FINAL REPORT OF THE ICCAT SHORT-TERM CONTRACT: MODELLING APPROACHES - SUPPORT TO ICCAT TROPICAL TUNAS MSE PROCESS

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SUMMARY

This document describes the activities of the first phase of the Atlantic tropical tunas Management Strategy Evaluation project, developed during the second semester of 2018. The main objective of the project is to support the development of a robust advice framework consistent with the Precautionary Approach for the Atlantic tropical tunas and the first phase was dedicated to design the numerical framework, to initiate its implementation and to engage with ICCAT experts in intersessional meetings and one specific workshop. This has been described in several working documents and presentations to the tropical tunas working group. Throughout this document we briefly describe how the uncertainties identified for tropical tunas can be characterized with Operating Models conditioned from the most recent stock assessments and a first attempt to describe candidate multispecies Management Procedures for tropical tunas. We also describe the simulation software proposed for this MSE, the specific tasks completed in this first phase and a scheme of the second and third phases foreseen for this project.

RÉSUMÉ

Ce document décrit les activités de la première phase du projet d'évaluation de la stratégie de gestion des thonidés tropicaux de l'Atlantique, développé au cours du second semestre 2018. L'objectif principal du projet est de soutenir le développement d'un cadre d'avis solide conforme à l'approche de précaution pour les thonidés tropicaux de l'Atlantique. La première phase a été consacrée à la conception du cadre numérique, au lancement de sa mise en œuvre et à la participation d'experts de l'ICCAT à des réunions intersessions et à un atelier spécifique. Ceci a été décrit dans plusieurs documents de travail et présentations au Groupe d'espèces sur les thonidés tropicaux. Tout au long de ce document, nous décrivons brièvement comment les incertitudes identifiées pour les thonidés tropicaux peuvent être caractérisées à l'aide de modèles opérationnels conditionnés à partir des évaluations de stocks les plus récentes et d'une première tentative de description de possibles procédures de gestion multi-espèces pour les thonidés tropicaux. Nous décrivons également le logiciel de simulation proposé pour cette MSE, les tâches spécifiques réalisées dans cette première phase et un schéma des deuxième et troisième phases prévues pour ce projet.

RESUMEN

En el presente documento se describen las actividades de la primera fase del proyecto de evaluación de estrategia de ordenación de los túnidos tropicales del Atlántico, desarrollado durante el segundo semestre de 2018. El principal objetivo del proyecto es respaldar el desarrollo de un marco de asesoramiento sólido que sea coherente con el enfoque de precaución para los túnidos tropicales del Atlántico, y la primera fase se dedicó a diseñar el marco numérico, iniciar su aplicación y participar con expertos de ICCAT en reuniones intersesiones y en un taller específico. Esto se ha descrito en varios documentos de trabajo y presentaciones al grupo de especies de túnidos tropicales. A lo largo de este documento se describe brevemente cómo se pueden caracterizar las incertidumbres identificadas para los túnidos tropicales con modelos operativos condicionados a partir de las evaluaciones de stock más recientes y un primer intento

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de describir los procedimientos de ordenación para varias especies para los túnidos tropicales. También describimos el software de simulación propuesto para esta MSE, las tareas específicas completadas en esta primera fase y un esquema de la segunda y tercera fases previstas para este proyecto.

KEYWORDS

Management Strategy Evaluation,
Tropical tunas, Atlantic, Precautionary Approach, uncertainty

1. Introduction

The main objective of this project is to support the development of a robust advice framework consistent with the Precautionary Approach (PA) for the Atlantic tropical tuna stocks. For this, in the first phase (July-December 2018) we have started the design of the MSE framework, including its main three components (Operating Models (OM), management Procedures (MP) and Observation Error Model (OEM)). The MSE framework will be developed in following phases of the project. All components of the MSE are being and will defined through a broad consultation and dialogue with experts in the Atlantic tropical tuna fisheries.

The International Commission for the Conservation of Atlantic Tunas (ICCAT) has committed to a path of adopting Harvest Strategies (HS) or MP to achieve its management objectives of high long-term yields whilst maintaining stocks within sustainable limits with high probability, consistent with the PA. The PA seeks to protect fish stocks from fishing practices that may put their long-term viability in jeopardy despite the many unknowns on stocks biology, response to fishing or exact state of exploitation (Garcia 1996). In practice, the PA requires fisheries management bodies to determine the status of fish stocks relative to target reference points (TRP) and limit reference points (LRP), to predict outcomes of management alternatives for reaching the targets while avoiding the limits, and to characterize the uncertainty in both cases. The current management framework of ICCAT's tropical tuna stocks is based on [REC 11-13], which has been updated several times more recently through [REC 16-01]. This recommendation establishes management actions for the different states of exploitation of the stocks, expressed in biomass and harvest rates relative to their corresponding Maximum Sustainable Yield RPs. The implicit target of this recommendation is to maintain the stocks in the green area (B>BMSY and F<FMSY) with high probability, which adds to the traditional objective of achieving the maximum sustainable catch (MSY). However, this recommendation relies on the interpretation of what is considered 'high probability' and 'as short a period as possible'.

ICCAT's Working Group to Enhance the Dialogue between Fisheries Scientists and Managers (SWGSM) recommended ways to further define the current tropical tuna management framework, in particular in relation to reference points (RP), associated probabilities and timeframes. Such recommendations from SWGSM, led to commitment of using MSE to evaluate Harvest Control Rules (HCR) for priority stocks, including tropical tunas (REC 15-07). This commitment is now reflected as one of the main goals of ICCAT's Standing Committee for Research and Statistics (SCRS) Science Strategic Plan (2015-2020). The goal is to evaluate precautionary management RPs and MPs that are robust to the many uncertainties inherent to fisheries. The evaluation and potential adoption of Harvest Control Rules (HCR), reflects a change in the management paradigm of ICCAT to one were pre-agreed MP are used to set limits to catch or effort. This paradigm change is being considered, or has already been implemented (CCSBT, IOTC) in other tuna RFMOs. Therefore, ICCAT is continuing to move towards a scientifically sound and more predictable and transparent decision-making scheme. MSE allows for such management evolution to be guided by a transparent and collaborative process that involves all stakeholders. The process involves technical modelling work carried out by scientists and consultations with stakeholders aimed at making sure that performance criteria used in the evaluation of MPs and assumptions made by modellers are consistent with management objectives and risk perceptions from stakeholders.

The tropical tuna species working groups recognize the difficulties in characterizing the many sources of uncertainty inherent to these fisheries, including the limitations of current stock assessment models, inaccurate/incomplete and sometimes conflicting data and the lack of information on key biological processes such as stock structure, movement, growth, maturity, mortality, selectivity and recruitment (ICCAT 2014; ICCAT 2015; ICCAT 2016c). For this reason, the assessment of Atlantic tropical tuna stocks is currently carried out using a variety of models, alternative combinations of data, hypotheses and input parameters. In this regard, the ongoing

Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP) is producing significant amounts of information that will contribute to reduce the uncertainty on growth, mortality and movement among others. The AOTTP will also contribute to help evaluate how best use this information for the purposes of stock assessment and evaluation of current and future management.

MSE is designed to enable identification of pathways to the achievement of management objectives, despite expected persistence of key uncertainties. While demonstrated difficulties in conducting stock assessments may be resolved through data collection and research, some difficulties will likely remain. MSE is conducted to identify a reduced set of MPs that can be proposed for consideration of managers, by acknowledging the limitations imposed by current data and knowledge about stock dynamics. Identifying such MPSs can be achieved through the evaluation of performance, across a variety of scenarios with the help of a selected set of performance indicators that can be tied to management objectives (Miller and Shelton 2010). Candidate MPs are to be evaluated by considering management trade-offs because performance indicators reflect conflicts in management objectives (e.g. you cannot achieve simultaneously maximum catches and stock sustainability).

At the core of the MSE process is the development of a modelling framework within potentially contentious management arenas, this approach requires consensus on defining the suite of scenarios to be considered. However, this approach does not require any one scenario to be favoured over another.

ICCAT defines MSE as an inclusive, interactive and iterative process for evaluating the performance of MPs in relation to management objectives, including the risk associated with not achieving those objectives (REC 15-07). MSE is a valuable tool to estimate the probability of achieving management objectives in a given timeframes through different management options. MSE evaluates the robustness of alternative management strategies across plausible alternative hypotheses about population structure and dynamics. In other words, MSE involves using simulation to compare the relative effectiveness for achieving management objectives of different MPs, i.e. combinations of (i) data, (ii) methods of analysis and (iii) decision making processes and management actions (Punt et al., 2014).

Conducting an MSE requires following a series of basic steps (Rademayer, Plaganyi *et al*. 2007; Punt, Butterworth et al. 2014) that include (i) identifying management objectives, (ii) identifying a broad range of uncertainties to which management should be robust, (iii) developing Operating Models (OM) which provide mathematical representation of the system, (iv) selecting the parameters of the OMs and quantifying uncertainty, (v) identifying candidate management procedures (MP) which could realistically be implemented and that include data sources, methods of analysis and decision-making frameworks, (vi) simulation and (vii) summarizing and interpreting the performance statistics from each MP. The manner that these steps will be applied towards completing the MSE for Atlantic Ocean tropical tuna stocks will be described in the methodological section.

MSE is a particularly adequate method for supporting the development of a robust advice and management framework for the Atlantic tropical tuna stocks for the following reasons:

- The MSE tropical tuna has scheduled the development of MSE for the period 2018-2021, which means that it will be developed in conjunction with the next stock assessments in 2018 (bigeye), 2019 (yellowfin) and 2020 (skipjack) . This will facilitate the engagement of the MSE process with the tropical tuna group rapporteurs and experts. Also, this will mean that the MSE will benefit from the most recent knowledge and information available for these stocks.
- Tropical tunas represent an opportunity to explore options for multi-species management measures, such as limitations on effort or fishing gears. Tropical tuna stocks are often captured together, specially by purse seine fleets using Fish Aggregation Devices (FADs) (Fonteneau, Chassot et al. 2013). The use and regulation of FADs is currently been discussed in ICCAT (ICCAT 2016b) and other tuna RFMOs (tRFMO 2017). The MSE that will be developed within this project will allow evaluating options for FAD management, including reductions in number or usage by purse seine fleets. The specific evaluation of single species and multispecies HCRs is one of the goals of this project.
- The development of MSE for Atlantic tropical tuna stocks will benefit from the progress made in the Indian Ocean Tuna Commission (IOTC). In this RFMO, MSE works supported the adoption of a HCR for Indian Ocean skipjack (Resolution 16-02, (IOTC 2016)). The IOTC bigeye and yellowfin MSEs are near completion and have produced valuable insights and information that will help the completion of this project.
- AOTTP project will support the development of OMs and other components of the MSE with FLBEIA model, a bio-economic impact assessment model (explained more in the methodological section).

All components of the MSE will be completed and refined through open consultation and dialogue with experts of the Atlantic tropical tuna fisheries, including each species working group rapporteurs, SCRS Chair and ICCAT's population dynamics experts. The technical progress will also be periodically presented to the Working Group on Stock Assessment Methods (WGSAM). Also, the development of tropical tunas MSE will require feedback with policymakers and stakeholders. ICCAT's Panel 1, the Standing Working Group on Dialogue between Fisheries Scientists and Managers (SWGSM) and Commission meetings will represent the opportunity to agree on specific management objectives, performance statistics and the type of MPs to be evaluated. This communication has been very fruitful in the past (e.g. North Atlantic albacore) and we expect that will also ensure the adequate development of the MSE for Atlantic tropical stocks.

2. Material and Methods

Description of activities of the first phase of the project

The objective of the first phase of this project has been to initiate the design of a Management Strategy Evaluation framework to support a robust advice framework for the Atlantic tropical tuna stocks consistent with the Precautionary Approach. For this, the main tasks have been to develop a workplan for the MSE simulation framework, to initiate its implementation and to engage with ICCAT experts in meetings and a specific workshop (Report in Appendix).

In this first phase, a series of SCRS papers and presentations have been completed and a three-day workshop was carried out to discuss progress and potential developments. Overall, a suitable methodology has been identified and potential paths of development have been outlined.

The MSE model is FLBEIA, a bio-economic impact assessment model based on R and FLR libraries. FLBEIA is a modelling toolbox that allows the evaluation of biological and economic variables in mixed fisheries. It has been demonstrated that this model can be used to evaluate multi-stock harvest control rules for multi-specific fisheries such as the Atlantic tropical tunas.

During the six months of this project a series of SCRS papers (4) and presentations (2) have been produced with preliminary implementations of the MSE and with alternatives of the development for each of its components. These documents represent the deliverables of this project and include a design document that details the object oriented design of the MSE model (SCRS/2018/112), a plan for development for Eastern Atlantic skipjack (SCRS/P/2018/052), plans for designing Operating Models (OMs) consistent with decisions of the tropical tuna groups (SCRS/2018/146), a proposal for potential Management Procedures (MP) (SCRS/2018/147), a proposal for a Shinny demonstrator to facilitate communication with stakeholders (SCRS/P/2018/053) and a discussion paper with options for the Observation Error Model (SCRS/2019/015).

All the technical progress made during the project was presented and discussed in a specific workshop held in Pasaia (Spain) on the 11-13th of December. This workshop, together with the bigeye assessment session (Pasaia, 16-20th July) and the Species WG meeting (24-28th September) was the way to liase and communicate with ICCAT experts in the fields of stock assessment methods, tropical tunas and MSE. The Passaia workshop was attended by twelve scientists (five from the project consortium, the three Chairs of the Atlantic tropical tuna stocks, two experts in MSE and tropical tunas and two participants from ICCAT Secretariat). During the workshop, the potential development of the tropical tunas MSE was outlined.

Tasks

The work of the first stage of the project included five tasks that have been completed as specified below:

1. *To work with the tropical tuna Species Group and its Rapporteurs, the SCRS Chair and ICCAT Secretariat to develop the detailed workplan for implementation of the tropical tuna MSE work plan*. A core group has been formed to start developing the workplan towards the tropical tunas MSE. This work has included experts from the Consortium, experts from tropical tuna working groups (including the Chairs of the three stocks) and experts from the Secretariat. This group has been informed of all the progress done during the project and have actively collaborated on this first stage.

2. *Initiate design and implementation of the MSE framework under the guidance of the tropical tuna Species Group and its Rapporteurs, the SCRS Chair and the ICCAT population dynamics expert (or any other specialist designated by the ICCAT Secretariat)*; The initial steps of the conditioning of Operating Models, features of FLBEIA and drafts of the deliverables were first presented during the bigeye stock assessment session (July 2018). Also, more advanced versions were presented and discussed in the Species Groups in September. Finally, during a dedicated workshop in Pasaia (Spain, 11-13th December), finalized papers and the developments if the main components of the MSE framework were presented to the project consortium and to relevant experts of the tropical tuna Species group, including their three Rapporteurs, SCRS Chair and two population dynamics experts.

3. *Participate in expert workshops to develop and specify and program uncertainties, scenarios and robustness tests to be considered in the MSE*. This Consortium has participated in a series of meetings during 2018. These are the Atlantic bigeye stock assessment session (16-20 July, Pasaia, Spain), the Commission Panel 1 Intersessional meeting (23-25 July, Bilbao, Spain), the SCRS tropical tunas species group (26-28 September) and the Standing Working Group on the Dialogue between Fisheries Scientists and Managers (21-23 May, Funchal, Madeira, Portugal). Experts from the project team attended these meetings and participated in all discussions relative to the MSE for tropical tunas. Also, members of the project team attended the bigeye tuna data preparatory meeting (23-27 April, Madrid) and ICCAT's Working Party on Stock Assessment Methods (7-11 May, Madrid). All matters relative to the development of the MSE framework including uncertainties, scenarios and reference and robustness tests have been discussed in these meetings (mostly in the bigeye stock assessment session and the Species Group). At this stage, the management objectives for tropical tunas are not specified yet.

4. *Liase with members of the tropical tuna Species Group to ensure the technical integration of new assessment methods and structural uncertainties within the Operating Model and MSE framework*. This has been throughout the duration of the project and has been discussed during the Species Group meeting in Madrid and during the specific workshop of December. The most recent stock assessment is Atlantic bigeye, and a similar structural uncertainty has been considered for the conditioning of its Operating Model. For the other two stocks, preliminary work has been carried out and discussed with the group.

5. *Liase with the tropical tuna scientists, the ICCAT Secretariat and other data providers to ensure compatibility of formats and quality control of input data sets*. This has been an important component of the work advanced so far. The OMs are conditioned from the stock assessment models used in the latest assessments of bigeye and yellowfin. All the conditioning is based on data that has been available for stock assessment. With regards to Eastern skipjack, a new stock assessment has been drafted also using the information available in the Secretariat.

3. Results

In the first phase of the project, four SCRS papers have been developed (one without a number yet) and one more is to be completed (five in total). The deliverables also include two SCRS presentations. As promised in the project proposal, these deliverables include a design document that details the model capabilities to achieve the objectives of this project (SCRS/2018/2012), a plan for development for a SS3 model for Eastern skipjack (SCRS/P/2018/052, SCRS paper to be completed), plans for designing OMs consistent with decisions made by tropical tuna species group (SCRS/2018/146), an Observation Error Model development to evaluate the usefulness of different data collection (SCRS/2019/015), a document with a summary of potential alternative Management Procedures (SCRS/2018/147) and a proposal for a Shinny demonstrator (SCRS/P/2018/053):

- SCRS/2018/112 A simple operating model for a basis of a discussion about the development of a management strategy evaluation for tropical tuna fisheries. Urtizberea A., Merino G., García, D., Korta M., Santiago J., Murua H., Walter J., Die D., and D. Gaertner.

- SCRS/2018/146 The steps to consider during the conditioning of the OMS of a multispecific model of tropical tuna fisheries in a Management Strategy Evaluation frame work Urtizberea A., Merino G., García D., Korta M., Harford W., Die D., Walter J., Gaertner D., Santiago J., and Murua H.

- SCRS/2018/147 Management procedure options for a Management Strategy Evaluation in tropical tuna fisheries Urtizberea A., Merino G., García D., Harford W., Die D., Walter J., Gaertner D., Santiago J., and Murua H.

- SCRS/P/2018/052 Initial development of a stock synthesis model for Eastern skipjack tuna to support tropical tuna management strategy evaluation Harford W.J., Die D., Urtizberea A., Murua H., Walter J.F., and Merino G. (One SCRS paper will also be submitted with this task).

- SCRS/P/2018/053 The initial steps of a shiny web application developed to facilitate communication and share the results of the management strategy evaluation model for tropical tuna fisheries Urtizberea A., Merino G., García D., Korta M., Harford W., Die D., Walter J., Gaertner D., Santiago J., and Murua H.

- SCRS/2019/015 Observation Error Model for tropical tuna Fisheries in a Management Strategy Evaluation framework. Urtizberea A., Merino G., García D., Korta M., Harford W., Die D., Walter J., Gaertner D., Santiago J., and Murua H.

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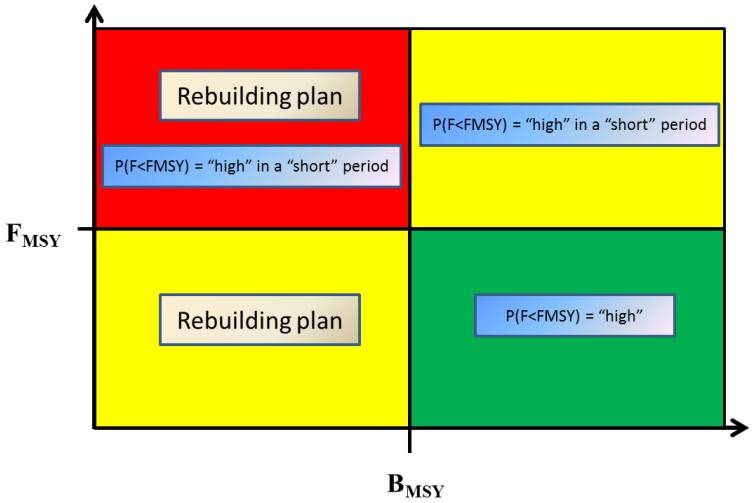

Figure 1. ICCAT's management framework based on Recommendation 11-13.

Appendix

REPORT OF THE TROPICAL TUNAS MSE WORKSHOP
Pasaia, Spain, 11-13th December 2018

1. Opening, adoption of agenda and meeting arrangements

The meeting was held at the AZTI-Tecnalia Laboratory in San Sebastian, Pasaia (Spain) from December 11 to 13, 2018. Dr Gorka Merino opened the meeting and welcomed meeting participants ("The Group"). Dr Merino highlighted the importance of the work to be done by the Group during the meeting, indicating the objectives of the project and the workshop. Dr Merino proceeded to review the Agenda, which was adopted without changes. The List of Participants is included at the end of this Appendix as it is the List of presentations.

2. Introduction to FLBEIA and applicability to tropical tuna fisheries

The software FLBEIA was presented to the Group. It was noted that this software can evaluate multispecific Harvest Control Rules and the impact of alternative data sources on stock assessments. For example, it can evaluate the potential impact of the data generated in the AOTTP program in tropical tuna stock assessments. It was clarified that this model is not spatially explicit. FLBEIA can adapt to relatively simple MP (model based or empirical) but also to more complex models. For example, it can evaluate the potential benefit of moving from SS3 to a simpler SS3 set up, a surplus production etc. The implementation can be fleet, gear, time, or other variables dependent.

In the tropical tuna fisheries there may be more than one management objective, and the economic features of FLBEIA may not be used in this project. However, despite not having economic objectives, the fleet dynamics within the model can still use economic criteria to distribute effort among métiers.

3. Operating Models and main sources of uncertainty for the three tropical stocks considered

- *Stock Synthesis for East Atlantic skipjack*

The preliminary steps towards developing the Eastern Skipjack OM was presented. For this, it was necessary to understand a previous SS3 model (Quang.) and to make small modifications. For example, it is necessary to change the two baitboat periods to reflect the exact dates when this fleet started operating on FADs. The Group agreed on conditioning the Eastern stock only for the MSE. The Group also noted that the latest assessment for this stock was in 2014. The new assessment is scheduled for 2020 and this project could contribute to that assessment with this SS3 application.

A question was raised on the uncertainty that would be covered by the skipjack OMs. Skipjack is the stock with less information available and the stock that can be considered uncertain and therefore, the factors to be considered in the OMs should be large. On the other side, there is no indication of any management problem for this stock and therefore, the group considered that less attention could be paid to this stock in the MSE.

- *Conditioning stocks in FLBEIA*
    - *Yellowfin*

The preliminary steps towards conditioning the yellowfin stock in the MSE framework were presented. This has been done from the available Stock Synthesis assessment for this stock (2016). However, the group noted that this stock will be evaluated in 2019 and a new SS3 will be available for conditioning. In the 2016 stock assessment there were two clusters based on two hypotheses and they were given equal plausibility. In the 2019 stock assessment, there will probably be a joint CPUE index.

The group agreed that there is advantage on using the same fleet structure for bigeye and yellowfin stock assessments.

It was noted that the impact of not including size frequency data for Japanese LL in the last years (due to high grading) could be evaluated using the MSE framework. Other sources of uncertainty to be considered would be sex specific growth curves and one alternative natural mortality.

- *Bigeye*

The preliminary steps towards conditioning the bigeye stock in the MSE were presented. This work is more advanced than for yellowfin. The options that could be considered in the uncertainty grid include natural mortality range, sex specific curves, growth patterns as seen in other oceans and steepness. Also, catch is probably the main source of uncertainty for Atlantic bigeye and it is not currently addressed in the assessments. The Group noted that overall catch from tropical stocks is well estimated but it is the species composition were there may be more uncertainty (e.g. if we overestimate bigeye we could be underestimating skipjack). The characterization of these sources of uncertainty could lead to a large number of OMs and loglikelihood could be used to reject some of these.

As it happened with skipjack, the Group discussed the convenience of covering more or less uncertainty for this stock. It could be argued that more is necessary because there is a management problem (stock in the red quadrant in 2018) but less because there is agreement that the stock is well characterized and we could send the wrong message to the Commission that there is uncertainty on the recent assessments, which is not. In this regard, one of the challenges of the MSE is that some of the hypotheses considered may result in undermining the confidence in the assessment and the advice the tropical tuna working groups have provided to the Commission. The Group agreed that the value of this MSE may be more on the "new" alternatives for the MPs rather than characterizing uncertainty in the OMs. In other words, to test how sensitive to MP is the impact of the uncertainty in the current knowledge of the stock. It is important to communicate well the purpose of this MSE. To sum up, it is not to add uncertainty to the current advice give on stock status but on to evaluate how alternative management systems could work to manage the tropical tuna stocks' system. For this, we can use Reference OMs as the scenarios used in the stock assessment and Robustness tests for the MPs that have performed better in the Reference OMs. This would be informative also to discuss exceptional circumstances.

The Group noted that the Commission has a problem, they don't know how to reduce bigeye catch and not reduce catch of the others. This is a hard decision for the Commission and this MSE could be used to propose alternative management systems to achieve this. The MSE should be able to predict changes on fleets' strategies for different MPs and estimate scenarios with associated changes in selectivity and catchability.

For tropical stocks, the MSE can also be used to evaluate how the stock assessment will continue working with the current problems with data.

4. Observation Error Model: Options

A preliminary review of options for the Observation Error Model (OEM) was provided. This model is used to simulate the differences between the dynamics of the OMs and the data it is generated for use in the MP. In this regard, it was agreed that the error in catch reporting would need to be considered. With regards to both the errors in catch and catch per unit of effort three alternatives were discussed: Random errors (CV), bias (trends) and autocorrelated residuals. It was noted that catchability changes due to technological improvements of purse seiners and due to changes in targeting for longliners would also need to be considered.

Another source of error that would need to be considered is the Implementation Error. In the past, often the TAC has been exceeded and this needs to be considered. This error could be characterized as a random error but also as bias, with scenarios of exceeding or not reaching TAC in average.

5. Management Procedures: Options for single-multispecific management

Options for the multispecific Management Procedures available with FLBEIA were presented. Some of these are used in pelagic and demersal ICES fisheries. FLBEIA can simulate model based (from surplus to simplified versions of SS3) and empirical HCRs. For the empirical HCRs it is key to identify the indices that will be used to estimate TAC of TAE. This index will need to be maintained in the future. The performance of different indices can be evaluated in the MSE framework. In the MP, limits to changes in TAC can be added.

The Commission has the challenge of controlling the catch of the three tropical stocks and the MSE should be built to address this issue. One potential option is to control the fishing effort. Another option could be to set a multispecies TAC. This could be one empirical HCR based on the CPUE of one stock and fleet or may be a composite.

Another challenge for the Commission is that it is reluctant to change operations (move from FADs to FS etc.) and allocations. This could be addressed with tables of different allocation schemes between fleets for the managers. The present MSE should be able to evaluate the impact of changes in allocation.

With the Multispecies HCR there will be a tradeoff between management objectives. If the aim is to keep all three stocks above B_{MSY}, some catch potential will be lost. If total catch is maximized, for example the catch of the most valuable species, the MSE should be able to evaluate what would happen with the other two stocks. The MSE could also be used to evaluate what would be the impact of using a Multispecies MSY, which species would be above or below B_{MSY}? How much? Trade-offs should be explored. Despite some stocks being below B_{MSY}, what would be the probability of having all stocks above their Limit reference points? Note there are no adopted limit reference points for Atlantic tropical stocks.

The model should still be able to produce HCRs for single stocks and then evaluate their impact in the three tropical tuna stocks system. And also we should be able to do three independent MSE's for each of the three stocks separated.

6. Prospects for the MSE research for ICCAT tropical tunas, next steps for this project

The Group discussed the potential paths for continuing this project. It was suggested that in 2019 we could start with the completion of a single MSE for Atlantic bigeye. At the same time, develop the capacity to do multispecies MSE in ICCAT groups. In summary, the next steps were agreed:

- Three steps for next stages of the project:
    1) Single species MSE for bigeye
    2) Identify further the options for the candidate MP
        - How the MP links with management objectives. Be explicit on what can be achieved by each MP
        - What is the strategy on developing relatively simple MPs and doing benchmark assessments (SS3, MFCL) every 5-10 years to monitor the performance of the MP (albacore and bluefin).
        - Surplus production models for tropicals may not be adequate due to selectivity changes. Often, these models have not converged. Start with empirical HCRs.
    2) Evaluate impact of HCR for bigeye in other stocks
    3) Develop multispecies HCRs

Draft agenda for the tropical tuna MSE project workshop

Date: 11-13 December

Location and venue: AZTI-Pasaia

Time: 09:00-17:00 daily

1. Welcome and introduction to the meeting and project (Gorka Merino)

    a) Objectives of the project
    b) Review of tasks, progress and deliverables

2. Introduction to FLBEIA and applicability to topical tuna fisheries (Dorleta García)

3. Operating Models and main sources of uncertainty for the three tropical stocks considered (bigeye, yellowfin and East Atlantic skipjack)

    a) Stock Synthesis for East Atlantic skipjack (William Harford)
    b) Conditioning the three stocks in FLBEIA (Agurtzane Urtizberea)

4. Observation Error Model: Options (Agurtzane Urtizberea)

5. Management Procedures: Options for single-multispecific management (Agurtzane Urtizberea)

6. Prospects for the MSE research for ICCAT tropical tunas, next steps for this project (Gorka Merino)

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List of presentations

A multi-stock harvest control rule to support a consistent management along stocks in the framework of fishing mortality ranges	García, D.
A multi-stock harvest control rule as a step towards an ecosystem based fisheries management	Garcia, D., Prellezo, R., Urtizberea, A., Sanchez, S.
Towards an operating model for skipjack tuna	Harford, W.
Conditioning the Operating Models of a multispecific model for tropical tuna fisheries in a MSE framework	Urtizberea, A., Merino, G., García, D., Korta, M., Harford, W., Die, D., Walter, J., Gaertner, D., Santiago, J., Murua H.
Management Procedure options for a MSE in tropical fisheries	Urtizberea, A., Merino, G., García, D., Korta, M., Harford, W., Die, D., Walter, J., Gaertner, D., Santiago, J., Murua H.
Operating Error Model for tropical tuna Fisheries in a MSE framework	Urtizberea, A., Merino, G., García, D., Korta, M., Harford, W., Die, D., Walter, J., Gaertner, D., Santiago, J., Murua H.