had the largest effect on set level interaction rates, with significant decreases in interaction rates with the use of large circle hooks and/or finfish bait. In the second analysis, interaction rates of olive ridley, loggerhead and green turtles with deep set longlines were highest for those hooks closest to floats. In the third analysis, at-vessel mortality rates were influenced by turtle species, with the lowest mortality rates for leatherback and loggerhead turtles, and increased mortality rates with increased fishing depths. Participants concluded that mitigation measures based on hook shape and size, bait species, and removal of the hooks nearest each float in deep longline sets should be priorities for further analysis. The workshop also generated preliminary species-specific maps of relative abundances. A Delphi technique peer review process is being considered to confirm these maps. A second workshop, to be held in November 2016, will focus on estimating baseline interaction and mortality rates under current fishing operations and testing various mitigation scenarios to determine their effectiveness in reducing impacts.

The Sub-committee inquired whether the ABNJ Tuna Project has plans to conduct similar analysis for other oceans basins. It was indicated that the current project is aiming to estimate interactions and mortalities for the entire Pacific, but might be constrained by the availability of longline effort data for the eastern Pacific. There are no plans under the existing scope of work for the ABNJ Tuna Project to extend the analysis to other Oceans. The Sub-committee was also interested in the source of the SST data used in the analyses. It was pointed out that SST data collected from observers was not fully reliable and, therefore, 1^{o}x1^{o} monthly Reynolds SST data was used in the workshop.

SCRS/2016/125 stated that in 2010, the International Commission for the Conservation of Atlantic Tunas (ICCAT) requested its Standing Committee on Research and Statistics (SCRS) to conduct an assessment of the impact of ICCAT fisheries on sea turtles (ICCAT 2009). Information on the area of operation and reported fishing effort of 16 longline fleets fishing in the Atlantic in 2014 was obtained from the ICCAT EFFDIS (effort distribution) database. Sea turtle by-catch rates were identified for six fleets operating within the ICCAT Convention area through a comprehensive literature review. For the remaining nine fleets for which data were not available, we assigned by-catch rates based on spatial overlap of fleets with published rates. The total number of sea turtle

interactions was estimated using the reported and assigned sea turtle by-catch rates per fleet and multiplied by reported total fishing effort deployed by the fleets. The total number of sea turtle interactions (all species combined) ranged from 18,708 to 25,731 for all ICCAT fleets fishing in 2014. However, this estimate should be considered an underestimation, as not all the pelagic longline effort was taken into consideration in the present study.

The Sub-committee supported the approach used to obtain the preliminary estimates of sea turtle interactions and agreed with the authors with regard to the assumptions, limitations, and future improvements of this work. Most importantly, the Sub-committee agreed that national scientists should review the by-catch rate substitutions used and provide their input (see **Appendix 4**). It was indicated that mortality and number of interactions are not the same. The Sub-committee discussed that there are a number of sources of post-release mortality (SCRS/P/2016/045) that are difficult to quantify, and therefore an estimation of number of interactions is a useful first step. It was also pointed out that sea turtle by-catch rates are dependent on many factors (e.g., hook type and size, bait type) which should be considered when assigning by-catch rates from one fleet to another. But, it was also recognized that such detailed information was not available for most fleets to use in the process of assigning by-catch rates. The Sub-committee agreed in using this work as a platform upon which to improve the estimation of the number of sea turtle interactions. As such, new estimations will be conducted using an updated EFFDIS with the estimated total effort and any new by-catch rate information that might become available. At the same time, the Group agreed to pursue, if possible, other approaches like stochastic modeling to estimate number of sea turtle interactions. The Sub-committee held an extensive discussion with regard to other available sources of sea turtle by-catch data. Most specifically, the Sub-committee discussed the observer data submitted using the ST09 form. The Secretariat informed the Sub-committee that the data submitted was very limited. In view of this, the Sub-committee discussed that one of the reasons for such poor reporting of observer data might be related to the complexity of the ST09 form. The Secretariat agreed to present to the Sub-committee on Statistics a proposal to potentially reduce the complexity of this form with the expectation that this might increase the reporting rates.

The pelagic longline fishery in Brazil started in the mid-fifties according to SCRS/2016/169. This fishery uses different strategies to catch swordfish, tunas and dolphin fish, however those strategies also affect the incidental capture of sea turtles. If the fishing strategies change according to target species and if these strategies affect the sea turtle capture, then classify and group the distinct longline fisheries, based on its characteristic and according to the homogeneity principle becomes necessary to better understand the incidental capture of sea turtles, their causes and consequences. Nevertheless, this approach has not been used and, usually, pelagic longline fisheries have been analyzed as a unique administrative unit, as being homogeneous when affecting the biota. Here we used the information from Projeto Tamar's database (1999-2016) and divided the Brazilian pelagic longline fishery in five distinct fisheries, according to its own characteristics. The results show significant differences for both CPUEs and size classes by turtle specie captured on different longline fisheries. This fact has important implications for the marine turtle conservation as well as for the management of fisheries. When longline fisheries with distinct characteristics are grouped into a single longline fishery, we lose the capacity to understand why some turtle species (or turtle size classes) are more susceptible than others. Thus, the document recommended using "Fishery" as administrative unit in order to understand and reduce marine turtle interactions in fisheries.

The Sub-committee discussed that this document pointed to the fact that caution should be used when assigning by-catch rates to a fleet. It was asked if the 'administrative units' (i.e., fleets with a unique fishing strategy) that operate in large areas might also have different sea turtle by-catch rates in different areas, but no analysis was conducted that could answer that question. The Sub-committee was interested in learning how constant was the gear configuration within each 'unit'. It was pointed out that for some aspects of the gear configuration, the vessels within a unit use a range of values (e.g., number of hooks between floats), but for other variables, such as the use of wire leader, all vessels in the unit use the same. It was also asked how constant through time the components of the 'administrative units' are. The Sub-committee discussed the complexity of the Brazilian fleet, but the vessels of the 'administrative units' described in the document have remained fairly constant for the period of the study.

São Tomé has recorded, as regular species on the high seas and in its coastal waters, five species of marine turtle which come inland to nest (SCRS/2016/172). They also nest in the region of the Atlantic coast of Africa. Despite the importance of the region as a habitat for marine turtles, there is little scientific documentation on the utilisation of the habitat, their abundance and distribution (Thomas *et al*. 2010). The turtles are mainly found in the clear waters of the shallow coastal reefs, bays, estuaries and lagoons. However, the young spend their first few years at sea where they float, which enables them to be carried by the currents before they move towards safer coastal waters. According to the 4th National Report on Biodiversity (2009), *Lepidochelys olivacea* (the olive ridley sea turtle) is the smallest species of turtle and is easily caught by fishers while making its way to the beach to spawn. The study carried out by Carvalho (2008), from MARAPA, an NGO informed that the local population fishes this

species of turtle due to the unavailability of other types of food sources such as meat. Moreover, the eggs and nests are taken due to tradition and cultural reasons. For this reason, protection of this species is a priority for the conservation of natural resources in the archipelago. The Gulf of Guinea is also an important food source, migratory route and nesting area for the five marine turtles, where they can be observed. They all appear on the red list and protection lists of international organisations. According to the data from the neighbouring island of Bioko, the olive ridley (*Lepidochelys olivacea*), the hawksbill (*Eretmochelys imbricata*), the loggerhead (*Caretta caretta*) and the leatherback (*Dermochelys coriacea*) regularly nest on the south beach of São Tomé, mostly between October and February.

The Sub-committee inquired if estimates of the number of sea turtle interactions with artisanal fisheries exist and the potential impact of such interactions. It was explained that that information is not yet available, but it is one of the goals of the conservation plan. Population estimates are not available either, at this time only information on the number of nests for those nesting sites that are being monitored is available. The Sub-committee asked is the fishing sector that used to harvest sea turtles and their eggs is now involved in the development of eco-tourism which seems to be the case. There was also interest in finding out if the coastal artisanal gillnet fishery was targeting small tunas. Such fishery exists and there are regulations in place to limit that mesh size that can be used, but enforcement of such regulations has been difficult.

The report outlined in SCRS/P/2016/048 is part of a larger study investigating the efficacy of sea turtle by-catch regulations implemented in U.S. Atlantic and Pacific longline fisheries. Since 2004, longline vessels targeting swordfish (shallow-set) in Hawaii and some regions in the North Atlantic Ocean have had extensive fisheries regulations in place aimed to protect endangered and threatened sea turtles. Specifically, use of maximum 10 degree offset 18/0 circle hooks has replaced traditionally used J or tuna hooks, and fish bait are regulated in many locations where squid baits were once commonly used. In addition, U.S. vessels had mandatory increases in observer coverage (100% in Hawaii shallow-set and 8% for parts of the Atlantic), limits on turtle captures (Hawaii only), as well as additional requirements specific to protected species handling. This report presents longline observer data from the Atlantic Ocean's pelagic observer programme (POP) from the time periods prior to the turtle regulations (~ 1992-2001) and post regulation (~ 2004-2015). Analyses include relationships between the number and species of turtle interactions and operational components such as fishing region, hook type, bait type, SST, use of light sticks, etc. The current analysis includes data from swordfish and mixed sets (swordfish- plus tuna-targeted sets) only, and omits data from fishing experiments. In total, we analyzed statistics from 11,982 unique sets. We analyzed catch probabilities specifically for loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) sea turtles. A variety of methods were used, including general linear models (GLMs), general additive models (GAMs), and non-parametric statistics to identify factors related to the fishery dynamics that affect catch risk and magnitude of turtle catch rate (per unit fishing effort). In summary, results of our 20+ year data analyses indicate clear temporal and spatial patterns in sea turtle capture rates by species, and confirm the value of eliminating J hooks and reducing use of squid bait, as well as the value of restrictions on effort and turtle captures.

It was expressed to the Sub-committee that some of the results of the GLM are confound by management regulations. The Sub-committee inquired why the results of the GLM showed that the use of circle hooks had no significant effect on the BPUE when circle hooks is one of the most important mitigation measures to reduce by-catch rates. Such result is due to the fact that the fleet switched from using J-hooks to Circle hooks practically overnight and therefore the model does not have a period where the use of both hook types overlap to assess the effect of hook type on the by-catch rates. The Sub-committee was interested in learning how the 'annual limits' with regard to sea turtle interactions were chosen or determined. It was explained that sea turtle population biologist conduct such determination. As with other cases, the Sub-committee discussed how changes in population size can confound the assessment of the effectiveness of mitigation measures. In the case of sea turtles, it was explained that given their life history, changes in population size happen slowly allowing for a better determination of the effectiveness of mitigation measures. It was also asked if models other than the delta lognormal were used to standardize the BPUE. The authors explained that other models were also tested, but the results are still considered to be preliminary. Finally, the Sub-committee asked why hook size was not considered as a variable in the models as it is well known that small circle hooks are less effective as a mitigation measure than larger hooks. It was explained that the U.S. fleet only uses 16/0 and 18/0 circle hooks which are considered to be 'large' circle hooks and are effective as mitigation measures.

7.1 Work plan for sea turtles

Recognizing that there is a paucity of by-catch data submitted to the ICCAT Secretariat despite repeated requests for this information, the Sub-committee recognized that the method described in SCRS/2016/125 can be used as an alternative method to facilitate the Sub-committees work as this model uses sea turtle CPUE reported in published literature. Thus, the Sub-committee agreed to review and improve the method in 2017, especially with regard to the utilization of observer data collected by CPCs. For this purpose, CPCs are requested to submit sea turtle by-catch information including data not reported using the ST09 data submission form, and also to estimate total removals using their observer data. In 2017, the method and data to be used to estimate the total removal of sea turtles by longline fisheries will be finalized.

8. Seabirds

The agenda for seabirds had been developed to focus largely on a review of Rec. 11-09. However, due to a lack of data, this assessment was not possible. Consequently, the headings in this report have been changed from those listed in the Tentative Agenda to better reflect the presentations and discussions that took place at the meeting.

8.1 Review of seabird conservation measure Rec. 11-09

As context to ICCAT's review of the effectiveness of its seabird conservation measures (Rec. 07-07, Rec. 11-09), a summary was provided on the work of CCSBT's Seabird Mitigation Measure Technical Group (SMMTG) to develop methods for reviewing the effectiveness of tuna RFMO seabird management measures. The CCSBT SMMTG has agreed that the following elements should be included in tuna RFMO seabird assessments:

1. By-catch indicators: monitor seabird BPUE and total birds killed per year.
2. Review degree of implementation: this would involve collaboration of ecosystem and by-catch working groups with relevant compliance Committees.
3. Review and monitor data availability (observer coverage and representativeness, quality of observer data in relation to data fields, quality of fishing effort data), in order to gauge the reliability of the assessment
4. Review content of seabird CMMs (including by-catch mitigation measures, area of application, vessels to which measure applies).

The CCSBT SMMTG also highlighted the importance of tuna RFMOs working collaboratively in their seabird assessments, and the advantages of combining regular monitoring of seabird by-catch by each tuna RFMO with periodic (every 3-5 years) joint tuna RFMO work at a more detailed level. The seabird by-catch component of FAO's GEF-funded Common Oceans Tuna Project is progressing some of the actions identified by CCSBT's SMMTG.

Document SCRS/2016/174 presented an analysis of tracking data for nine species of albatrosses and petrels and the degree of overlap of these species with pelagic longline fishing effort in the Atlantic Ocean. The results of the study are broadly consistent with the previous (2010) overlap analysis, confirming the global importance of the ICCAT area for a suite of albatross species. The Critically Endangered Tristan albatross and Endangered Atlantic yellow-nosed albatross, along with the Vulnerable white-chinned petrel, have the highest exposure to ICCAT longline hooks of the species analyzed. Adjacent to the southern African coast the same two albatross species - plus black-browed albatross migrating from South Georgia – range as far north as 10°S where the *Supplemental Recommendation by ICCAT on Reducing Incidental By-catch of Seabirds in ICCAT Longline Fisheries* [Rec. 11-09] does not currently apply. Estimates of the number of pelagic longline hooks set south of 25°S suggest that pelagic longline effort in areas of high seabird abundance has decreased since between the initial period (2000-2005) and the most recent period (2010-2014).

Considering the result that at least three of the seabird populations for which tracking data are available (Atlantic yellow-nosed, black-browed from South Georgia and Tristan albatross) forage as far north as 10°S in the eastern Atlantic, outside of the area of application of Rec. 11-09, the Sub-Committee highlighted the need to collect by-catch data from these areas. It was noted that BirdLife International's Albatross Task Force are currently working with Namibian fleets, and an observer is being deployed imminently to collect seabird by-catch data on a pelagic longline vessel. The Sub-Committee recognised that although indicative of the possible encounter rate, overlap indices such as those applied in this study do not consider susceptibility to capture, and that the probability of by-catch for a given species depends on their behavioral traits and other factors. As was the case with the first ICCAT seabird assessment (2006-2009), the overlap analysis should be treated as a component of a broader assessment,

and provides a coarse map of potential risk. The Sub-Committee agreed that it would be useful to compare the areas of high overlap with by-catch information from observer data, and also to ensure that areas of high overlap were being sufficiently sampled by observer programmes.

SCRS/2016/167 outlined work being progressed by ACAP to develop seabird by-catch indicators and to consider data needs, methodological approaches and reporting requirements. ACAP is currently ratified by 13 countries. In addition, a number of non-Party Range States actively participate in the work of the Agreement. ACAP provides a framework for coordinating and undertaking international activity to mitigate known threats to populations of affected species, including fisheries by-catch. In order to monitor and report on the performance of the ACAP, a Pressure-State-Response framework is being developed and implemented by ACAP. The primary Pressure indicator for by-catch comprises two linked components: i) the seabird by-catch rate across each of the fisheries of member Parties, and ii) the total number of birds killed (by-caught) per year of ACAP species (per species where possible). The Seabird By-catch Working Group of ACAP is currently undertaking work to develop guidelines on issues that need to be considered in estimating and reporting against these by-catch indicators and, considering the estimation methods currently in use, to propose guidance and recommendations to achieve consistent reporting. This paper provides an outline of the recommendations and guidelines that have been developed to date. It is important to note that this represents work in progress, and is presented to encourage linkages between the ACAP process and similar work being undertaken within ICCAT and other RFMOs.

The Sub-Committee agreed that this work is of relevance to ICCAT's review of the seabird conservation measure, Rec. 11-09. It was noted that the Sub-Committee had previously (in 2015) agreed that the by-catch indicators proposed (by-catch rates, and total number of birds killed) would be useful candidate indicators for the review of Rec. 11-09. It was noted that the ACAP process would focus initially on ACAP countries, and that the reporting framework is being developed to incorporate data rich and data poor scenarios. However, it is intended that the guidelines would be more broadly applicable and hopefully help facilitate a wider-scale assessment of seabird by-catch. The Sub-Committee agreed that it would be useful to maintain linkages between the ACAP process and efforts within ICCAT to estimate and monitor seabird by-catch.

8.2 Review of data received from CPCs on seabird by-catch

The ICCAT Secretariat presented the observer data received from CPCs using the newly adopted ST09 data collection forms (**Table 2 and 3**). The Secretariat highlighted the fact that very few data regarding seabird interactions had been submitted using these forms. The majority of information has been received from a single fleet with little other available information. As such, the Sub-committee questioned whether this data was useful for evaluating the efficacy of Rec. 11-09. It was noted that these forms have recently been adopted, and are quite complex. The Sub-Committee therefore suggested that the these forms be evaluated to simplify the reporting requirements. It was agreed that this would be done intersessionally through collaboration between CPC scientists and the Secretariat.

The problem of data availability to review the efficacy of Rec. 11-09 was further discussed. It was suggested that as the data are not being submitted to the Secretariat at this stage, scientists from the CPCs who are fishing south of 25S should be engaged in a collaborative effort to share operational observer data to evaluate the catch rates of seabirds in this region. This approach was utilized successfully in the sharks species Working Group, and it was recommended that this approach be adopted for this study. As such, a table was created based on the newly developed Effdis dataset, that showed which CPCs have reported fishing south of 25ºS (**Table 4**). It was agreed that these CPCs will be contacted to collaborate and share data to assess the efficacy of Rec. 11-09.

8.3 Seabird papers submitted by CPCs

SCRS/2016/039 reviewed interactions between seabirds and the Spanish surface longline fishery targeting swordfish in the South Atlantic Ocean. A total of 92 sets (132,268 hooks) targeting swordfish between November and March in the years 2010-2014 in the south Atlantic (Lat ≥ 25ºS) were analysed. Various types of bait were used for night setting with monofilament surface longlines. No interaction with seabirds was detected during any of the sets observed and the interaction rate was therefore nil, confirming the low level of interaction with seabirds regularly seen for this type of fishing in large areas of the North and South Atlantic. The use of night setting, low levels of lighting during setting operations and the type of fishing conducted by vessels were identified as the most important factors to explain the lack of interaction with seabirds. Observations of seabirds were also made. Most of the sightings occurred during daytime sailing. During some manoeuvres when vessels were setting or hauling there were sporadic sightings of the spectacled petrel (*Procellaria conspicillata*) and the occasional albatross,

although no interaction with fishing operations occurred. The species most often seen was *P. conspicillata*, with groups estimated at over 150 individuals being sighted. Other species observed were *Calonectris diomedea*, various types of storm petrels, and other species such as *Hydrobates leucorhous, Thalassarche chlororhynchos, Diomedea exulans* and very rarely *Thalassarche melanophris*.

It was reported to the Sub-Committee that the Spanish fleet is using mitigation requirements in accordance with ICCAT Rec. 11-09. Spanish legislation includes mitigation requirements applicable to the whole Spanish surface longline fishing fleet irrespective of the area and ocean in which they fish. The Sub-committee observed that given the use of the mitigation measures described it would be expected that by-catch rates would be low, particularly in the area observed in the south and central Atlantic where seabird densities are relatively low. The Sub-Committee observed that in the south West Atlantic where effort is high, observer coverage is very low, and that there is a need for more representative observer data. It was noted that it is challenging to cover trips in specific areas in specific time periods and selection depends on a combination of factors such as vessel access, vessel skipper and other logistics and considerations.

A series of papers were presented using Japanese observer programme data. SCRS/2016/162 examined factors affecting seabird by-catch occurrence rate in the southern hemisphere in the Japanese longline fishery using a random forest model. In order to analyse significant factors affecting by-catch occurrence rate the authors constructed four models (albatross mitigation, albatross, petrel mitigation, petrel) examining the effect of species group, season, year, environmental factors, distance from the colonies, a lunar phase, and fish catch. The model was thought likely to be a statistically appropriate because out of bags were in an acceptable range, though a little high. Significant variables in common with the four models analysed were latitude, longitude, elapsed days from the first day of the year, number of observed hooks, species group, sea surface temperature in this study. Also year, cruise ID and lunar phase were significant variables in common with two to three models. Those variables would have the large impact on by-catch occurrence rate. Thus, it was suggested that those variables should be considered in the comparisons between CPCs and in collaboration work.

It was noted that by-catch occurrence rate was higher off southern Africa and in the Tasman Sea than in other areas fished, and that by-catch occurrence rate increased in January-March during the albatross breeding season. The authors clarified that data from 1997 to 2015 were used for the albatross model while data from 2011-2015 was used for the albatross mitigation model. Mitigation measures were not a significant variable in the model. The authors indicated that this may be caused by the timing of the introduction and use of mitigation measures in the Japanese longline fleet, as a portion of the Japanese longliner fleet had already voluntarily introduced mitigation before Rec. 11-09 came into force, which might explain why it is not a significant variable.

The Sub-Committee observed that using random forest models is a useful approach. It was noted that time-series seabird data from breeding colonies could help determine if catch is independent of population trends. The Sub-Committee recommended that it would be useful to develop the model further to better understand factors contributing to seabird by-catch.

Document SCRS/2016/163 modelled by-catch occurrence rates of seabirds for Japanese longliners operating in the southern hemisphere in consideration of factors of year and season, and examined longitudinal changes in the rate across years, using operational data obtained by scientific observers from 1997 through 2015. As a preliminary analysis, differences in species composition of seabirds by-caught between northern and southern regions of waters south of 20°S were examined through hierarchical cluster analysis. By-catch species composition changed at the boundary of 40°S, 35°S and 40°S, off southern Africa, in the Indian Ocean and in the Tasman Sea, respectively. Presence/absence of seabird by-catch data by set was modelled with a generalized additive model (GAM). The data for the GAM analysis were split in two by a boundary dividing the data into northern and southern areas. Estimated by-catch occurrence rate varied at relatively low level in the model of the northern area, while that varied at relatively high level in the model of the southern area. By-catch occurrence rates in an east-west direction differed not only among year periods but also among seasons in both waters north and south of 35°S. The analysis highlighted the importance of consideration of longitudinal variation of by-catch occurrence rate among year and season to estimate total by-catch number.

The authors noted that the results were consistent with those using a random forest model (document SCRS/2016/162), and clarified that clusters used in the analysis were based on the species composition of by-catch. The results showed that grey-headed albatross was the dominant by-catch species in the southern areas, whereas white-chinned petrels were the dominant species bycaught in the northern areas. The authors clarified that the boundaries selected for the study were based on current information regarding species composition and by-catch rates increasing further south. The Sub-Committee noted that the cluster analysis was based on species composition of the BPUE, and demonstrated a notable step-change in species composition of by-catch at 35°S in the Indian Ocean.

Document SCRS/2016/164 provided information of seabirds by-catch south of 25°S latitude between 2010 and 2015, reviewing by-catch data collected by on-board observers on Japanese vessels in the Atlantic and the Indian Ocean. Results revealed that there is a common tendency in between the southern bluefin tuna catch pattern and seabird by-catch pattern. Seabird by-catch pattern is also suggested to be influenced by geographical area as well as environmental conditions. The results of this study also indicate that the recent increasing trend of the nominal CPUE of seabirds is biased by the recent increase of the observer data in the area with higher seabird CPUE. Authors indicated these findings should be considered in future catch and effort data analysis.

The study identified 13 seabird groups. Sub-areas 6 and 7, south west of southern Africa, were found to have high CPUE of birds, with the grey-headed and black-browed albatrosses dominating by-catch. There is a 33°S -45°S band of high capture off South Africa, and highest by-catch rates are in Q2. The authors pointed out that in the south East Indian Ocean, even at higher latitudes, there are notable levels of observed by-catch.

It was explained to the Sub-Committee that CCSBT observers are the main source of Japanese observer data. Coverage of other vessels is therefore relatively low, so values are somewhat biased. The authors expressed concern that nominal CPUE of seabirds show an increasing trend (approximately 0.3 birds/1000 hooks in 2015) off South Africa in the area 20°W-50°E, 25°S-55°S, and suggested that urgent action is required to better understand the reasons for the by-catch and to address them. It was proposed that the previously low estimates of seabird by-catch could be due to low southern bluefin tuna quota allocation and an associated low number of observers. The authors suggested that the trend of increasing by-catch may be because observer coverage has improved, leading to improved estimates of by-catch. The Sub-Committee was informed that Japan is conducting a questionnaire survey and interviews with industry to try to clarify causes for this trend. The Sub-Committee recognised that the document presents useful information, and the authors suggest that it would be possible to extrapolate the data to estimate total mortality and highlighted that it would be beneficial to compare results with those from other CPCs.

Document SCRS/2016/161 describes the operational pattern of Japanese longliners south of 25°S in the Atlantic and the Indian Ocean for the consideration of seabird by-catch. Catch and effort data of Japanese longliners operating south of 25°S in the Atlantic and the Indian Oceans in the period between 2010 and 2015 was analysed to investigate its effect on the seabird by-catch. Waters off South Africa and the southwest Indian Oceans were indicated to be main fishing ground of Japanese longliners, where they caught southern bluefin tuna, albacore, bigeye and yellowfin tunas. Results of the analysis indicate a general increase of the ratio of southern bluefin tuna and a decreased ratio of albacore and bigeye tunas between 2010-2013 and 2014-2015, respectively. This target shift accompanies the southward shift of operational ground. The results of this study also indicated that the main fishing grounds of Japanese longliners off South Africa are located further south by about five degrees compared to the main fishing ground in the south west Indian Ocean due to the effect of warm Agulhas Current. These findings should be considered in the analysis of seabird by-catch data.

The Sub-committee noted that species composition of target catch has changed drastically by area and that environmental conditions complicate catch patterns off South Africa. Eastern Indian Ocean environmental conditions are more consistent and less complex, and fish composition doesn't show the same spatial variability. The authors highlighted that in the eastern Indian Ocean area that they considered Japanese longline vessels target southern bluefin tuna and seabird by-catch species composition is different. The Sub-committee recognised that it is important to consider and account for these factors when assessing seabird by-catch.

8.4 Mitigation trials and advice

SCRS/2016/165 presented results from a study in the Brazilian pelagic longline fleet to compare sliding weights (Lumo Leads) and traditional line weighting in respect of sink rates and catch rates of target and non-target species. Four cruises were conducted in 2015. Three treatments were used to compare catches of target fish species, seabird by-catch and identify sink rates: (1) 60 g Lumo Lead weight at 1.0 m from the hook; (2) 60 g Lumo Lead weight at 3.5 m from the hook, and; (3) 60 g leaded swivel at 3.5 m from the hook. There was no difference in the catch

rates of target species among treatments. Eleven seabirds were caught during the experiment (five black browed albatrosses, five white-chinned petrels and one great shearwater). All birds were caught at night and without tori lines. One bird was caught on treatment 1 (0.11 BPUE), three birds in the treatment 2 (0.33 BPUE) and seven birds in treatment 3 (0.85 BPUE). Lumo Leads placed at 1.0 m from the hook sank faster than Lumo Leads and weighted swivel placed at 3.5 m. The high seabird mortality rates on treatments 2 and 3 suggests that the combination of night setting and line weighting placed at 3.5 m is not sufficient to reduce seabird by-catch in the South-west Atlantic to negligible levels.

The Sub-Committee noted that an increasing body of research has shown that reducing the distance between the weight and hook (leader length) improves the sink rate of branch lines, and thus reduces the frequency of seabirds becoming hooked during line setting, with no detectable impact on target fish catch rates. When used in combination with bird scaring lines, line-weighting should ensure that the baited hooks sink fast enough to deter birds from attacking hooks outside the area protected by the bird scaring line. It is also important to reduce the likelihood of albatrosses getting hooked as a result of deep diving species returning baits to the surface. Based on the diving depths of petrels that are commonly caught as by-catch, the baited hooks need to sink below a depth of 10-12 m before the risk to seabirds is significantly reduced. Lumo leads were designed to reduce the incidence of fly-back events following bite-offs, and therefore improve crew safety. The Sub-Committee noted the significant reduction of seabird by-catch using weights at 1 m compared to 3.5 m from the hook reported in the Brazilian study, and that this is consistent with, and provides support for, the ACAP best practice advice presented in SCRS/2016/166.

SCRS/2016/166 presented the current advice provided by the Agreement on the Conservation of Albatrosses and Petrels (ACAP) for reducing the impact of pelagic longline fishing operations on seabirds. The incidental mortality of seabirds, mostly albatrosses and petrels, in longline fisheries continues to be a serious global concern and was the major reason for the establishment of ACAP. ACAP routinely reviews the scientific literature regarding seabird by-catch mitigation in fisheries, and on the basis of these reviews updates its best practice advice. The most recent review was conducted in May 2016, and the document presents a distillation of that review for the consideration of the ICCAT Sub-committee. On the basis of the most recent review, ACAP has confirmed that a combination of weighted branch lines, bird scaring lines and night setting remains the best practice approach to mitigate seabird by-catch in pelagic longline fisheries. Changes to previous advice apply only to the recommended minimum standards for line weighting regimes, now updated to the following configurations: (a) 40 g or greater attached within 0.5 m of the hook; or (b) 60 g or greater attached within 1 m of the hook; or (c) 80 g or greater attached within 2 m of the hook. In addition, ACAP endorsed the inclusion in the list of best practice mitigation measures of two hook-shielding devices. These devices encase the point and barb of baited hooks until a prescribed depth or immersion time has been reached (set to correspond to a depth beyond the diving range of most seabirds) thus preventing seabirds gaining access to the hook and becoming hooked during line setting. ACAP recognizes that factors such as safety, practicality and the characteristics of the fishery should also be taken into account when considering the efficacy of seabird by-catch mitigation measures and consequently in the development of advice and guidelines on best practice.

It was noted that the update to the ACAP advice regarding line-weighting was based on the provision of new results on the sink rates of different line weighting configurations, and studies relating line-weighting configurations to seabird by-catch rates, including the study reported in SCRS/2016/165. The Sub-Committee supported the updated ACAP advice on minimum standards for line-weighting. It was noted that line weighting is one of the three mitigation measures listed in Rec. 11-09. The minimum line-weighting standards included in Rec. 11-09 conform with the previous ACAP advice, and would thus need to be updated to bring them in line with the updated advice from ACAP.

The Sub-committee acknowledged the advice from ACAP regarding the inclusion of two hook-shielding devices as best practice measures. However, given the novel nature of these measures, and that the source papers used by ACAP to conduct their assessment are still in the process of being peer-reviewed for publication, the Sub-committee did not have sufficient information on these two devices and their performance to recommend their inclusion in the list of available seabird mitigation measures for ICCAT fisheries. It was recommended that the scientific papers on the hook-shielding devices be made available to the Sub-committee as soon as they are available.

8.5 Seabird by-catch and mitigation in the Mediterranean

SCRS/2016/173 presented information on seabird by-catch mitigation developments in the Mediterranean, particularly in relation to the General Fisheries Commission for the Mediterranean (GFCM). Recommendation GFCM/35/2011/3 on reducing incidental catches of seabirds in fisheries is now in place. The recommendation

does not include requirements for the implementation of mitigation measures by vessels. In order to strengthen the collection and processing of data across the region the GFCM SAC has developed the Data Collection Reference Framework, which establishes a minimum set of parameters against which countries must report. Currently, GFCM Members are discussing the implementation of a mid-term strategy towards the sustainability of Mediterranean and Black Sea fisheries (2017-2020), which is expected to establish a by-catch monitoring programme to obtain representative data on discards and incidental catches, with a view to facilitating the adoption of required management measures towards the reduction of by-catch rates.

The Sub-Committee was reminded that at the time when ICCAT Rec. 11-09 was under discussion, there was insufficient information on by-catch to make a requirement for use of by-catch mitigation measures in Mediterranean waters, and that it would be beneficial to undertake a review of data now available. It was observed that there is in general a limited amount of targeted fisheries data from the Mediterranean that is reported to the Secretariat, but that it would be a useful to query the ICCAT by-catch metadatabase to obtain any relevant data and extract seabird by-catch related documents to determine what information may be available. It was noted that improved data collection, both due to the GFCM DCRF plus the European Commission implementing decision for new programme for data collection for 2017-2019 should ensure improved data on incidental capture of vulnerable species in the Mediterranean.

8.6 Seabird workplan

Recognising that the paucity of seabird by-catch data submitted to the ICCAT Secretariat has prevented an assessment of Rec 11-09, the Sub-committee noted that there are opportunities to progress this work intersessionally through additional mechanisms. The seabird component of the GEF Common Oceans Tuna project will be holding a series of workshops on seabird by-catch assessment in 2017 and 2018, and the Sub-committee agreed that these workshops provide an opportunity to help support an assessment of seabird by-catch within ICCAT, and facilitate a harmonised approach across tuna RFMOs. It was noted that the agenda for these workshops is in the process of being prepared, and the Sub-committee on By-catch Chair and several Sub-committee members offered to help develop the agenda and help progress these initiatives.

The Sub-committee recognised that although the main focus of seabird work would be a review of the effectiveness of Rec. 11-09, there is a need for a separate strategy to investigate seabird by-catch in the Mediterranean area. One of the first steps should be to investigate what fisheries operating in the Mediterranean area are incidentally catching seabirds. The Sub-Committee also recommended that the gillnet workshop planned for 2017 could provide an opportunity to consider seabird issues in the Mediterranean.

9. Other matters

A presentation (SCRS/2016/158) was provided regarding the *Faux Poisson* fishery in Côte d'Ivoire. It was noted however, that this fishery could be better assessed in a stock assessment exercise if the data is available and therefore this presentation is more appropriate for the small tunas or tropical tuna Group. The author thus agreed to present this document in those Working Groups.

Document SCRS/2016/171 described how many of the species managed by tuna RFMOs are data poor and have never undergone a stock assessment. This leaves these stocks vulnerable to over exploitation. Data-limited approaches are available to address the information shortfall. The Data-Limited Methods Toolkit (DLMtool) provides a scientific framework to address these challenges in a transparent and comprehensive manner.

Although the Sub-committee welcomed these new tools to evaluate data poor stocks, it was generally felt that these methods and indeed the proposed course could not be recommended by the Sub-committee at this stage. It was felt that these tools should be evaluated by the Working Group on stock assessment methods who would then be in a more suitable position to evaluate the utility of this proposal to the SCRS.

A research cruise in support of the International Seafood Sustainability Foundation (ISSF) by-catch reduction project was conducted on the tuna purse seine vessel Cap Lopez, 20 July – 5 August 2015 in Ghana waters and described in document SCRS/2016/127. The primary objective was to test the efficacy of a 10m2 net panel to selectively release sharks in good condition from purse seines. Observations of FAD design and by-catch entanglement rates were also conducted with no entanglements observed. However, evaluation of cruise objectives was hindered by a general lack of sharks encountered during the cruise. The release panel was initially trialed in the equatorial western Pacific where a deep, warm mixed layer and a deep net promoted the separation of silky

shark (*Carcharhinus falciformis*) and tuna. None of these conditions existed during the Cap Lopez cruise. That and other technical issues suggest that the potential for developing a shark release panel concept is region and vessel specific. The shallow thermocline, shallow net and relatively small size of the vessel created a situation where selective release of sharks would be difficult. Recommendations for further research are provided.

The author noted that even under ideal conditions, the issue still remains to attract sharks out of the net even when the window opens correctly as the presence of fish and/or the FAD in the net encourages the sharks to remain in the net. The author stressed it was difficult to extrapolate data from different oceans and vessels, as the conditions and operations are different. It was also noted that Non-entangling FADs and best release practices are a good solution to reduce shark by-catch.

SCRS/2016/156 outlined a research cruise in support of the International Seafood Sustainability Foundation (ISSF) by-catch reduction project that was conducted on the tuna purse seine vessel MAR DE SERGIO, during March-April 2016 in the eastern tropical Atlantic Ocean. During a 4-week period a group of three scientists joined the fishing trip with the following objectives: (1) Improving pre-set estimation of species composition, sizes, and quantities of tunas associated with FADs using acoustics: Attaching fishers´ echo-sounder buoys from four different brands to the FADs to compare signals; (2) Use of three scientific echo-sounders with frequencies of 38, 120 and 200 kHz and an EK80 wideband echo-sounder for the frequency band from 85 kHz to 170 kHz onboard a work boat, followed by intensive spill sampling to compare acoustic data and species composition; (3) Study of fish behavior inside the net; (4) shark capture and release from the net; (5) Making other observations that could lead to further tests of mitigation techniques. Preliminary results of these studies are presented.

The Sub-committee raised their concern that the type of catch and release described in this study may be too time consuming and complicated for most fishermen to adopt and may be dangerous when handling larger sharks. The author stressed, however, that release from the net is important as mortality is higher when individuals are brought onboard. The author stressed that although one fisher was necessary to conduct this activity, it was performed during the purse seine fishing operation, with no extra time for the purse seine activity, resulting in 20% of sharks released alive from the net. This technique is under development, which means the time needed to perform the operation, safety, and the percentage of released sharks should be improved. It was also suggested that fishermen have a responsibility to mitigate by-catch and therefore need to find solutions in order to avoid sharks by-catch.

SCRS/2016/155 provided information regarding a research cruise in support of the International Seafood Sustainability Foundation (ISSF) by-catch reduction project which was conducted on the sailing/research vessel Sea Dragon, 4-22 October 2015 in the tropical eastern Atlantic. The outcomes from the cruise characterized: (1) the behavior of tunas and other fishes around purse seine drifting FADs; (2) FAD design in relation to entanglements; and (3) horizontal and vertical behavior of oceanic sharks on and off FADs. The vertical behavior and diurnal presence/absence of tropical tunas and non-target FAD associated species were remotely monitored using pressure-sensitive acoustic tags and satellite linked receivers attached to four drifting FADs. Observations of FAD-associated fauna and FAD design were performed by SCUBA and snorkel surveys. Skipjack, bigeye and yellowfin tunas, rainbow runner (*Elegatis bipinnulata*) and oceanic triggerfish (*Canthidermis maculata*) were monitored with acoustic tags. Silky shark (*Carcharhinus falciformis*) and oceanic white tip sharks (*C. longimanus*) were tagged with a mix of acoustic and satellite linked pop-off tags. The fine scale vertical and horizontal behavior of FAD associated tuna, other finfish and sharks is described.

The author clarified that this work is ongoing. The Sub-committee welcomed this news as it was noted that this is an important study on natural behavior although it was acknowledged that more data is needed. It was suggested that this work could benefit from the AOTTP project should spaghetti tags be used in the future as that project is conducting a strong tagging awareness and recovery activity.

10. Recommendations

Recommendations for by-catch:

1. The Sub-committee recommends that the ST09 observer data submission forms be revised to simplify the reporting requirements in order to facilitate increased submission of observer data. This should be done intersessionally through collaboration between CPC scientists and the Secretariat. This proposal along with suggestions for revising the forms is to be presented to the Sub-committee on statistics in 2016 after which a preliminary version will be presented to the Sub-committee on Ecosystems in 2017 for potential adoption by the SCRS later that year.

2. The Sub-committee requests the Secretariat to initiate, as a priority, the recovery of Task II data, especially for more recent years in order to improve the information available for estimating the Effdis data crucial to ongoing seabird and sea turtle assessments.

3. The Sub-committee recommends that the Secretariat should continue to revise and update longline and purse seine Effdis, though collaboration with CPCs to support the work of the Sub-committee on Ecosystems.

4. The Sub-committee recommends that the SCRS should request that CPCs provide annual sea turtle and seabird by-catch information including by-catch rates and number for each fleet harvesting ICCAT species. Catch rate and number should be broken down to a lower taxonomic level as possible. In addition, mitigation measures adopted by each fleet should also be described.

5. In relation to seabird by-catch mitigation, the Sub-Committee recommended that the line-weighting specifications in Rec. 11-09 be updated to conform with the latest ACAP advice: (a) 40 g or greater attached within 0.5 m of the hook; or (b) 60 g or greater attached within 1 m of the hook; or (c) 80 g or greater attached within 2 m of the hook. CPCs are encouraged to test the safety and practicality of the above measure and report the results back to the SCRS.

6. CPCs are encouraged to provide information on best practices for handling and dehooking sea turtles with a goal of preparing and developing a flyer. An identification guide is also required.

7. It is recommended that the ACAP seabird by-catch identification guide be linked to the ICCAT website.

Recommendations for Ecosystem:

8. It is recommended that the next meeting of the Dialogue between Science and Managers Working Group (SWGSM) include an agenda item on the implementation of an EBFM framework for ICCAT.

9. It is recommended that at the next Species Working Group meeting in 2017 that there be a meeting between the Working Group chairs and the Ecosystem Sub-committee Conveners in order to discuss the contribution of input to ICCAT's EBFM framework.

10. The Sub-committee recommends that document SCRS/2016/171 be presented to the Working Group on Stock Assessment Methods (WGSAM) and the Small Tuna Working Group in order to review the proposal to host a workshop that was described therein.

Financial Recommendations:

11. The Sub-committee recommends that regional workshops should be held with the goal of recovering Task II and other information (e.g. sea turtle and seabird by-catch) on gillnet fisheries, from CPCs in which this method of fishing occurs. The Sub-committee recommends searching for sources of funding in order to conduct these workshops and that by-catch related issues be included in the agenda of the gillnet workshops.

11. Adoption of the report and closure

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

The meeting was adjourned.

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Table 1. Summary of information in Task II CE dataset suitable for use to estimate Effdis (for LL).

Sum of recs				YearC																										
StatusTypeID	Flag	TStrata	GeoStrata	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CP	Angola	mm	1x1																									8	
	Barbados	mm	1x1																					24	12	12	12	12	
			5x5																				23						
	Belize	mm	1x1															4		20									
			5x5																7		29	7	26	50	113	120	145	23	23
	Brazil	mm	5x5	48	35	150	250	159	206	145	508	307	1093	1675	1444	1525	1391	1389	1880	1787	1083	804	654	511	160	896	562	761	
	Canada	mm	5x5			6	12	1	1	110	127	113	120	114	106	103	107	101	106	90	100	85	85	89	73	52	53	64	
	China PR	mm	5x5										66	61	95	131	52	76	120	209	337	285	128	80	167	85	101	57	
	EU.Bulgaria	mm	5x5																					17	24	11	12		
	EU.Cyprus	mm	1x1											33		22	11	10	10	3		5		5					
			5x5																		6				7				
	EU.Denmark	mm	5x5																					1					
	EU.España	mm	5x5			164	206	220	360							22								7		60	33	76	
	EU.France	mm	1x1																									4	
	EU.Greece	mm	5x5															8	8										
	EU.Italy	mm	1x1																						2	3	2	4	
			5x5																					11	13				
	EU.Malta	mm	1x1																		152								
			5x5										16	18					10			165	78	100	92	97	140	271	301
	EU.Portugal	mm	1x1					10		38	2	29		71	127	437	288	247	1000	972	1104	589	688	724	617	14	10	5	
			5x5						34		13	30	115	29	11	35	190	259	46	58	78	301	53	12	43	959	736	763	
	EU.United Kingdom	mm	5x5															4	12				53	34		27	23	25	
	FR.St Pierre et Miquelon	mm	1x1																				2					4	
			5x5																					4	1		2		
	Guinea Ecuatorial	mm	5x5								1												3						
	Iceland	mm	1x1																							2			
	Japan	mm	5x5	288	262	155	267	50	34	41	24	44	39	38	20	38	32	37	41	40	42	42	1101	1018	907	891	620	697	
	Korea Rep.	mm	5x5	37	39	8	12	34			2	11	37	13	1		6	28	33	48			27	26		265	198	97	
	Libya	mm	5x5												1														
	Maroc	mm	5x5																							12	11		11
	Mexico	mm	1x1				10	24			6		10																
			5x5									11		10			28	32	40	37	31	32	34	35	33	35	29	78	
	Namibia	mm	5x5													155		144	196	380	341	211	102	237	171	129	177	196	
	Panama	mm	1x1											121						19	207	368	236				1398	507	
	Philippines	mm	1x1									9	24																
			5x5														2					4		8	8	9	95	43	
	Senegal	mm	1x1																					49	36				
			5x5																			42				157	122	50	
	South Africa	mm	1x1									5	2										266	439	333	253	381	347	
			5x5											110	174	240	107	143	127	93	162	124							
	St. Vincent and Grenadines	mm	5x5													53	111	20		96	124	226	138	207	246	70	200		
	Trinidad and Tobago	mm	1x1																				53	66					
			5x5														91	75	70	52	45				72	77	78	79	
	Turkey	mm	1x1																				1			4	4	2	
	U.S.A.	mm	1x1	83		142	16	24	47		26	22	14	25	19								1125						
			5x5							23														310	420	421	417	327	
	UK.Bermuda	mm	1x1																						17				
			5x5																				13	13		5		5	
			LatLon																								5		
	UK.Sta Helena	mm	5x5												2	7													
	UK.Turks and Caicos	mm	5x5																									5	
	Uruguay	mm	1x1																			189							
			5x5																	37	46				125	69	8		
	Vanuatu	mm	1x1															1328	2664	6164									
			5x5																					187	364	300	328	190	
	Venezuela	mm	1x1			20	33	64	42	45	67	42	307	637			87	701	307	455	1024	568							
			5x5								2												130	191	212	213	387	356	
NCC	Chinese Taipei	mm	5x5	148	157	73	444	942	355	469	304	257	251	117	85	85	1035	866	906	1145	1216	748	724	679	863	850	729	620	661
NCO	Chinese Taipei (foreign obs.)	mm	1x1						5						12														
			5x5											16															
	Cuba	mm	5x5	109												12													
	Dominica	mm	5x5																				2						
	Grenada	mm	1x1																	12	12	12							
	Japan (foreign obs.)	mm	1x1						5						10														
Grand Total				713	493	718	1250	1528	1089	871	1082	880	2094	3088	2107	2865	3538	5472	7583	11717	6139	4807	5745	5134	5131	6098	7018	5676	996

Table 2. Information regarding sea birds and sea turtles for 2014 submitted using ST09 observer data collection forms.

		Canada			EU.Malta			EU.PRT.Mainlan			Japan			Korea			USA			EU.France		
Common Name	Row Label	CatchWgt	NoDL	NoDD	CatchWgt	NoDL	NoDD	CatchWgt	NoDL	NoDD	CatchWgt	NoDL	NoDD	CatchWgt	NoDL	NoDD	CatchWgt	NoDL	NoDD	CatchWgt	NoDL	NoDD
Albatrosses nei	ALZ										48		53									
Cory's shearwater	CDI																	0	1			
Atlant. yellow-nosed albatross	DCR										4		2									
Grey-headed albatross	DIC										228.1		52									
Black-browed albatross	DIM										21.1		6									
Southern royal albatross	DIP										6	1	1									
Wandering albatross	DIX											1										
Leatherback turtle	DKK	1150	1					22	19	3		25		110	1			49	1		3	
Northern fulmar	FNO											1										
Olive Ridley turtle	LKV							43	35	8	24		2								22	
Great black-backed gull	LVU	2																				
Hall's giant petrel	MAH										28.4		6									
Antarctic giant petrel	MAI										47.5		10									
Grey petrel	PCI										9.3		8									
Light-mantled sooty albatross	PHE										10.2		2									
Sooty albatross	PHU												1									
White-chinned petrel	PRO										1.2		1									
Loggerhead turtle	TTL	440	9			3		6	5	1	28	1						12	0		10	
Marine turtles nei	TTX										83.5	6	4								3	
Green turtle	TUG										45		2								2	

Table 3. Information regarding sea birds and sea turtles for 2015 submitted using ST09 observer data collection forms. (Note: EU. Portugal submitted multiple ST09 forms, which are being verified for possible duplications or redundancies).

		Belize				Canada				EU.Cyprus				EU.France				EU.Spain(AZTI_IEO)				Japan				Korea				USA			
Common Name	Code	CatchNo	CatchWgt	NoDL	NoDD	CatchNo	CatchWgt	NoDL	NoDD	CatchNo	CatchWgt	NoDL	NoDD	CatchNo	CatchWgt	NoDL	NoDD	CatchNo	CatchWgt	NoDL	NoDD	CatchNo	CatchWgt	NoDL	NoDD	CatchNo	CatchWgt	NoDL	NoDD	CatchNo	CatchWgt	NoDL	NoDD
Albatrosses nei	ALZ																					43	87.4	1	42								
Tristan albatross	DBN																					3	22.5		3								
Grey-headed albatross	DIC																					164	118		164								
Black-browed albatross	DIM																					16	118.5		16								
Wandering albatross	DIX																					10	83	2	8								
Leatherback turtle	DKK					9	2254	8								5		2	543	2		8	16	7	1			2		0		24	0
Northern fulmar	FNO																					1	1.1		1								
Olive Ridley turtle	LKV	6		4	2											45	1	28	931.2	28		14	221	8	6			2					
Kemp's ridley turtle	LKY															1																	
Great black-backed gull	LVU					1	3		1																								
Hall's giant petrel	MAH																					5	4	2	3								
Antarctic giant petrel	MAI																					3	9.1		3								
Grey petrel	PCI																					10	5.2		10								
Light-mantled sooty albatross	PHE																					11	5		11								
Sooty albatross	PHU																					17	29		17								
White-chinned petrel	PRO																					6	8		6								
Great shearwater	PUG	8		6	2																	7	8		7								
Hawksbill turtle	TTH															1																	
Loggerhead turtle	TTL					5	188	5								16						11	217	1	10					1		20	0
Marine turtles nei	TTX									0	0	8	2			13						10	3	7	1								
Green turtle	TUG															3		1	8.48	1													

Table 4. EFFDIS estimates of total hooks for CPCs fishing south of 25ºS and their submission of ST09 forms and/or seabird related information.

CPC	2010	2011	2012	2013	2014	Grand Total	ST09 submission	Seabird information
Belize	2579887.731	3548715.108	4230785.849	4383854.879	1001022.966	15744266.53	Yes	No
Brazil	1477254.734	639209.4918	2308197.463	1907959.74	814554.0707	7147175.499	No	No
China PR		63278.40359		456433.71		519712.1135	Yes	No
Chinese Taipei	24288011.99	29782205.89	25375825.03	25622647.32	20472706.18	125541396.4	Yes	No
EU.España	5027110.471	5128721.199	4212748.549	3123223.261	3895889.948	21387693.43	Partial	No
EU.Portugal	1452475.695	2386276.063	761655.6883	283942.6493	65474.06338	4949824.159	Yes	Blank form
Japan	5948906.791	5767462.238	6548398.871	7632855.344	7113351.098	33010974.34	Yes	Yes
Korea Rep.				268001.065		268001.065	Yes	No
Namibia	312930.6327	164853.7547	122790.952	58238.32028	108750.6983	767564.358	No	No
Other	1581704.399	3085535.113	3047860.458	1858246.94		9573346.91	-	-
South Africa	846159.927	969790.7177	337545.0493	837559.8687	1186153.898	4177209.461	No	No
St. Vincent and Grenadin	653322.0275	1197148.517		354472.365	209867.1865	2414810.096	No	No
Vanuatu	299996.7078	94402.90744	8764.464117		3612.126595	406776.206	No	No

Appendix 1

AGENDA

1. Opening, adoption of Agenda and meeting arrangements

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

3. Develop proposals for obtaining common Oceans ABNJ tuna project funding to support a joint meeting between tRFMOs on the implementation of the EBFM approach.

4. Establish clear EBFM goals and objectives to be discussed and considered by the Commission.

5. Assess research needs and prioritize research activities in order to develop a long term research plan

   By-catch

6. Total effort estimates by fishery

   6.1. Longline

      6.1.1. Review Task II longline catch and effort data coverage.

      6.1.2. Review the methodology to be used to update the longline EFFDIS data

   6.2 Other gears

7. Sea Turtles

   7.1 Work Plan – Sea Turtles

8. Seabirds

   8.1 Review of seabird conservation measure Rec. 11-09

   8.2 Review of data received from CPCs on seabird by-catch

   8.3 Seabird papers submitted by CPCs

   8.4 Mitigation trials and advice

   8.5 Seabird by-catch and mitigation in the Mediterranean

   8.6 Work plan - Seabirds

9. Other matters

10. Recommendations

11. Adoption of the report and closure

Appendix 2

LIST OF PARTICIPANTS

CONTRACTING PARTIES

BRAZIL
Neves, Tatiana
Projeto Albatroz, Rua Marechal Hermes, 35, CEP: 11.025-040 Santos Sao Paulo
Tel: +55 13 3324 6008, Fax: +55 13 3324 6008, E-Mail: tneves@projetoalbatroz.org.br

CANADA
Hanke, Alexander
Scientific, St. Andrews Biological Station/ Biological Station, Fisheries and Oceans Canada, 531 Brandy Cove Road, St. Andrews New Brunswick E5B 2L9
Tel: +1 506 529 4665, Fax: +1 506 529 5862, E-Mail: alex.hanke@dfo-mpo.gc.ca

CÔTE D'IVOIRE
Amandè, Monin Justin
Chercheur Halieute, Centre de Recherches Océanologiques de Côte d'Ivoire, Département Ressources Aquatiques Vivantes - DRAV29 Rue des Pêcheurs, BP V 18, Abidjan 01
Tel: +225 05 927 927, Fax: +225 21 351 155, E-Mail: monin.amande@yahoo.fr; monin.amande@cro-ci.org

EUROPEAN UNION
Fernández Costa, Jose Ramón
Ministerio de Economía y Competitividad, Instituto Español de Oceanografía - C. Costero de A Coruña, Paseo Marítimo Alcalde Francisco Vázquez, 10 - P.O. Box 130, 15001 A Coruña, Spain
Tel: +34 981 218 151, Fax: +34 981 229 077, E-Mail: jose.costa@co.ieo.es

Juan-Jordá, María Jose
AZTI, Marine Research DivisionHerrera Kaia, Portualdea z/g, E-20110 Pasaisa Gipuzkoa, Spain
Tel: +34 671 072900, E-Mail: mjuanjorda@gmail.com

Lopez, Jon
AZTI-Tecnalia, Herrera kaia z/g, 20110 Pasaia, Gipuzkoa, Spain
Tel: +34 634 209 738, Fax: +34 94 657 25 55, E-Mail: jlopez@azti.es

Poisson, François
IFREMER - l'Unité Halieutique Méditerranée (HM) UMR - Ecosystème Marin Exploité (EME), Avenue Jean Monet, B.P. 171, 34203 Sète, France
Tel: 33 499 57 32 45/33 679 05 73 83, E-Mail: francois.poisson@ifremer.fr

JAPAN
Inoue, Yukiko
Assistant Researcher, Ecologically Related Species Group, Tuna and Skipjack Resources Division, National Research Institute of Far Seas Fisheries, 5-7-1 Orido, Shimuzu-Ku, Shizuoka-City, Shizuoka 424-8633
Tel: +81 543 36 6046, Fax: +81 543 35 9642, E-Mail: yuinoue@affrc.go.jp

Okamoto, Kei
Researcher, National Research Institute of Far Seas Fisheries, Japan Fisheries Research and Education Agency, Ecologically Related Species Group, 5-7-1 Orido, Shimizu, Shizuoka 424-8633
Tel: +81 54 336 6047, Fax: +81 54 335 9642, E-Mail: keiokamoto@affrc.go.jp

Oshima, Kazuhiro
National Research Institute of Far Seas Fisheries, Japan Fisheries Research and Education Agency, 5-7-1, Orido, Shizuoka Shimizu-ku 424-8633
Tel: +81 543 36 6047, Fax: +81 543 35 9642, E-Mail: oshimaka@affrc.go.jp

Yokawa, Kotaro
Research Coordinator, National Research Institute of Far Seas Fisheries, Japan Fisheries Research and Education Agency, 5-7-1 Orido, Shimizu-ku, Shizuoka 424-8633
Tel: + 81 54 336 6016, Fax: +81 54 335 9642, E-Mail: yokawa@affrc.go.jp

MAURITANIA
Brahim, Khallahi
Institut Mauritanien de Recherches Océanographiques et des Pêches, BP 22, Nouadhibou
Tel: +222 2242 1009, Fax: +222 4574 5081, E-Mail: medfall_khall@yahoo.fr

NAMIBIA
Uanivi, Uatjavi
Minstry of Fishereis and Marine Resources, Directorete Resource Management, Strand Street, Swakopmund
Tel: +264 64 410 1176, Fax: +264 64 404 385, E-Mail: uatjavi.uanivi@mfmr.gov.na

S. TOMÉ E PRÍNCIPE
Carvalho d Almeida Godinho, Virginia
Technicienne de la pêche, Direcçao das Pescas, Largo das Alfandegas, P.O. Box 59
Tel: +239 990 7655, E-Mail: virginiacarvalho998@hotmail.com

UNITED KINGDOM (OVERSEAS TERRITORIES)
Luckhurst, Brian
2 Via della Chiesa, Acqualoreto, 05023 Umbria, Italy
Tel: +39 339 119 1384, E-Mail: brian.luckhurst@gmail.com

UNITED STATES
Díaz, Guillermo
NOAA-Fisheries, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami Florida 33149
Tel: +1 305 898 4035, E-Mail: guillermo.diaz@noaa.gov

Schirripa, Michael
NOAA Fisheries, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami Florida 33149
Tel: +1 305 361 4568, Fax: +1 305 361 4562, E-Mail: michael.schirripa@noaa.gov

Swimmer, Jana Yonat
NOAA - Pacific Islands Fisheries Science Center, 501 W. Ocean Blvd., Long Beach California 90802
Tel: +1 562 980 4015; +1 310 770 1270, E-Mail: yonat.swimmer@noaa.gov

URUGUAY
Domingo, Andrés
Dirección Nacional de Recursos Acuáticos - DINARA, Laboratorio de Recursos Pelágicos, Constituyente 1497, 11200 Montevideo
Tel: +5982 400 46 89, Fax: +5982 401 32 16, E-Mail: adomingo@dinara.gub.uy;dimanchester@gmail.com

OBSERVERS FROM INTERGOVERNMENTAL ORGANIZATIONS

AGREEMENT ON THE CONSERVATION OF ALBATROSSES & PETRELS - ACAP
Wolfaardt, Anton
Convenor of ACAP's Seabird Bycatch Working Group, Agreement on the Conservation of Albatrosses and Petrels (ACAP) 27 Salamanca Square, Battery Point, 7004 Tasmania, Australia
Tel: +61 3 6233 3123; +27 716229678, E-Mail: acwolfaardt@gmail.com

WCPFC
Clarke, Shelley
WCPFC, Kaselehlie Street, 96941 Kolonia, Pohnpei, Federated States of Micronesia
Tel: +691 320 1992, Fax: +691 320 1108, E-Mail: shelley.clarke@wcpfc.int

OBSERVERS FROM NON-GOVERNMENTAL ORGANIZATIONS

BIRDLIFE INTERNATIONAL - BI
Mulligan, Berry
BirdLife International Marine Programme Officer, RSBP The Lodge, Potton Road, Sandy, Bedfordshire SG19 2DL, United Kingdom
Tel: +44 1767 693 655, E-Mail: berry.mulligan@rspb.org.uk

Small, Cleo
Head, BirdLife International Marine Programme, BIRDLIFE International Global Seabird Programme, RSPB, The Lodge, Sandy, Bedfordshire SG19 2DL, United Kingdom
Tel: +44 1767 693 586, Fax: +44 1767 692 365, E-Mail: cleo.small@rspb.org.uk

INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION – ISSF
Moreno Arriola, Gala
ISSF, 805 15th NW Suite 708, Washington DC 20005, United States
Tel: +1 703 226 8101, Fax: +1 215 220 2698, E-Mail: gmoreno@iss-foundation.org

Parga, Mariluz
ISSF, Submon, C/ Rabassa 49, 08024 Barcelona, Spain
Tel: +34 646 582 922, E-Mail: mariluz@submon.org

SCRS CHAIRMAN
Die, David
SCRS Chairman, Cooperative Institute of Marine and Atmospheric Studies, University of Miami, 4600 Rickenbacker Causeway, Miami Florida 33149, United States
Tel: +1 305 421 4607, Fax: +1 305 421 4221, E-Mail: ddie@rsmas.miami.edu

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ICCAT Secretariat
C/ Corazón de María 8 – 6th floor, 28002 Madrid – Spain
Tel: +34 91 416 56 00; Fax: +34 91 415 26 12; E-mail: info@iccat.int

ICCAT
De Bruyn, Paul
Kell, Laurence

AOTTP Program
Beare, Doug

Appendix 3

LIST OF DOCUMENTS

SCRS/2016/039	Interaction Between Seabirds and the Spanish Surface Longline Fishery Targeting Swordfish in the South Atlantic Ocean (south of 25ºS) During the Period 2010-2014	Ramos-Cartelle, A., Carroceda, A., Fernández, J., and Mejuto, J.
SCRS/2016/125	Preliminary estimates of the number of sea turtle interactions with pelagic longline gear in the ICCAT Convention area	Mckee Gray C.,Diaz G., and Swimmer Y.
SCRS/2016/127	ISSF by-catch reduction research cruise on the F/V Cap Lopez, Gulf of Guinea 2015	Itano D., Filmalter J.D., and Forget F.
SCRS/2016/155	ISSF by-catch reduction research cruise on the Sea Dragon, Eastern Atlantic Ocean 2015	Itano D., Filmalter J.D., and Hutchinson M.
SCRS/2016/156	ISSF by-catch reduction research cruse on the F/V Mar de Sergio in 2016	Sancristobal I., Martinez U., Boyra G., Muir J.A., Moreno G., and Restrepo V.
SCRS/2016/158	Utilization and trade of faux poisson landed in Abidjan	Amandà M. J., N'Cho A.J., Kouakou N. D., N'Cho C.M., Koffi K.F., Kouadio A.N.C., Dewals P., and Restrepo V.
SCRS/2016/160	Aspects of The Migration, Seasonality And Habitat Use Of Two Mid-Trophic Level Predators, Dolphinfish (*Coryphaena Hippurus*) And Wahoo (*Acanthocybium Solandri*), in The Pelagic Ecosystem Of The Western Atlantic Including The Sargasso Sea	Luckhurst B.E.
SCRS/2016/161	Operational pattern of Japanese longliners in the south of 25S in the Atlantic and Indian Ocean for the consideration of seabird by-catches	Yokawa K., Oshima K., Inoue Y., and Katsumata N.
SCRS/2016/162	Examination of factors affecting seabird by-catch occurrence rate in southern hemisphere in Japanese longline fishery with using random forest	Inoue Y., Kanaiwa M., Yokawa K., Okamoto K., and Oshima K.
SCRS/2016/163	Modeling of bycatch occurrence rate of seabirds for Japanese longliners operated in southern hemisphere	Inoue Y., Kanaiwa M., Yokawa K., Okamoto K., and Oshima K.
SCRS/2016/164	Information on seabirds bycatch in area south of 25S from 2010 to 2015	Katsumata N., Yokawa K., Okamoto K., and Oshima K.
SCRS/2016/165	Comparative Trails of Lumo Leads And Traditional Line Weighting In The Brazilian Pelagic Longline Fishery	Neves T., Claudino R., Silva-Costa A., Sant'Ana R., Gianuca D., Yates O., and Marques C.

SCRS/2016/166	ACAP Advice For Reducing The Impact Of Pelagic Longline Fishing Operations On Seabirds	Wolfaardt A., Favero M., and Walker N.
SCRS/2016/167	The Development Of ACAP Seabird Bycatch Indicators, Data Needs, Methodological Approaches And Reporting Requirements	Wolfaardt A., Debski I.,Misiak W., Walker N., and Favero M.
SCRS/2016/168	The Conservation Status And Priorities For Albatrosses And Large Petrels	PhillipsR.A., Gales R., Baker G.B., Double M.C., Favero M., Quintana F., Tasker M.L., Weimerskirch H., Uhart M., and Wolfaardt A.
SCRS/2016/169	Fishery As Administrative Unit: Implications For Sea Turtle Conservation	Giffoni, B.B., Olavo G., Leite Jr., Britto. M.K., N.O., and Sales G.
SCRS/2016/170	The Ecosystem Subcommittee's Long Term Research Needs And Priorities As Outlined In The 2015-2020 SCRS Science Strategic Plan	Hanke A.
SCRS/2016/171	Training On Data-Limited Assessments For Tuna And Tuna-Like Species	Gutierrez N.L., Carruthers T., and Newman D.
SCRS/2016/172	Les Tortues Marines de STP	Godinho V.
SCRS/2016/173	Seabird Bycatch Mitigation In The Mediterranean	Tarzia M., Mulligan B., Campos B., and Small C.
SCRS/2016/174	Albatross And Petrel Distribution In The Atlantic Ocean And Overlap With ICCAT Longline Effort	Carneiro A., Mulligan B., Beare D., and Small C.
SCRS/2016/175	Modelling the oceanic habitats of Silky shark (*Carcharhinus falciformis*), implications for conservation and management	Lopez J., Alvarez-Berastegui D., Soto M., and Murua H.
SCRS/P/2016/046	Evaluation of Methods of Incorporating Oceanographic Indicators into Indices of Abundance for Stock Assessment: Project Overview and Progress	Schirripa, M. J., Forrestal, F. Goodyear, C. P.
SCRS/P/2016/047	An Initial EBFM Framework for ICCAT	Hanke, A.
SCRS/P/2016/048	Sea turtle bycatch in U.S. Atlantic & Gulf of Mexico pelagic longlines: Analysis of observer data (POP) 1992-2015	Swimmer, Y. and Guttierrez, A.

From SCRS/2016/125. By-catch rates (sea turtles /1000 hooks), reported fishing effort (number of hooks) from EFFDIS, estimated total interactions (number of individuals) by species and area and associated quarter (QTR) in the ICCAT Convention Area for different fleets. 'Reference' indicates the study from which the bycatch rates were assigned to the different fleets.

FLEET	SPECIES	AREA	QTR	BYCATCH RATE	EFFORT	NO. INT.	REFERENCE
BELIZE	*C. caretta*	N Atlantic	1	0-0.0128	3,692,311	47	Huang 2015
		Tropics	1	0-0.003	2,403,650	7	Huang 2015
		S Atlantic	1	0-0.0239	210,544	5	Huang 2015
	D. coriacea	N Atlantic	1	0-0.0104	3,692,311	38	Huang 2015
		Tropics	1	0-0.03	2,403,650	72	Huang 2015
		S Atlantic	1	0-0.0038	210,544	1	Huang 2015
	L. olivacea	Tropics	1	0.0024	2,403,650	6	Sales et al., 2008
	C. mydas	Tropics	1	0.0032	2,403,650	8	Sales et al., 2008
BRAZIL	*C. caretta*	SW Atlantic	1	0.39-1.78	1,609,178	627-2864	Pons et al., 2010
		Tropics	1	0.07	2,828,310	198	Sales et al., 2008
	D. coriacea	Tropics	1	0.03	2,828,310	85	Sales et al., 2008
	L. olivacea	Tropics	1	0.01	2,828,310	28	Sales et al., 2008
	C. mydas	Tropics	1	0	2,828,310	0	Sales et al., 2008
CANADA	*C. caretta*	NW Atlantic	2	0.138	134,869	19	Garrison & Stokes, 2014
		NW Atl. coastal	3	0.313	662,795	207	Garrison & Stokes, 2014
		NW Atl. offshore	3	0.119	327,378	39	Garrison & Stokes, 2014
		NW Atl. coastal	4	0.145	156,175	23	Garrison & Stokes, 2014
		NW Atl. offshore	4	0.262	81,614	21	Garrison & Stokes, 2014
	D. coriacea	NW Atlantic	1	0.179	17,779	3	Garrison & Stokes, 2014
		NW Atlantic	3	0.35	327,378	11	Garrison & Stokes, 2014
		NW Atlantic	4	0.295	156,175	46	Garrison & Stokes, 2014
CHINA	*C. caretta*	N Atlantic	1	0-0.0128	60,374	0-1	Huang 2015
		Tropics	1	0-0.003	6,153,398	0-18	Huang 2015
	D. coriacea	N Atlantic	1	0-0.0104	60,374	0-1	Huang 2015
		Tropics	1	0.03	6,153,398	0-184	Huang 2015
	L. olivacea	Tropics	1	0-0.0232	6,153,398	0-143	Huang 2015

FLEET	SPECIES	AREA	QTR	BYCATCH RATE	EFFORT	NUMBER INT.	REFERENCE
CHINA-TAIPEI	*C. caretta*	N Atlantic	1-4	0-0.0128	2,630,935	0-34	Huang 2015
		Tropics	1-4	0-0.003	33,488,024	0-100	Huang 2015
		S Atlantic	1-4	0-0.0239	14,748,208	0-352	Huang 2015
	D. coriacea	N Atlantic	1-4	0-0.0104	2,630,935	0-27	Huang 2015
		Tropics	1-4	0-0.03	33,488,024	0-1005	Huang 2015
		S Atlantic	1-4	0-0.0038	14,748,208	0-56	Huang 2015
	E. imbricata	SE Atlantic	1-4	0.001	8,473,921	8	Petersen et al., 2009
	L. olivacea	N Atlantic	1-4	0	2,630,935	0	Huang 2015
		Tropics	1-4	0-0.0232	33,488,024	0-777	Huang 2015
		S Atlantic	1-4	0-0.0032	14,748,208	0-47	Huang 2015
	C. mydas	SE Atlantic	1-4	0.001	8,473,921	8	Petersen et al., 2009
		Tropics	1-4	0.0032	33,488,024	0-107	Sales et al., 2008
JAPAN	*C. caretta*	N Atlantic	1-4	0-0.0128	6,323,814	0-81	Huang 2015
		Tropics	1-4	0-0.003	30,323,819	0-91	Huang 2015
		S Atlantic	1-4	0-0.0239	9,438,423	0-226	Huang 2015
	D. coriacea	N Atlantic	1-4	0-0.0104	6,323,814	0-66	Huang 2015
		Tropics	1-4	0-0.03	30,323,819	0-910	Huang 2015
		S Atlantic	1-4	0-0.0038	9,438,423	0-36	Huang 2015
	L. olivacea	Tropics	1-4	0-0.0232	30,323,819	0-704	Huang 2015
		S Atlantic	1-4	0-0.0032	9,438,423	0-30	Huang 2015
	C. mydas	SE Atlantic	1-4	0.001	9,433,049	9	Petersen et al., 2009
	E. imbricata	SE Atlantic	1-4	0.001	9,433,049	9	Petersen et al., 2009
KOREA	*C. caretta*	N Atlantic	1-4	0-0.0128	244,852	0-3	Huang 2015
		Tropics	1-4	0-0.003	1,179,180	0-3	Huang 2015
	D. coriacea	N Atlantic	1-4	0-0.0104	244,852	0-3	Huang 2015
		Tropics	1-4	0-0.03	1,179,180	0-35	Huang 2015
	L. olivacea	N Atlantic	1-4	0	244,852	0	Huang 2015
		Tropics	1-4	0-0.0232	1,179,180	0-27	Huang 2015
	C. mydas	Tropics	1-4	0.0038	1,179,180	4	Sales et al., 2008
	C. caretta	N Atlantic	1-4	0-0.0128	244,852	0-3	Huang 2015
NAMIBIA	*C. caretta*	SE Atlantic	1-4	0.02	1,210,015	24	Petersen et al., 2009
	D. coriacea	SE Atlantic	1-4	0.01	1,210,015	12	Petersen et al., 2009
	C. mydas	SE Atlantic	1-4	0.001	1,210,015	1	Petersen et al., 2009
	E. imbricata	SE Atlantic	1-4	0.001	1,210,015	1	Petersen et al., 2009
PORTUGAL	*C. caretta*	NE Atlantic	1-4	0.104	131,870	1	Mejuto et al., 2008
		S Atlantic	1-4	1.505	54,414	82	Santos et al., 2013
	D. coriacea	NE Atlantic	1-4	0.391	131,870	52	Mejuto et al., 2008
		Tropics	1-4	0.45	50,204	23	Santos et al., 2012
		S Atlantic	1-4	0.188	54,414	10	Santos et al., 2013
	L. olivacea	Tropics	1-4	1.2	50,204	60	Santos et al., 2012

FLEET	SPECIES	AREA	QTR	BYCATCH RATE	EFFORT	NUMBER INT.	REFERENCE
SOUTH AFRICA	*C. caretta*	SE Atlantic	1-4	0.02	149,216	3	Petersen et al., 2009
	D. coriacea	SE Atlantic	1-4	0.01	149,216	1	Petersen et al., 2009
	E. imbricata	SE Atlantic	1-4	0.001	149,216	0	Petersen et al., 2009
	C. mydas	SE Atlantic	1-4	0.001	149,216	0	Petersen et al., 2009
SPAIN	*C. caretta*	NW	1-4	1.758	3,860,843	6787	Mejuto et al., 2008
		NE Atlantic	1-4	0.104	3,779,639	393	Mejuto et al., 2008
		Tropics	1-4	0.421	5,081,172	2139	Mejuto et al., 2008
		S Atlantic	1-4	0-0.0239	2,833,280	68	Huang 2015
	D. coriacea	NW	1-4	0.349	3,860,843	1347	Mejuto et al., 2008
		NE Atlantic	1-4	0.391	3,779,639	1478	Mejuto et al., 2008
		Tropics	1-4	0.631	5,081,172	3206	Mejuto et al., 2008
		S Atlantic	1-4	0-0.0038	2,833,280	11	Huang 2015
ST. Vincent and the Grenadines	*C. caretta*	N Atlantic	1-4	0-0.0128	10,647,265	0-136	Huang 2015
		Tropics	1-4	0-0.003	2,127,643	0-6	Huang 2015
		S Atlantic	1-4	0-0.0239	164,344	0-4	Huang 2015
	D. coriacea	N Atlantic	1-4	0-0.0104	10,647,265	0-111	Huang 2015
		Tropics	1-4	0.0.03	2,127,643	0-64	Huang 2015
		S Atlantic	1-4	0-0.0038	164,344	0-1	Huang 2015
	C. mydas	S Atlantic	1-4	0	164,344	0	Sales et al., 2008
	L. olivacea	S Atlantic	1-4	0.01	164,344	2	Sales et al., 2008
VANUATU	*C. caretta*	N Atlantic	1-4	0-0.0128	1,027,757	0-13	Huang 2015
		Tropics	1-4	0.0135	202,295	3	Sales et al., 2008
		S Atlantic	1-4	0-0.0239	36,303	0-1	Huang 2015
	D. coriacea	N Atlantic	1-4	0-0.0104	1,027,757	0-11	Huang 2015
		Tropics	1-4	0.035	202,295	7	Sales et al., 2008
		S Atlantic	1-4	0-0.0038	36,303	0-1	Huang 2015
	L. olivacea	N Atlantic	1-4	0	1,027,757	0	Huang 2015
		Tropics	1-4	0.0024	202,295	1	Sales et al., 2008
		S Atlantic	1-4	0-0.0032	36,303	0-1	Huang 2015
VENEZUELA	*C. caretta*	Tropics	1-4	0-0.003		16	Huang 2015
	D. coriacea	Tropics	1-4	0-0.03		158	Huang 2015

FLEET	SPECIES	AREA	QTR	BYCATCH RATE	EFFORT	NUMBER INT.	REFERENCE
UNITED STATES	*C. caretta*	Florida E Coast	1	0.027	271,589	7	Garrison & Stokes,
		Florida E Coast	3	0.087	180,957	16	Garrison & Stokes,
		Florida E Coast	4	0.054	196,463	11	Garrison & Stokes,
		Gulf of Mexico	1	0.009	441,554	4	Garrison & Stokes,
		Gulf of Mexico	2	0.008	382,056	3	Garrison & Stokes,
		Gulf of Mexico	4	0.021	283,930	6	Garrison & Stokes,
		Mid Atl. Bight	2	0.038	240,897	9	Garrison & Stokes,
		Mid Atl. Bight	4	0.179	186,193	33	Garrison & Stokes,
		NE Coastal	3	0.313	632,043	198	Garrison & Stokes,
		NE Coastal	4	0.145	173,992	25	Garrison & Stokes, S
		Atl. Bight	2	0.02	414,278	8	Garrison & Stokes,
	D. coriacea	Florida E Coast	1	0.027	271,589	7	Garrison & Stokes,
		Florida E Coast	2	0.057	182,088	10	Garrison & Stokes,
		Florida E Coast	4	0.051	196,463	10	Garrison & Stokes,
		Gulf of Mexico	1	0.09	441,554	40	Garrison & Stokes,
		Gulf of Mexico	2	0.0921	382,056	35	Garrison & Stokes,
		Gulf of Mexico	3	0.021	458,515	10	Garrison & Stokes,
		Gulf of Mexico	4	0.047	283,930	13	Garrison & Stokes,
		Mid Atl. Bight	4	0.108	186,193	20	Garrison & Stokes, S
		Atl. Bight	1	0.044	383,385	17	Garrison & Stokes, NE
		Coastal	2	0.065	167,733	11	Garrison & Stokes, NE
		Coastal	3	0.179	632,043	113	Garrison & Stokes, NE
		Coastal	4	0.295	173,992	51	Garrison & Stokes,