REPORT OF THE 2012 MEETING OF THE ICCAT WORKING GROUP ON STOCK ASSESSMENT METHODS

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ICCAT WG STOCK ASSESSMENT METHODS – MADRID 2012

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(Madrid, Spain, April 16 to 20, 2012)

1. Opening, adoption of Agenda and meeting arrangements

Mr. Driss Meski, ICCAT Executive Secretary, opened the meeting and welcomed participants. The meeting was chaired by Dr. Paul De Bruyn. Dr. De Bruyn welcomed the Working Group participants, reviewed the objectives of the meeting and proceeded to review the Agenda which was adopted without changes (**Appendix 1**).

The List of Participants is attached as **Appendix 2**.

The List of Documents presented at the meeting is attached as **Appendix 3**.

The following participants served as Rapporteurs for various sections of the report:

Section	*Rapporteurs*
1	P. de Bruyn
2	M. Ortiz
3	S. Cass-Calay
4	S. Miller
5	D. Gaertner
6	L. Kell
7	G. Diaz
8-10	P. de Bruyn

2. Generic methods for combining and standardizing multiple CPUE series

The Group discussed current methods for combining CPUE series. It was noted that there are different objectives for combining relative indices of abundance: a) to produce a single series for input in an assessment model either to minimize model convergence problems arising from conflicting indices and or reduce the number of indices in the model. This objective in general has been applied to production models analyses (e.g., 2011 Yellowfin Tuna Stock Assessment: Anon. 2012). A second objective b) is to integrate and summarize the information provided by multiple indices into a single trend. This is typically done to compare trends of abundance for the overall population, rather than to use as a tuning indicator for assessment models.

The most common practice at the SCRS working groups for combining multiple indices of relative abundance is through a GLM model. The GLM model takes as input the standardized series with at least two fixed factors, index and year. The model assumes a normal distribution, with equal weighting for each series as a default. However, alternative weighting schemes have been proposed or used; index weighting by the proportion of the catch by year, or the relative geographic coverage (for example the number of 5x5 degree squares covered), or a variation of both. The GLM combined method requires the following; the units of each index to be the same (numbers or biomass), if combining indices of different time periods it is recommended to scale each index by the mean of each series to a set of common years among all indices when possible. The combined index will be the estimated LSMeans by year.

Other approaches have been used for combining information provided by several indices, although not necessarily for using as input for a particular model. During the 2009 Sailfish Stock Assessment, several methods were evaluated to summarize the trends of multiple indices of abundance that did not have clear trends (Anon. 2010). These methods included:

- Applying a non-parametric smoother function (e.g. Loess, splines) to overlapping indices of abundance scaled to the mean of each series. The objective in this case is to identify the main trend of the whole CPUE series. Smoother functions can be applied to individual indices to remove year to year variability, or as model in a non-parametric approach with GAMs models to estimate multiple index general trend.

- In a similar fashion, correlation analyses can be performed on multiple index series to identify particularly negative correlations amongst indices.

- Another approach was a robust procedure to estimate confidence intervals for the median ratios of the indices in one year relative to the indices in another year. The 95% confidence intervals were estimated using the binomial distribution for the median of the CPUE ratios relative to a standard year, following the procedures described by Conover (1980). Estimates of the confidence interval for the ratio each year were obtained from the relative values, an example of the approach is given in Anon. 2010 (see Figures 21 and 22)

- The Working Group noted also that during the 2009 meeting of the Working Group on Stock Assessment Methods the Dynamic Factor Analysis (DFA) method was presented. This method can be used to identify common patterns in sets of CPUEs (Gaertner, 2010). This method can be complementary to the combined CPUEs approach described earlier, or for evaluating general trends of CPUE series. The advantage of this approach is that it offers a statistical criterion, the AIC for assessing the main trends. In the example applied to yellowfin tuna this method allows the analyses of multiple indices by areas and fishing gear types.

The Working Group reviewed a recently published approach for combining multiple CPUE series (Conn, 2010). The method uses a hierarchical framework for analyzing multiple indices with the goal of estimating a single time series of relative abundance. The method assumes that each index is a measure of relative abundance and is subject to process error. In simulation testing the method performed well (Conn, 2010). The author provided the r-scripts to the Working Group so that the method could be evaluated for use by the SCRS at a later date.

3. Protocols for the inclusion or use of CPUE series in assessment models.

3.1 Minimum required elements for the documentation of CPUE standardization

The Working Group constructed a detailed set of instructions for authors that describe the information and some of the analyses required for the appropriate construction, documentation and evaluation of CPUE series presented to the SCRS (**Table 1**). The Working Group recommends that species group rapporteurs distribute these instructions to national scientists charged with developing CPUE series well in advance of stock assessment meetings, and that the Secretariat distribute these guidelines along with the meeting announcement and make it available on the ICCAT website. Furthermore, the Working Group recommends that the listed elements be completed to the satisfaction of the members of the species group prior to the inclusion of any CPUE series in a stock assessment model. Authors who require assistance to complete the required diagnostics should consult the documents by Ortiz and Arocha (2004), Kell et al. 2010 and Kell et al. 2011 for detailed examples.

3.2 Protocols for inclusion

One document (SCRS/2012/039) was presented to the Working Group. It described a simple, objective technique that could be useful to evaluate candidate CPUE series for inclusion into surplus production models. Given certain assumptions (r, $B1$ and $Umax$), the method identifies index values that exhibit single year increases or decreases that exceed biological plausibility, and provides an estimate of the frequency and severity of such deviations. Deviations from biological plausibility could be caused by a variety of reasons including: inadequate index standardization, environmental changes, and unmodeled changes in catchability or targeting. Indices that exhibit extra-biological variability should be scrutinized to determine whether the index is appropriate to include in a production model context. The authors also applied the methodology to the production model CPUE indices developed for the 2011 yellowfin tuna stock assessment.

The Working Group generally supported the utility of this method for surplus production models and noted that the extension of this method to age-specific indices will require further development. The Group discussed that this method could be useful to identify changes in fishing behavior, gear, targeting, survey design, environment etc. that might cause extra-biological variation in an index of abundance, and could also be used as one criterion for inclusion/exclusion of CPUE series from surplus production models.

3.2.1 Tools to guide the selection of CPUE series and evaluate their utility

The Working Group developed two tools. The first is a flowchart that is intended to guide the appropriate use of CPUE series in stock assessment models used by ICCAT given the assumptions of those models (**Figure 1**). The Working Group recommends that species groups use this flowchart prior to the construction of stock assessment models to ensure that CPUE series used in a stock assessment model conform to the assumptions of that model to the greatest extent possible.

The second tool is a table intended to evaluate the sufficiency of CPUE series, and inform decisions regarding their inclusion in stock assessment models (**Table 2**). The Group recommends that the table elements be evaluated by the species groups before stock assessment models are constructed but noted that the table elements may not be applicable to all stock assessment formulations. Given this, species groups should evaluate the sufficiency of CPUE series with regard to the table elements and the stock assessment model chosen. In principle, only CPUE series judged to be sufficient should be included in stock assessment models. The conclusions of the species groups should be documented and justified in the report of the meeting.

4. CPUE standardization for by-catch species including revision of method used to estimate the overall Atlantic effort in the evaluation of the impact of tuna fisheries on by-catch species and GLMtree models.

The Working Group considered that this topic could be more suitably addressed in conjunction with the Sub-Committee on Ecosystems and thus recommended that this meeting be arranged during the week of the species group meetings.

5. Methods for monitoring and evaluating recreational fisheries

The ICCAT Sub-Committee on Statistics was asked by an ICCAT Commission recreational fishery working group to establish a work plan implementing rules and guidelines for collecting sport fishery data. In spite of efforts since 1997, few CPCs have been submitting sport and recreational fishery statistics to ICCAT and that to date there are no common methodologies to collect valuable information on these fisheries assumed to be non-commercial [Rec. 05-08].

In 2010 an *ad hoc* Working Group of the SCRS evaluated the minimum standard data that should be collected by CPCs but a specific form focusing on these data has not yet been developed by ICCAT.

The Working Group recognizes the difficulties involved in classifying the different types of recreational activities which can differ among CPCs. In spite of the fact that CPCs must report all landings of the species concerned by recreational and sport fisheries to ICCAT it seems that most CPCs have not yet included this aspect in their own Data collection plan. The participants to the Method Working group, reinforce the conclusions of the SCRS ad hoc Working Group with respect to the need to consider useful additional information (e.g., discards by species, release mortality, etc), not traditionally reported in Task I and II, to evaluate accurately fishing mortality in stock assessment studies. The Group thus recommended that the secretariat develop a form to distribute among the CPCs to obtain information on the nature of their recreational/sport fisheries and details of the data being collected.

The Methods Working Group was informed that the ICCAT Secretariat was contacted by the Western Central Pacific Fisheries Commission and other tuna RFMOs sport fishery working groups to share information on this topic and it was recommended that ICCAT benefit from the experience gained by other RFMOs facing the same problems in the collection of recreational and sport fisheries data.

6. Testing generic assessment techniques and methods through simulations

SCRS/2012/034 discussed how empirical studies have shown that there is significant correlation between the life history parameters such as age at first reproduction, natural mortality, and growth rate. This means that from something as basic as maximum size it is possible to infer other life history parameters, which are difficult to measure such as natural mortality. It was shown how to simulate stock dynamics based on life history theory. The simulator can be used to estimate reference points and population growth rates, derive priors for stock assessments, validate parameters used in assessments, conduct sensitivity analysis, develop simulation models for Management Strategy Evaluation and parameterise leslie matrices for use in Ecological Risk Assessments.

SCRS/2012/036 noted that the adoption of the Precautionary Approach requires a formal consideration of uncertainty, for example in the quality of the available data and knowledge of the stocks and fisheries. An important principle is that the level of precaution should increase with uncertainty about stock status, so that the level of risk is approximately constant across stocks. However, even when data are limited empirical studies of teleosts have shown that there is significant correlation between the life history parameters such as age at first reproduction, natural mortality, and growth rate. This document showed how life history theory can be used to derive parameters for use in stock assessments where data and knowledge are limited and to validate the assumptions used in data-rich stock assessments. This was done for an example based on North Atlantic albacore.

SCRS/2012/036 discussed that the Kobe II Strategy Matrix (K2SM) is an important tool for communicating between stakeholders within the tuna RFMOs. The K2SM assists the decision-making process by allowing a consideration of the different levels of risk. However, substantial uncertainties still remain in stock assessments. Therefore, it is important to develop research activities to help better quantify the uncertainty and understand how this uncertainty is reflected in the risk assessment inherent in the K2SM. This was emphasized and recognised at the KOBE III meeting. The document simulated stock dynamics based on life history theory to evaluate the impact of uncertainty about biological processes on the K2SM.

These papers demonstrated how biological knowledge on life histories can be used within stock assessment groups.

7. Implications of Recommendation 11-13 and Resolutions 11-14 and 11-17 that the SCRS should consider

7.1 *Recommendation by ICCAT on the Principles of Decision Making for ICCAT Conservation and Management Measures* [Rec. 11-13]

The Group agreed that although the purpose of [Rec. 11-13] is to guide the Commission on actions to be taken to achieve the Convention objectives, the SCRS should also use it as a framework when developing limit reference points and harvest control rules and when conducting Management Strategy Evaluations (MSE).

7.2 *Resolution by ICCAT to Standardize the Presentation of Scientific Information in the SCRS Annual Report and in the Working Group Detailed Reports* [Res. 11-14]

SCRS Detailed Reports

The Secretariat presented a list of elements that could be included in all working group detailed reports with the goal of standardizing them. The list presented by the Secretariat was based on the 2010 bigeye tuna stock assessment meeting report. The Group discussed ways to streamline the presented report and to incorporate the requirements of [Res. 11-17]. Despite the need to standardize all SCRS reports, it was recognized that flexibility was needed to accommodate the particular nature of the data preparatory and assessment meeting reports. The Group agreed that the information presented and included in a data preparatory meeting report should only be referenced in the assessment report, but not fully repeated. The assessment report should contain a description of all assumptions relevant to the assessment analyses. The Group also reviewed the templates of assessment reports used by ICES. However, the Group considered that there was no need to change the structure of the detailed reports that has been in use until now. There was general agreement that major differences in the reports prepared by the different SCRS working groups was mostly due to the amount of information included in each section and not on the structure of the reports. The Group also recommended that working group chairs develop the meeting agendas in accordance with the different sections of the detailed report. **Appendix 4** presents the template for SCRS detailed reports that should be adopted by all Working Groups and it includes instructions on the information to be included in the different sections.

The Group also discussed how to summarize uncertainty with respect to the estimate of stock status and fishing mortality in the Kobe phase plot. Various ways were discussed, e.g., contours and shading points corresponding to densities or plotting contours corresponding to probability levels. The Group considers this an important area of future work.

SCRS Executive Summaries

The Group reviewed the current template of the Executive Summaries and incorporated the new requirements as described in [Res. 11-17]. The new template agreed by the Group is presented in **Appendix 5**. The Group emphasized that the summary tables in the executive summaries must contain at a minimum all the elements shown in the example table in **Appendix 5**. The working groups are reminded that the Executive Summary should reflect a synthesis of the essential elements to be communicated to the Commission and the working groups should, therefore, make efforts to limit the number of pages of the executive summaries.

***7.3 Resolution by ICCAT on Best Available Science* [Res. 11-17]**

The SCRS Chair summarized in a presentation (SCRS/2012/042) the major points of [Res. 2011-17]. The SCRS Chair's presentation also included past actions, current mechanisms, and a 2013 Plan of Action that addressed several of the requirements of the mentioned resolution particularly related to quality assurance. Under the umbrella of improving the quality assurance of the functioning of the SCRS, the Group discussed available options for the quality control and validation of stock assessment software used by SCRS and the difficulties associated to this task. It was pointed out that SCRS could explore using similar methodologies and approaches that are already in place in several assessment software repositories (e.g., NOAA Fisheries Toolbox in the US). The Secretariat informed the Group on the Strategic Initiative on Stock Assessment Methods (SISAM) which aims to advance knowledge on operation and development of stock assessments, to strengthen stock assessment processes and the management advice system, help to guide scientists to the most appropriate stock assessment software/methods, and to generate ideas for the features of the next generation assessment models. SISAM will also hold a world conference on stock assessment methods. Developing a repository of stock assessment methods is also under discussion. The Group agreed that SISAM is an important initiative and recommended that ICCAT collaborate with SISAM. In addition, the Group agreed that the SCRS should consider conducting discussions with SISAM to explore the possibility of the ICCAT software catalogue becoming part of a worldwide repository of stock assessment methods. The Secretariat also indicated that SISAM is requesting test data sets to use to compare the performance of different stock assessment models. The Secretariat indicated that the North Atlantic Albacore stock could be a good case study and the Working Group recommended that the SCRS consider sharing this data set with SISAM.

The Group discussed that concerns regarding the validation of assessment models are aimed to newly developed models that on occasions are used in stock assessments and for which the SCRS has not yet conducted any validation. The Secretariat indicated that a protocol for software validation and quality control is already in place. The Group recommended that the protocol in place continued to be used and that the Software Catalogue Committee should review and, if necessary, update it.

On the issue of the transparency of the work of the SCRS, it was indicated that the last external peer review of ICCAT considered the SCRS work to be highly transparent. The Group recognized the importance of taking steps towards maintaining and even improving the transparency of the work of the SCRS. The Group acknowledged that currently the SCRS does not have a code of conduct for scientist and observers attending its meetings and, therefore, it recommended that such a code of conduct be drafted to comply with the requirements of [Res. 11-17].

The Group was reminded that peer reviews of the work of SCRS working groups have already been conducted in the past and that a protocol to conduct such reviews is already in place. For example, in 2003 the Albacore Species Group (SCRS/2003/113) and the Methods Working Groups (SCRS/2003/039) were both peer-reviewed under the ICCAT Stock Assessment Peer Review program. The Group also acknowledged that other types of peer reviews, such as participation of external experts in SCRS meetings, publication of SCRS works in peer review journals, world conference, have also been used.

It was agreed that the current protocol for peer review of the SCRS work should be revised and updated. The Group also agreed that the Secretariat should prepare and keep a list of experts who have been agreed to participate in the peer review process and who have been judged to have the necessary experience and expertise to perform that task. This will allow the selection of external experts as soon as the SCRS calendar of assessment meetings has been approved by the Commission.

The Terms of Reference for the participation of external experts as peer reviewers in the SCRS stock assessment meetings are the following:

1) Prior to the meeting, the external reviewer(s) will be given access to previous reports of the working group.

2) Fully participate in the discussions of the appropriate analyses to be conducted at the meeting including, but not limited to:
   - The selection of the assessment model(s) to be used, model assumptions, biological parameters, selection of model run(s).
   - When appropriate, suggest alternative assessment methods that could better characterize the dynamics of the stock.
   - Participate in the development of the main conclusions of the stock assessment and management recommendations from the meeting.
   - Participate in the identification of specific research needs for the future.
3) The comments and suggestions of the external reviewer will be taken into consideration by the Working Group during the stock assessment process and in the preparation of the meeting report. The external reviewer will prepare an independent report with recommendations to improve the assessment and the review processes which will be added to the meeting report as an annex upon its completion.

The Group recognized that for the Secretariat and the SCRS to effectively implement peer reviews of stock assessments with the participation of external reviewers, the Commission needs to allocate specific funds to cover the costs of this process. For that purpose, the Commission should be provided with multiannual plans detailing the financial requirements for that period or, alternatively, the Commission could allocate permanent funds to support the financial needs of a peer review process. It was also suggested by the Group that an external performance review of the review process be conducted after a period of approximately 5 years to assess its effectiveness, financial implications, and to consider potential improvements.

8. Methods for improving scientific training and building methodological skills amongst scientists of the SCRS

The Group recognized the importance of improving the scientific skills and understanding amongst the scientists participating in the SCRS, particularly given the trend for increasing complexity and multitude of tasks required to provide scientific advice. Training is required at two levels. Firstly, training is needed to improve the capacity amongst SCRS scientists to be able to conduct assessments and provide scientific management advice using state of the art techniques and models. Training aimed at scientists who already possess an advanced knowledge of stock assessment techniques will be to ensure that the number of scientists who are able to lead stock assessments within the SCRS is increased; this means that the absence of an individual would not also result in the SCRS not being able to utilize a particular technique and also that the burden to conduct stock assessments does not always fall on a limited number of CPCs. Another level of training would be to help fishery and stock experts to fully participate within the assessment process. So that participants within stock assessments could fully understand the assumptions and data requirements of models being used. To this end, several initiatives and future training activities were identified.

8.1 Webinars; web based training material should be developed that allows scientists to learn new techniques for data analysis, stock assessment and running models. For example how to access the ICCAT databases and conduct the type of analyses required in data preparatory meetings, checking GLM model diagnostics or running the life history simulator to derive priors for use in stock assessments.

8.2 Stock Synthesis courses. SS3 is an important tool for stock assessment. However, Its application in the SCRS is limited due to limited expertise. As identified by the Working Group, there is need for two levels of training, i.e., to allow more scientists to lead SS3 assessments and for stock experts to participate in the assessment process. Both types of courses need to be planned.

8.3 Joint ICCAT/ICES MSE training group. The group was made aware of a joint ICCAT/ICES training course on Management Strategy Evaluation to be held in January 2013 at the European Commission's Joint Research Center (JRC) in Ispra, Italy. This course is intended to help the process needs to be more widely implemented in ICCAT as recommended by Kobe III.

9. Other matters

9*.1 Joint Tuna RFMO Management Strategy Evaluation Working group*

Kobe III (Document K3-REC-A) recommended under science (I.3) to set up a Joint MSE Technical Working Group, i.e., recognizing that a Management Strategy Evaluation (MSE) process needs to be widely implemented in the tRFMOs in the line of implementing a precautionary approach for tuna fisheries management. It is recommended that a Joint MSE Technical Working Group be created and that this Joint Working Group work electronically, in the first instance, in order to minimize the cost of its work.

ICCAT has volunteered to lead this working group. All the tRFMOs have been contacted and have nominated members. The next step is to decide upon Terms of Reference and ways of working. The Group comprises experts in MSE and it is envisaged that they will be primarily concerned with development of methods rather than development of case studies. Therefore, the main point of contact for the SCRS with the MSE WG will be via the Methods Working Group. Several issues were discussed and it was agreed that initially important technical areas were communication of uncertainty to the Commission and within species groups.

It is recognised that communication about risk and uncertainties is an interactive process of exchange of information and opinion on risk among stock assessors, managers and other stakeholders. This will be important for agreeing consensus amongst stake holders when evaluating HCRs using MSE as well as presenting advice to the Commission. Methods for risk communication should therefore be developed.

The FAO Technical Consultation on the Precautionary Approach to Capture Fisheries (FAO, 1996) recommended the use of harvest control rules to specify in advance what actions should be taken when limits are reached. However, although harvest control rules may include several precautionary elements, it does not necessarily follow that they will be precautionary in practice (Kirkwood and Smith 1996). Since many harvest control rules are not evaluated formally to determine the extent to which they achieve the goals for which they were designed, given the uncertainty inherent in the system being managed (Punt 2008). Therefore, Management Strategy Evaluation (MSE) based on simulation modeling has increasingly been used to evaluate the impact of the main sources of uncertainty inherent in the system being managed (Kirkwood and Smith 1996; Cooke 1999; McAllister et al. 1999; Kell et al, 2010).

In addition to the reference points and the specification of a HCR, the minimum data and knowledge requirements for types of assessment methods to be used for decision-making are evaluated. MSE allows uncertainty, beyond just the assessment process to be considered, since under active management, uncertainties about management decisions, their effects and their implementation also affect management outcomes. However, fisheries management advice has traditionally been based on a reductionist approach, where tasks are considered in a linear fashion e.g., collect the data, perform the assessment, compute reference points, then set the quota. However, just as in ecology where it is argued that inappropriate use of reductionism limits our understanding of complex systems, we need to understand how systems work and in particular how feedback loops influence those systems. Management Strategy Evaluation (MSE) has therefore become an important tool for evaluating management advice.

Fisheries management requires consideration of a range of sources of uncertainty. Traditional stock assessment mainly considers only uncertainty in observations and process (e.g. recruitment). However, uncertainty about the actual dynamics (i.e., model uncertainty) has a larger impact on achieving management objectives (Punt 2008). Therefore, when providing management advice it is important to consider appropriate sources of uncertainty. Rosenberg and Restrepo (1994) catagorised uncertainties in fish stock assessment and management as:

- Process error; caused by disregarding variability, temporal and spatial, in dynamic population and fisheries processes;
- Observation error; sampling error and measurement error;
- Estimation error; arising when estimating parameters of the models used in the assessment procedure;
- Model error; related to the ability of the model structure to capture the core of the system dynamics;
- Implementation error; where the effects of management actions may differ from those intended.

Sources of uncertainty related to Model Error include:

- Structural uncertainty; due to inadequate models, incomplete or competing conceptual frameworks, or where significant processes or relationships are wrongly specified or not considered. Such situations tend to be under-estimated by experts (Henrion and Morgan, 1990) and
- Value uncertainty, due to missing or inaccurate data or poorly known parameters.

9.1.1 Parallel Computing

Running MSEs are computer intensive therefore the use of cloud distributed and parallel computing needs to be explored.

9.2 Availability of data on ICCAT website

The Group was requested to provide feedback as to whether data that includes estimations (and thus assumptions and calculations) made by the secretariat should be available on the ICCAT webpage (e.g., catch-at-age and effort estimations). It was generally agreed that the website should specify that the data exists and is available on request. Scientists requesting the data can then be provided with the additional information regarding these data sets to ensure their correct use.

10. Recommendations

1) Consistency of stock assessment parameters should always be checked and confirmed. For example age specific mortality vectors should be consistent with the growth curve assumed by the model.
2) The sharepoint should be made available as a scientific collaboration tool with connection through the internet, not just through the ICCAT network. This should be accomplished as soon as possible. Other online collaboration tools should be investigated.
3) Data preparatory meetings should be held, as both data preparation and complex assessments cannot be done in a single week. Where possible, these meetings should be held in the same year.
4) Working groups must use the CPUE protocols and provide feedback on their utility and potential improvements.
5) Life history parameters should be collated by the secretariat for use by SCRS working groups, e.g., on tunas, mackerels, billfish, sharks and bycatch species and made available to others so that they can be used within meta-analysis. Life history relationships could be used to validate the biological assumptions made in assessments and to derive priors for key parameters as presented in SCRS/2012/036.
6) Improved methods to further evaluate model uncertainty should be explored by the SCRS.
7) During 2013 the 2014-2020 SCRS Science Strategic Plan (including Quality Assurance, Capacity Building and Code of Conduct text,) should be developed by the SCRS.
8) ICCAT should become involved in the SISAM initiative to improve quality control of assessment models and also offer to provide the albacore data to the SISAM group as a useful case study.
9) Development of the CPUE manual as an electronic version with assistance from CPC scientists, to be coordinated between the Secretariat and the SCRS.
10) The Group recommends that the Secretariat develop a form to distribute among the CPCs to obtain information on the nature of their recreational/sport fisheries and details of the data being collected.
11) The Group recommended that ICCAT benefits from the experience gained by other RFMOs facing the same problems in the collection of recreational and sport fisheries data and participate in the WCPFC and other tuna RFMOs recreational fishery working group.
12) All working groups must use the new templates for the detailed report and executive summary to standardize the provision of information to the SCRS and commission.

Additional recommendation

1) Distribute this report and templates to the various working groups in 2012 for reference purposes and feedback.

11. Adoption of the report and closure

The report was adopted during the meeting. The Chairman thanked the participants for their hard work.
The meeting was adjourned.

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Table 1. Instructions for authors describing the information required to facilitate the appropriate construction and evaluation of CPUE series.

DESCRIPTION OF THE DATA SOURCE

1. Fishery Independent Indices
   a) Describe the survey design.
   b) Describe sampling methodology.
   c) Describe any changes in sampling methodology.
   d) Describe the variables used in the development of the index.
   e) What species or species assemblages are targeted by this survey.
   f) Describe the size/age range that the index applies to. Include supporting figures.
2. Fishery Dependent Indices
   a) Describe the data source, type of fishery and target species.
   b) Describe any changes to reporting requirements, variables reported, etc.
   c) Describe the variables used in the development of the index, including variables related to targeting.
   d) Describe the size and/or age range that the index applies to. Include supporting figures.
   e) Description of changes in the fishery that might affect catch rates such as changes in fishing power, market conditions etc.

METHODS

1. Data Reduction and Exclusions.
   a) Identify any data exclusions and the rationale used.
   b) Provide an assessment of the quality of the data used.
2. Management Regulations.
   a) Provide a history of management regulations in the fishery.
   b) Identify the potential effects of management regulations on CPUE.
   c) Discuss methods used (if any) to account for the potential effects of management measures and their implementation on the CPUE series.
3. Describe Analysis Dataset (after exclusions and other treatments).
   a) Provide tables and/or figures of number of all observations and, where relevant, positive observations by factors (including year, area, etc.) and interaction terms.
   b) Provide an evaluation of the annual spatial extent of the fishery noting any changes.
   c) Describe the effort catch variables and the units. If more than one effort variable is present in the dataset, justify selection.
4. Model Standardization
   a) Provide the rationale for the standardization technique.
   b) GLM model standardization:
      i) Describe model structure (e.g., delta-lognormal).
      ii) Describe construction of GLM components (e.g., forward selection from null etc.).
      iii) Describe inclusion criteria for factors and interactions terms.
      iv) Are YEAR*FACTOR interactions included in the model? If so, how (e.g., fixed effect, random effect)? Were random effects tested for significance using a likelihood ratio test?
      v) Provide a table summarizing the construction of the GLM components.
      vi) Summarize model statistics of the mixed model formulation(s) (e.g., log likelihood, AIC, BIC etc.).
      vii) Report convergence statistics.
   c) If other modeling standardization approaches were used:
      i) Describe the model used, criteria for the selection of factors, and report relevant statistics.

MODEL DIAGNOSTICS

1. Provide appropriate model diagnostics

MODEL RESULTS

1. Provide a table including, at the minimum, nominal CPUE, standardized CPUE and coefficients of variation (CVs). Other statistics may also be appropriate to tabulate.
2. Figure of nominal and standardized index with measure of variance (i.e. CVs).

IF MULTIPLE MODEL STRUCTURES WERE CONSIDERED: (***Note: this is always recommended but required when model diagnostics are poor***.)

1. Plot of resulting indices and estimates of variance
2. Table of model statistics (e.g. AIC criteria)

Table 2. Elements to evaluate the sufficiency of CPUE series.

ELEMENT	*DESCRIPTION*	*SUFFICIENCY SCORE (1 is poor, 5 is best)*				
		1	*2*	*3*	*4*	*5*
1	Diagnostics	No diagnostics or assumptions clearly violated				Full diagnostics and assumptions fully met.
2	Appropriateness of data exclusions and classifications (e.g., to identify targeted trips).	Not appropriate				Fully appropriate
3	Geographical coverage	Small localized fishery/survey				Represents geographic range of population
4	Catch fraction	Small				Large
5	Length of time series relative to the history of exploitation.	Short				Long
6	Are other indices available for the same time period?	Many				It is the only available index
7	Does the index standardization account for known factors that influence catchability/selectivity?	No				Fully
8	Are there conflicts between the catch history and the CPUE response?	Yes				No
9	Is the interannual variability outside biologically plausible bounds (e.g., SCRS/2012/039)	Frequently				Seldom
10	Are biologically implausible interannual deviations severe? (e.g., SCRS/2012/039)	Very severe				Minimal
11	Assessment of data quality and adequacy of data for standardization purposes (e.g., sampling design, sample size, factors considered)	Low				High
12	Is this CPUE time series continuous?	Very discontinuous				Completely

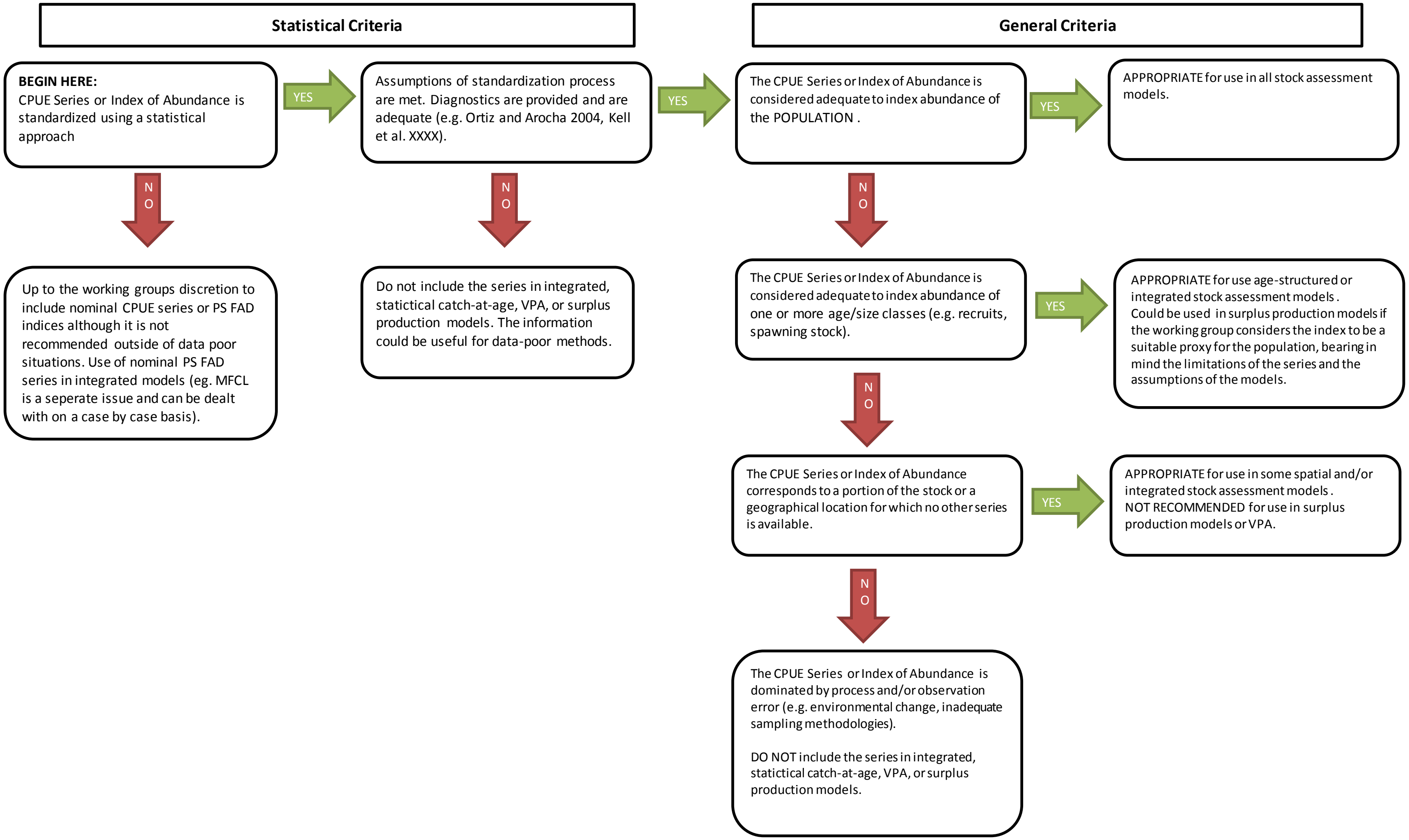

Figure 1. A flowchart to facilitate the appropriate application of CPUE series to stock assessment models used by ICCAT.

Appendix 1

AGENDA

1. Opening, adoption of agenda and meeting arrangements
2. Generic methods for combining and standardizing multiple CPUE series
3. Protocols for the inclusion or use of CPUE series in assessment models
4. CPUE standardization for by-catch species including revision of method used to estimate the overall Atlantic effort in the evaluation of the impact of tuna fisheries on by-catch species and GLMtree models.
5. Methods for monitoring and evaluating recreational fisheries
6. Testing generic assessment techniques and methods through simulations
7. Implications of Recommendation 11-13 and Resolutions 11-14 and 11-17 that the SCRS should consider
   - 7.1 [Rec. 11-13] *Recommendation by ICCAT on the Principles of Decision Making for ICCAT Conservation and Management Measures*
   - 7.2 [Res. 11-14] *Resolution by ICCAT to Standardize the Presentation of Scientific Information in the SCRS Annual Report and in Working Group Detailed Reports*
   - 7.3 [Res. 11-17] *Resolution by ICCAT on Best Available Science*
8. Methods for improving scientific training and building methodological skills amongst the scientists of the SCRS
9. Other matters
10. Recommendations
11. Adoption of the report and closure

Appendix 2

LIST OF PARTICIPANTS

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Ortiz, Mauricio
Kell, Laurence
Palma, Carlos

Appendix 3

LIST OF DOCUMENTS

SCRS/2012/034	A Generic Population Simulator Based on Life History Theory. Kell, L. and de Bruyn, P.
SCRS/2012/035	Sensitivity of the Kobe II Strategy Matrix to Life History Assumptions. Kell, L. and de Bruyn, P.
SCRS/2012/036	The Use of Life History Theory in Stock Assessment; An Albacore Example. Kell, L. and de Bruyn, P.
SCRS/2012/039	Identifying biologically implausible interannual variability in CPUE indices; with application to Atlantic yellowfin tuna. Walter, J.F. and Cass-Calay, S.L.
SCRS/2012/042	Implementation of Best Science in the SCRS. Santiago, J., Scott, G.P. and Pereira, J.

Appendix 4

PROPOSAL FOR DETAILED REPORT STRUCTURE

***TITLE:* REPORT OF THE 2010 ICCAT TUNA STOCK ASSESSMENT SESSION**
(Place and Date of the meeting)

SUMMARY

The Meeting was held in…

1. Opening, adoption of Agenda and meeting arrangements

The Meeting was held at .... from x to x, 20x. Dr. ...., opened the meeting and welcomed participants ("the Working Group").

2. Biology and ecology

2.1 Biology
Document SCRS/2010/090 studied ......:

2.2 Ecology and ecosystems considerations
Include information on the by-catches of the different fleet segments and fisheries, as well as other ecosystems considerations

3. Fisheries

3.1 General descriptions

3.2 Recent trends

4. Available data for assessment

4.1 Biological parameters

Table with specifications of the Biological Parameters used in the assessment;
Default parameters:
Alternative biological parameters evaluated:

4.2 Fisheries statistics

4.2.1 Task I
4.2.2 Task II
4.2.3 CAS methods and estimation
4.2.4 CAA methods and estimation
4.2.5 Others

4.3 Relative abundance estimates

Presentation of documents and discussion regarding CPUEs

4.3.1 Evaluations of available indices

Conclusions and guidelines on what indices to use in model assessment

4.3.2 Combined indices

Methods and conclusions

4.4 Other fishery indicators

Other fishery indicators: mean weight/length, size frequency analysis. Include a scoring table addressing data completeness and quality with the format set out in **Appendix 4-Table 1**.

4.5 Effects of current regulations

Summary table with the management measures in place, both ICCAT and national measures, and its effects.

5. Methods and assumptions relevant to the assessment

Working Groups should be sure to classify models based on standardized nomenclature

5.1 Biomass dynamic models

Include a general paragraph for all Production Models including data and indices used, common decisions of the working group regarding this type of models, etc.

5.1.1 Data inputs and assumptions for biomass dynamic models

Model 1
Model 2

5.2 Age structured dynamic models

Include a general paragraph for all age structured models including data and indices used, common decisions of the working Group regarding this type of models, etc.

5.2.1 Data inputs and assumptions for age structure models

Model 1
Model 2

5.3 Other methods

5.3.1 Data inputs and assumptions for other models

Model 1
Model 2

6. Stock status results

6.1 Biomass dynamic models

6.1.1 Model 1

6.1.2 Model 2

6.2 Age Structure models

6.2.1 Model 1

6.2.2 Model 2

6.3 Other methods

6.3.1 Model 1

6.3.2 Model 2

6.4 Discussion on stock assessment results

Include a discussion on stock assessment results the current stock status and the selection of model/runs used for projections and management advice.

Include a statement characterizing the robustness of methods applied to assess stock status and to develop the scientific advice. This statement should focus on modeling approaches and on assumptions
Include a Kobe plot chart showing:

a) Management reference points expressed as FCURRENT on FMSY (or a proxy) and as BCURRENT on BMSY (or a proxy) (**Appendix 4-Figure 1**)
b) The estimated uncertainty around current stock status estimates (**appendix 4-Figure 1-2**);
c) The stock status trajectory (A**ppendix 4-Figure 1**)
d) A pie chart summarizing the stock status showing the proportion of model outputs that are within the green quadrant of the Kobe plot chart (not overfished, no overfishing), the yellow quadrant (overfished or overfishing), and the red quadrant (overfished and overfishing) (**Appendix 4-Figure 3**).
e) An indication of the modeling approaches used by the SCRS to conduct the stock assessment shall be included in the caption and in the corresponding text accompanying the introduction of the matrices and the charts.

The Kobe plot chart should reflect the uncertainties on the estimates of the relative Biomass (BCURRENT on BMSY or its proxy) and of the relative fishing mortality (FCURRENT on FMSY or its proxy), provided that statistical methods to do so have been agreed upon by SCRS and that sufficient data exist to do so (**Appendix 4-Figure 4**).

Include tables of the estimated time series of stock biomass (or spawning stock biomass), F, relative biomass (or relative spawning stock biomass), and relative F.

6.5 Uncertainties

A statement characterizing the robustness of methods applied to assess stock status and to develop the scientific advice. This statement should focus on modeling approaches and on assumptions.

The Kobe II strategy matrices are intended to reflect the scientists understanding of the uncertainties associated with their model estimates. Therefore, where models and/or data are insufficient to quantify those uncertainties, the SCRS should consider alternative means of representing them in ways that are useful to the Commission.

7. Projections

7.1 Assumptions and methods for projections.

Describe projection scenarios, specification, assumptions, and if used model weighting factors.

The Kobe II strategy matrices are intended to reflect the scientists understanding of the uncertainties associated with their model estimates. Therefore, where models and/or data are insufficient to quantify those uncertainties, the SCRS should consider alternative means of representing them in ways that are useful to the Commission.

Recommendation [11-13] should be used as a framework to establish management control rules. In those cases where the Commission indicated a different framework, the Working Group should make reference to it in a specific section to be included in the detailed report

7.2 Results

Include a statement concerning the reliability of long term projections period.

8. Management Recommendations

Include the following elements according to the format shown in **Appendix 4-Table 2**.

a) A Kobe II strategy matrix indicating the probability of B>BMSY for different levels of catch across multiple years.
b) A Kobe II strategy matrix indicating the probability of F<FMSY for different levels of catch across multiple years.
c) A Kobe II strategy matrix indicating the probability of B>BMSY and F<FMSY for different levels of catch across multiple years.
d) Kobe II strategy matrices to be prepared by the SCRS should highlight in a similar format, as shown in **appendix 4-Table 2**, a progression of probabilities over 50 % and in the range of 50-59%, 60-69%, 70-79%, 80-89% and ≥ 90%.
e) When the Commission agrees on acceptable probability levels on a stock by stock basis and communicates them to the SCRS, the SCRS should prepare and include, in the annual report, the Kobe II strategy matrices using color coding corresponding to these thresholds.
f) When, due to data limitations, the SCRS is unable to develop Kobe II strategy matrices and associated charts or other estimates of current status relative to benchmarks, the SCRS should develop its scientific advice on fisheries indicators in the context of Harvest Control Rules, if previously agreed upon by the Commission

8. Other matters

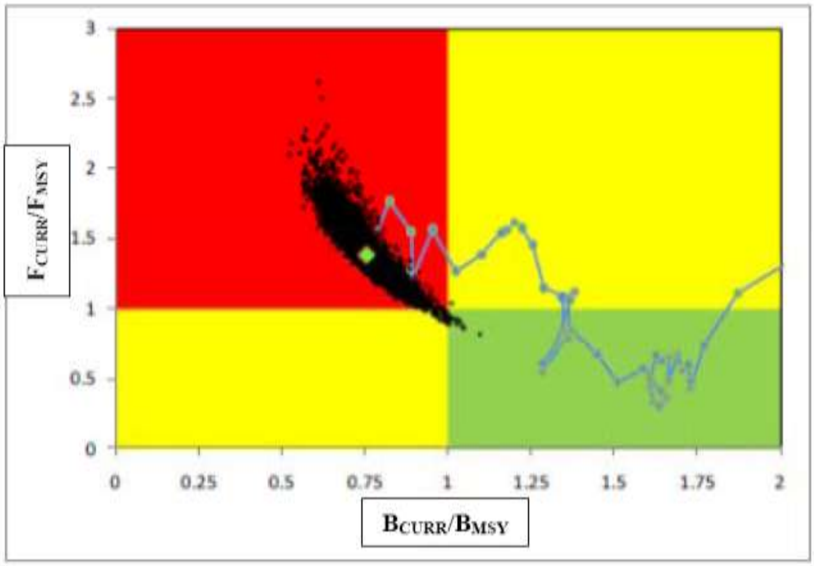
9. Adoption of the report and closure

10. Literature cited

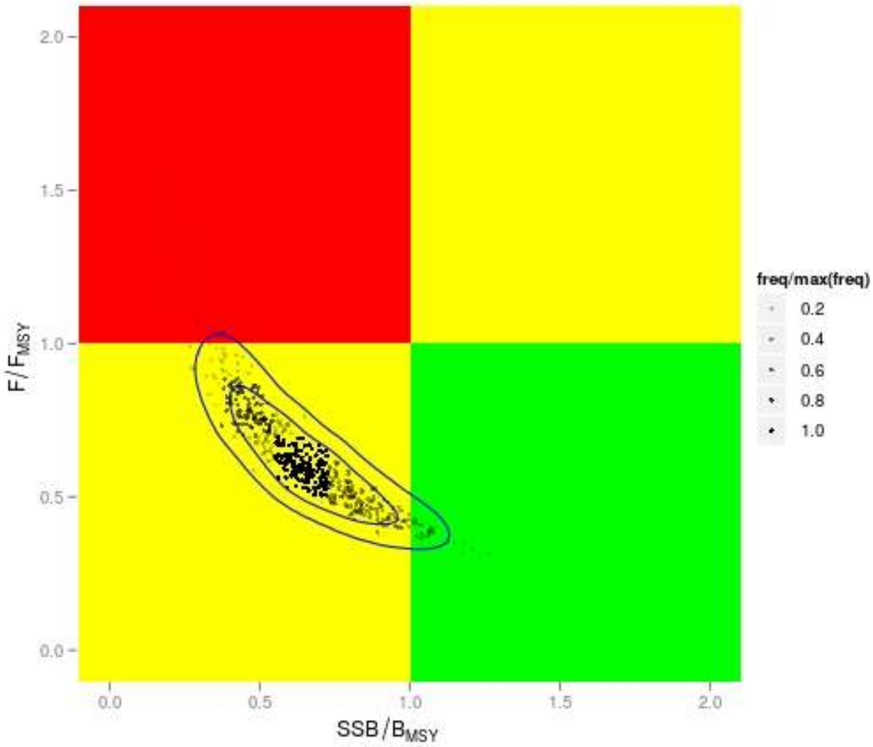
Appendix 4-Table 1. Possible format for reporting scores on data completeness and quality as included in the 2011 SCRS Annual Report.

App_4_Table 2. Format of a Kobe II strategy matrix indicating the probability of B>BMSY, or F<FMSY or B>BMSY and F<FMSY for different levels of catch limits and years.

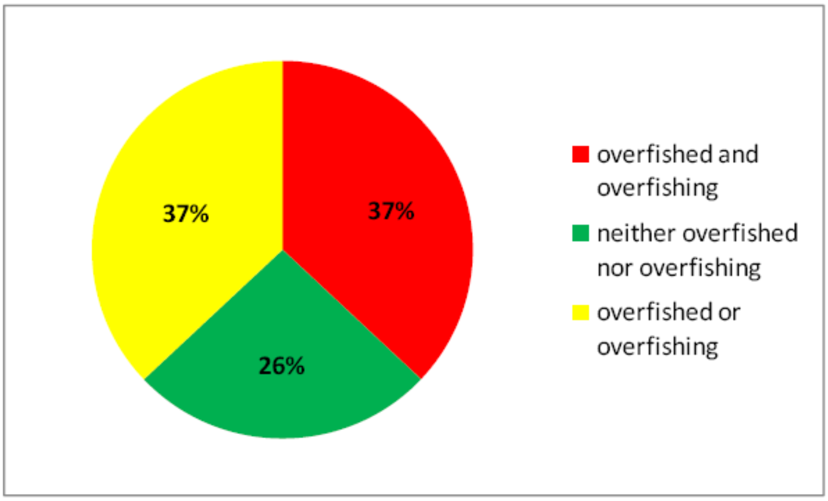
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
0	25%	51%	70%	78%	84%	87%	89%	91%	92%	93%
250	24%	48%	66%	76%	81%	85%	87%	89%	90%	92%
500	24%	45%	63%	73%	78%	82%	85%	87%	89%	90%
750	24%	43%	59%	69%	75%	79%	82%	84%	86%	87%
1000	24%	40%	54%	65%	71%	75%	78%	81%	82%	84%
1250	24%	37%	49%	59%	66%	70%	73%	76%	78%	80%
1500	23%	35%	45%	53%	59%	64%	67%	70%	72%	74%
1750	23%	32%	40%	46%	51%	55%	58%	61%	64%	65%
2000	23%	29%	35%	39%	43%	45%	47%	49%	51%	53%
2250	22%	26%	29%	31%	33%	34%	36%	36%	37%	38%
2500	20%	21%	22%	22%	22%	21%	21%	21%	21%	21%



Appendix 4-Figure 1. Example of a Kobe plot chart showing the stock status trajectory (intervals around relative biomass and relative fishing mortality will be included when available).



Appendix 4-Figure 2. Example of a Kobe phase plot where transparency of points reflects density and contours are the 90 and 60% probability levels.



Appendix 4-Figure 3. Example of pie chart summarizing the stock status showing the proportion of model outputs that are within each quadrant of the Kobe plot chart.

Appendix 5

PROPOSAL FOR EXECUTIVE REPORT STRUCTURE

TUN- Tuna species Executive Summary Report

The last stock assessment for … tuna was conducted in … through...

TUN-1. Biology

Bigeye tuna are distributed throughout the Atlantic Ocean between...

TUN-2. Fisheries indicators

The stock has been exploited...

The total annual Task I catch **(TTT-Table**, **TTT-Figure)** increased up...

TUN-3. State of the stock

The 2010 TUN stock assessment was

Include a statement characterizing the robustness of methods applied to assess stock status and to develop the scientific advice. This statement should focus on modeling approaches and on assumptions.

Include a Kobe plot chart showing:

a) Management reference points expressed as FCURRENT on FMSY (or a proxy) and as BCURRENT on BMSY (or a proxy) (**Appendix 4-Figure 1**).
b) The estimated uncertainty around current stock status estimates (**Appendix 4-Figure 1-2**)
c) The stock status trajectory (**Appendix 4_Figure 1**).
d) A pie chart summarizing the stock status showing the proportion of model outputs that are within the green quadrant of the Kobe plot chart (not overfished, no overfishing), the yellow quadrant (overfished or overfishing), and the red quadrant (overfished and overfishing (**Appendix 4_Figure 3**).
e) An indication of the modeling approaches used by the SCRS to conduct the stock assessment shall be included in the caption and in the corresponding text accompanying the introduction of the Kobe plots.

TUN-4. Outlook

The outlook for Atlantic … TUN ...

A statement concerning the reliability of long term projections period

The Kobe II strategy matrices are intended to reflect the scientists understanding of the uncertainties associated with their model estimates. Therefore, where models and/or data are insufficient to quantify those uncertainties, the SCRS should consider alternative means of representing them in ways that are useful to the Commission

TUN-5. Effects of current regulations

During the period……………………..

TUN-6. Management recommendations

Current and alternative Harvest Control Rules specification(s)
Projections indicate that catches ….
Therefore, the working group recommends …..

Include the following elements according to the format shown in **Appendix 4-Table 2**:

a) A Kobe II strategy matrix indicating the probability of B>BMSY for different levels of catch across multiple years.
b) A Kobe II strategy matrix indicating the probability of F<FMSY for different levels of catch across multiple years.
c) A Kobe II strategy matrix indicating the probability of B>BMSY and F<FMSY for different levels of catch across multiple years.
d) Kobe II strategy matrices to be prepared by the SCRS should highlight, in a similar format as shown in **Appendix 4-Table 2**, a progression of probabilities over 50 % and in the range of 50-59%, 60-69%, 70-79%, 80-89% and ≥ 90%.

An indication of the modeling approaches used by the SCRS to conduct the stock assessment shall be included in the caption and in the corresponding text accompanying the introduction of the matrices.

When, due to data limitations, the SCRS is unable to develop Kobe II strategy matrices and associated charts or other estimates of current status relative to benchmarks, the SCRS should develop its scientific advice on fisheries indicators in the context of Harvest Control Rules, if previously agreed upon by the Commission

The SCRS should indicate in its annual report those cases where the modeling approaches used during the assessment and/or data limitation did not allow for the preparation of the elements mentioned above

ATLANTIC TUNA SUMMARY

	Stock 1	**Stock 2**
Maximum Sustainable Yield	X t (provide confidence interval)[1]	X t (provide confidence interval)[1]
Current (20xx) TAC	X t	X t
Current (20xx) Yield	X t	X t
Yield in last year used in assessment (20xx)	X t	X t
B_{MSY}	X (provide confidence interval)	X (provide confidence interval)
F_{MSY}	X (provide confidence interval)	X (provide confidence interval)
Relative biomass (B_{20xx}/B_{MSY})	X (provide confidence interval)	X (provide confidence interval)
Relative fishing mortality (F_{20xx}/F_{MSY})	X (provide confidence interval)	X (provide confidence interval)
Stock status	Overfished: YES/NO Overfishing: YES/NO	Overfished: YES/NO Overfishing: YES/NO
Management measures in effect:	Country-specific TACs [Rec. xx-xx]; Minimum size	Country-specific TACs [xx-xx] Minimum size

[1]Use footnotes to indicate models used to produce advice, confidence intervals, provisional yields, etc.