Report of the 1st Meeting of Core Modelling Group

1-4 December 2014,

ICCAT Secretariat, Calle Corazón de Maria 8, 28002 Madrid, Spain

1. **Opening of the meeting (CD)**

Dr Davies, Chair and MSE Coordinator, opened the meeting and welcomed participants to the first meeting of the BFT Modelling and MSE Group.

Apologies were received from:

* Dr. Clay Porch, Rapporteur W-BFT,
* Dr. Sylvain Bonhommeau, Rapporteur E-BFT,
* Dr. Polina Levontin, independent expert in risk assessment, Imperial College,
* Dr. Rich Hillary, independent expert in stock assessment and MSE, CSIRO,
* Prof. Doug Butterworth, University of Capetown

who were not able to attend the meeting.

The list of participants is attached in Annex 1

1. **Confirmation of agenda (CD)**

The agenda was accepted as circulated (Annex 2).

1. **Nomination of Rapporteur(s) (CD)**

Rapporteurs were appointed as follows

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| Rapporteurs | Item |
| Antonio Di Natale | Update on progress and funding decisions for GBYP |
| Campbell Davies | Relevant outcomes of SCRS and Commission meeting; Overview of draft modelling and MSE work program; Revision of modelling and MSE work program. |
| Tom Carruthers | Review of deliverables from current MSE modelling contract |
| Laurie Kell | Review or previous and current GBYP and ICCAT activities on modelling and MSE; Engagement strategy for BFT-SpG, SCRS & Commission |
| David Die, Haritz Arrizabalaga, Yukio Takeuchi | Review of stock assessment requirements and work plan 2015-2016 |
| Paul De Bruyn | Data collation requirements |

1. **Relevant outcomes from 2014 Annual meeting of Commission**

The report from the 2014 Commission meeting was not available at the time of the meeting. However, Dr. Pillarès provided an overview of the items of relevance to the Modelling Group.

These included:

* The agreed recommendations for eastern (14-04) and western (14-05) BFT, which included TAC increases for both stocks.
* The high priority the Commission placed on the completion of the MSE work program and development of new and/or improved assessment methods for BFT, in particular to inform advice in 2016.
* Identification of important uncertainties in state and productivity of the two stocks, including: the form of the stock-recruitment relationship for both stocks, population structure and connectivity among East and West management units, and the nature of the relationship between stock abundance and the available abundance indices (i.e. CPUE). The respective recommendations request that the SCRS provide advice on the sensitivity of the current and 2016 advice to these uncertainties via MSE.
* Re-iterate quantitative objectives for the rebuilding plans of the respective stocks, including desired levels of performance and the need to revisit these in light of the 2016 assessment and, possibly, the MSE.
* Request the SCRS advice on: i) what constitutes a “serious threat of stock collapse” and ii) the potential utility of time-area closures in the management of the bluefin spawning stocks.

The Group thanked Dr. Pillarès for her summary, noting that the outcomes of the Commission provided considerable guidance for the Modelling and MSE work program. The specifics of the relevant Commission and SCRS outcomes as they related to the Modelling and MSE work program were revisited in detail under item 9.

1. **Update on progress, current status and funding of ICCAT GBYP**

The GBYP coordinator provided an overview of progress of the relevant ICCAT GBYP activities, which can be useful for the development of MSE. The full and detailed description of the updated GBYP activities is on the document SCRS/2014/051.

The Group was informed about the data mining and data recovery activities, specifying the data that are already quality checked, controlled and included in the ICCAT BFT database. The trade, auction and market data sets are now validated and should be included in the ICCAT BFT database as soon as possible, after setting a proper format in the ICCAT data base. These data are available for SCRS uses, and the few ancient trap data sets obtained in the last part of Phase 4 are still to be checked and are likely to form only a small part of the historical Task I series, dating from 1512, is already available.

The group reviewed the summary of data collected by the three GBYP aerial surveys on spawners and the plan for future aerial surveys under Phase 5. The Group was advised about the tagging activities (both conventional and electronic) and the initial results about evidence of mixing both between the east and the west and within the Mediterranean. The results of the biological work were also presented, including the preliminary results of the genetic and microchemistry analyses, showing the possible presence of multiple populations and the variable W/E mixing in some areas with relevant inter-annual variability.

The group discussed the available sources of evidence of bluefin tuna movements in different parts of the ICCAT area which were assembled by GBYP in the first four Phases and which could be considered in the MSE development. This discussion was picked up in the review of the work program, in particular the proposed workshop to review in detail alternative hypotheses for population structure and connectivity and the priority for a comprehensive analysis of the individual and combined sources of information available through the GBYP and various related national research initiatives (see Table 1 of revised work program and task description for analysis and workshop).

1. **Overview of draft Work Program for Stock Assessment and Management Strategy Evaluation for Bluefin Tuna**

The Modelling and MSE Coordinator provided an introduction and overview of the draft work program. The draft circulated to the Group (Davies, 2014) had been updated for the outcomes of the SCRS meeting, but not the Commission. The Coordinator recalled the objectives for Modelling and MSE component of the GBYP:

1. Collate, manage and synthesise new data and information collected through GBYP Program and other appropriate sources;
2. Facilitate consultation and capacity building on Reference Points, Harvest Strategies and MSE for Bluefin for the SCRS and Commission;
3. Develop, document and maintain an integrated MSE modelling platform for:
   1. Examining the relative plausibility of alternative hypotheses about the population structure and dynamics of BFT and fisheries;
   2. Developing and testing new stock assessment approaches;
   3. Evaluating alternative harvest strategies and reference points, and;
   4. Building capacity and understanding of the role of reference points, harvest strategies and MSE in the fisheries monitoring, assessment and management system.
4. Facilitate the evaluation, selection and adoption of harvest strategies for bluefin that meet the objectives of ICCAT, as specified by the SCRS and Commission.

That the work program has been structured in five components:

1. Data collation, management and synthesis
2. Review and selection of alternative stock assessment models
3. Development of MSE modeling platform
4. Capacity building in Harvest Strategies, Reference Points and MSE (see: <http://iccat.int/Documents/Meetings/Docs/2014-SWGSM_ENG.pdf> )
5. Consultation and engagement in design and evaluation of Harvest Strategies.

The Core Modelling Group has been convened to provide expert advice and guidance on the development and implementation of the work program and to assist the implementation of the program through the BFT Species Group, SCRS and Commission, as appropriate.

The Group reviewed the Terms of Reference and name of the group previously approved by the GBYP Steering Committee. The group considered that the TORs as drafted were appropriate, although it was noted that the current title and the fact that participation in this 1st meeting of the Group was restricted to members and *ex-officio* participants had raised concerns that participation in future meetings of the group may be to narrow, and that this was undesirable in the context of transparency and the capacity building objectives of the process.

The Chair clarified that this was not the intention; the limited participation in this first meeting of the Group was to facilitate the focused technical discussions required to refine and finalise the work-program and consider the role of the Group and its relationship with the BFT Species Group and SCRS and other working groups more generally.

It was agreed that:

* future meetings and activities of the Group will generally be open to participants in the BFT Modelling and MSE work program;
* the group shall be retitled “GBYP Modelling and MSE Group”; and
* the secondary role of the group and the BFT Modelling and MSE work program in contributing to broader capacity development in stock assessment, reference points, HCR and MSE across ICCAT will be promulgated through the SCRS and relevant working groups by the SCRS Chair and Rapporteurs.

The Group re-affirmed the objectives and proposed structure of the work program and Terms of Reference for the operation of the GBYP Modelling and MSE Group and recommended the name of the Group be revised as proposed to emphasise it’s open, inclusive and transparent operation.

1. **Presentation of the initial deliverables under the Modelling Contract 2014-2**

GBYP 2014-2 includes three principal deliverables:

*(1) A design document that details an object orientated (OO) design with code based on C++ and/or S4 classes for i) a multi-population OM that can be conditioned on a variety of data sets and hypotheses and ii) an Observation Error Model (OEM) that can be used to evaluate different data collection regimes e.g. aerial survey, tagging programs, catch and catch per unit effort (CPUE) and size to age conversions.*

To address this deliverable, Report 1 of the contract includes a full description of the preliminary MSE framework including diagrammatic representations of the relationship of objects, the definition of these classes and their related methods (See XX GBYP\Modelling and MSE).

*(2) Summary of alternative management procedures including alternative stock estimation procedures with coding requirements and appropriate code, libraries and packages. For example there are a variety of stock assessment methods already coded up and these may need modification to be used within a common MSE framework or adapted to use GBYP data and BFT stock assessment assumptions.*

In collaboration with the MSE Modelling Group a simulation evaluation study was carried out on a total of 26 potential management procedures. The approach and results have been summarized in a draft peer-reviewed paper that was made available for the meeting (Carruthers et al 2014b).

*(3) MSE demonstrator for use with stakeholders to illustrate the impact of uncertainty on management objectives and collaboration on a manuscript describing these results.*

A streamlined demonstration of the preliminary BFT MSE was made available to the group including the fully specified Bayesian belief network for dynamic investigation of the preliminary MSE results. All code for the MSE framework was shared with the group and is available for the GBYP Modelling and MSE program. The group discussed the relative merits of software for communicating MSE concepts and results to wider audiences. While Bayesian Belief Networks (BBN) may be suitable for other scientists or more technically oriented stakeholders they may not necessarily be appropriate for Commission members and other higher-level decision makers.

Other potentially suitable tools include ‘shiny’, which is an online presentation tool used by the International Pacific Halibut Commission to explore MSE outputs, and/or further development of the presentation approaches developed as part of the previous risk and uncertainty perception (Leach *et al*., 2014). The group noted that there was a general need for presentation and communication approaches for science and non-technical audiences as part of the MSE, reference points and HCR processes running across multiple RFMOs and that there would be both capacity building and process efficiencies. It was agreed that this should be recommended as an agenda item for the proposed meeting of the MSE technical advisory group associated with the GEF-FAO-WWF sustainable tuna ABNJ currently planned for the middle of 2015.

Dr. Kell presented preliminary results of simulation testing of assessment models as a basis for understanding the behaviour and estimation properties of statistical models that might be considered for use in a Management Procedure (MP) or Harvest Strategy (HS). This test case explored the mismatch in assumptions between data simulated from an age-structured model, with an implied production function that is asymmetrical, and a biomass dynamic model with symmetrical production function. The mismatch in assumptions only biased estimation by the “assessment model” for certain target exploitation rates and was largely independent of the choice of harvest control rule. This simple example clearly demonstrates that the interaction between “truth”, sampling error and the structural assumptions of an “assessment model” used in an MP can be subtle and counter-intuitive. This underscores the value of using simulation testing to explore the statistical properties of candidate “assessment models” for inclusion in management procedures. This work will be completed by Kell, Kimoto et al., and published in 2015 (see Kell *et al*., 2015)

Cross-validation (also known as retrospective testing) was noted as an alternative approach to simulation testing assessment approaches that might be considered for use in MPs, or as alternatives to the current VPA assessment used for BFT. This involves sequentially removing historical data and the re-running the assessment model to test its ability to predict the data that has been removed. This approach may be a useful preliminary test of candidate assessment methods for BFT because it is simple, transparent and based on real data that familiar to scientists working on BFT and is less time and resource intensive than full simulation evaluation.

Dr. Kell initiated a discussion on the graphical representation of MP performance using plot from Kell *et al*. (2014, ‘Exorcising the Spectre...’) as a straw man example. The multiple panel plot allows users to compare results from multiple assessment models, reference points and/or management procedures that satisfy a particular level of performance for multiple performance metrics. In the approach precented, each alternative was equally weighted. The group agreed that model weighting is a central step in the MP evaluation process and a substantive, in-principle discussion is required to scope out and agree a process and consider the details of alternative technical methods for the BFT MSE.

The group discussed future developments of the MSE modelling framework for 2015. The group considered the identification and selection of a range of “assessment models” and associated data that were considered most likely to be used in model-based/empirical MPs in the short term to be a high priority.While there are a range of potential candidates, including current and previous approaches used for BFT (e.g. extended survivorship analysis (XSA), virtual population analysis, statistical catch-at-age assessment, statistical catch-at-length assessment, spatial surplus production models and spatial delay-difference models) it was noted that a) not all would be suitable for inclusion in MPs and c) it would not be possible to evaluate them all by MSE within the time and resources available before the scheduled advice to the Commission in 2016. It was noted that the draft work program included a workshop, either associated with or shortly after the scheduled BFT data meeting in 2015, to identify candidate assessment approaches, agree on the testing criteria and ensure that the required data sets would be available for the MSE work program. The current rules for inclusion of new software in the ICCAT software catalogue was agreed as an appropriate basis for candidate assessment models for inclusion in MPs.

The other high priority deliverables that were identified were:

* the development of a spatial operating model that can be empirically fitted to the range of fishery, tagging and genetics and otolith micro-constituent data that are available for BFT, or are likely to become available within the duration of the current work program; and
* confirmation of the methods for raising of catch composition data to the total catch-at-age dataset required by virtual population analyses and extended survivorship analyses.

The group agreed that imputation approaches developed for tropical tunas under previous contract (Carruthers XX, 2012) should be investigated in the context of BFT in order to understand the impact on assessments and to better characterize observation models for such data for data generation in operating models.

The group thanked Dr. Carruthers for his presentation and work delivered through GBYP 2014-2. This represents a substantial contribution to the tools available for the BFT modelling and MSE program for evaluation of assessment approaches and development and testing of harvest strategies and reference points. The group also complimented Dr. Carruthers on the thoroughness of the documentation and examples provided with the code, which would be of considerable assistance to other users. In this regard, the group noted that while these MSE tools have been developed under GBYP, their generic and flexible nature means that can be readily apply to other species and stocks and, as such, will assist in advancing the HS, reference point and MSE work program across ICCAT more generally.

1. **Review of previous work under GBYP Modelling and MSE**

There are a few projects relevant to MSE that have been conducted to support western BFT assessments and management. John Walter (NMFS) and Mark Maunder (IATTC) are collaborating to apply the MSE approach developed for Pacific Albacore (Maunder, 2014), which uses two linked SS3 models for Atlantic BFT. Lisa Kerr and Steve Cadrin are working with Nathan Taylor's MAST model to serve as an operating model for an MSE as well (Kerr *et al*., 2012; Kerr *et al*., 2014; Galuardi *et al*., 2014) and have a proposal to the 2014 NSF round to extend this work.

A new candidate for an alternative modeling approach for BFT stock assessments, based on applying Statistical-Catch-At-Length (SCAL) (Butterworth and Rademeyer, 2014a, 2014b, 2014c), was presented at the 2014 stock assessment of the Western and Eastern stocks of BFT. The SCAL model could also be considered as a candidate for an operating model for a MSE. Prof. Butterworth has advised the group (through the Chair) that they intend continuing the refinements of these models for the consideration in the 2016 assessment and use as an operating model for evaluation of MPs as part of the MSE program. The Chair also noted, that Prof. Butterworth has commented that he considered empirical harvest control rules likely to be more appropriate for BFT than model-based MPs, but this would be determined through MSE testing of potential candidates.

US scientists from NMFS (John Walter, Matt Loretta), VIMS (Jan McDowell, John Graves) and University of New Hampshire (Molly Lutcavage) are collaborating with CSIRO scientists (Campbell Davies, Peter Grewe and Mark Bravington) on a pilot project to determine the design of an application of the Close-kin Mark Recapture (CKMR) to assessment of BFT, in the first instance to the Western stock. This approach has been successfully applied to Southern Bluefin tuna (Bravington *et al*., 2014) to the extent it is being considered for long-term monitoring of the stock. It is expected that if this approach is successful for western BFT it will provide the first estimates of spawning stock abundance that are independent of fishery data. The group considered it may be important to use an MSE approach to evaluate the value of such new method to management of BFT.

1. **Review and detailed discussion of tasks for stock assessment modelling and MSE 2015-2016**
   1. Overview and proposed priorities given 2014 Commission decisions

The Group reviewed the draft detailed work program provided in Table 1 of Davies, 2014, in light of the relevant reported outcomes of the Commission, the status of the GBYP and the work completed to date under the Modelling and MSE program.

The Group noted:

* The outcomes and deliverables achieved to date under the GBYP Modelling and MSE program to date, in particular, the deliverables provided through project 2014-2 men that the program is well placed to complete delivery of the operating models, candidate management procedures and new assessment approach 9es) required to improve the scientific basis for advice on bluefin tuna.
* That while this program was focussed on bluefin, the flexible nature or the tools and comprehensive review of harvest control rules drawn from a range of tropical and temperate tunas and other stocks, means that the tools, capacity and knowledge developed through this GBYP program would be of great value to the wider reference points, harvest control rules and implementation of the Precautionary approach in ICCAT more generally.
* The request for new stock status and management advice in 2016 would place considerable strain on available stock assessment and modelling capacity among the CPCs. Hence, the dedicated coordination, advice and technical support of the MSE Coordinator and Expert Technical Assistant would be essential in meeting the requests of the Commission and the objectives of the program. Continuity of expertise was considered a high priority to maintain current *momentum* and meet the timelines requested by the Commission.
* The expectation of “new data” and “new modelling approaches” to inform SCRS advice to the Commission in 2016 (14-04 and 14-05) and 2017 (14-04) means confirming and addressing the priority data collation tasks for the March 2015 BFT data preparatory meeting and consolidation and analysis of the available tagging, Genetics and micro-constituent data were a high priority and urgent task for 2015.
* The important of engaging the wider BFT Species Group and SCRS in the work program and delivery of essential tasks as soon as possible.
* To the extent possible, meetings of the Modelling and MSE Group should be scheduled to coincide with existing meetings (e.g. Species Groups, Methods Working Group) and/or larger workshops to minimise additional travel costs and increase the opportunity for participation and capacity building for CPC scientists.
* It was important for transparency and acceptability of the final outcomes that the dedicated technical workshops were open to participation of external experts and scientists with particular expertise in bluefin biology and ecology and design and evaluation of management strategies.
* The desirability of initiating regular dialogues with commissioners, scientific advisors, industry, NGOs and others interested parties on reference points, harvest control rules and MSE from early in the process to build understanding, confidence and engagement in the development and evaluation process.
* The SWG-SM was the natural forum for engaging in this more informal dialogue, assuming this is considered appropriate by the Commission and the Chair of the SWG-SM.
  1. Testing and evaluation of alternative assessment approaches for 2016 BFT Assessment

The current assessment for BFT is done with a VPA approach. Other assessments methods that have been used include SCAL, iScam and SS3 for the eastern stock. In addition, a biomass dynamics approach has recently been developed for the western stock. A variety of alternative management procedures are available for consideration for BFT (e.g. Carruthers *et al*., 2014). As noted by the group above, not all of these are likely to be appropriate for use as “assessment models’ in MPs and not all have been tested in to determine whether they meet the requirements of the ICCAT software catalogue.

There is a range of related aims that can be addressed through simulation modelling using a operating models, including testing the statistical properties and predictive abilities of assessment models, evaluation of reference points, harvest control rules and management procedures. Kell *et al*., 2006, for example, used the current (at the time) stock assessment model to test its ability to estimate the population parameters using data generated by the same population model. While the use of the assessment model as the operating model seems to imply that the assessment model describes the underlying reality almost perfectly, if an assessment model cannot perform well when the underlying reality is effectively identical to itself (i.e no model/structural uncertainty), it is unlikely to perform adequately for more comprehensive representations of the uncertainty. Kimoto, Kell and others are working on the four assessment methods prepared for the 2014 BFT assessment update to examine in more detail why they provide different results and to determine the extent to which they could be used as alternative operating models for the BFT MSE.

The other extreme is when the emphasis is on expert beliefs and other *a priori* information about the processes that may affect the behaviour of management systems in the future (i.e. the focus is on the future, not on fitting historical data). This is a less data-, and more hypothesis-orientated approach.

For example, climatic change studies may show that a regime shift is possible (even though one has never been seen in the historical data sets) and should be taken into account when selecting ways to provide management advice (e.g. Ravier and Fromentin, 2001; Dufour *et al*., 2010; Fromentin *et al*., 2010, 2013). Alternatively management has resulted in past fisheries data being unreliable and unrecoverable. It is important therefore that OMs are flexible so that they can deal with such factors.

* 1. Review of current status and ongoing work

The Secretariat made an extensive summary of a variety of modelling tasks completed so far. Prior to the GBYP several peer review papers related to bluefin MSE have been published (e.g. Kell *et al*., 2003) and the evaluation of the robustness of maximum sustainable yield based management strategies to variations in carrying capacity and migration pattern for bluefin (Kell and Fromentin, 2007; Fromentin and Kell, 2007).

Under phases II, III and IV of the GBYP, additional progress was made in support of the MSE process, with SCRS and peer review papers published and proposed. These include Risk Analysis, example MSEs, development of Operating Models (OMs) Observation Error Models (OEMs) and Management Procedures (MPs). SCRS papers have also been written on diagnostics and presentation of advice and software has been developed in R (e.g. Kell et al., 2007). An example MSE based on the CCSBT Harvest Control Rule (HCR) has also been evaluated Kell et al. (2014). This will aid in developing and running the MSE. Most of the assessment tasks for bluefin have already automated using R scripts. All software and code will be open source and made available on the ICCAT cloud server.

A review of historical uncertainty (Fromentin *et al*., 2014) and a qualitative Risk Assessment have been conducted with members of the SCRS and the Commission (Leach *et al*., 2014). Following these papers a quantitative analysis (Kell, 2014b) was used to identify the main sources of uncertainty that could be developed for the Operating Model and ways of weighting then proposed (Levontin *et al*., 2014).

The secretariat also identified work in progress, including elasticity analysis, a review of population hypotheses and stock assumptions, alternative management procedures, cross-validation of stock assessment methods and the use of PID control systems.

A summary of the t-RFMO MSE working group was also provided. A variety of related activities are being conducted under the tRFM-MSE WG, e.g. the Review of Kobe Strategy Matrix, comparative studies (e.g. across species or across RFMOs), MSE-lite, Communication, Code sharing repositories, Parallel Computing, and developing Glossary of terms and bibliography repository. It is proposed to have a meeting in the 2nd-3rd quarter of 2015, under the GEF ABNJ umbrella to agree future activities. Activities under GEF are aimed to build capacity amongst stakeholder groups, while that of the tRFMO-MSE group is to build capacity with tRFMO scientific committees. Additional intra-regional collaboration is also being developed, as agreed under the Strategic Plan, for example on Social Economics factors as required by the SWGSM Standing Working Group on Science and Managers), with ICES and EU.

* 1. Considerations for Modelling and MSE in context of 2016 BFT stock assessment

The next eastern Atlantic Bluefin tuna stock assessment is scheduled in 2016. This assessment is scheduled to be a new (not just an update) assessment, incorporating new information and improved assessment approaches as well as updated fishery data. The Atlantic-wide Research Program for Bluefin tuna (GBYP) and various National programs have produced a wide range of new information on the biology and fisheries for bluefin tuna. This information was reviewed in the 2014 BFT data preparatory meeting, aiming to incorporate the new fishery information in ICCAT databases as well as introducing some new pre-analysis and assessment modelling approaches. However, it was evident during the 2014 assessment that some of the available data has yet to be fully processed and reviewed, and the proposed modelling frameworks are not yet fully developed or tested.

Additional progress will be evaluated during the 2015 Data preparatory meeting. The main data issues for that meeting are related to the revision of Task II data by validating and integrating the catch at size statistics with new information from farms, both data during harvesting as well as that coming through the stereo-video cameras, as well as other sources of information.

Additional tasks to be achieved during the 2015 data preparatory meeting are to review past and recent tagging data, review progress on developing age-length keys, and review progress on life history studies such as maturity and fecundity schedules, stock structure and mixing rates (using otolith microchemistry, genetics, electronic tagging etc.). The Modelling group considered it would be important, as part of the agenda of the data preparatory meeting, to include an item on the development and testing of new assessment approaches being considered for use in the 2016 assessment. The Group recommended this include two components:

* The assessment methods to be considered for use in 2016 and appropriate criteria for determining their suitability for use an assessment models in 2016; and
* Consideration of a process for comparative evaluation of the alternative methods and how this may be completed as part of the longer term work program beyond the immediate need for assessment advice in 2016.

During the species group meetings, the Bluefin working group is expected to update fishery indicators (i.e. catch rates), as well respond to Commission requests as in the 2014 Commission report (not available at the time of drafting this report).

During the last couple of years, several alternative modelling approaches have been developed, including SCAL, iScam and SS. These approaches are expected to further be developed during 2015-2016 and considered for use in the 2016 assessment. The group, following earlier recommendations from the WGSAM, noted the need to validate and catalogue any new software used to evaluate stocks. Recommended approaches for validation of assessment methods include those of considered at SISAM (Deroba et al. 2014), cross-validation and simulation evaluation using an Operating Model, as recommended in the draft Modelling and MSE work program. The group noted, however, that simulation evaluation was resource and time intensive and that it would not be possible to complete such a detailed evaluation prior to 2016.

The group noted that these alternative assessment approaches could be useful for conditioning OMs in the MSE framework developed by Dr. Carruthers. However, the current methods/codes are likely to require additional refinement in order to run reliably in a simulation context and to provide more realistic representations of dynamics and uncertainty. Additional considerations include: complex subpopulation structure, temporal shifts in targeting and biological features and/or environmental influences on BFT population dynamics (e.g. Fromentin *et al*., 2014; Arrizabalaga *et al*., 2014).

The Group recommended that it would be necessary for proponents/developers of alternative approaches to provide the code and data and parameter inputs to the Expert MSE Technical Assistant so that the code could be refined and optimised for inclusion in the MSE modelling platform. This would ensure consistency and transparency of approach and provide a platform for consistent testing and comparison of assessment methods proposed for use in harvest strategies/management procedures. This was considered a priority task that should be completed by the Expert MSE Technical assistant in 2015 for consideration at the 2015 meeting of the BFT Species Group. This would require attendance by the Expert MSE Assistant at the 2015 BFT Data Preparatory meeting to ensure that the data required for likely candidates was going to be available and in the form required for evaluation.

Finally, during the last decades, within the GBYP and other national and international research programs, important amounts of new biological information has been generated, especially on population structure and mixing (e.g. see the report of the meeting on Biological parameters in Tenerife, 2013). This information is especially valuable to inform the development and specification of alternative hypotheses and scenarios for the MSE process, in particular to parameterize plausible population structure and mixing hypotheses.

As the new data and hypotheses are based on different sources of data and methodologies (e.g. electronic tagging, microchemistry, genetics…) and in many cases the raw data is not held by ICCAT, the Modelling group recommended that consolidated analyses be conducted through a coordinated project (in 2015) and workshop in late 2015 or early 2016. The objectives of such a task and dedicated workshop would be to confirm the plausible hypotheses to be used in MSE, as discussed in the 2013 Tenerife meeting, parameterize the spatial structure and connectivity in the MSE operating models, and engage the wider scientific community in the BFT Modelling and MSE process. The group agreed that, while analysis based on the primary datasets is desirable, it may be difficult to reach agreement on data sharing and analysis arrangements. A default postion in the case that data access can not be achieved would be for the Group to request specific and simple queries on estimated transition probabilities from the relevant research groups. This may be sufficient to start parameterize the spatial structure and mixing hypotheses in the OM for the MSE in the short-term.

The Group recommended that the Chair of the GBYP Modelling and MSE Group contact each of the relevant research groups and invite them to participate in the development of the OMs through the provision of data, analysis results and participation in the planned proposed workshop. This should be done as early in 2015 as possible in order to provide sufficient time for analyses of the new data and organization of the workshop in late 2015-early 2016.

1. **Detailed review and refinement of work program for evaluation of management frameworks**

The results of the detailed review of the work program are given in Table 1.

The recommended meetings to be attended by the MSE and Modelling Coordinator and MSE Expert Technical Assistant are:

1. ICCAT Methods Working Group meeting: 16-20 February 2015. Campbell Davies (MSE and Modelling Coordinator) to potentially attend in conjunction with Tuna ABNJ meeting in Panama.
2. ICCAT BFT data preparatory meeting: 2-6 March 2015. Tom Carruthers (Expert MSE Technical Assistant) to attend.
3. ICCAT Species Group meetings: 23-25 September 2015. Campbell Davies (MSE and Modelling Coordinator) to attend. Need for Expert MSE Technical Assistant to attend to be confirmed, pending outcomes of Data Preparatory meeting
4. Population structure and connectivity work shop with 2nd GBYP MSE and Modelling Group meeting. December 2015/January 2016. Both Campbell Davies (MSE and Modelling Coordinator) and Tom Carruthers (Expert MSE Technical Assistant) to attend.
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**Table 1. Draft Budget for BFT MSE work program 2014-2018.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **LEAD** | **Item/Activity** | **Indicative Budget** |
| **2014** | MSE – Coordinator | i) Review work program; ii) Convene Core Modelling Group (CMG); iii) Develop revised Modelling and MSE program. | 34,000 |
|  | MSE – Tech Expert | i) Preliminary scoping and coding of Operating Model; ii) Review and evaluation of potential harvest control rules iii) MSE *Geni* demonstrator model. See Carruthers et al 2014a. | 53,500 |
|  | MSE – Coordinator | CMG Meeting 1 - Review MSE modeling platform, SCRS & Commission outcomes, MSE demonstrator, HCR review and general MSE progress and refine detailed work program (1-4 December, Madrid). See terms of reference CMG. | 7,5000 |
|  | MSE – Tech Expert | Paper: Preliminary evaluation of performance of range of HCR for BFT. See Carruthers et al 2014b. |  |
|  |  |  | **95,000** |
| **2015** | ICCAT - GBYP | MSE & Modelling Coordinator Contract (0.2 FTE). See terms of reference 1. | 52,000/yr[[1]](#footnote-1) |
|  | ICCAT – GBYP | MSE Tech Expert Contract (1.0 FTE) . See terms of reference 2. | 125,000/yr[[2]](#footnote-2) |
|  | MSE Coordinator | In cooperation with GBYP Coordinator, coordinate collation and analysis of electronic tag data for parameterization of population structure and connectivity hypotheses.  See TORs for analysis project |  |
|  | Pop Dyn Expert | Glossary for technical terminology associated with Precautionary approach, MSE, HCR and Reference Pts.  Paper to Methods Working Group meeting. See terms of reference X. |  |
|  | SCRS Chair/Pop Dyn Expert | Stock Assessment Methods Working Group meeting (16-20 February, Miami).  i) Communicating BFT Modelling and MSE work program; contribution to wider MSE, HCR and Ref Pts program across ICCAT.  BFT Modelling Coord to attend. Part travel costs met by ABNJ capacity building project | 1000  MMC attendance |
|  | MSE Coordinator | MSE Tech Expert Tasks – Dec 2014-Mar 2015   1. Incorporation of candidate assessment methods in MSE modeling platform 2. Effects of data imputation on assessment uncertainty. 3. Papers for consideration at BFT Data preparation meeting. See Task X1 |  |
|  | SCRS Chair/Pop Dyn Expert | BFT Data Preparatory meeting 2-6 March, France – MSE Tech Expert to attend  Papers and presentations on assessment and imputation; technical contributions to development of specific tasks associated with evaluation and selection of candidate assessment methods for 2016. | 2,500 |
|  | SCRS Chair/Pop Dyn Expert/BFT Rapp | BFT Species Group meeting and SCRS – X-X September, Madrid   1. Update on progress with Modelling and MSE Program (SCRS Chair). 2. Pop Dyn Expert papers on cross-validation methods for stock assessment (see Kell et al XX). 3. Final papers on: data imputation; Precautionary Approach, Ref points and MSE; simulation evaluation of assessment methods for BFT (MSE Tech Expert; MSE Coord).   Attendance of MSE Coord contingent on final agenda and outcomes of BFT Data prep and SWG-SM: default is non-attendance. | 2,500  (5,000 for MMC) |
|  | MSE Coordinator | MSE Modelling Workshop – Seattle/Glouster/Miami/Madrid? – early December 2015.   1. Population structure and movement for operating modeling and MSE 2. Results of comprehensive analysis of population structure and connectivity project. 3. Invited papers and presentations.   Attendance by 1 invited expert in spatial population modelling. See draft scope and agenda 3. | 30,000 |
|  | MSE Coordinator | BFT-MMSE Meeting 2 – As per workshop, early December 2015, (One day prior and 1-2 days post workshop.)   1. Review OM population structure, connectivity and fishery structures; 2. Review proposed approach to conditioning spatial MSE operating models. | Included in workshop budget |
|  |  |  | **213,000** |
| **2016** | ICCAT - GBYP | MSE & Modelling Coordinator Contract (0.3 FTE) – 2016 | 78,000/yr |
|  | ICCAT – GBYP | MSE Tech Expert Contract (1.0 FTE) – 2016 | 125,000 |
|  | BFT Rapp | BFT Data Preparatory meeting for 2016 Assessment.  MSE Tech Expert to attend. MSE Coordinator TBC.   1. Papers and presentation on preliminary conditioning of OMs, and; 2. Evaluation of implications of current assessment assumptions and management objectives for consideration in context of 2016 assessment process. 3. Preliminary consideration of criteria “serious threat of fishery collapse” | 5,000 |
|  | SCRS Chair | Standing Working Group on Science and Management, date and location TCB   1. Participation in SWG-SM by Modeling coordinator.ii) 2. Facilitated session on objectives and performance measures based on outcomes of work presented at Data preparatory meeting. | 5,000 |
|  | SCRS Chair | BFT Species Group meeting, X-X September, Madrid  MSE Coord and Tech Expert participation,   1. Presentations 2. Particpate in assessment review and present update on MSE program, in particular relative performance of alternative assessment approaches, and; 3. Present and facilitate discussion on updated conditioning of OMs for MSE work in 2017. | 12,500 |
|  | MSE Coordinator | MSE Modelling Workshop – (Bilbao? – late Nov/Early Dec).   1. Review of conditioning of OM, including population and fishery structure and mixing hypotheses; 2. Initial consideration of candidate Harvest Strategies. 3. Initial selection of reference set and Robustness tests for MSE based on outcomes of 2016 assessment process and Population structure and Connectivity workshop outcomes. | 30,000 |
|  | MSE Coordinator | BFT-MMSE Meeting 3 - Review OM conditioning, candidate HCR and potential objectives and performance measures from SWGSM/Commission; (In conjunction with MSE modeling workshop) |  |
|  |  |  | **255,500** |
| **2017** | ICCAT - GBYP | MSE & Modelling Coordinator Contract (0.2 FTE) – 2017 | 55,000/yr |
|  | ICCAT – GBYP | MSE Tech Expert Contract (0.6 FTE) – 2017 | 75,000 |
|  | ICCAT – GBYP/MSE Coord | Participation in SWG-SM ( Mar?, location TBC)   1. Session on OM with performance of alternative harvest strategies and assumptions/hypotheses 2. Facilitated discussion for refinement objectives, performance measures and operational requirements for final evaluation of candidate harvest strategies | 7,500 |
|  | MSE Coordinator | MSE Modelling Workshop – Review of final conditioning of OM and selection of final harvest strategies based on Commission guidance on objectives and performance measures (TBC- Apr). | 30,000 |
|  | MSE Coordinator | BFT-MMSE 4- Review OM conditioning, candidate harvest strategies and potential objectives and performance measures from SWGSM/Commission; (Sept, Madrid) |  |
|  | ICCAT – BFT Rapp | MSE Coord and Tech Expert participation, briefing for delegations and presentations to BFT Sp Gp and/or SCRS (Sept, Madrid) | 10,000 |
|  |  |  | **177,500** |
| **2018** | ICCAT - GBYP | MSE & Modelling Coordinator Contract (0.2 FTE) – 2017 | 55,000/yr |
|  | ICCAT – GBYP | MSE Tech Expert Contract (0.6 FTE) – 2017 | 75,000 |
|  | MSE Coordinator | MSE Modelling Workshop – Final testing, selection and tuning of selected harvest strategy to Commission’s objectives (Morocco? - Apr). | 30,000 |
|  | ICCAT – BFT Rapp | MSE Coord and Tech Expert participation, briefing for delegations and presentations to BFT Sp Gp and/or SCRS (Sept, Madrid) | 10,000 |
|  | ICCAT – SCRS Chair | SCRS Chair and MSE Coord - Consultations and presentation to Commission of final recommendation for harvest strategy for BFT. | 5,000 |
|  | MSE Coordinator | BFT-MMSE Meeting 5 - early December, Madrid  Debrief and review meeting of BFT MSE & Modelling Group to document outcomes and lessons | 10,000 |
|  |  |  | **185,000** |

**Annex 1: Membership of GBYP Modelling and MSE Group and participants at 1st meeting, 1-4 December 2015, Madrid.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Position** | **Role** | **Attendance at 1st Meeting** |
| Campbell Davies | Consultant | Chair & Modelling and MSE Coordinator | Y |
| Polina Levontin | Independent Scientist | Member | N |
| Richard Hillary | Independent scientist | Member | N |
| Toshihide Kitakado | CPC MSE Expert | Member | Y |
| Yukio Takeuchi | CPC BFT assessment scientist | Member | Y |
| Haritz Arrizabalaga | CPC BFT assessment scientist | Member | Y |
| Doug Butterworth | CPC MSE Expert | Member | N |
| Tom Carruthers | Consultant | Expert MSE Technical Assistant | Y |
| Clay Porch | WBFT Rapporteur | Ex- Officio | N |
| Sylvain  Bonhommeau | EBFT Rapporteur | Ex- Officio | N |
| Laurie Kell | Population  Dynamics Specialist | Ex- Officio | Y |
| David Die | SCRS Chair | Ex- Officio | Y |
| Paul De Bruyn | Secretariat  Statistical Dept. | Ex-Officio | Y |
| Antonio Di Natale | GBYP Coordinator | Ex- Officio | Y |
| Pilar Pillarès | Scientific Coordinator | Ex- Officio | Y |

**Annex 2: Agenda for 1st Meeting of the GBYP Modelling and MSE Group**

**ICCAT GBYP Modelling and MSE Sub-Program**

1st Meeting of Core Modelling Group

1-4 December 2014,

ICCAT Secretariat, Calle Corazón de Maria 8, 28002 Madrid, Spain

Note: There is the option to start on the 1st and finish on the 4th if particpants can arrive arrive on the 30th Nov.

Draft Annotated Agenda

**Day 1, 1 December**

9:00 Welcome and Introductions (Campbell Davies, Modelling Coordinator)

9:05 Opening of meeting (Driss Meski, ICCAT Executive Secretary)

Priority of MSE process for Commission

Specific issues from the Commission for the CMG

9:15 Confirmation of agenda

Start and finish times

Group Dinner

Departure details

9:25 Nomination of Rapporteur(s)

1. Stock assessment
2. MP development
3. Data collation and synthesis
4. Engagement and capacity building
5. Collation and editing of final draft detailed work program (Davies)

9:30 Update on progress, current status and funding of ICCAT GBYP (Antonio Di Natale, GBYP Coordinator)

Summary of outcome of Commissions consideration and decisions on the GBYP in general and Modelling and MSE work program in particular.

Approved budget for 2015 and provisional budget for 2016-18

Priority deliverables for SCRS and Commission 2015-16.

Dates for meetings that have already been agreed.

10:00 Draft Work Program for Stock Assessment and Management Strategy Evaluation for Bluefin Tuna (Campbell Davies)

Short presentation and initial discussion of the draft work program and budget developed by Dr Davies in consultation with MSE Technical Assistant and Secretariat. See Table 1, Davies 2014, *Draft work plan for Management Strategy Evaluation for Atlantic Bluefin Tuna.*

The focus of this session is: i) the overall scope and structure of the work program; ii) whether there are any major missing elements; and, in particular the timing of essential elements and decision points (e.g. data cut offs, model structures and final conditioning of operating models/stock assessments).

A key consideration is the practical feasibility of developing and conditioning a multi-population assessment and/or operating models within the schedule requested by the Commission and reaching agreement on the final reference set of models. This issue, amongst others, will be picked up in throughout the meeting but, in particular detail on day 2 and 3 in the sessions on stock assessment, MSE and data synthesis and collation.

In addition, the group should reflect on the TORs and composition of the Core Modelling Group and whether there is the need to consider any refinements to its mandated purpose and operation going forward.

Output of this session is a list of substantive outstanding issues/details that need to be resolved at this meeting for the work program to be finalised.

11:00 Morning break

11:30 Presentation of the initial deliverables under the Modelling Contract 2014-2 (Tom Carruthers)

GBYP Tender 02/2014 – Modelling approaches to support BFT stock assessment appointed Dr Tom Carruthers (UBC, Canada) as the Expert MSE Technical Assistant to assist the Modelling and MSE Coordinator and complete three initial pieces of work to substantially advance the MSE modelling program: i) Development of flexible code and documentation for operating models; i) Review and code a range of alternative forms of management procedure/harvest control rules; and, iii) an MSE demonstrator model to facilitate understanding of purpose and concepts underpinning evaluation of alternative management approaches (i.e. MSE).

This and the following two sessions will review the draft outputs of this contract and provide feedback for their finalisation (as part of this contract) and further development (as part of the future work program). Outputs of this session will include: i) a set of topics/tasks for further detailed technical discussion and specification of resources and responsibilities (Day 3, morning Day 4) and ii) points of interaction/linkage with the stock assessment and population dynamics review to be picked up in Day 2.

* MSE simulation framework: Flexible object orientated code for operating and observation models

See Carruthers et al, Draft Final Report “Evaluating Management Strategies for Atlantic Bluefin Tuna” and the following link: <https://drive.google.com/folderview?id=0B0HYOP0BN5RPdUYxQzVFcDh3dUE&usp=sharing>

13:00 Lunch

14:30 Continuation of the presentation of deliverables (Tom Carruthers)

* Preliminary simulation testing of existing and new Harvest Control Rules

See Carruthers et al a, Draft Final Report *Evaluating Management Strategies for Atlantic Bluefin Tuna* and Carruthers et al b, Draft Manuscript *Performance Review of Simple Management Procedures*

* Potential use of Bayesian Belief networks for MSE demonstration

See Carruthers et al a, Draft Final Report *Evaluating Management Strategies for Atlantic Bluefin Tuna*

15:30 Afternoon break

16:00 Review of previous work under GBYP modelling contracts and tasks agreed at Gloucester 2013 (Laurie Kell)

* Risk assessment
* Review of updated separate assessment approaches
* Review of initial mixed stock models and refinement of alternative mixing structure scenarios
* Tool for visualizing movement
* Meeting including stakeholders (finalise at 2013 Commission meeting)

17:30 End Day 1

**Day 2, 2 December**

9:00 Opening of Day 2 and Recap from Day 1 (Campbell Davies)

9:10 Review and detailed discussion of tasks, schedule and resourcing of Stock Assessment Work Program (2015-2016) (Sylvain Bonhommeau)

11:00 Morning break

11:30 Review and detailed discussion of tasks, schedule and resourcing of Stock Assessment Work Program (2015-2016) in context of GBYP Modelling Program (Clay Porch)

13:00 Lunch

14:30 Data and synthesis requirements for Stock Assessments and MSE (Paul Debruyn?)

15:30 Afternoon break

16:00 Refinement of Draft Work Program - Stock Assessment (Laurie Kell & David Die)

17:30 End Day 2

**Day 3, 3 December**

9:00 Opening of Day 3 and Recap from Day 2 (Campbell Davies)

9:10 Review of steps required to conduct an MSE (Campbell Davies)

11:00 Morning break

11:30 Detailed review and update of Technical Workplan to accomplish MSE under GBYP (Tom Carruthers & Campbell Davies)

13:00 Lunch

14:30 Detailed review and update of proposed engagement strategy with SCRS, COMM and CPCs

* Building capacity (Technical and Understanding)
* Clarifying Harvest Control Rules, Harvest Strategies and Performance Measures
* Processes for specifying objectives and performance measures and eliciting trade-offs

15:30 Afternoon break

16:00 Refinement of Draft Work Program - MSE modelling and Engagement (Campbell Davies)

17:30 End Day 3

**Day 4, 4 December**

9:00 Opening of Day 4 and Recap from Day 3 (Campbell Davies)

9:10 Small group detailed discussions on each component of the work program and agreement on specific tasks and responsibilities:

* stock assessment and MSE modelling
* data collation and synthesis
* Capacity building and engagement

11:00 Morning break

11:30 Update, circulate and review revised work program and budget (Davies, Di Natale, Porch, Bonhommeau, Die, Kell) & small group discussions (others)

13:00 Lunch

14:30 Review and adopt revised detailed work program, including list of tasks and responsibilities

15:30 Afternoon break

16:00 Summary of outcomes, immediate tasks and next steps (Campbell Davies)

16:30 Meeting close

1. This would be the cost to ICCAT with 30% of full cost being met by CSIRO. [↑](#footnote-ref-1)
2. Expected cost per year for 2015 and 2016 based on EoI from T.Carruthers. [↑](#footnote-ref-2)