2012 INTER-SESSIONAL MEETING OF THE SUB-COMMITTEE ON ECOSYSTEMS

(Sète, France – July 2 to 6, 2012)

1. Opening, adoption of Agenda and meeting arrangements

The Meeting was held at the *Centre de Recherche Halieutique Méditerranéenne et Tropicale* (CRHMT) in Sète, France from July 2 to 6, 2012. The Sub-Committee on Ecosystems Convener, Dr. Shannon L. Cass-Calay (USA) welcomed the group, and described the objectives and logistics of the meeting. Following these opening remarks, Dr. Philip Cury, Director of the CRHMT, welcomed participants ("the Sub-Committee") and made a brief presentation of the activities of the Center and in particular those related with the research for an ecosystem approach to fisheries, within the context of global climatic change and overexploitation. Dr. Cass-Calay thanked Dr. Cury for his presentation, then introduced Dr. Alex Hanke (Canada), the new ecosystems Co-Convener for the Sub-Committee. Dr. Cass-Calay also introduced Dr. Rui Coelho (Portugal), who was hired by ICCAT to assist the Sub-Committee to assess the impact of ICCAT fisheries on sea turtles.

Drs. Shannon Cass-Calay and Alex Hanke co-chaired the meeting, Dr. Cass-Calay presented a revised Agenda reorganized in order to facilitate the discussions on bycatch assessment and mitigation measures and ecosystem based fisheries management. She also proposed a timetable for the meeting. The revised Agenda was adopted without changes (**Appendix 1**) as well as the timetable.

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*
Item 1, 13	P. Pallarés
Item 2	R. Coelho, G. Díaz
Item 3	D. Die
Item 4	L. Stokes
Item 5, 11	P. de Bruyn
Item 6	C. Small
Items 7, 10	S. Cass-Calay
Item 8	H. Arrizabalaga
Item 9	H. Arrizabalaga, M. Schirripa
Item 12	L. Kell

2. Review of information needed to assess the impact of ICCAT fisheries on sea turtles

2.1 Review the available data and identify gaps in knowledge

Document SCRS/2012/049 presented a compilation and revision of the literature and data currently available to assess the impacts of ICCAT-fisheries on sea turtle populations. ICCAT is preparing an assessment on the impacts of ICCAT fisheries on sea turtle population, and this paper is integrated in the initial data preparatory process. The revision included the Atlantic Ocean and the Mediterranean Sea. More emphasis was given to interactions with ICCAT fisheries (e.g., pelagic longlines, purse seines, driftnets and tuna traps), but other non-ICCAT fisheries that operate within the ICCAT convention area (e.g. trawl and nets) were also briefly addressed.

A comment from Chinese Taipei was made that previous to the present call specific for sea turtles, general bycatch data (including sea turtles) had already been submitted to the Secretariat. That comment was followed and confirmed by the Secretariat, and the table summarizing CPC data in the document was corrected and updated. It is also noted that some additional new information on CPUE time series standardizations was presented during the meeting, and that new information will be available in the future. A discussion regarding the issue of the data gaps was carried out, with some participants noting that submitting this type of information (i.e., complete catch and effort information from the fishery observer programs) could be very time consuming and difficult, and that those issues such as CPUE time series standardization should probably be carried out by the CPCs. A note was also made by some participants that for some fisheries, such as purse seines, indicators other than CPUEs would probably be more appropriate, including for example relationships between the

captured sea turtles and the target species. Such indicators should also be estimated annually and followed in time series. A final and updated version of the document was prepared and provided to the participants before the end of the meeting.

Document SCRS/2012/085 presented the activities of the Groupe Tortues Marine France (GTMF). This group was created in 2007 by the French Ministry in charge of the Natural Environment aims to exchange information, to reflect and make propositions on all issues concerning the management of sea turtles in all French waters, including overseas territories, with links to the conservation actions at the international level. The work of GTMF is organized into 5 working groups concerning the following themes: databases, bycatch reduction, habitat restoration, public awareness, legislation and training. The main actions carried out by the bycatch working group during these last years were to take stock of the situation of the sea turtles in the different French waters based on the analysis of a National questionnaire on various interactions of fisheries with sea turtles. Provisory maps on distribution of turtle strandings and catches were drawn with information on the most impacting gears.

The U.S. delegation briefly presented a compilation of sea turtle related documents that were prepared, and that were circulated and made available to the Sub-Committee. Those included documents on interactions between sea turtles and fisheries, literature on biology of sea turtles and on methods for data analysis.

The working group also considered a presentation of Phillips (2011) that analyzed a twenty year mark-recapture dataset from the loggerhead nesting beach on Keewaydin Island, off the southwest coast of Florida. By using a two-state open robust design model (Kendall and Bjorkland 2001, Kendall 2010) implemented in Program MARK (White & Burnham 1999) Phillips estimated changes in the nesting assemblage over the period 1990-2009. A total of 2,292 encounters of sea turtles, representing 841 individual tag IDs were used for this analysis. Apparent survival, which may include tag shedding, and migration in and out of the assemblage, was estimated at 0.73 (95% CI 0.69-0.76). All nesting females were double tagged so tag shedding of both tags is estimated to be low, at about 1% per year. Phillips (2011) found no evidence of time trends in either the remigration rate or clutch frequency suggesting that the parameters characterizing the nesting assemblage have not changed over time. The mark-recapture analysis was supplemented with a satellite tracking component to identify the offshore foraging areas utilized by Keewaydin nesters. Eleven nesting females were outfitted with platform terminal transmitters, which transmitted for between 42 and 330 days. After nesting most sea turtles migrated to foraging grounds in the Florida West Coast shelf, but one did move to the Bahamas.

The presenter explained that the sample size could be considered large, and that the study used double tagged specimens in order to reduce bias in the analysis. A note was made that this study refers mainly to adult females nesting, while the majority of sea turtle interactions with ICCAT fisheries are with the juveniles in the open ocean. It was also noted that the outputs of this analysis (e.g. survivorship parameters) could be useful for other analysis such as demographic models (e.g. Leslie matrices). However, it was recognized that there are complications, including the fact that sea turtles interact with a variety of different fisheries.

Document SCRS/2012/098 reported a study based on observer data from 2003 and 2011 regarding marine turtle interaction with EU purse seine fishery. Scientific observers on-board EU purse seine vessels were present, from 2003 to 2011, in a total of 2762 fishing operations or sets during 148 fishing trips in the Atlantic Ocean. The sampling coverage increased since the beginning of the observer program and approached almost 10% at the end of 2007. During the observed fishing operations, a total of 171 individuals belonging to 6 different species of sea turtles were recorded, of which only 4 were dead. It was estimated that the percentage of sea turtles that are released alive was approximately 98%. All sea turtles found alive, either on/around the FAD or in the net were freed in apparent good condition. Sea turtles species composition was dominated by the olive ridley sea turtle (*Lepidochelys olivacea*), especially since 2008, followed by the Kemp's ridley (*Lepidochelys kempii*), the leatherback (*Dermochelys coriacea*), the green sea turtle (*Chelonia mydas*) and the loggerhead sea turtle (*Caretta caretta*).

The Sub-Committee inquired on the total number of FADs currently operating, and if there were plans to estimate total sea turtle catches from purse seines. It was indicated that currently the CPCs have to provide information on the number of FADs operating and, therefore, it may be possible to obtain those estimates in the future. However, it was noted that some difficulties exist in terms of extrapolation mainly due to the low coverage of fishery observers. The issue on the FAD design was further addressed, and it was mentioned that in general fishing companies typically prefer to deploy one single FAD design that works and that is safer for sea turtles.

2.2 Review methods used to estimate bycatch rates and/or extrapolate total bycatch using data from the reporting fleets

The Sub-Committee reviewed the documents listed below. However, it should be noted that the Sub-Committee did not conduct a thorough evaluation of the presented CPUEs with respect to their utility to estimate total sea turtle takes by ICCAT longline fisheries.

Document SCRS/2012/050 (estimation of bycatch) compiled and presented information on some of the currently available methodological approaches to analyze interactions and impacts of fisheries on sea turtle populations. The document mostly emphasized methods for standardizing CPUE time series, which are useful and can provide relative indexes of abundance for the species. The types of both the response and explanatory variables that can be considered in the models were presented, and the limitations of the different modeling techniques to specific types of data were addressed. Some available statistical modeling techniques, such as GLMs, GAMs, and Mixed Models, were presented and discussed. The problem of overdispersion and zero-inflation in the data, common in the datasets for many bycatch species, including sea turtles, was addressed, and possible solutions such as zero inflated models, the delta-method approach, and tweedie models were also presented and discussed.

The Sub-Committee noted that for data sets that contain zero values, it can be more appropriate to use a lognormal approach rather than adding a constant value to all observations depending of the proportion of zero observations in the data. It was pointed out that model diagnostics are often informative in this regard, and should be used to guide the model selection.

The Sub-Committee also mentioned that the approach selected to estimate CPUEs should take into consideration what the indices will be used for. For example, for stock assessment purposes it is necessary to estimate annual CPUE values. But, different sets of covariates could be incorporated in the models if the CPUEs will be used for spatial analysis or for a specific fraction of a population.

Document SCRS/2012/081 presented information on observer coverage estimation in relation to management objectives. The levels of observer coverage needed to detect given changes in discard rates were estimated for the Canadian pelagic longline fishery using historical ratio estimates of discarding and data for seven species of special conservation concern. The required estimates of coverage were shown to vary among the species and among the years within species. The relationships between the coverage estimates and the statistical properties of the ratio estimate such as the correlation between the number discarded and an auxiliary variable are also described.

The Sub-Committee acknowledged the utility of the presented technique and the particular importance of being able to detect population changes. The Sub-Committee also discussed the costs associated with increasing observer coverage. It was noted that in general cost may not increase linearly as coverage increases. The Sub-Committee discussed and agreed on the utility of the study and that, in a way, it could be considered a power analysis.

Document SCRS/2012/093 analyzed 13 years of data describing the incidental capture of loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) sea turtles by the Brazilian and Uruguayan pelagic longline fishing fleet from total sampled effort of 8,975,249 hooks. A total of 6545 loggerhead and 890 leatherback sea turtles were captured. Loggerhead turtles occur mainly below 25ºS and the largest BPUE (bycatch per unit effort) was observed during the fall (0.9613 turtles/1000 hooks). Genetics studies showed that pelagic longline fleets from both countries capture loggerhead sea turtles from rookery beyond Brazil (i.e., USA, Mexico, Greece and Turkey). Leatherback sea turtles were most common between longitude 40ºW and 55ºW, and latitude 25ºS and 40ºS. The largest BPUE was also observed during the fall (0.1437 turtles/1000 hooks). Leatherback turtles from the Gabon rookery, a principal nesting area in the world, have been caught by Brazilian and Uruguayan longline fishing fleet. Telemetry studies have shown that leatherback high use areas overlap with the main fishing areas of these two fleets. As sea turtles are highly migratory animals, a regional approach would allow for a better understanding of the sea turtle distribution in the southwestern Atlantic Ocean and, thus, contribute to the development of initiatives for the monitoring of the longline fisheries and the implementation of mitigation measures aiming to reduce the incidental capture and mortality of sea turtles.

The Sub-Committee inquired if information collected on sea turtle catches also included the fate of the animals incidentally caught. The authors indicated that such information is available, but it was not included in the document. The Sub-Committee also discussed if the estimated index of abundance could be considered an index of abundance for the populations nesting in Brazil. The authors argue that genetic studies of sea turtles caught in

the area of study showed many different haplotypes corresponding to different nesting areas such as the Gulf of Mexico, the Mediterranean Sea, and the Indo-Pacific, and, therefore, the index might not solely reflect the abundance of the sea turtle populations nesting in Brazil. The Sub-Committee also inquired about the significance of the Kernel analysis presented in the document, but the authors were unable to provide any further information besides what was already included in the document. It was also pointed out that the apparent increases in loggerhead sea turtle populations in the area of study were the result of better management and control of the nesting beaches in Brazil and not necessarily due to lower interaction rates with the fishing fleets operating in the area.

Document SCRS/2012/086 presented an update of the standardized loggerhead turtle bycatch rate observed in the Uruguayan and Brazilian longline fleets. The study covered the period 1998-2010 and the area between parallels 19ºS and 40ºS in the Southwestern Atlantic Ocean. The proportion of positive observations ranged between 20 and 60% by year. Therefore, catch rates were standardized using Generalized Linear Models with a Delta Lognormal approach. The variables tested for inclusion in the model were Year, Season, Area, Sea surface temperature, and Gear-style. The variables Year, Gear, Area, Quarter and their interaction with the Year factor were included in the final model of positive bycatch rates. The same variables in addition to sea surface temperature were significant for the proportion of positives model. The standardized and nominal loggerhead CPUE series did not show a clear trend, although the standardized CPUE showed less variability between years compared to the nominal CPUE.

The authors indicated that the areas used in the standardization model might need to be revised in the future. However, given that the areas were defined based on observed catch rates and oceanographic features together with the fact that the factor 'A*rea*' was found to be significant in the model might be an indication that the current area definitions might be appropriate. It was also indicated to the Sub-Committee that the different fleets operating in these fishing grounds sometimes use different areal definitions.

Document SCRS/2012/087 explored different methods to extrapolate observed bycatch data of loggerhead sea turtles (*C. caretta*) in the southwestern Atlantic Ocean. The authors used data from the scientific onboard observer programs of pelagic longliners from Uruguay and Brazil and data reported by the CPCs available in the Task 2 Catch/Effort ICCAT database. The area selected was delimited between 20-40ºS because bycatch of this species is negligible north of 20ºS in the southwestern Atlantic. A total of 6,851,086 hooks were observed in 4,703 sets between 2004 and 2009. A subset of the Task II catch/effort database was selected to perform the extrapolation, including only data corresponding to the same spatial extent and temporal frame of the observed data. As a result, a total of 98.3 million hooks, representing the effort reported by 9 CPCs (Belize, Brazil, Chinese Taipei, Spain, Portugal, Japan, Philippines, St. Vincent and Grenadines, and Uruguay) were used to estimate the total loggerhead bycatch. The methods used were: Generalized Linear Models (Delta Lognormal, Delta Poisson and Negative binomial) and Random Forest (RF). To compare the accuracy of the estimates, the Mean Square Errors were calculated. The same explanatory variables were used in all models (Year, Area and Quarter) and no variable selection was performed. The Negative binomial model and RF provided the most robust estimates compared to the Delta approaches. In addition, RF had the smallest confidence interval, estimating that 79,854 to 90,865 loggerheads sea turtles could have been captured between 2004 and 2009 in the area of the southwestern Atlantic Ocean considered in the study. The authors suggested that other variables including hook depth, soak time duration, sea surface temperature, bait type and size, and hook type and hook size should be considered in future analyses. However, most of this information is not available from ICCAT's Task II catch/effort database.

Document SCRS/2012/096 presented preliminary estimates of nominal incidental catch rates of sea turtles from the Taiwanese large scale tuna longline operating in the Atlantic Ocean. One hundred and three trips, 13,096 observed sets and 40.75 million hooks were analyzed. The incidental catch rates ranged from 0.000-0.0311 per 1000 hooks which were highest in tropical Atlantic Ocean from April to June. The major incidental catch of sea turtle species corresponded to leatherbacks.

Document SCRS/2012/097 presented information on sea turtle bycatch distribution and standardized CPUEs of the Japanese longline fleet in the Atlantic from data collected by the Japanese scientific observer program for the period 1997 to 2010. In general, leatherback and the other sea turtles were mainly caught in the northern area and in the eastern tropical area. However, bycatch distribution changed by species and/or season. No sea turtles were caught in the area off South Africa at any season. Standardized CPUE for leatherback turtle and the other turtles (loggerhead and olive ridley turtles) were estimated using a Delta-lognormal approach. CPUE ranged from 0.00017 to 0.00207 for leatherback and from 0 to 0.00030 for other turtles.

The Sub-Committee noted that the estimated CPUEs were 2 or 3 orders of magnitude lower than those estimated for other fleets and inquired about the units of efforts used to estimate the CPUE. The authors confirmed that the provided CPUEs corresponded to number of sea turtles caught per 1,000 hooks. It was briefly discussed that dividing the Atlantic ocean into very large areas for the GLM might artificially result in very small estimates of CPUE. For Example, when turtles do not inhabit the entire area for which a BPUE is calculated, the effort from fishing in the non-turtle part of the domain artificially lowers the BPUE. Thus, trying to compare the BPUE from different sources becomes problematic unless we adopt standard area-time strata so that observed differences are a result of fishing practices and not the areal or temporal boundaries.

The Sub-Committee also reviewed a presentation titled "Precision in bycatch estimates: the case of tuna purse-seine fisheries in the Indian Ocean". The Sub-Committee acknowledged that the results of this study confirmed previous findings by this Sub-Committee that the required observer coverage to achieve a certain level of precision mainly depends on the catch rates and the variability of these catch rates, and often exceeds 10-20%. The Sub-Committee also discussed the practical difficulties of increasing observer coverage to such high percentages. In particular, it was noted that the daily cost of one observer varies widely among CPCs and that longline fleets with a relatively high proportion of small vessels, it is not always possible to increase observer coverage to cover these small vessels (i.e., vessels are too small to safely carry an observer).

3. Review methodologies to assess the impact of fisheries on bycatch species

Document SCRS/2012/050 presented a review of Ecological Risk Assessment (ERA) a potential technique for assessing the impacts of ICCAT fisheries on sea turtle populations. The ERA determines the vulnerability of a stock to a fishery as a function of productivity and susceptibility components. With this type of analysis it is possible, for example, to identify species with high susceptibility to the fishery but where productivity (biological) information is still lacking, and that could help to establish needs in terms of management and research priorities. ERA approaches can be categorized depending on the level of quantitative information used, and one advantage is that the analysis is highly flexible. Examples of applications of ERA analysis to other fisheries and other taxa are provided in the document, and the list of parameters (with thresholds and scores) currently recommended by the US NOAA/NMFS Vulnerability Evaluation Group are also included. Tables with summaries of compiled available biological data on sea turtles are provided, and those can be used in the productivity components of an ERA analysis for sea turtles. For the vulnerability components there is a general need to compile CPCs data (either logbook or fishery observer data) in terms of sea turtle captures, overlapping (both horizontal and vertical) of the fisheries/fleets with the various sea turtle species, and estimation of mortality rates.

The Sub-Committee noted that it is worth supporting the consolidation of satellite track data onto databases like seaturtle.org to facilitate studies of areas of the ocean that are highly used by sea turtles. The identification of the geographical overlapping between those areas of high utilization by the sea turtles and the areas of operation of the fishing fleets can support the ERA, as it is a susceptibility parameter that can be used in the analysis.

Another useful assessment method could be to compare sea turtle bycatch in ICCAT fisheries to non-ICCAT fisheries. This comparison will require a review of literature and possibly contacting experts from other fishery commissions to collect all relevant information. The review can identify sources of published data on bycatch, but may not be able to estimate bycatch levels for all non-ICCAT fisheries. Examples of such comparisons can be found in Domingo et al 2006, Wallace et al 2010.

3.1 Review methods to estimate mortality of sea turtle associated with incidental catch

Document SCRS/2012/050 provided a section on estimation of mortality that presents a review of methods to estimate and analyze mortality rates on sea turtles that interact with fisheries. This section of the document focuses mainly on short term mortality and on some statistical methods available to analyze such data. The types of response variables and examples of possible explanatory variables are presented and discussed. Analyses of model parameter and interpretation of odds-ratios are also discussed, including how odd-ratios estimates can contribute to a better understanding of particular factors that may significantly affect sea turtle mortality rates. Although the main focus of the document is on short term mortality, the issue of planning and conducting studies for analyzing post release mortality was also addressed.

The Sub-Committee discussed that in the studies to estimate of post-release survival attention has to be paid on how individual animals are selected for tagging. It is essential that the tagged population is representative of the stock/population studied. For example, tagging only those animals that seem to be in better condition and seem to have a higher probability of surviving will lead to biased estimates of survival.

3.2 Summarize data requirements and assumptions of the different methods

The Sub-Committee reviewed all the methods presented and generated a table that summarizes the main objectives, outputs and constraints of each of the methods for evaluating impacts of fisheries on ICCAT species (**Table 1**).

3.3 Identify analytical techniques that may be possible, and appropriate to implement given the available data

After this review the Sub-Committee agreed that, the assessment of impacts of ICCAT fisheries on sea turtles should be conducted using more than one single method given the constraints and benefits described above. The Sub-Committee gave the highest priority to work in support of the task of comparing the impact of ICCAT fisheries with non ICCAT fisheries. Second priority was assigned to the Productivity-Susceptibility Analysis (PSA). Moreover it was agreed that the PSA analysis should be used to identify gaps in the data to avoid focusing only on the fisheries/locations for which we have information. Finally, the Sub-Committee agreed that an attempt would be made intersessionally to develop a Leslie matrix model to estimate the intrinsic rate of growth for use in the PSA.

4. Review of progress and research made on bycatch mitigation measures

Document SCRS/2012/051 compiled and presented the currently active mitigation recommendations and resolutions across the five Tuna Regional Fishery Management Organizations (tRFMOs) that manage fisheries targeting tuna and tuna-like species worldwide. Additionally, the currently active recommendations and resolutions for other Regional Fishery Bodies (RFBs) in the Atlantic Ocean and adjacent seas, whose areas of competence also include the high seas, were presented.

The Sub-Committee discussed that although observer coverage is not a mitigation measure, it is an important component for collecting data useful to understand bycatch. Mitigation measures (e.g., circle hooks, whole finfish bait) were reviewed, and proper training for the implementation of release protocols were highlighted as priorities. Identifying data gaps is necessary. The Secretariat noted the difference in the use of terminology between 'recommendation' and 'resolution' among the tRFMOs and suggested that the document be annotated to address this. A final and updated version of the document, including this and other minor corrections, was prepared and provided to the participants before the end of the meeting.

Document SCRS/2012/089 described the results of an ongoing study on the effects of hook type and bait on sea turtle bycatch in the Portuguese southern Atlantic swordfish longline fishery. Data on sea turtle bycatch composition and rates, hooking location and status at haulback and at release were provided, based on a total of 310 longline sets (446,400 hooks). The highest BPUE values occurred with J style hooks baited with squid. For the loggerheads, changing the bait type from squid to mackerel reduced the odds of accidental capture between 64-82%. Regarding the hook styles, changing from J-style to circle hooks was only significant when using squid bait. Hooking location was species-specific, with most loggerheads hooked by the mouth, while leatherbacks were mostly retained by the flippers. Hooking mortality was species specific, with a higher percentage of living leatherbacks (85%) compared to loggerheads (63%).

Document SCRS/2012/090 described the results of an ongoing study on the effects of hook type and bait on sea turtle bycatch in the Portuguese swordfish longline fishery operating in the northeastern Tropical Atlantic region. Data on sea turtle bycatch composition and rates, hooking location and status at haulback and at release were provided, based on a total of 202 longline sets (254,520 hooks). The highest BPUE values occurred with J style hooks baited with squid. For the leatherbacks, changing the hook style from J to circle hooks reduced the odds of their accidental capture between 48-61%, but no significant differences were found when changing from squid to mackerel bait. Hooking location was species-specific, with most leatherbacks being retained externally (by the flippers or entangled), while loggerheads generally swallowed the hook and were captured by the mouth or the esophagus. Similar percentages of living releases were observed for leatherbacks (91%) and loggerheads (90%).

The Sub-Committee determined that it was important to consider not just the shape of the hook, but also bait effect on target species. There are a variety of opinions regarding the effect of circle hooks, with different bait types and offsets. The proceedings from the International Circle Hook Symposium held in the USA in May 2011 will be available within the next two months, and the information contained in the proceedings could be used to generate a table to summarize the results from circle hook research. It was indicated to the Sub-Committee that the proceedings will include a manuscript that summarizes the major findings of the symposium with a section focused on sea turtles. Because leatherbacks feed primarily on jellyfish, bait type preference is not an issue for

this species and they are caught mostly by entanglement or external hooking on the flippers. Sea turtle abundance in the areas was discussed, and generalizations are not appropriate because hooking location and mortality are species specific. The Sub-Committee discussed the experimental design and that using different bait types on the same set may be confounding. The Sub-Committee also discussed that recommending the use of a particular bait type may not be always feasible because in some fisheries fishermen use whatever bait is available in the market and is affordable. It was indicated that due to US domestic management regulation aimed at reducing sea turtle mortality, the U.S. pelagic longline fleet operating in the North Atlantic can only fish using finfish bait regardless of the bait market availability and/or cost. An important consideration, not reported here, is the effect on target species. Regional differences were discussed, in some areas mackerel are a more effective bait for swordfish, while squid is used when targeting tuna. In the case of the Portuguese fleet, the opposite was true. An increase in shark bycatch with circle hooks and mackerel has also been observed. It was suggested that target should be reported in addition to other gear characteristics. Bait loss was discussed, and research is being conducted to test how different bait types behave on various hook types to account for reductions in effort based on differential bait loss.

5. Review the form prepared by the Secretariat and the information provided by CPCs on scientific observer program information requested under the ICCAT Rec. [10-10]

The new forms prepared by the Secretariat to organize the information provided by the CPCs in response to Rec. [10-10] were presented to the Sub-Committee. Although the utility of the forms was acknowledged, the Sub-Committee made several comments regarding the functionality of the forms. It was pointed out that the forms had been created in a pdf format that is difficult to modify/complete/save without a full version of Adobe Acrobat. This is problematic as many CPC institutes/scientists do not use or have no access to these versions. The Sub-Committee also noted that there was some confusion as to what information is required in certain fields and indicated that the Secretariat should provide guidance to help to resolve this issue, and that the form is relatively inflexible to the incorporation of additional information collected by CPCs.

Examples of additional detailed information which is difficult to include are:

- Self-sampling schemes (the fishing crew samples the catch) which are an important component of some National Data Collection Programs.
- Effective observer coverage per trip should be included (i.e., how much coverage the observer has of the actual fishing operation. Does he view all the sets on a trip, or only, for example, 50%), rather than just the overall observer coverage of the fleet.

The Secretariat agreed to compile the comments provided by the Sub-Committee and reporting CPCs to improve the form in the future.

Another issue raised was that although the current form addresses Rec. [10-10] and collects information on the observer programs conducted by the various CPCs, an additional form is necessary for CPCs to report their observer data in response to Rec. [11-10]. It was pointed out that the SCRS recommended in 2011 that this form be developed by the Secretariat for distribution to the CPCs. The Secretariat agreed to develop a preliminary observer data collection form, based on existing CPC data collection and taking into account improvements made in other oceans to collect this information. The Secretariat will distribute a draft form to the SC_ECO and SC_STATS during the species group meeting in September.

6. Plan of action (2013-2015) to evaluate the efficacy of the seabird bycatch mitigation measures defined under Rec. [11-09]

Document SCRS/2012/083 presented information on improvement of data quality of seabird bycatch data from the Japanese scientific observer program. To achieve that, authors crosschecked the seabird identification in observer data with experts and updated the identification guide for the observer program to one based on the new classification system. The authors also started to collect feather samples in the observer program for DNA analysis because of the limitations of identification using photos for certain species. The final goal is to identify seabird bycatch hotspots, to consider effects on populations and to evaluate the effects of the introduction of mitigation measures.

Document SCRS/2012/088 reviewed the actions taken by Uruguay to address seabird bycatch in the pelagic longline fishery. Uruguay has undertaken scientific research in the last decade to characterize bycatch. This process has involved the Uruguayan government (Dirección Nacional de Recursos Acuáticos, DINARA), and the cooperation of other countries, the fishing industry and NGOs. The characterization of bycatch has been the basis for the development of mitigation measures in the fleet. Uruguay has already obtained results (or ongoing studies) on the efficiency of several mitigation measures (e.g. night setting, tori line, weighted branch lines) and has identified areas and seasons where bycatch is more intensive. Best practices in Uruguay to minimize the incidental catch of seabirds in pelagic longline include the combined use of night setting, tori line and weighted branch lines within 1 m of the hook. However, more research is need to reduce tori line entanglements with fishing gear and to determine the effect of alternative weighted branch lines on the catch of species of commercial interest.

The Sub-Committee discussed the line weight systems that are currently available, including the Safe Lead (also available in a luminescent version), the Japanese double weight system and conventional lead swivels. The former two have been designed to increase safety for the crew. The Sub-Committee noted that the safe lead is designed for use on monofilament only. It was noted that research on the impact of line weights on target catch is important in order to address fishermen's concerns that adding weights could affect target catch.

The authors agreed to bring examples of line weighting gear to future ICCAT meetings (including Commission meeting) to show these options to the fishing industry.

Document SCRS-/012/099 compared the catch rate of target species over nine pelagic longline cruises with leaded swivels placed at 2 m and 5.5 m from the hooks. In total, 92 sets and 87,098 hooks were observed with a catch of 3,868 fishes belonging to 16 taxa. For the main target species, the difference between the total CPUE of branch lines with 2 m leaders and 5.5 m leaders were equal or less than one fish per 1,000 hooks, except for *T. albacores,* for which the CPUE of 2 m leaders was around three fish per 1,000 hooks higher than for 5.5 m leaders. A Generalized Linear Model analysis showed that there is no significant difference between the effects of 2 m or 5.5 m leaders on the catch rate of target species. The results constitute evidence that changing line weight regimes does not negatively affect the catch rate of target species in pelagic longlines.

It was noted that Rec. [11-09] requires SCRS to conduct an assessment of the efficacy of the seabird bycatch mitigation measures in 2015, and that SC-ECO will need to develop a method and a process for undertaking this in time for 2015.

The Sub-Committee encouraged CPCs to continue studies on bycatch mitigation measures and their effect on target species catch rates.

7. Review the results of the tRFMOs meeting on the harmonization of PS observer programs

Following the recommendations of the second Kobe meeting of the tRFMOs, a Joint RFMO Bycatch Technical Working Group (JRBTWB) was convened with the intended purpose of identifying the minimum data standards and data fields that should be collected across all tRFMOs to facilitate interoperability. To proceed toward this objective, several members of the JRBTWB (Chair JRBTWB, SCRS Chair, Secretariat and SC-ECO Convener) participated in a meeting of technical experts from tuna purse-seine fisheries observer programs during 5-9 March 2012 in Sukarrieta, Spain. This meeting, funded by the International Seafood Sustainability Foundation, was convened to discuss harmonization of data collection across purse seine observer programs. Two reports were developed at this meeting, the report of the Chair, Dr. Martin Hall, and a second report prepared by the Chair of the JRBTWB, Dr. Simon Nichol.

The Sub-Committee reviewed both reports and acknowledged that the progress to date towards harmonization is encouraging, but incomplete. Some concern was expressed that national observer programs possess better expertise to collect, report and analyze the data from their own programs. However, overall the Sub-Committee supported the objectives of the JRBTWB, and agreed that harmonization across tRFMOs would facilitate important scientific research including: comprehensive reporting on the status of bycatch species, identification of fisheries practices that cause or increase bycatch and evaluation of the performance of mitigation measures.

The Sub-Committee also considered a proposal from the Sukarrieta meeting, that ICCAT volunteer to lead the effort to harmonize observer programs for longlines. The Sub-Committee, in agreement with the Working Group on Stock Assessment Methods supported this proposal and recommended that the SC-ECO/BYC Convener, the

SCRS Chair and the Secretariat communicate with Simon Nichol (Chair JRBTWB) to coordinate and initiate that effort.

8. Review of new information on the major environmental factors and their effects, ecosystem modeling approaches and ecosystem indicators

Two documents were presented under this section of the agenda.

Document SCRS/2012/082 presented progress on Towards an Integrated Ecosystem Assessment for the Gulf of Mexico. The Gulf of Mexico (GOM) is a semi-enclosed coastal sea with a vast array of topography and moderately high productivity that supports biological diversity and a high biomass of fish, sea birds and marine mammals. Along with supporting a large recreational and commercial fishing industry, the GOM also provides vital services such as oil and gas production, tourism, habitat for endangered species, and support for many Gulf state economies. It is also the only known spawning ground for the western stock of the bluefin tuna. However, despite the many ecosystem services provided by the GOM Large Marine Ecosystem (LME) management of the system historically has been done on a case by case or single species basis with little or no integration. First conceived in 2008, the GOM Integrated Ecosystem Assessment (IEA) is an interdisciplinary, interagency effort whose goal is to address all the various ecosystem services in one unified management framework. The intent of the IEA is to make more obvious the tradeoff between often conflicting ecosystem services. Through state of the art ecosystem models such as Atlantis, OSMOS, and Ecopath_Ecosim, management strategy evaluations (MSE) will be performed that seek to manage the GOM LME from a more holistic, broader perspective than what the current single species models are capable of.

After the presentation, the author noted that although the initiative is only 3 years old, enthusiasm, cooperation and funding for the program continues to increase. The Sub-Committee agreed that this GOM initiative would be helpful for the SC-ECO efforts in the near future, especially in aspects related to the approach, the organization flowchart, the goals, and the products. Also, some intermediate output of the GOM experience might be of interest for the SC-ECO like the spatially explicit biomasses for the pelagic components and the trophic connections. In addition, the list of indicators used in the GOM can be used as a basis for the SC-ECO.

Document SCRS/2012/091 presented progress made on a meta-analysis concerning the impact of climate variability and climate change on the distribution of Atlantic tunas and billfishes. In response to recent climate change, tunas and billfishes are likely to shift their distribution towards higher latitudes. Albacore, bigeye, bluefin, skipjack and yellowfin tunas as well as swordfish, sailfish, white and blue marlin longline catch per unit of effort data were analysed in the northern and southern Atlantic Ocean. Correlations between latitudinal distribution of Atlantic tunas and billfishes and SST were computed and analyzed in a meta-analytic framework. No global positive effect was found at the Atlantic scale, but results indicate that, in the northern Hemisphere, tuna latitudinal distribution was affected by the latitude of the isotherm of 20ºC temperature, suggesting that tuna and billfish might be adapting their latitudinal distribution in response to climate change.

The Sub-Committee discussed that the evolution of the spatial distribution of the different species could be used as an ecological indicator, which could be regionalized. Other, more global environmental indicators (such as the NAO) could also be used to test correlations with spatial distribution of different species, but are more difficult to interpret than variables reflecting local conditions of the seawater that tunas and billfishes inhabit. Although tunas might easily adapt their distribution to climate change and environmental variability, some domestic fisheries might have progressively increasing difficulties to access fishing grounds as they shift to the north (in the case of the North Atlantic). For example, the recent distribution shift of albacore tuna from the Bay of Biscay to an area closer to the Irish platform makes them less accessible to Spanish baitboat fleets.

9. Review of stocks managed/assessed using an ecosystem approach

A presentation by the SC-ECO Convener provided an overview of the Ecosystem Based Fishery Management (EBFM) approach including what EBFM is, its requirements, main obstacles to its implementation and general recommendations. The elements of an EBFM include the following:

1. Employs spatial representation
2. Recognizes the importance of climatic-oceanic conditions
3. Emphasizes food web interactions and pursue ecosystem modeling and research
4. Ensures broader societal goals are taken into account
5. Incorporates improved habitat information (target and non-target species)

6. Expands monitoring
7. Acknowledges and responds to higher levels of uncertainty

As part of item 4 above, the presentation included a table with a range of different objectives (e.g. ecological, societal, economic), data requirements and example indicators that could be used as a template for discussion within the WG. The presentation also included examples of attempts to implement the EBFM approach from around the world. This included several case studies, approaches and conceptual models.

The Sub-Committee fully agreed that the presentation was very useful for driving the future work of the SC-ECO. Some specific recommendations included further exploring the costs of implementing the EBFM, as well as developing a specific plan for the SC-ECO to work on during the next 5-6 years.

9.1 Obstacles to the ecosystem based management of stocks assessed by ICCAT

The Sub-Committee held a discussion on possible objectives and obstacles to Ecosystem Based Fisheries Management (EBFM). Despite these obstacles, the Sub-Committee agreed to develop an EBFM plan and expressed support for such an interdisciplinary approach. The discussion was centered on describing the limitations and associated solutions to EBFM as well as proceeding with a potential test case scenario. The discussion was initiated by outlining the elements of EBFM according to Marasco, R. J., D. Goodman, et al. (2007). The point-by-point summary of the discussion of the elements described in section 9 is given in **Table 2**.

Instead of a potential test case for guiding the discussion, the Sub-Committee favored a more general approach for describing obstacles to implementing EBFM. The Sub-Committee recognized that the SCRS has implemented aspects of the EBFM approach in its assessment of stocks and these were summarized along with the obstacles to implementing a fully operational EBFM model. The details of this discussion are summarized in **Table 2**. The Sub-Committee recognized that EBFM objectives need to be clearly defined before an effective approach can be formulated. These objectives should be based on statements that explicitly express how uncertainties in the current assessment and management process could be improved by implementing an EBFM approach. Examples of such objectives discussed were the creation of a target catch limit designed to buffer against changes in the environment/ecosystem as well as the use of reference areas as an EBFM tool. Recommended SCRS actions to promote EBFM were as follows:

1. Delineate geographic extent of ecosystem(s) within the ICCAT convention area.
   - Characterize the biological, physical, chemical dynamics of ecosystem.
   - Determine alternative users.
2. Develop model of food web.
3. Describe habitat needs of different life history stages for all plants and animals that are a significant part of the food web.
4. Calculate total removals, including incidental mortality, and show how they relate to standing biomass, production, optimum yields, natural mortality and trophic structure.
5. Assess how uncertainty is characterized. Show how management and conservation actions will be buffered against uncertainty.
6. Develop indices of ecosystem health as targets for management.
7. Describe available monitoring data and how they will be used.
8. Assess the ecological, human and institutional elements of the ecosystem that most substantially affect fisheries and are outside ICCAT's authority. Determine how to include those influences.

Finally, the results of this discussion were used to help develop the 2013 work plan. The Sub-Committee noted the additional resources (people, time, funding) would be necessary to fully implement the work plan.

10. Evaluate the efficacy of the work of the Sub-Committee after being restructured, and develop a work plan for 2013-2014

10.1 Efficacy

The Sub-Committee discussed the efficacy of the working group since the addition of the Ecosystems Co-Convener in 2011. The Sub-Committee recognized that the objectives of the two groups are somewhat divergent, but concluded that at this time, a formal division of the groups would likely reduce the capacity and experience of both groups. The Sub-Committee also acknowledged that Commission requests to assess the impact of ICCAT fisheries on bycatch species and prepare ecological based fisheries management products have and will

continue to increase. Therefore, in order to assure sufficient time to carry-out the work of the Sub-Committee, it was concluded that longer meetings and/or parallel sessions may be required, particularly when impact assessments are to be conducted. Given that ecosystem based approaches are the long term objective of this Sub-Committee, and that these approaches require a comprehensive understanding of the fisheries, bycatch and ecosystem characteristics, the Sub-Committee concluded that extended meetings are the best solution.

The Sub-Committee recognizes the value of an inter-disciplinary approach that encourages the participation of scientists with diverse expertise, including fisheries, ecology, data collection protocols, observer programs and modeling approaches. To that end, the Sub-Committee will seek external support, as necessary, through protocols approved by the SCRS in 2011.

To facilitate the 2013 impact assessment for sea turtles, as well as future meetings, the Sub-Committee recognized the need for inter-sessional preparatory work and noted the corresponding recommendations of the WG-SAM regarding shared work directories and video conferencing.

The Sub-Committee also noted the trend toward increasingly demanding agendas in recent SCRS meetings and recommended that the SCRS Chair reiterate to the Commission our concerns regarding the increased workload versus the available resources. The Sub-Committee also recommended that its Conveners facilitate an efficient agenda by defining clear objectives and a plan to move forward with those objectives. To facilitate progress toward these objectives, the Conveners were also encouraged to proactively request the submission of relevant working documents well in advance of the Sub-Committee meeting. The Sub-Committee requests that participants who intend to submit a document provide a provisional title, list of authors and keywords to the Secretariat (pilar.pallares@iccat.int) no later than 30 days prior to the meeting. This request will be included in future communications (i.e. ICCAT circulars) from SC-ECO. The Sub-Committee also agreed on the usefulness of authors submitting their documents in advance of the meeting so to give the meeting attendees the opportunity to review them prior to the start of the meeting. This is particularly important for those documents that present BPUEs.

10.2 Work plans

10.2.1 Working Plan Pertaining to Bycatch

The Sub-Committee concluded that the following bycatch related activities are important to complete during 2012 and 2013.

2012

1. The Secretariat will circulate a new call for sea turtle data amongst CPCs This will be drafted by the SC-ECO Bycatch Convener and the SCRS Chair, and will be reviewed, approved and circulated by the Secretariat. The data will be required no less than 4 months prior to the assessment meeting. The data request will include, for example:
   i) Estimates of BPUE for sea turtles (standardized if possible)
   ii) Estimates of observer coverage
   iii) Estimate of total extrapolated bycatch of sea turtles, if available
   iv) Estimates of mortality at release

2. The SC-ECO/BYC Convener will organize a subgroup to develop the required elements of an Ecological Risk Assessment/Productivity Susceptibility analysis, for example the Leslie Matrix parameters to estimate the intrinsic rate of population growth. Following collation of the required elements, collaboration with other tRFMOs could be sought to contrast and improve the product, as necessary. The resulting product will be presented to SC-ECO in 2013 to facilitate the Sub-Committee deliberations. The work of this subgroup will be conducted intersessionally.

3. The SC-ECO/BYC, the SCRS Chair and the Secretariat will communicate with the Joint tRFMO Technical Working Group on Bycatch chair to request that ICCAT lead efforts to harmonize data reporting protocols (e.g. minimum standard data collection) for longline observer programs.

4. (September 2012) The SC-ECO will review the draft form to be prepared by the Secretariat for the reporting of data from national observer programs [Rec. 11-10].

2013

1. Compile/develop estimates of sea turtle bycatch in ICCAT fisheries from CPC data and other sources.
2. Compile/develop estimates of sea turtle bycatch in non-ICCAT fisheries from CPC data and other sources.
3. Assess relative magnitude of turtle bycatch in ICCAT vs. non-ICCAT fisheries.
4. Review the work products of the subgroup (e.g., ERA-PSA). Make recommendations regarding the parameterization and use of these approaches.
5. Review sea turtle available bycatch mitigation and safe-release protocols measures, and make recommendations as necessary.
6. Prepare response to the Commission regarding Rec. 10-09.
7. Review other matters related to bycatch and bycatch mitigation.

10.2.2 Working Plan pertaining to ecosystems

The Sub-Committee determined that the following ecosystem related activities would be important to complete in 2013:

1. Populate a list of indicators reflecting stated fishery resource, ecological, economic and social objectives.
2. Determine which indicators of ecosystem status can be used in a traffic light report card.
3. Identify a suitable domain as a test case for implementing the EBFM approach.
4. Review the progress that has been made in implementing ecosystem values in enhanced stock assessments or an EBFM.
5. Review conceptual models for EBFM that explore the potential impact of perturbations on the model elements, reveals data gaps, identifies important relationships and identifies thresholds for change within the system.

11. Other matters

11.1 Useful online resources

Several websites were presented that contain useful tools and information that can be used by the Sub-Committee for future bycatch and ecosystem analysis. These websites included:

a) Seaturtle.org (http://seaturtles.org) and seaturtlestatus.org (http://seaturtlestatus.org/) – Resources for information on sea turtles specifically. Tools to support research and conservation efforts in the sea turtle community.

b) OBIS (http://www.iobis.org/) – OBIS allows users to search marine species datasets from all of the world's oceans.

c) WCPFC Bycatch Mitigation Information System (BMIS) (http://bmis.wcpfc.int/) – Developed to manage and facilitate access to information covering (i) bycatch and (ii) bycatch mitigation in the western and central Pacific Ocean (WCPO).

d) Consortium for Wildlife Bycatch Reduction (http://www.bycatch.org/) – A searchable database of references and summaries from bycatch reduction studies, as well as descriptions of bycatch mitigation techniques.

e) ISSF (http://iss-foundation.org/issues/bycatch/bycatch-resources/) – A list of references and resources compiled and carried out by the ISSF regarding bycatch issues.

11.2 Others

Document SCRS/12/084 presented the current status and future plans for the ICCAT bycatch meta-database. In order to improve and better coordinate the knowledge and information available for bycatch species, the ICCAT meta-database was developed in 2010. The meta-database was populated with information regarding bycatch species contained within the ICCAT collected volumes as well as the ASFA database. The information in the database can be extracted in a variety of ways of use in different analyses. The database contains a wide variety of information on bycatch species within the Atlantic region. Although the database is well designed and very

useful, it has several limitations. These limitations could largely be overcome by migrating the meta-database from its current format to an open source platform and made available online. In particular, the online reference management solution Zotero (www.zotero.org), is a promising candidate for the migration of this database.

The Sub-Committee was supportive of the suggestion to make the database as easily accessible as possible by migrating it to an online source. It was also agreed that the Secretariat should maintain a quality control role in the management of the database. It was also noted that this database fulfills a different role to the WCPFC Bycatch Mitigation Information System (BMIS) which is more aimed at bycatch mitigation measures rather than metadata for bycatch studies and data.

SCRS/2012/095 presented a characterization of interactions between marine mammals, whale sharks and tropical tuna purse seine fishery in the Indian and Atlantic Oceans. A seasonal and annual variation in the frequency of co-occurrence distribution between the tuna purse seine fishery and marine organisms was highlighted with specific areas. These organisms seemed to hold an important place and close relationship with the tuna purse seine fishery, but despite these, impact of the fishery remained low in the AO and IO.

The Sub-Committee noted that the observations are strongly reliant on the fleet operations. Observations are only recorded in areas where the fleet is operating and for the seasons of operation.

Document SCRS/2012/092 presented a comparison of how the five tRFMOs are setting up their scientific longline observer programs, which will be important for the collection of data on catches of non-target taxa. The Kobe process aims to harmonise data collection across the tRFMOs. All tRFMOs are following a model of using national observer programs to establish a regional observer program, but vary in the types of data required to be collected and reported, and the extent of Secretariat coordination. While WCPFC and IOTC have gained agreement from CPCs to submit raw data or trip reports, others only require summary annual reports or have not yet set requirements. Some CPCs voice data confidentiality issues and further clarification is needed. Four of the 5 tRFMOs require 5% coverage by longline fleets, which will not be sufficient for monitoring impacts on many non-target species. The paper recommended clarification of data confidentiality concerns in order to overcome them, following WCPFC lead in the Secretariat taking an accreditation and data quality role, and a consistent approach to small vessels.

It was noted the various tRFMOs have different approaches in terms of the data collection processes, ata analysis techniques, and the quantity of data currently being received Therefore comparisons between different tRFMOs may be difficult and need to be interpreted with care. The Sub-Committee also stressed that the scoring system developed by the author did not fully capture the way bycatch issues and observer programmes are addressed across the different tRFMOs. It was also mentioned that efforts are underway to harmonize purse seine minimum data collection standards across the tRFMOs, and there is also a general recognition that longline observer programs also require harmonization. Some members of the Sub-Committee expressed concern that no tRFMO is presently considering increasing the minimum standard of 5% fisheries observer coverage, although the Sub-Committee recognized that the minimum necessary observer coverage will depend on the taxa being analyzed, and that for many CPCs it may not be possible to implement needed increases in the near future due to costs. However, the Sub-Committee also agreed that even at 5% coverage, observer programs can collect very useful information on the way fisheries operates, gear configuration, catch and effort data, etc. It was also noted that for the specific case of the EU and associated purse seine fisheries, there is an effort to increase the fisheries observer coverage to 100%. The need to harmonize minimum standards for data collection amongst tRFMOs was agreed by the Sub-Committee. It was noted that there has been a proposal that ICCAT take a lead role in the tRFMO process to develop harmonized minimum data standards for tRFMO longline observer programs, and the Sub-Committee supported this. The Sub-Committee also agreed that Rec. [11-10] requires ICCAT to develop forms for CPCs to report data from observer programmes and agreed that the Secretariat should develop draft forms for consideration by SC-ECO and SC-Stats.

Presentation on the Sargasso Sea

During the meeting a representative of the Sargasso Sea Alliance (SSA) discussed their initiative. The Sub-Committee encouraged the SSA's representative to submit to the Sub-Committee a SCRS document or similar report with more detailed information on their initiative. A summary paragraph was provided and is included as **Appendix 4**.

12. Recommendations

The Sub-Committee recognized the excellent work conducted by Dr. Rui Coelho in compiling data, methodologies and literature references pertaining to the impact of ICCAT and non-ICCAT fisheries on sea turtles. Dr. Coehlo's preparatory work has expedited the work of the Sub-Committee and has provided an excellent foundation for the 2013 impact assessment. The Sub-Committee acknowledged the value of ICCAT initiative to provide financial support to hire experts to contribute to the SCRS's work and strongly recommended continuing with these productive activities.

1. Sea turtle assessment
    - The Sub-Committee recommended to develop a new data request for sea turtle information on bycatch per unit effort, observer coverage levels and total extrapolated bycatch. This will be drafted by the SC-ECO bycatch Convener and the SCRS Chair.
    - Recognising that other tRFMOs are undertaking assessment of sea turtle bycatch in their fisheries, the SC-ECO recommended that, when available, the proposed ICCAT sea turtle methodology be circulated to other tRFMO working groups for information, and encouraged the ICCAT bycatch coordinator to liase with other tRFMOs on this matter.
    - The SC-ECO recognised that it would be valuable to collate and assemble density distribution maps for sea turtles, for example making use of and contributing data to seaturtlestatus.org, seaturtle.org. Also, it was advisable to collaborate with the Inter-American Convention for the Protection and Conservation of Sea Turtles.
    - The Sub-Committee encouraged CPCs to conduct research on sea turtle population genetics.
2. The SC-ECO recommended that ICCAT coordinate with the tRFMO Joint Technical Working Group on Bycatch in order to assume a leadership role in developing minimum standards for harmonised longline observer data collection for the tRFMOs.
3. The SC-ECO recommended that the Secretariat develop a draft form for reporting observer programme data in line with Recommendation [11-10] which will be reviewed by SC-ECO and SC-Stat in 2012.
4. The Secretariat will update the effort distribution data base (i.e., EFFDIS) prior to the 2013 SC-ECO meeting.
5. The Sub-Committee recommends that when CPCs provide standardised indices of BPUE that they include diagnostics and conform to the guidance developed by the WGSAM (2012 WGSAM report).
6. Recognising the importance of external support in the work of the Sub-Committee, it is recommended that a group conformed by the Secretariat, SC-ECO and SCRS chairs be convened to identify individuals with appropriate regional and technical expertise, and solicit nominations for participation in the Sub-Committee as required.
7. The Sub-Committee recommends that the bycatch meta-data base be converted to an easily accessible platform such as Zortero in order to facilitate its use and that a clear link be made via the ICCAT website.
8. The Sub-Committee recommends that CPCs continue to provide information on the efficiency of bycatch mitigation measures and their effects on target species.
9. The Sub-Committee recommends that the SCRS consider that EBFM is an important area for cultivating collaboration with ICES and other RFMOs and Conventions.

13. Adoption of the report and closure

The report was adopted during the meeting. The Chair thanked CRHMT, the Secretariat and participants for their hard work.

The meeting was adjourned.

Literature cites

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Table 1. Summary of potential methods for the assessment of the impacts of ICCAT fisheries on sea turtles.

Method	*Objectives*	*Outputs*	*Data requirements*	*Available at ECO (now or future)*	*Comments*
Tabulation comparing ICCAT with non-ICCAT impacts on sea turtles	To estimate total interactions/mortality in ICCAT fisheries and compare with other fisheries	Qualitative/quantitative comparison between ICCAT with other fisheries	Qualitative/quantitative data from literature and CPCs (e.g. Task 1 data)	Not currently available, but soe data exists and additional data can be requested from CPCs, as well as compiled from the literature	Priority analysis. Subsequent analysis should follow this initial step; few CPUE series currently provided by CPCs - estimating total catches from these may be difficult/ limited, need to identify the data gaps to complete this analysis, need to decide if the tabulations will refer to sea turtle interactions or mortalities
PSA	Identification of relative risk; Provide advice on management actions and research initiatives; Identification of data gaps	Rank of vulnerabilities to the fishery, focus concerns on productivity or susceptibility	Productivity and susceptibility parameters	Yes, conditional to the provisions of detailed data from CPCs on ICCAT and non-ICCAT fisheries	Concerns that the analysis may only be possible for some fisheries/fleets and on how adequate such analysis would be
PSA-Spatial	Spatial extention to PSA	Rank of vulnerabilities to the fishery, focus concerns on productivity or susceptibility per area	Productivity and susceptibility parameters per area	Yes, conditional to the provisions of detailed data from CPCs to ICCAT and non-ICCAT fisheries per area	Same as PSA, but additional to capabilities of reporting spatial data in 5x5 or 1x1 degree quadrants
Demographic model (e.g. Leslie Matrix)	Model population in an equilibrium state	r	Survivorship between ages/stages; age/stage at maturity; fecundity	Yes for a stage based model; No for an age based models	Stage based models may be more appropriate given the life history characteristics of sea turtles. Sensitivity and elasticity analyses may be appropriate given the uncertainties in the parameters. State-space models are commonly used in conservation biology.
Potential Biological Removals (PBR)	Estimate levels of bycatch that allow for population growth	Level of incidental catch related to population growth	r, estimates of population size, removals, all other sources of mortality	No	Concerns that all sources of mortality must be accounted for
Stock assessment (e.g. surplus production)	Harvest control rules, Indicators of abundance, Characterize current biomass relative to k; Examine trends in biomass and the level of incidental bycatch	r, K, MSY, BMSY, current stock status relative to K	Total catch data, Stdz CPUEs (must be relatively long time series with contrasts)	No total catch data available and difficulties in estimating	Concerns that surplus production (MSY) may not be appropriate for sea turtles, concerns regarding the fact that CPUEs estimated from longline ICCAT fisheries interactions only represent part of the populations

Table 2. Elements of an EBFM[1]. The Sub-Committee engaged in an exercise designed to tabulate the obstacles of implementing the EBFM approach in stocks that ICCAT assesses. The responses were structured by the elements of an EBFM approach outlined by Marasco et al. 2007 and are given below. The Sub-Committee responses relative to the required elements acknowledge actions currently taken by ICCAT which may not be at a level sufficient for the complete implementation of an EBFM approach.

1. Employ spatial representation

- ICCAT currently manages species that have large stock structure boundaries (i.e., East vs. West)
- Many assessments involve CPUE standardization using area
  - In some cases terrestrial boundaries are used as a proxy for marine spatial info
  - Data are given by grid squares is coarse (5x5 resolution for longline and 1x1 for surface fleet)
  - Coordinates are available for some fishing events
- Awareness of spatial scale of the environmental drivers is required
- Providing exact temporal and spatial information may violate data confidentiality rules
- Tagging data (conventional) is available for most species
- There is limited understanding of spatial use by life stages of both target and non-target species
- Boundaries for open ocean ecosystems are not well defined (these are often 3-dimensional)

2. Recognize the importance of climatic-oceanic conditions

- This element is partially addressed in some CPUE standardization
  - Account for the effect of the oxygen minimum zone
  - Account for short-term climate change using season
  - Use of temperature and depth as proxy for habitat suitability
- Large scale oceanographic and climatic processes are not currently recognized in the management of our fisheries
- Current methods employed in assessments can only partially accommodate climatic-oceanic conditions

3. Emphasize food web interactions and pursue ecosystem modeling and research

- Some of the research on ecosystem issues is not currently applied to the assessment process
- The SCRS has been introduced to ecosystem models as when the SEAPODYM model was presented to SCRS
- There is no formal mechanism that will easily accommodate new elements into our assessments
- Data is limiting for describing interactions

4. Ensure that broader societal goals are taken into account

- ICCAT recognizes that bycatch is a concern to society
- ICCAT has recognized the particular nature of artisanal fishers
- ICCAT involves both stakeholders and NGOs in its working group in a transparent way
- ICCAT maintains the objective of long term maximum sustainability of the various fisheries (reflect more fully the actual convention objective)

5. Incorporate improved habitat information (target and non-target species)

- Meso-scale habitat information is involved in the standardization of CPUE however we assume that the features are stationary at the present time
- There is limited information on the abundance and distribution of forage species important to the survival of the target species
- Knowledge of how target species respond to FADs informs the CPUE standardization

[1]Marasco, R. J., D. Goodman, et al. (2007). "Ecosystem-based fisheries management: some practical suggestions." *Canadian Journal of Fisheries and Aquatic Sciences*, 64(6): 928-939.

6. Acknowledge and respond to higher levels of uncertainty

- ICCAT employs the Kobe II strategy matrix to reflect the quantified uncertainty of its advice
- Management strategy evaluation is increasingly being considered to inform decision making
- Resolutions 11-14 and 11-17 on the protocols for providing best science advice to the Commission were adopted
- Sensitivity analyses are employed to capture model uncertainty
- Several models are often combined to capture joint model uncertainty
- The SCRS has considered mixing scenarios between the eastern and western bluefin tuna stocks. The SCRS recognizes that there may be separate stock components within the Mediterranean.
- Limit reference points for swordfish and albacore will be established in 2013
- The Working Group on Stock Assessment Methods developed protocols for the estimation and selection of relative abundance based on CPUE.

Appendix 1

AGENDA

1. Opening, adoption of agenda and meeting arrangements
2. Review of information needed to assess the impact of ICCAT fisheries on sea turtles
   - 2.1 Review the available data and identify gaps in knowledge
   - 2.2 Review methods used to estimate bycatch rates and/or extrapolate total bycatch using data from the reporting fleets
3. Review methodologies to assess the impact of fisheries on bycatch species
   - 3.1 Review methods to estimate sea turtles post-release mortality
   - 3.2 Summarize data requirements and assumptions of the different methods
   - 3.3 Identify analytical techniques that may be possible, and appropriate to implement given the available data
   - 3.4 Recommend analytical approaches
4. Review progress and research made on bycatch mitigation measures
5. Review the form prepared by the Secretariat and the information provided by CPCs on scientific observer program information requested under the ICCAT Rec. [10-10]
6. Plan of action (2013-2015) to evaluate the efficacy of the seabird bycatch mitigation measures defined under Rec. [11-09]
7. Review the results of the tRFMOs meeting on the harmonization of PS observer programs
8. Review of new information on the major environmental factors and their effects, ecosystem modeling approaches and ecosystem indicators
9. Review of stocks managed/assessed using an ecosystem approach
   - 9.1 Obstacles to the ecosystem based management of stocks assessed by ICCAT
10. Evaluate the efficacy of the work of the Sub-Committee after being restructured, and develop a work plan for 2013-2014
11. Other matters
12. Recommendations
13. Adoption of the report and closure

Appendix 2

LIST OF PARTICIPANTS

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Appendix 3

LIST OF DOCUMENTS

SCRS/2012/049 A review of fisheries within the ICCAT convention area that interact with sea turtles. Coelho, R., Fernández-Carvalho, J., N. Santos, M. at al.

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SCRS/2012/093 captura incidental de duas espécies de tartarugas marinhas (*Caretta caretta* e *Dermochelys coriacea*) pelas frotas de espinhel do Brasil e Uruguay. Giffoni, B and Domingo, A.

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Appendix 4

SARGASSO SEA ALLIANCE (SSA) INITIATIVE

(Summary provided by SSA)

The SSA expressed their interest to participate in ICCAT meetings in the future The Sargasso Sea Alliance (SSA), led by the Government of Bermuda, is seeking to gain international recognition of the importance of the Sargasso Sea and to work within existing frameworks to seek better protection for it. The area of particular interest to the SSA is between 22°-38°N, 76°-43°W centered upon 30°N 60°W. It covers an area of about 4 million km2 and is essentially the western basin of the wider Sargasso Sea. It is bounded by clockwise rotating currents and lies within the North Atlantic subtropical gyre. There are three interrelated areas of science that combine to establish the importance of the area. The oceanography of the area with its enclosing currents traps and retains things within the central gyre, this simplistic picture is complicated by a variety of mesoscale and frontal phenomenal, but essentially it is the long residence times of material within the gyre that is of great importance here. Secondly, the ecology of the gyre presents unique and important features. It is based upon two species of Sargassum weed, the world's only holopelagic large algae, which form mats and host a wide spectrum

of communities, including 10 endemic species. The Sargassum mats act as spawning, feeding and nursery areas for a wide range of animals, including fish, turtles and birds, and other fish, turtles and whales migrate to or through the area. On the sea bed, there are seamounts with hundreds of endemic species, and within the deep water column there is evidence for both enhanced diversity and the presence of large sharks. The third reason is the importance of the area for global oceanography and monitoring. The world's longest time series of oceanographic measurements is situated within the Sargasso Sea. According to the SSA, the entire three dimensional ecosystem is of international importance and is currently threatened. The SSA is preparing a science case to establish this and has submitted a proposal to the Convention of Biological Diversity to recognize the area as an Ecologically and Biologically Significant Area (EBSA). It is the intention of the Bermuda Government to host an international meeting of interested countries next year. Meanwhile, the SSA is interacting with appropriate sectoral bodies, including ICCAT.