2010 INTER-SESSIONAL MEETING OF THE SCRS SUB-COMMITTEE ON ECOSYSTEMS

(Madrid, Spain – May 31 to June 4, 2010)

1. Opening, adoption of agenda and meeting arrangements

The Meeting was held at the ICCAT Secretariat in Madrid from May 31 to June 4, 2010. Dr. Pilar Pallarés, on behalf the ICCAT Executive Secretary, opened the meeting and welcomed participants ("the Working Group").

Dr. Haritz Arrizabalaga (Spain), meeting Chairperson, welcomed meeting participants and proceeded to review the Agenda which was adopted with 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 and 9	P. Pallarés
Item 2	M. Schirripa and T. Carruthers
Item 3	G. Díaz
Item 4	M.J. Juan-Jordá and H. Arrizabalaga
Item 5	J. Cotter
Item 6	O. Anderson and A. Wolfaardt
Items 7 and 8	H. Arrizabalaga

2. Review of new information regarding ecosystems

Seven presentations, four accompanied by papers, described new information regarding ecosystem modelling research. Two presentations concerned the use of habitat based methods of simulating population distribution at fine spatio-temporal resolution using the SEAPODYM approach (Spatial Ecosystem and Populations Dynamics Model; SCRS/2010/059). Robert Olson of the Inter American Tropical Tuna Commission (IATTC) presented an overview of the Ecosystem Considerations section of the Fisheries Status Report published each year by the IATTC for the eastern Pacific Ocean (EPO). Two papers were described that concerned a spatially explicit, multispecies production model and the derivation of priors for this model (SCRS/2010/055 and SCRS/2010/056, respectively). A detailed report of observer detections of by-catch of non-target species by the Taiwanese longline fleet was also presented to the group (SCRS/2010/046). Additionally US scientists provided a summary of experiments evaluating the effect of hook type on the by-catch rates of bluefin tuna caught by longline fleets targeting yellowfin tuna in the Gulf of Mexico.

A general presentation of recent developments and applications of the SEAPODYM model was provided by Dr. Patrick Lehodey. SEAPODYM was developed for prediction and analysis of spatio-temporal dynamics of tuna populations under the influence of environmental factors and fishing pressure (e.g. Lehodey *et al.* 2008). It has been applied to skipjack, bigeye, yellowfin and (south Pacific) albacore in the Pacific Ocean (Lehodey and Senina, 2009).

The model has several components. The first is a Mid-Trophic Level (MTL) model (Lehodey *et al.* 2010) that predicts variables central to the feeding and spawning habitat of large oceanic species (in particular tunas). These habitats are defined in SEAPODYM and used alongside temperature and oceanic currents to control population dynamics processes (both spatial and temporal). For example, movement to the feeding or spawning grounds, natural mortality and predation. The current parameter estimation approach involves the minimization of a cost function (i.e. a log-negative likelihood). This objective function includes both predicted and observed catch or CPUE at the original resolution (usually 1x1 deg for pole-and-line and purse-seine fisheries and 5x5 for long liners), in addition to sampled versus computed relative length frequencies that are available at a coarser spatial resolution (5 x 5 deg up to 10 x 20 deg ocean squares).

Several applications were presented. A simplified version (i.e., for a single cohort) of the habitat and movement sub-models used likelihood approaches to assimilate electronic tagging data in the model. This model was used to obtain the best estimates of feeding habitat and movement parameters of Atlantic bluefin tuna based on two pop-up tagging experiments off the Gulf of Maine. The same approach is intended for the modelling of Atlantic blue marlin (SCRS/2010/059, see below).

The type of results that may be obtained when modeling the full spatial population dynamics of a given species were exemplified by Pacific skipjack and bigeye tuna case studies. To evaluate the capacity of the model to capture the essential features of the dynamics of the tuna species, hindcast simulations back to the early 1960s were carried out with the fixed "best-parameterization" achieved from optimization experiments in a different time period. Predicted catches based on observed fishing effort were compared to observed catches. Predicted biomass trends are also compared to the estimates from stock assessment model (MULTIFAN-CL) used for tuna stock assessment studies by the WCPFC. Finally, projections based on future oceanic conditions can be simulated once the optimal parameterization has been achieved and evaluated. For example, a preliminary simulation of the impact of climate change (IPCC A2 scenario) has been tested (Lehodey *et al. in press*).

In addition to the details of applications in other oceans, the group was presented with a proposal to model the habitat of Atlantic blue marlin using the SEAPODYM approach (SCRS/2010/059). It is proposed that fishing data and electronic tagging data may be used to calibrate and evaluate the model. It is anticipated that this study will provide an estimate of the spatial distribution of blue marlin habitat. This estimated distribution will be a new piece of information not currently available to ICCAT. This study is also a preparatory phase to investigate in more detail the spatial population dynamics of blue marlin and to develop stock assessments studies with a new generation of model not yet used by ICCAT. The results of such modeling may be compared to other stock assessment models estimates.

Document SCRS/2010/055 describes a spatially explicit production model (SEMIPRO). The model has been made deliberately simple to (1) provide the basis for spatial modeling of those species with less supporting data such as non-target species and (2) provide a sufficiently fast model to undertake multispecies management strategy evaluation. The central objective is to offer a tractable solution to spatial modeling in order to investigate spatial management options. The model is simulation tested and applied to the assessment of yellowfin tuna, bigeye tuna, northern swordfish, southern swordfish, northern albacore, southern albacore, blue marlin and white marlin over 13 Atlantic regions from 1955 to 2006. The research reveals that spatial abundance indices can inform a simple spatial population dynamics model (no tagging data are required). Tagging data may be included to support the estimation of movement or to describe more complex movement dynamics. The model provides a basis with which to evaluate tagging designs and spatially allocate fishing in order to maximize yields while protecting the most vulnerable species.

The modeling of SCRS/2010/055 relies on the derivation of prior probability distributions for the intrinsic rate of increase, r for each species. The inputs and outputs of the demographic method for determining these priors are detailed in SCRS/2010/056. A central finding of this paper is that the prior probability distributions for r were much lower than those used in the most recent assessment of certain species such as Atlantic yellowfin and bigeye tunas. These priors use the same or a similar mathematics, have similar input values but have means that are up to 100 per cent higher than those calculated in this analysis (SCRS/2010/056).

Robert Olson of the IATTC presented an overview of the Ecosystem Considerations section of the Fisheries Status Report published each year by the IATTC for the eastern Pacific Ocean (EPO). The Fisheries Status Report provides an annual summary of the fishery for tunas in the eastern Pacific Ocean (EPO), assessments of the major stocks of tunas and billfishes that are exploited in the fishery and an evaluation of the pelagic ecosystem. Previous reports are available at http://www.iattc.org/FisheryStatusReportsENG.htm. The presentation was intended to familiarize the group with the format and content of the reported used by IATTC to summarize a variety of information concerning the pelagic ecosystem in the EPO. The Ecosystem Considerations section does not yet provide management advice.

The Ecosystem Considerations Report summarizes the direct impact of the tuna fishery on stocks of individual species including the tunas, billfishes, marine mammals, sea turtles, sharks, and other large fishes, as well as miscellaneous pertinent information on other major ecosystem components, for example, sea birds, forage organisms, larval fishes and plankton. These components and the physical environment are surveyed and studied during the STAR cruises of the Southwest Fisheries Science Center, U.S. National Marine Fisheries Service using acoustics, net sampling, dipnet surveys, and jigging for squids. Brief mention was made of the apparent increasing importance of jumbo squid (*Dosidicus gigas*) in the ecosystem indicated by very large range expansions to the north and south.

A greater understanding of the trophic links and biomass flows in the food web is necessary for representative modeling of food webs. Currently, stomach contents and stable isotope analyses are used to inform such models. An ecosystem model based on Ecopath with Ecosim exists for the pelagic EPO with the goal to better understand the general construct of the ecosystem, the ecological impacts of different fisheries and fishing strategies and the variability imparted by a variable environment.

Document SCRS/2010/046 describes the sightings by observers (not necessarily interacting with fishing gear) of ecologically related species in the Atlantic Ocean on Taiwanese tuna longline fishing vessels from 2004 to 2008. More than 50 species were recorded including 36 species of seabirds, 5 species of sea turtles and 8 species of cetaceans. Most of the sea turtles and cetaceans were recorded in tropical areas including Olive Ridley turtles, leatherback turtles, pantropical spotted dolphins and bottlenose dolphins. A small number of loggerhead turtles and whales were observed in temperate waters. Sea birds were distributed over the entire range of the Atlantic Ocean with varying species composition among areas. Northern fulmar, black-legged kittiwake, and great shearwater were observed in the northern Atlantic Ocean. Shearwaters, boobies, terns, storm-petrels, gulls and gannets were abundant in tropical areas. Eight species of albatrosses and petrels were distributed in the southern area. In order to avoid the incidental catch of those species all Taiwanese vessels operating south of 20 S are required to set bird scaring lines and other mitigation measures. The continued collection of such data could provide valuable information for conservation purposes.

The United States presented the results of experiments conducted in 2008 and 2009 to mitigate bluefin tuna by-catch in the U.S. yellowfin longline fishery in the Gulf of Mexico. An experimental circle hook size 16/0 made with the material used for 15/0 hooks (3.65 mm wire) was developed and tested against the traditional 16/0 used by the yellowfin fishery (4.0 mm wire). The experimental hook was weaker than the traditional hook and therefore capable of bending under the stress exerted by large bluefin tuna, allowing the animal to escape. The experimental hook showed a statistically significant 75% reduction in bluefin tuna CPUE while the 5.6% reduction in yellowfin CPUE was not significant. The experimental hook has also the potential to reduce the by-catch of other large species. Preliminary results showed significant reductions in shark CPUE (all species combined) but not for blue marlin. The group discussed the impact of a potential widespread use of the experimental hook by the longline fleet in the Gulf of Mexico on the bluefin tuna CPUE time series. The Group also acknowledged that the experimental design used to test the experimental hooks (alternating experimental and control hooks along the longline) was the proper design to assess the performance of these hooks as a mitigation measure.

3. Optimum observer coverage for reliable estimates of by-catch

Document SCRS/2010/058 presented a simulation study to estimate the effect of different observer coverage on the coefficient of variation (CV) of estimated dead discards. The study used data collected during the extended observer coverage period of the US pelagic longline fleet in the Gulf of Mexico. This extended coverage has been in place approximately from mid-April through mid-June 2007-2009 to better characterize the interaction between the U.S. longline fleet and bluefin tuna during the spawning season. For each level of observer coverage considered, 1000 simulations were run. An average number of dead discards and the associated CV was estimated (for each level of coverage) from the 1000 simulations. Results were obtained for 27 different species that included both target and by-catch species. The results indicated that the level of observer coverage depends on several factors such as the objective of the program, the frequency of occurrence (proportion of positive trips/sets), the variability in the catch/discard rate of the positive trips, and lastly the desired coefficient of variation of the by-catch estimates. The document provided a table with estimated CV of by-catch rates at different levels of observer coverage. This table could be applied to any species with a similar frequency of occurrence and CV to those species included in the table.

Document SCRS/2010/062 presented a simulation framework to help assess on the optimum observer coverage required to get acceptable precision levels in by-catch rate estimates for different fleets and taxa. Simulation parameters were based on data of 17 species of shark by-catch on purse seiners but the framework can be adapted to any other taxa and fleet. Similarly to document SCRS/2010/058, the authors also indicated that the required level of observer coverage depends on the frequency of occurrence, variability of positive by-catch rates (CV), and the accepted level of precision of the estimated by-catch rates.

Document SCRS/2010/063 provided the species composition of the Uruguayan longline fleet catch using data collected by the Uruguayan observer program. A total of 89 species were part of this fleet catch during the period 1998-2009. An analysis based on data collected by the observer program during 2005-2007 provided the proportion of capture, frequency of occurrence and species richness. The species with highest catch (42%-22%) and highest frequency of occurrence (96%) was the blue shark followed by swordfish. Nine species were found in the range of 1-5% of the total catch. Nine percent of the catches corresponded to 19 species whose frequency of occurrence varied from 0.1 to 0.9%. Species richness during this period (65 species) varied among years and areas and it was estimated to be probably 31% higher.

Document SCRS/2010/064 described the different factors affecting the observer coverage in the Uruguayan longline fleet such as climate, oceanographic conditions, fishing strategies, labor and union conflicts, etc. Some of these factors cannot be taken into consideration *a priori* while developing a sampling design. The document also described potential biases that might occur when less than 100% of the fishing operation (i.e., set and haulback) is observed.

The results presented in the documents described above and the discussions held by the Group indicated the difficulties on agreeing and recommending a single optimum level of observer coverage for the wide range of ICCAT fisheries and taxa being caught. In fact, within a single fishery, the optimum level of coverage would vary between the different taxa being caught. And similarly, the estimation of precise by-catch rates for a given taxa might require substantially different coverage rates in different fleet, (e.g. due to contrasting probabilities of occurrence).

The Group also noted that the estimation of relatively precise number of by-caught individuals for rare species would require extremely high (sometimes close to 100%) observer coverage. Moreover, for some of these species, by-catch rates are so low that the potential impact by ICCAT fisheries might be negligible and, therefore, high observer coverage to precisely estimate numbers of individuals taken might not be warranted for these species. However, this is difficult to determine *a priori* because assessing the impact of ICCAT fisheries on by-catch populations requires some analyses. It was therefore recommended to collect data on the whole range of species by-caught. Analysis of these data can provide a basis identifying species of concern. The Group also discussed that such priorities could be established on a scientific basis (e.g. through ERA including all by-catch species), or other criteria (e.g. requests from the Commission).

It was agreed that the level of observer coverage depends on several factors, the frequency of occurrence being one of the most important. **Table 1** shows ranges of frequency of occurrence for different species based on data from the U.S. and Uruguayan longline fleets. The table clearly shows that for some species these two fleets have very different frequencies of occurrence. Therefore, the same species might potentially require different observer coverage in each one of these fleets, and a given observer coverage would produce estimates of by-catch with different precision (as indicated in **Tables 2** and **3**). For example, sharks showed a frequency of occurrence ranging from 0% to 65% when excluding blue sharks (which have a frequency of occurrence as high as 97%) and Istiophorids from 1% to 47%. **Table 2** shows estimated catch rate CV with a 20% observer coverage. Using **Table 2** (as well as tables in SCRS/2010/062) and sailfish as an example, it can be seen that, depending on the CV of the positive catches, sailfish by-catch rate can be estimated with a CV of 6 to 33 % in the US fleet (frequency of occurrence 0.14 of sets), but with the same observer coverage the CV estimated for the Uruguayan fleet would be approximately 31-58% (frequency of occurrence 0.014 of sets).

In view of the difficulties in recommending one level of observer coverage, taking into consideration past ICCAT Recommendation [96-01], and results presented to the Subcommittee indicating levels of observer coverage at which gain of precision are the highest, the Subcommittee recommends the adoption of a minimum observer coverage for ICCAT fleets of 5-10%.

4. Ecosystem indicators useful for the SCRS

Three presentations were made in this section.

Robert Olson, on behalf of other coauthors, presented a case study to evaluate three possible metrics of ecosystem impact of the purse seine fishery in the eastern Pacific Ocean. Ecosystem-based fisheries management requires an understanding of the ecological implications of fisheries removals. The degree to which fisheries affect ecosystems depends on the composition, magnitude, life history, and ecological role of the different species captured. Previous analyses in the eastern Pacific Ocean (EPO) compared the relative impacts of three methods of purse-seine fishing based only on numbers of individuals in the by-catch (defined here as non-target species, either retained or discarded), and found levels of discarded by-catch in floating-object sets thousands of times greater than in dolphin sets and hundreds of times greater than in unassociated tuna sets. The authors expanded the analysis by examining a mix of ecosystem indicators based on the *type* and *amount* of biomass of species and functional groups caught (total removals) by the fishery. They compared removals (landings and discards) in three ways: trophic level, replacement time, and diversity. They computed mean trophic level as the biomass-weighted mean of the trophic level of each ecological group, the mean replacement time as the biomass-weighted mean of the replacement time (1/(production/biomass ratio)) of each ecological group, and diversity of removals using the Shannon diversity index.

Total annual biomass removals averaged more than 500,000 metric tons per year over the 16-year period from 1993-2008, and were dominated by the primary target species, yellowfin, skipjack and bigeye tunas. Fishing by setting on dolphins, floating objects, and unassociated schools of tuna averaged 30%, 44% and 26% of the biomass removed, respectively. Discarded by-catch in numbers of individuals was 70 times greater in floating-objects sets than in dolphin sets, not thousands of times greater, when discarded target species are also counted. The biomass-weighted average trophic levels of total removals were similar for the three fishing methods. Slight, but statistically significant, declines over the 16-year period were apparent for dolphin sets and unassociated sets, due to increasing catch proportions of skipjack tuna. Mean time to replace biomass varied by fishing method: lowest for dolphin sets (0.48 years), intermediate for unassociated sets (0.57 years), and highest for floating-object sets (0.74 years). Biomass-weighted average replacement times of the discards (non-retained by-catch and target species) were positively related to the proportions of dolphins discarded in dolphin sets, and to the proportions of sharks in the discards of unassociated sets. Diversity of removals across the whole time period was lowest for dolphin sets (0.64), intermediate for unassociated sets (1.30) and highest for floating-object sets (1.41). The diversity index for the discards was responsive to the proportions of by-catch taxa (especially dolphins, sharks, and billfishes) in the discards.

Although reduction of by-catch has played an important role in the management of the purse-seine fishery for tunas in the EPO, a full evaluation of ecosystem effects must be based on total removals, not just the by-catch, and must take into account size, life history characteristics, susceptibility to overfishing, and position in the food web of the species taken from the ecosystem. For the diversity and replacement time indices, reduced values were consistent with by-catch reduction goals. Given the ecological tradeoffs between the three methods of purse-seine fishing, determining the optimal mix of the three depends on policy objectives for ecosystem management.

Discussion among the meeting participants focused on the fact that the metrics are sometimes problematic to derive and difficult to interpret in relation to the management goals, but that this approach is a necessary first step for developing ecosystem indicators.

The Group highlighted the importance of the ecological indicators presented and their usefulness to monitor the effects of fishing overtime. Discussion among meeting participants focused on the fact that ecosystem indicators can be quite difficult to interpret if clear management objectives are not stated. Moreover, the group felt that there are inherent difficulties on quantifying the robustness and usefulness of the several indicators (e.g. since trophic level of the catch can be impacted by both "fishing down the food web" (Pauly *et al.* 1998) as well as "fishing through the food web" (Essington, 2006) effects. In spite of the fact that it is difficult to define what it is a desirable level of fishing impacts on marine ecosystems, indicators are useful to identify and quantify changes of the ecosystems over time and it should be first step towards characterizing the effects of fishing on marine ecosystems. The second presentation on this agenda item (SCRS/2010/061) presented three ecological indicators and one threat indicator to quantify the effects of fishing on the Atlantic Scombridae stocks at several taxonomic and spatial scales using mixed modeling techniques. The four indicators were also compared with the exploitation status of the stocks according to the standard reference points (SSB/SSB_{MSY} and F/F_{MSY}). Overall the annual rates of change showed a decline in the three biomass, age and size indicators: spawning stock biomass -2.4% (CI: -4.1, – 0.8), adult mean age -0.2% (-0.3,-0.1) and mean body size of the catches -0.12% (-0.2, 0.02) across all Atlantic scombrid stocks over the last 56 years of exploitation. This is equivalent to a 69% decline in spawning stock biomass, 10% decline in the mean age of adults and 9% decline in the mean body size of the catches across all the Atlantic stocks. Threat status has increased over time for the majority of the Atlantic stocks having declined at a sufficient rate to qualify as threatened according to IUCN A1 criteria. In the Atlantic Ocean, the scombrids with the highest threatened category were the western bluefin tuna, the northern Albacore tuna and the northwest Atlantic Canadian mackerel stock, all of which currently could be classified as endangered. It is shown that management status defined by F/F_{MSY} and SSB/SSB_{MSY} is consistent with the recent trends in each of the four indicators. Among all the taxonomic groups, tunas have experienced the largest changes in biomass, age and size structure in the last 50 years of exploitation. Future work will compare and contrast the four indicators across stocks to evaluate to what extent they are interlinked.

Although the biomass, size and age related indicators presented could potentially be used to characterize and monitor the effects the effects of fishing over time on Atlantic scombrid stocks, the group expressed several concerns about the indicators 1) it is hard to interpret the significance and the meaning of the indicators when there are not defined thresholds which determine what are sustainable levels of fishing exploitation. 2) The Group advised that the indicator which looks at the trends in the mean body size of the catches related to the length of maturity of the stock could not be interpreted without knowing what it is the relative importance of the catches in relation to the total abundance of the stock. In the case of northwest Atlantic Canadian mackerel, it was noted that that population is currently assessed as a larger geographic unit, and the results of the most recent assessment give a different impression of the extent of depletion.

The group highlighted the potential benefits of understanding how the several ecosystem indicators are related to the exploitation status of the stocks determined by their stock assessments. This could help to determine the robustness of the several indicators presented. This knowledge could potentially be useful to manage data poor species which lack stock assessments based on simple indicators.

In the third presentation by Simone Libralato, the decrease in production is proposed as a proxy for quantifying ecosystem effects of fishing, and it is formally defined in a new index of ecosystem overfishing, L (Loss in production) index (Libralato *et al.*, 2008).

On the basis of theoretical ecology and analysis, L index is calculated integrating the primary production required to sustain the catches (PPR) relative to the primary production (PP) in the ecosystem, the transfer efficiencies (TE, i.e., the efficiency in the transfer of energy from a trophic level to another) and the trophic level of the catches (TLc). Thus the formulation is based on properties of the catches (TLc, PPR) and of exploited ecosystems (PP and TE) and allows estimating the index from model outputs and directly from landing data. These input data are opportunely combined to measure the Loss in secondary production due to fishing (the L index) and to evaluate ecosystem effects of fishing.

Application of the index to 51 ecological models of exploited ecosystems, previously classified as overexploited or sustainably exploited according to Murawski (2000), allows associating a probability of being sustainably fished (Psust) to each index value (Libralato *et al.,* 2008). Moreover, by fixing desired Psust levels (e.g., 75% and 95%) as reference points, the corresponding index values provide basis for back-estimating the associated Ecosystem-based Maximum Sustainable Catches (EMSC).

Some applications of the L index were presented, with estimates from landing data and outputs of ecosystem models for the Mediterranean Sea. This allowed the quantification of the current level of exploitation, expressed as probability of being sustainably fished, and determining viable solutions for EMSC (see also Libralato *et al.*, 2005). The index has been also applied to outputs of dynamic models of exploited ecosystems (Catalan Sea) allowing an evaluation of sustainability of fisheries along time for the past fishing history and for future scenarios of alternative management options (Libralato *et al.*, 2005).

The Loss in production index and the probability of sustainability of fishing have been used also to evaluate ecosystem overfishing at a global scale for the present and past decades (Coll *et al.*, 2008). Moreover, recently, the index was also related the effectiveness of fishing management to fishing sustainability (Mora et al., 2009).

L index quantification can be adapted to specific spatial scales (regional spatial assessment) and to large pelagic areas exploiting data from satellite for estimating PP, catches and available data on diets (for TL estimates). Compensatory processes and feedbacks and delayed effects can be included in the L index evaluation if a dynamic model is used.

The approach proposed integrates and complements previous analyses (Pauly and Christensen 1995; Pauly *et al.* 1998; Tudela *et al.* 2005), allowing a broad and general application of the index using both landings data and ecosystem models. L index can give rough estimates of overfishing status and management advices measures, but it allows to define a region of viable solutions (Cury *et al.*, 2005): within these solutions other constrains at lower hierarchical contrains (community/population) can be defined and applied for the proper identification of best management option. The index might be useful, thus, used in combination with other approaches.

Results evidence the usefulness of L index in providing general basis for quantifying the level of disruption for ecosystems subjected to different fishing pressures and allow defining an ecosystem-based reference framework for fisheries management.

The group highlighted the usefulness of the index because it can be compared to a sustainability metric. For any given L index, the probability of the ecosystem to be sustainably fished can be obtained and this relationship allows estimating the ecosystem based maximum sustainable catches in the system. Ecosystem level reference values were calculated using a diverse set of published ecosystem models which previously have been classified as being overexploited or sustainably exploited. However, the pelagic ecosystems were underrepresented in these set of ecosystems used to estimate the relationship between the Lindex and the probability of the ecosystem to be sustainably fished. It was also emphasized that the type of sustainability implied in the index was based in using the primary productivity in a sustainable way. It does not look at the sustainability of individual species. Therefore, the ecosystem indicators might not translate directly to management advice to manage better the target species of ICCAT. The index has also the advantage that it can be easily calculated if the total removals of the ecosystem are known. If the index was to be applied only the top predators, new ecosystem reference levels would need to be recalculated using outputs from ecosystems models restricted to these taxa.

The three presentations proposed a list of interesting metrics that cover some of the major types of indicators identified in the literature, such as environmental and low trophic indicators, high trophic level indicators, trophodynamic indicators, size based indicators and diversity based indicators (Daan *et al.* 2005). The group highlighted the importance of using a range of ecosystem indicators to better understand the effects of fishing on the Atlantic marine system, as well as to evaluate the robustness of the several indicators presented.

Several alternatives not covered by the presentations were also discussed. When considering indices of stock vulnerability to fishing, demographic methods may offer a tentative 'early warning system' for stocks that are not assessed (while time series of catch or effort may not be available, demographic information may be available). The sustainable fraction of the population that may be caught F_{MSY}, can be derived from either the intrinsic rate of increase (*r*) or leading parameters such as steepness (e.g., Forrest *et al.*, 2008). For example in a production model with an inflection point in the production curve at half of unfished biomass, $F_{MSY} = r/2$. Demographic methods to calculate *r* have been described for example by McAllister *et al.* (2001). The Schaefer model (B_{MSY}, = K/2) may be inappropriate for some species (e.g., Maunder 2003) and instead the inflection point of the production curve may also be determined for output produced by demographic analysis (McAllister et al. 2001) and the generalized production model of Pella and Tomlinson (1969) may be applied to calculate F_{MSY}. To identify possible values for steepness, meta analyses are available for various taxa (e.g. Myers *et al.* 1999). In itself F_{MSY} is difficult to interpret unless the current fishing mortality can be estimated (through for example a tagging study and reliable reporting rate estimates). However if catchability can be assumed to be similar or greater than that of an assessed species (that per unit of fishing effort, the same or larger fraction of the population is caught) a rough estimate of F_{MSY} may help to identify those stocks that are most likely to be adversely affected by fishing and require greater attention. The results of such a method should be treated with caution and assumptions regarding catchability made explicit, preferably with sensitivity analysis to any such assumptions.

Finally, a presentation by ICCAT Secretariat allowed evaluating the data available at the Secretariat that might be of use to compute these or similar ecosystem indicators. **Figure 1** and **Tables 4** and **5** show that reporting for Tasks I and II has been quite variable in the last years for the range of species and CPCs represented in the database. This indicates that the data held at the secretariat should be used with caution for the purposes of estimating certain ecosystem indicators, since heterogeneity in reporting might affect the outcome of the indices, as well as their interpretation.

5. Review of work conducted under the short term by-catch contract

A draft final report of the By-catch co-ordination contract was distributed in the week prior to the meeting (SCRS/2010/047). John Cotter of FishWorld Science Ltd., the contractor, presented findings of the 4 tasks, beginning with task 3, concerning the collection of unreported by-catch data and a compilation of by-catch projects. 36 projects were identified by looking through reports and publications, and 20 requests were sent out to national scientists to submit observer data for compilation in a database being prepared by the contractor. Submissions of data were disappointing. Only one set was received, for bluefin tuna in the Mediterranean. During discussion, it was recognized that:

1. Some CPCs are prevented from sharing data by national agreements and legalities. The Confidentiality Agreement drafted by SCRS cannot sweep away these difficulties.
2. Others have not sufficient resources to prepare voluntary retrievals of by-catch data (which may be extensive).
3. The observer data may be subject to ongoing quality control or research.

Similar difficulties could arise if submission of observer data becomes mandatory under ICCAT rules.

The second part of the contractor's presentation dealt with the task 4 on protocols and forms for collection of by-catch data. The Group recalled earlier discussions (ICCAT, 2007) on the Terms of Reference of the Sub-

Committee on Ecosystems and their priorities, and agreed that the primary objective is to characterize the amount, composition (species and sizes) and disposition or fate of the by-catch in ICCAT fisheries. It was also agreed that, while the contractor's report on Task 4 of the contract was a valid response to the general wording of that task, he should add a short section in response to the meeting of SCECO held in 2010, to identify clearly the data that need to be collected for the agreed primary objective.

The group agreed that observer programs should also consider other important objectives such as understanding the factors contributing to by-catch, the effect of the by-catch on the populations, or the effectiveness of mitigation measures that are used. Data collection forms should be modified by including the relevant variables according to the specific objectives and nature of the fisheries on a case by case basis, with an eye to compatibility between fisheries, when possible. Although the report might have suggestions for how to collect this information, priority should be given to the minimum data collection standards for the main primary objective identified above, namely for all observer programs to characterize the volume, composition and disposition of the by-catch in ICCAT fisheries.

As such, it was thought essential that observers record details for *every* species of the by-catch on a form as follows:

1. Species identification. Reference numbers should be recorded for photographs or specimens taken for better identification.
2. Numbers (or weight) caught
3. An indication of sizes (e.g. average length and range, 25^{th}, 50^{th}, and 75^{th} quantiles, or size distribution).
4. The fate of each individual (e.g. kept, discarded dead or released alive).
5. The fishing effort that gave rise to the observed by-catch. To clarify: the observed effort will be smaller than the total fished effort if by-catch from some of the fishing operations was not processed by the observer.
6. The total fished effort and gear for the observed trip (to enable raising of by-catch estimates).

The requirement to identify *all* species was recognised to be demanding. It would be assisted by the species identification sheets being prepared by the contractor or, in some cases, available from other RFMOs. Some additional training of observers would be necessary in some countries. As an alternative, it was suggested that non-identified species could be photographed so that they can be later identified by experts. In future, in the light of experience with such a programme, reductions in the list of species to be identified could be considered (e.g. after establishing priority species through ERA analyses or other criteria).

The split between by-catch monitoring and other tasks would depend on the objectives of each observer program and nature of the fishery, so this would need to be specified in a case by case basis.

Reporting of by-catch data to ICCAT was also discussed. At present, there is no binding requirement to report observer data to ICCAT. It was agreed that the simplest approach in future would be to report by-catch with other species being reported under the ICCAT Task II (catch and effort) rules. It will be necessary to distinguish submission of catch and effort Task II logbook data from Task II observer data. The data could be aggregated by rectangle areas and time period, thereby providing a degree of anonymity which might assist CPCs to agree to the submission of observer data.

The contractor agreed to consolidate the 100 or so new species codes found to be necessary as a result of the by-catch project. A list would be sent to the ICCAT Secretariat for submission to the FAO coding authorities. Following discussions on protocols and forms, the contractor summarised the constraints and design of the By-catch database that had been developed using Microsoft Access 2007 for Tasks I and II of the by-catch project. A copy of the new database system was made available on the SCECO drive. Task I specified a metadatabase for storing reports and publications on by-catch. Task II called for a database for storing observer data as well as aggregated results taken from reports and publications. The contractor preferred to combine the two databases into one system because of several advantages seen, e.g. better linking of reports and data, and common reference information. Over 300 reports and publications were processed and added to the database together with over 4000 result records for individual species, mostly taken from the reports because of the lack of success under task 3 with the collection of unreported observer data. The contractor invited SCECO to try out the by-catch database and provide feedback on its acceptability and ease of use. Fuller information on the database was provided in the contractor's final report, and instructions for use are shown on the opening screen for the database.

It was agreed that, during the last month of the project (i.e. during June 2010), the contractor should:

1. Provide as many species identification sheets as possible.
2. Add further publications, reports, and data to the database.
3. Make sure that there is enough, clear documentation for new users to be able to work with the database.
4. Add a summary of information contained in the database to the final report, e.g. the numbers of records with different types of information.
5. Incorporate any other comments from SCECO and SCSTAT members in the final report or database.

6. Additional information on seabird data collection, assessment and management

Document SCRS/2010/050 presented an updated analysis of the degree of overlap between the distribution of albatrosses, petrels and shearwaters and ICCAT longline fishing effort. A similar analysis was conducted as part of the ICCAT six-stage seabird assessment, the results of which were presented at the 2009 Inter-sessional Meeting of the Sub-Committee on Ecosystems (McAllister, *et al.* 2000). A number of limitations in the previous methodology were identified, especially regarding the combined use of range data and foraging radii information, and it was recommended that a fuller analysis of the remote tracking data be undertaken. Sufficient data to produce reliable density distribution maps were available for 10 species (13 populations). Quarterly distribution maps for each species were calculated by creating density maps for each life history stage, and then weighting these based on the duration and proportion of the population involved.

Of the 10 species (13 populations) included in the analysis, the three populations (Balearic Islands, Canary Islands and the Azores) of cory's shearwater (*Calonectris diomedea*), tristan albatross (*Diomodea dabbenena*), and Atlantic yellow-nosed albatross (*Thalassarche chlororhynchos*) all had extremely high overlap (>93%) with the ICCAT fishing area in all four quarters of the year. Sooty albatross *Phoebetria fusca* from Gough Island, black-browed albatross (*Thalassarche melanophris*) from the Falkland Islands (Malvinas) and black-browed albatross and white-chinned petrel (*Procellaria* aequinoctialis) from South Georgia all had high overlap with the ICCAT fishing area, black-browed albatrosses and white-chinned petrels having particularly high degrees of overlap with ICCAT fishing effort during their non-breeding season (April-September).

The tracking analyses showed that cory's shearwaters from the Balearic Islands had by far the highest estimated level of overlap with ICCAT longline fishing effort, reflecting their wide distribution in the Atlantic, including across areas of intense fishing effort in tropical areas and the Mediterranean. In the previous analysis, cory's shearwater was also identified as having the highest overlap with ICCAT fishing effort. However, the current approach using tracking data produced overlap scores six times higher than determined by the simple approach. In general the simple approach tended to underestimate significantly the level of interaction between seabird distribution and ICCAT fishing effort. The tracking data highlighted that birds are not evenly distributed within their foraging distribution, but rather target specific areas that often coincide with areas of ICCAT fishing effort. It was noted that there remain many gaps in the remote tracking data, particularly for seabird species in the Mediterranean and North Atlantic, which are under-represented in this study. The Sub-Committee suggested that further tracking studies that provide fine-resolution data which differentiates between foraging and commuting tracks would be helpful in understanding better the potential level of interaction between seabirds and fishing effort.

Document SCRS/2010/054 provided advice on minimum data collection fields for quantifying seabird by-catch, understanding factors contributing to observed by-catch rates, and assessing efficacy of mitigation measures. It highlighted the need to collect data on observed effort on the haul, what species and numbers were being caught, and the status (i.e. dead or alive) of seabirds brought onboard. It also highlighted the need to collect data on gear characteristics, environmental conditions, and mitigation measures used in order to examine the factors influencing the levels of by-catch observed.

The Sub-Committee noted that the primary objective of the ICCAT by-catch data collection initiative is to quantify levels of by-catch occurring in all ICCAT fisheries and that specific data fields on gear characteristics, environmental conditions, and mitigation measures should be included when data collection protocols proceeded to the level of fishery type, e.g. purse seine or longline, and when considering the requirements for particular taxa.

The Sub-Committee also suggested that data collected on efficacy of mitigation measures should be reported through SCRS documents, although noted the appropriateness of consistency in data fields included in these reports.

The document SCRS/2010/65 presented information on tori lines tested in the Uruguayan pelagic longline fleet. Three trips were carried out on longline vessels in the Southwest Atlantic, in an area and season with reportedly high by-catch rates. Based on a randomized order employed, there were two different treatments during the longline sets: sets with a mixed tori-line (featuring long and short streamers) and sets without tori-line (control treatment). Five birds were captured in the control treatment (0.46 birds/1,000 hooks, n=12 sets), while no captures were recorded in the tori line treatment (n=11 sets). Results of the deviance analysis (GLM Binomial model) showed that use of the tori-line was the single significant variable (P=0.026) explaining the higher proportion of the model deviance. This work suggests that the use of a tori-line reduces seabird by-catch in pelagic longline fisheries; however, it will be extended to obtain a robust conclusion and try to sort some difficulties caused by the entanglement of the tori-line and fishing gear.

Document SCRS/2010/057 presents the results of research carried out onboard Brazilian pelagic longliners by Projeto Albatroz (Brazilian NGO) as part of the Albatross Task Force Program of BirdLife International in Brazil. The study compares the performance of a light tori line (short streamers) design and an 'emerging pelagic tori line' (long streamers) design. The findings were based on analysis of seabird attack rates, aerial extension of the tori lines, entanglement rates and actual seabird by-catch events. The results suggest that the light tori line may be as effective at reducing seabird attacks on baited hooks as the emerging pelagic tori line model (long streamers). There was also a significant difference in the area covered aft of the vessel with an average of 95.88 ± 13.03m aerial extent with the light tori line design compared to 82.23 ± 17.09m for the emerging pelagic tori lines (ANOVA: F = 19,95; p<0.0001). Importantly, given that 55% of recorded attacks were recorded >100m aft of the vessel, which in most cases was beyond the aerial coverage of the tori lines, and considering that research carried out in September 2008 with a similar gear configuration showed baited hooks remaining within 10m of the surface until >155m of the stern, there is a clear need for an additional mitigation measure (line weighting) to be used alongside tori line deployment to sufficiently protect baited hooks. For this reason, Brazil intend that the present study will continue throughout 2010, and examine the effects of using different line weighting regimes to improve hook sink rates in combination with tori lines.

Document SCRS/2010/053 presented data from Albatross Task Force mitigation research trials. Data from the Chilean pelagic longline fishery demonstrated that tori lines are effective in reducing attack rates of seabirds within their aerial extent. However, the substantial increase in attacks beyond the aerial extent of both designs indicated that the use of tori lines in isolation cannot sufficiently protect the area of interaction between seabirds and hooks and that additional mitigation (e.g. line weighting) is required. Preliminary data from the South African pelagic longline fleet found no influence of different line weighting regimes (60g versus 150g placed 3.5m from the hook) on levels of target or non-target catch. Further research (planned for 2010) is needed to confirm this.

The Sub-Committee noted that this preliminary data was positive in indicating the potentially limited impact of line weighting on target catch, but that at present no firm conclusions could be drawn and that further research was necessary. The Sub-Committee also noted the considerable variation in gear configurations among pelagic longline fisheries and that it is important that the potential impacts on target catch are thoroughly assessed across all fleets.

The Sub-Committee recognized the need for a combination of mitigation measures to be used to sufficiently protect seabirds from accessing baited hooks beyond the aerial extent achieved by tori lines, and that ensuring a rapid hook sink rate was a key element to this.

Document SCRS/2010/051 presented the results of an updated review of research on seabird by-catch mitigation measures for pelagic longline fisheries conducted by the Seabird By-catch Working Group of the Agreement on the Conservation of Albatrosses and Petrels (ACAP). In the review a number of recent papers were considered which dealt with tori lines, the impact on line sink rates of line shooters, bait life status, placement and amount of weight in relation to the hook, and bait thaw status. These papers highlighted a number of issues relevant to mitigating seabird by-catch in pelagic longline fisheries, and provided, for the first time, information on the effectiveness of some mitigation measures that have been advocated for many years, without appropriate empirical evidence.

ACAP's advice on best practice mitigation measures for pelagic longline fisheries was presented in Document SCRS/2010/052. It was noted that tori lines have been widely promoted to deter seabirds in pelagic longline fisheries, but that recent research has highlighted that they need to be combined with other mitigation measures to be consistently effective. The most effective way to reduce seabird by-catch in pelagic longline fisheries is to use tori lines with branchline weighting and, preferably setting at night. The importance of appropriate line-weighting was emphasized. It was noted that research on line weighting is still in progress and head-to-head comparisons of the effectiveness of line weighting regimes (and associated sink rates) as seabird deterrents are encouraged. Research into the impacts of line weighting on catch rates of target species and on the economics of fishing is urgently required.

ACAP indicate that there are a number of other measures that can assist in reducing seabird by-catch in longline fisheries, but these should not be considered as formal mitigation measures. These include:

- Setting mainlines in the 'surface set tight' configuration.
- Using dead bait.
- Using small species of fish bait
- Hooking baits in either the head (fish) or tail (fish and squid), not in the middle of the back or top of the mantle (squid)
- Retaining offal on the vessel; offal should not be discharged while setting.

The results of recent research on the effect of a line shooter on the sink rates of pelagic longlines and implications for seabird interactions (Robertson *et al.* 2010) were also presented. This research showed that mainline set into propeller turbulence with a line shooter without tension, as is normally the case when deep setting, significantly slows the sink rates of hooks. For this reason, use of a line shooter to set gear deep cannot, according to the authors and ACAP, be considered a mitigation measure.

The Sub-Committee noted that the key recommendation provided by ACAP to use a combination of tori lines, line weighting and night setting was consistent with the advice provided in the 2009 report of the Sub-Committee on Ecosystems.

7. Other matters

Three announcements were made under this Agenda item.

The US announced that it is organizing and hosting the first International Symposium on Circle Hooks. The symposium is aimed to discuss issues related to the performance of circle hooks in commercial and recreational fisheries and it will be scientific in nature. A web site with pertinent information will be functioning soon. The meeting will be held in the City of Miami, May 4-6, 2011.

It was reported that a regional fisheries observer workshop for South American ACAP Parties will be held in Buenos Aires, Argentina in September 2010. The aim of the workshop is to improve data and standardize data collection on incidental mortality of seabirds from South American Observer Programs.

Finally, Chinese Taipei announced that the Fifth International Fishers Forum will be held between August 3-5, 2010 in Taipei. The Forum co-hosts are the Western Pacific Regional Fishery Management Council, USA and the Fisheries Agency, Council of Agriculture, Taiwan. The mission of the International Fishers Forum series is to convene international meetings of fishermen; management authorities; seafood retailer industry; experts in fishing technology, marine ecology and fisheries science; and other interested parties to facilitate the sharing of information and experiences on: (i) sustainable fishery practices; and (ii) approaches to minimize problematic interactions with sea turtles, seabirds, sharks and cetaceans in fisheries.

8. Recommendations

The Sub-Committee continues to recommend that, if they have not yet done so, Contracting Parties and Cooperating non-Contracting Parties, Entities or Fishing Entities (CPCs) institute data collection procedures which permit quantifying the total catch (including by-catch), its composition and its disposition by the tuna fleets. The Sub-Committee recommends scientific observer and logbook programs, in combination, to be used for this purpose. The minimum information to be recorded by observers includes species identification, by-caught quantity, size, and fate, as well as the ratio of observed to exerted fishing effort. It is also recommended to record by-catch of all species so as to have a complete characterization of total removals. The Sub-Committee noted that the minimum observer coverage required depends on the specific objectives (e.g. desired precision levels for by-catch rates) and the variability of the by-catch events, which depend on specific taxa and fishery combinations. In any event, the Sub-Committee noted that in most cases by-catch estimates are highly imprecise for observer coverage below 5-10%, so it recommends minimum observer coverage rates of 5-10%. At the same time, the Sub-Committee notes that with this level of coverage, by-catch estimates will remain highly imprecise for low occurrence species, for which a higher level of coverage may be warranted depending upon the Commissions objectives.

The Sub-Committee recommends that national scientists periodically submit summary reports to the SCRS on subjects like by-catch characterization, trends in by-catch rates, effect of mitigation measures, etc.

Observer data (aggregated data in time and space if necessary to avoid some confidentiality restrictions) should also be submitted annually to the ICCAT secretariat. The Sub-Committee also recommends that the Secretariat develop the necessary mechanisms for CPCs to annually report their observer data (e.g., electronic forms, species codes, etc.).

The Sub-Committee continues to recommend that research be conducted on measures to mitigate by-catch in ICCAT fisheries. The research should include the effect of mitigation measures on both by-catch and target species

The Sub-Committee reaffirms the recommendations made in 2009 regarding the seabird by-catch mitigation.

The Sub-Committee recommends continuing research on ecosystem modeling (e.g. Ecopath, SEAPODYM, etc.), their application to Atlantic pelagic ecosystems and usefulness for a more realistic understanding of ecosystem dynamics, as well as to develop a basis to assess on the impact of ICCAT fisheries on the ecosystem. The Sub-Committee also recommends further research on the range of ecosystem indicators discussed by the group, specially focusing on interpretation of the indicators, robustness, and reference points.

10. Adoption of the report and closure

The report was adopted during the meeting.

The Chairman thanked the Secretariat and participants for their hard work.

The meeting was adjourned.

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Table 1. Frequency of occurrence (per set) of some species in the U.S. longline fleet operating in the Gulf of Mexico and the Uruguayan longline fleet (SCRS/2010/063).

			Frequency occurrence	
			US	*Uruguay*
Swordfish	*Xiphias gladius*	SWO	81	97
Yellowfin	*Thunnus albacares*	YFT	87	26
Blackfin	*Thunnus atlanticus*	BLF	32	0
Bluefin	*Thunnus thynnus*	BFT	26	0
Little tunny	*Euthynnus alletteratus*	LTA	2	0
Albacore tuna	*Thunnus alalunga*	ALB	1	54
Bigeye tuna	*Thunnus obesus*	BET	3	29
Skipjack tuna	*Katsuwonus pelamis*	SKJ	16	0.6
White marlin	*Tetrapturus albidus*	WHM	6	11
Sailfish	*Istiophorus albicans*	SAI	14	1.4
Blue marlin	*Makaira nigricans*	BUM	19	11
Mahi-Mahi	*Coryphaena hippurus*	DOL	47	45
Silky shk.	*Carcharhinus falciformis*	FAL	13	0.3
Bigeye thresher	*Alopias superciliosus*	BTH	6	7
Shortfin mako	*Isurus oxyrinchus*	SMA	9	65
Thresher	*Alopias spp.*	XTH	4	4
Longfin mako shk.	*Isurus paucus*	LMA	2	1
Tiger shk.	*Galeocerdo cuvier*	TIG	10	0.8
Sandbar shk.	*Carcharhinus plumbeus*	SSB	2	0.8
Dusky shk.	*Carcharhinus obscurus*	DUS	1	0
Hammerhead shk.	*Sphyrna spp.*	XHH	2	12
Blue shk.	*Prionace glauca*	BSH	1	97
Blacktip shk.	*Carcharhinus limbatus*	SBK	1	0
Night shk.	*Carcharhinus signatus*	SNI	1	8
Leatherback	*Dermochelys coriacea*	TLB	6	21
Loggerhead	*Caretta caretta*	TTL	1	58

Table 2. Estimated precision levels (CV) of by-catch rate for 20% observer coverage as a function of the probability of encounter within a range of 1-50% (left column) and CV of positive catches (top row) in the range of 0-150%.

		CV										
		0	*0.15*	*0.3*	*0.45*	*0.6*	*0.75*	*0.9*	*1.05*	*1.2*	*1.35*	*1.5*
Probability of Encounter	0.001	1.38	1.39	1.41	1.41	1.41	1.43	1.42	1.45	1.45	1.47	1.46
	0.050	0.28	0.28	0.29	0.31	0.33	0.36	0.41	0.46	0.51	0.57	0.65
	0.100	0.19	0.19	0.2	0.21	0.23	0.26	0.29	0.33	0.37	0.44	0.49
	0.150	0.15	0.15	0.16	0.17	0.18	0.21	0.23	0.27	0.31	0.37	0.41
	0.200	0.12	0.13	0.13	0.14	0.15	0.17	0.2	0.23	0.27	0.32	0.37
	0.250	0.11	0.11	0.12	0.13	0.14	0.15	0.18	0.21	0.24	0.29	0.34
	0.300	0.1	0.1	0.1	0.11	0.12	0.14	0.16	0.19	0.22	0.26	0.31
	0.350	0.09	0.09	0.09	0.1	0.11	0.13	0.15	0.17	0.21	0.24	0.29
	0.400	0.08	0.08	0.08	0.09	0.1	0.12	0.14	0.16	0.19	0.23	0.28
	0.450	0.07	0.07	0.08	0.08	0.09	0.11	0.13	0.15	0.18	0.21	0.26
	0.500	0.06	0.06	0.07	0.08	0.09	0.1	0.12	0.14	0.17	0.21	0.24

Table 3. Observer coverage required (%) to estimate by-catch rates with a precision of CV=30% as a function of the probability of encounter within a range of 1-50% (left column) and CV of positive catches (top row) in the range of 0-150%.

		CV										
		0	*0.15*	*0.3*	*0.45*	*0.6*	*0.75*	*0.9*	*1.05*	*1.2*	*1.35*	*1.5*
Probability of Encounter	0.001	84%	85%	85%	85%	85%	85%	86%	86%	86%	86%	86%
	0.050	18%	18%	19%	21%	24%	27%	32%	36%	42%	48%	53%
	0.100	9%	9%	10%	11%	13%	15%	19%	23%	28%	35%	41%
	0.150	6%	6%	7%	7%	9%	11%	13%	17%	21%	27%	33%
	0.200	4%	5%	5%	6%	7%	8%	10%	13%	17%	22%	27%
	0.250	3%	3%	4%	4%	5%	6%	8%	11%	14%	19%	24%
	0.300	3%	3%	3%	3%	4%	5%	7%	9%	12%	16%	21%
	0.350	2%	2%	2%	3%	3%	4%	6%	8%	10%	14%	19%
	0.400	2%	2%	2%	2%	3%	4%	5%	7%	9%	13%	18%
	0.450	1%	1%	2%	2%	3%	3%	4%	6%	8%	11%	16%
	0.500	1%	1%	1%	2%	2%	3%	4%	5%	7%	11%	15%

Table 4. Catalogue of by-catch species (only non-major tuna, tuna like & shark species), per year, available in the Task II catch & effort database (no flag or gear differentiation).

SpeciesGrp	SpeciesCod	SpeciesScie	199	199	199	199	199	199	199	199	199	199	200	200	200	200	200	200	200	200	200
3-Tuna (other)	BIL	*Istiophoridae*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	BLM	*Makaira indica*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	BUK	*Gasterochisma melampus*																			x
	MIX	*Mixed Tunas*			x	x	x				x		x	x	x	x	x	x			
	MLS	*Tetrapturus audax*												x							
	MSP	*Tetrapturus belone*										x				x					
	SBF	*Thunnus maccoyii*					x				x	x	x	x	x	x	x	x	x	x	x
	SIE	*Scomberomorus sierra*											x								
	SPF	*Tetrapturus pfluegeri*				x	x		x	x	x	x			x	x	x	x	x	x	x
	TUN	*Thunnini*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	TUS	*Thunnus spp*																		x	x
5-Sharks	AGN	*Squatina squatina*																	x	x	
	ALV	*Alopias vulpinus*												x	x	x	x	x	x	x	x
	ASK	*Squatinidae*																x	x	x	x
	AVO	*Anoplagonus inermis*											x								
	BRO	*Carcharhinus brachyurus*												x	x		x	x	x	x	x
	BSK	*Cetorhinus maximus*																x	x	x	x
	BTH	*Alopias superciliosus*											x	x	x	x	x	x	x	x	x
	CCE	*Carcharhinus leucas*											x			x		x		x	
	CCL	*Carcharhinus limbatus*											x	x	x	x	x	x	x	x	x
	CCP	*Carcharhinus plumbeus*																x	x		
	CCR	*Carcharhinus porosus*															x				
	CCS	*Carcharhinus signatus*												x		x			x		
	CCT	*Carcharias taurus*															x	x			x
	CPL	*Centrophorus lusitanicus*																x	x	x	x
	CTK	*Mustelus henlei*												x	x						
	CVX	*Carcharhiniformes*														x	x	x	x	x	x
	CXX	*Coastal Sharks nei*											x	x	x						
	CYO	*Centroscymnus coelolepis*																x	x	x	x
	CYP	*Centroscymnus crepidater*																x	x	x	x
	DCA	*Deania calcea*																x	x	x	x
	DGH	*Squalidae, Scyliorhinidae*																	x	x	
	DGS	*Squalus acanthias*																x	x	x	x
	DGX	*Squalidae*											x						x	x	
	DGZ	*Squalus spp*													x			x			
	DOP	*Squalus megalops*												x							
	ETX	*Etmopterus spinax*																		x	
	FAL	*Carcharhinus falciformis*													x	x	x	x	x	x	x
	GAG	*Galeorhinus galeus*											x	x	x	x	x		x	x	x
	GNC	*Ginglymostoma cirratum*												x	x	x	x	x	x	x	
	GSK	*Somniosus microcephalus*																x	x		x
	GUP	*Centrophorus granulosus*																x	x	x	x
	GUQ	*Centrophorus squamosus*																x	x	x	x
	LMA	*Isurus paucus*													x	x	x	x	x	x	x
	OCS	*Carcharhinus longimanus*											x	x	x			x	x	x	x
	OIL	*Ruvettus pretiosus*										x	x							x	x
	OXN	*Oxynotus paradoxus*																		x	
	OXY	*Oxynotus centrina*																x	x	x	x
	PXX	*Pelagic Sharks nei*		x	x	x	x	x	x	x	x	x	x	x	x						
	RHT	*Rhizoprionodon terraenovae*											x								
	RSK	*Carcharhinidae*													x	x		x	x	x	
	SAU	*Scomberesox saurus*											x								
	SBL	*Hexanchus griseus*												x	x	x		x	x	x	x
	SCK	*Dalatias licha*																x	x	x	x
	SCL	*Scyliorhinus spp*																x	x	x	x
	SDP	*Mustelus schmitti*																	x	x	
	SDS	*Mustelus asterias*																x	x	x	x
	SDV	*Mustelus spp*												x	x	x	x	x	x	x	x
	SHB	*Echinorhinus brucus*																x	x	x	x
	SHL	*Etmopterus spp*																x	x		
	SHO	*Galeus melastomus*																x	x	x	x
	SHX	*Squaliformes*		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
	SKH	*Selachimorpha(Pleurotremat*						x	x	x	x	x	x	x	x	x	x	x	x		
	SMD	*Mustelus mustelus*												x				x	x	x	x
	SPL	*Sphyrna lewini*											x	x	x	x	x	x			x
	SPN	*Sphyrna spp*												x	x	x	x	x	x	x	x
	SPY	*Sphyrnidae*													x						
	SPZ	*Sphyrna zygaena*												x		x		x	x	x	x
	SYC	*Scyliorhinus canicula*																	x	x	
	SYR	*Scymnodon ringens*																		x	x
	SYT	*Scyliorhinus stellaris*																x	x		x
	SYX	*Scyliorhinidae*																	x	x	
	THR	*Alopias spp*											x		x	x	x	x	x	x	x
	TIG	*Galeocerdo cuvier*												x		x	x	x	x	x	x
	TRK	*Triakidae*																x	x		x
	WSH	*Carcharodon carcharias*																x			
6- Other	DOL	*Coryphaena hippurus*		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x

Table 5. Task II size information (number of fish) of by-catch species only non-major tuna, tuna-like and shark species) available in the ICCAT-DB, per year and flag.

SpeciesGrp	SpeciesCo	ScieName	Flag	199	199	199	199	199	1995	199	199	1998	1999	2000	2001	2002	2003	2004	200	200	200	200	200
3-Tuna	BIL	*Istiophoridae*	EU.España						1	1	1	18			70								
			EU.Malta																				80
			U.S.A.	12																			
	BLM	*Makaira indica*	Belize																				46
			Chinese																	208	546	205	57
			EU.España														4						
			Japan	1		1			1						2								
	BLZ	*Makaira mazara*	EU.España														15						
	MIX		EU.España			331	788	631	5681														
	MLS	*Tetrapturus audax*	EU.España												1		1						
	SBF	*Thunnus maccoyii*	Japan	452	953	275	871	216	2193			2767	3233	6767	1291	3486	6898	1982			15		
			South														142	11	8				
	SPF	*Tetrapturus pfluegeri*	Brasil																		439		
			Cuba													157							
			EU.España							84	46	29	66	32	191	17	101		73				
			EU.Italy					60	160	51	18	53	134	370	532	226							
			Japan	14		8	9	10	64			36	255	135	6	3					1	33	
			U.S.A.	3	1	1					1												
			Venezuela			9	10	19	1		71	61	34										
	SSP	*Tetrapturus*	U.S.A.																			10	
	TUN	*Thunnini*	U.S.A.		11	17		1															
	TUX	*Scombroidei*	EU.España												3		1			1			
5-Sharks	AGN	*Squatina squatina*	EU.Malta																			38	
	ALV	*Alopias vulpinus*	EU.Malta																			5	
	BTH	*Alopias superciliosus*	Brasil																	252			
	CCB	*Carcharhinus brevipinna*	Côte													106	113						
	CCE	*Carcharhinus leucas*	U.S.A.														10		1			1	
	CCL	*Carcharhinus limbatus*	U.S.A.													278	1226	802	209	594	64	2	
	CCP	*Carcharhinus plumbeus*	U.S.A.													3562	8290	2804	428	233	537		
	CCS	*Carcharhinus signatus*	U.S.A.													1	8						
	DUS	*Carcharhinus obscurus*	U.S.A.													8	12						
	FAL	*Carcharhinus falciformis*	Chinese														133	85	271		36	2	
			Côte													78	50			114			
			U.S.A.													7	183	170	130	112	149	31	
	OCS	*Carcharhinus*	U.S.A.													78	218	94	220	37	58	116	
	SBL	*Hexanchus griseus*	EU.Malta																			124	110
	SHX	*Squaliformes*	U.S.A.												100	40	174	40	22	117			
	SKH	*Selachimorpha(Pleurotr*	U.S.A.														174	40		117			
	SPL	*Sphyrna lewini*	Côte													225	309			114			
	SPN	*Sphyrna spp*	U.S.A.													159	940	220	808	320	178	63	
	SPZ	*Sphyrna zygaena*	Côte													698	913			518			
	THR	*Alopias spp*	U.S.A.												40	64	300	106	108	140	48	205	
	TIG	*Galeocerdo cuvier*	U.S.A.												24	2	22	14	2	52	4	13	
6- Other	DOL	*Coryphaena hippurus*	U.S.A.													3170	2956	6228					
			Venezuela										90										

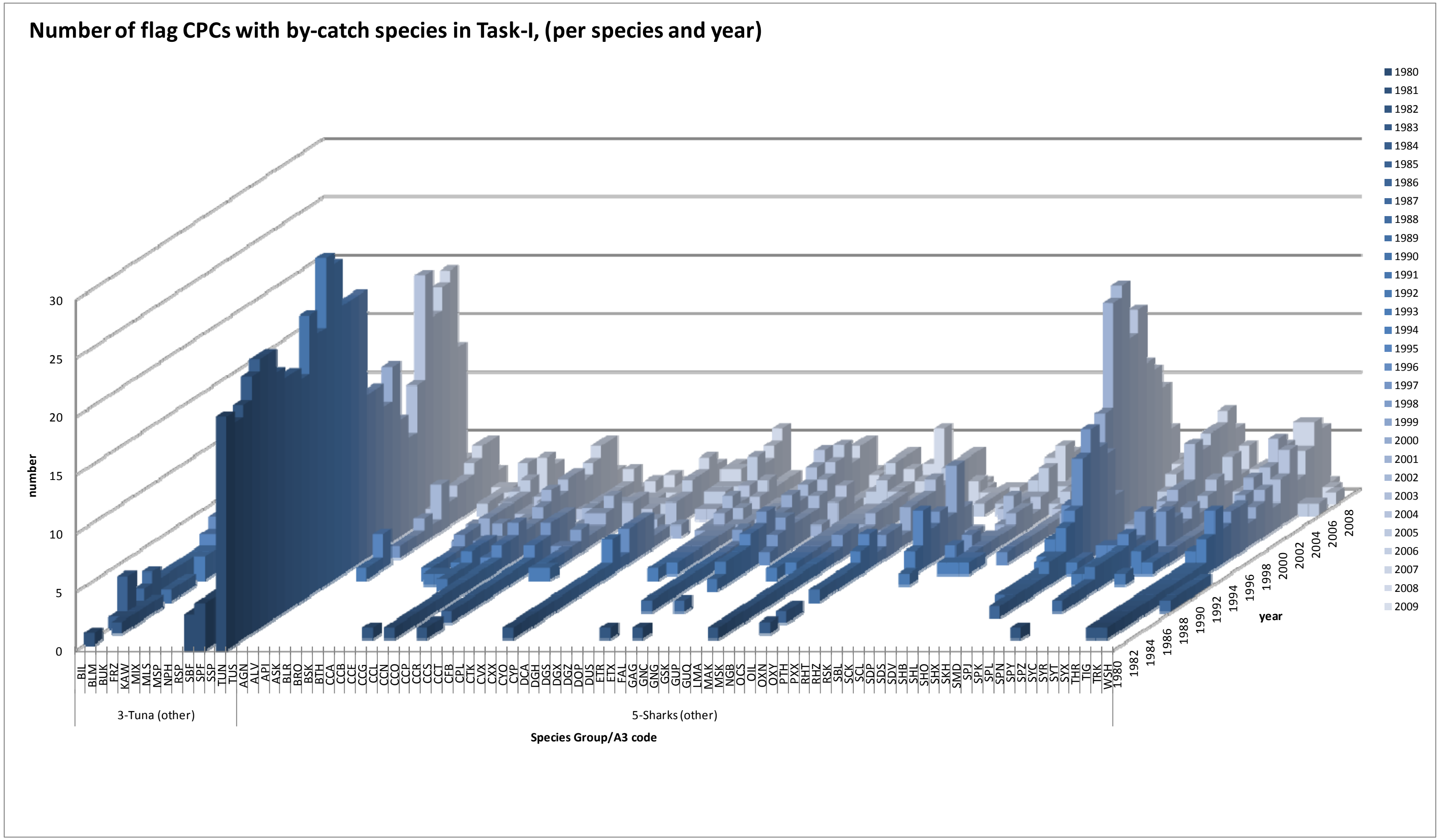

Figure 1. Number of Flag CPCs per species (only non-major tuna, tuna like & shark species) and year with Task I information available.

Appendix 1

AGENDA

1. Opening, adoption of the Agenda and meeting arrangements
2. Review of new information regarding ecosystems
3. Optimum observer coverage for reliable estimates of by-catch
4. Ecosystem indicators useful for the SCRS
5. Review of work conducted under the short term by-catch contract
6. Additional information on seabird data collection, assessment and management
7. Other matters
8. Recommendations
9. Adoption of the report and closure

Appendix 2

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Appendix 3

LIST OF DOCUMENTS

SCRS/2010/046	Distribution of ecological related species in the Atlantic Ocean: Sighting by Taiwanese tuna longline fishing vessels from 2004 to 2008. Hsiang-Wen Huang and Yu-Wen Huang.
SCRS/2010/047	Report of the by-catch coordinator. Cotter, J.
SCRS/2010/050	Albatross and petrel distribution in the Atlantic Ocean and overlap with ICCAT longline fishing effort. ACAP
SCRS/2010/051	Review of seabird by-catch mitigation measures for pelagic longline fisheries. ACAP.
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SCRS/2010/053	Albatros Task Force. Developments in Experimental Mitigation Research. ATF Progress Report Extracts January 2010. Birdlife Int.

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SCRS/2010/055 Spatial surplus production modelling of Atlantic tunas and billfish. Carruthers, T. and McAllister, M.

SCRS/2010/056 Computing prior probability distributions for the intrinsic rate of increase for Atlantic tuna and billfish using demographic methods. Carruthers, T. and McAllister, M.

SCRS/2010/057 A comparison of the effectiveness of light tori lines and an emerging pelagic tori line design in reducing seabird by-catch in the Brazilian pelagic longline fleet. Marques, C., Peppes, F., Sales, L. and Neves, T.

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SCRS/2010/064 Programa de observadores en el palangre pelágico: Cuándo, dónde y qué. Domingo, A., Abreu, M., Forselledo, R., Jiménez, S., Miller, P. and Pons, M.

SCRS/2010/065 Effectiveness of tori-line use to reduce seabird by-catch in the Uruguayan pelagic longline fleet. Jiménez, S., Abreu, M. and Domingo, A.