Indian Ocean Tuna Commission
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COMMON OCEANS

Report of the IOTC Management Procedure Dialogue

Colombo, Sri Lanka, 31st May, 2014.

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ACRONYMS

ABNJ	Areas Beyond National Jurisdiction
BET	Bigeye Tuna
BMSY	Biomass that achieves maximum sustainable yield
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CPCs	Contracting parties and cooperating non-contracting parties
CPUE	Catch per unit of effort
EU	European Union
EEZ	Exclusive Economic Zone
ENV	Environmental Effect
FAD	Fish-aggregating device
FAO	Food and Agriculture Organization of the United Nations
FMSY	Fishing mortality that achieves optimal yield.
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
IRD	Institut de recherche pour le dévelopement, France
IUU	Illegal Unreported Unregulated fisheries
IWC	International Whaling Commission
LL	Longline
MFCL	Multifan-CL
MPD	Management Procedure Dialogue
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
MSY	Maximum sustainable yield
OFCF	Overseas Fishery Cooperation Foundation of Japan
PL	Pole and Line
PS	Purse-seine
R	R Package for Statistical Computing
ROP	Regional Observer Programme
ROS	Regional Observer Scheme
SAS	Software for Analyzing Data
SC	Scientific Committee of the IOTC
STD	Standardized
tRFMO	tuna Regional Fishery Management Organization
VMS	Vessel Monitoring System
WP	Working Party of the IOTC
WPB	Working Party on Billfish of the IOTC
WPEB	Working Party on Ecosystems and Bycatch of the IOTC
WPM	Working Party on Methods of the IOTC
WPNT	Working Party on Neritic Tunas of the IOTC
WPDCS	Working Party on Data Collection and Statistics of the IOTC
WPTmT	Working Party on Temperate Tunas of the IOTC
WPTT	Working Party on Tropical Tunas of the IOTC
WWF	World Wildlife Fund
YFT	Yellowfin Tuna

Executive Summary

The Indian Ocean Tuna Commission met in Colombo on May 31st , 2014 to start the first Management Procedures Dialogue across the CPC's. Concepts of what the IOTC is trying to develop to insure the long term sustainability of the resource and the fishery were discussed, and put in context with the Precautionary Approach to fisheries. Most of the discussion was targeted to Resolution 13-10, that will need explicit definitions of some key elements to make it workable in the context of a Management Procedure (MP) evaluation. Perspectives from other RFMOs that already have a management procedure in place, CCSBT and the International Whaling Commission (IWC), were presented. A key message extracted from those cases is that in order to make the process more streamlined, explicit guidelines are required, and they will be easier to be put together when the stocks are in a healthy state rather than when the already are severely depleted, as in the case of CCSBT.

The current status of where the IOTC is with regards to MP's was discussed, and perspectives from the coastal and distant water fleets were also presented. Finally, some exercise were developed with the participants to assess their understanding of the issues, and how they would respond to different stock status advice in the context of probability.

Overall the following was assessed and recommended based on the discussions and exercises over the day:

1) Capacity building is essential for progressing the dialogue. This needs to occur on two levels:
    a. Level the playing field of understanding
    b. Managers/scientists/fishers/other stakeholders need to communicate in an understandable language
2) Develop rules when the going is good, i.e. be proactive rather than when things are in dire conditions
3) Develop rules where the onus of changes is equitable/Olympic TAC
4) Objectives need to be explicitly stated for a MP as it relates to Resolution 13-10
    1. Biological sustainability
    2. Economic benefits
        - License revenue?
        - Decent CPUE
        - Increased employment/onshore port facilities
        - Value-added (processing, post-harvest)
        - Foreign exchange
    3. Social
        - Food security
        - Increased employment
        - Given fisheries frequently artisanal
5) Clear communication/dialogue between scientists and managers, possibly through a WG, as it is a multi-stage process and dialogue.
6) Lack of information is not a reason to stall the process
7) Passing a resolution is easy, implementing it is hard (Resolution 13-10). With respect to that the following needs to be kept in mind:
    a. Need for common and consistent application
    b. Clear objectives are required for implementation with probabilistic targets
    c. Consistent means of evaluating a measure that relates to a harvest control rule

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1. OPENING OF THE MEETING AND ADOPTION OF THE AGENDA

1. A Workshop to deal with Management procedures and objectives was conducted on May 31st, 2014 in Colombo, Sri Lanka. The meeting was facilitated by Dr. Gerald Scott (ISSF) who welcomed XX people from 31 CPC's.

2. The workshop was sponsored by ABNJ GEF project Common Oceans to facilitate the dialog on setting objectives across the different RFMO's. This included sponsoring various experts and participants to the meeting, as well as insuring all logistics ran smoothly in Colombo.

3. The participants of the meeting are listed in Appendix I and the agenda for the Meeting was adopted as presented in Appendix II.

4. Rondolph Payet, executive secretary of the IOTC, introduced the concept, and welcomed participants to the meeting.

5. Dr. Scott informed the meeting about the scope of the meeting and the expected outcomes from the workshop. The agenda was adopted (Appendix II); and the participants were introduced.

2. WHAT IS A MANAGEMENT PROCEDURE ?

2.1 Concepts of stock assessments, and sustainable rates of fishing: what we know and how we work with that uncertain knowledge

6. Stock assessments are frameworks to integrate different sources of information in order to provide management advice. Assessments make use of models that approximate a complex reality. These can take on many forms, depending upon the information sets available. Uncertainty in stock status evaluations are quantified and that uncertainty is propagated and magnified into the future, a common feature in other forms of forecasting (e.g. like forecasting Tropical cyclones or predicting Tsunami impacts).

7. Communicating the best available scientific information on stock status and sustainable rates of fishing has been guided by agreements gained during the Kobe process. At Kobe I, tRFMOs recommended standardization of presentation of stock assessments and to base management decisions upon the scientific advice, including the application of the precautionary approach. Regarding standardization, it was agreed that stock assessment results across all five tRFMOs should be presented in the "four quadrant, red-yellow-green" format now referred to as the Kobe Plot. This graphical aid has been widely embraced as a practical, user-friendly method for presenting stock status information.

8. Many concepts about sustainability exist, and stocks are known to persist while supporting fishing at quite depressed stock levels. For the IOTC "*The objective of the Commission is to promote cooperation among its Members with a view to ensuring, through appropriate management, the conservation and optimum utilisation of stocks covered by this Agreement and encouraging sustainable development of fisheries based on such stocks*." IOTC members have agreed to use the Kobe plot and in and Res 13/10 also agreed to B_{MSY} and F_{MSY} as interim targets, in line with objectives of other tRFMOs, leading to achieving or maintaining healthy stocks. Furthermore, in embracing the Precautionary Approach, Parties to the IOTC have also indicated in Res 13/10 that an overriding objective for the tuna stocks is to maintain or attain the "green zone" with "high" probability.

9. At Kobe II, it was agreed that the next logical step in implementing precautionary fishery management is a "strategy matrix" for managers that lays out options for meeting management targets, including if necessary, ending overfishing or rebuilding overfished stocks. The Strategy Matrix was envisioned to

be a harmonized format for RFMO science bodies to convey advice. Based on targets specified by the Commission for each fishery, the matrix would present the specific management measures that would achieve the intended management target with a certain probability by a certain time. Probabilities and time frames to be evaluated would be determined by the Commission. In the case of fisheries managed under TACs, the outputs would be the various TACs that would achieve a given result. In the case of fisheries managed by effort limitations, the outputs would be expressed as, for example, fishing effort levels or time/area closures, as specified by the Commission. IOTC makes frequent use of the Strategy Matrix as a decision support tool for fisheries management.

10. Further advancing the precautionary approach within IOTC requires significant feedback (dialogue) between scientists and policy makers. What is needed from the tRFMO policy makers are definitions of the management objectives, timeframes, and tolerable risk-of-failure levels (degree of precaution) in achieving objectives. This has been established to some degree in Res [13/10] that provides a decision framework for implementation of the precautionary approach. What is needed from IOTC scientists is continued work toward full characterization of uncertainty in stock status evaluations and future forecasts to improve advice on the odds of achieving management objectives. While there are a number of methods employed to characterize and quantify these uncertainties, there remains a range of unquantified uncertainties that can be reasonably captured in Management Strategy Evaluations to move this process forward.

2.2 Overfishing, overfished and Risks

11. Tuna stocks were put in context with other terrestrial species. They are an apex predator, and have a key function in an ecosystem and as such are important to conserve and protect; hence the need for harvest control rules. Concepts of overfishing, and overfished were presented; Overfishing meaning that stocks were experiencing higher than optimum fishing mortality, though still in a healthy state, i.e. over optimal spawning stock size; overfished meaning that stocks were both experiencing a higher rate than optimal fishing levels, and a lower than optimal spawning biomass size.

12. The concepts of having some procedures in place, when stocks are threatened either due to a higher rate of fishing, or due to a low spawning biomass, to reduce fishing mortality so as to rebuild the stocks. i.e. the Management Procedure (MP). The idea was illustrated using some simple examples.

13. In the context of the IOTC; Resolution 13-10 with the key tenets were discussed (namely point 4 or Resolution 13-10):

    a. *In addition the IOTC Scientific Committee shall develop and assess potential harvest control rules (HCRs) to be applied, considering the status of the stocks against the reference points assessed in paragraph 3 for albacore, bigeye tuna, skipjack tuna, yellowfin tuna and swordfish. Based on the results of the MSE and considering the guidelines set forth in the UNFSA and in Article V of the IOTC Agreement, the IOTC Scientific Committee will recommend to the Commission HCRs for these tuna and tuna-like species, which among other factors, taking account of the following objectives:*

        i. *For stocks which assessed status will match with the lower right (green) quadrant of the Kobe Plot, aim at maintaining the stocks in a **high probability** within this quadrant;*
        ii. *For stocks which assessed status will match with the upper right (orange) quadrant of the Kobe Plot, aim at ending overfishing with a **high probability** in as **short a period as possible;***

iii. *For stocks which assessed status will match with the lower left (yellow) quadrant of the Kobe plot, **aim at rebuilding these stocks in as short a period as possible**;*
iv. *For stocks which assessed status will match with the upper left quadrant (red), aim at ending overfishing with **a high probability and at rebuilding the biomass of these stocks in as short a period as possible**.*

14. Concepts of "***as short a period as possible***", and "***high probability***" needed to be explicitly defined, and that was one of the main reasons the dialog was being initiated. In addition, the point that if we manage to F_{MSY}, we inherently run the risk of falling below the optimal biomass targets, and if we manage to some target below optimal fishing mortality F_{MSY}, the chances that we would drop below the optimal biomass targets substantially reduces. Thus, the Commission may want to consider some other targets, other than optimal fishing mortality if it is to be more in line with the Precautionary Approach in management. The concept of risk was introduced where for a fisheries manager risk is the probability of making the wrong decision, either i) of failing to detect an issue with a stock when there is one, or ii) unnecessarily restricting a fishery when fishing is optimal. Ultimately, it is a risk based decision or choice where one has to balance the long term yield of the stock with the long term spawning biomass that maybe observed in the stock.

2.3 Harvest Control Rules and Management Procedures

15. Harvest Control Rules (HCR) form an integral part of fisheries management strategies by explicitly linking outputs from monitoring and assessment to management to achieve the objectives of management. Management Strategy Evaluation (MSE) is a strategic risk assessment tool that can be used to prospectively evaluate the likely performance of alternative management strategies and/or policies.

16. A substantial advantage of adopting formal management strategies is the definition and agreement on management decisions and associated measures to change levels of fishing prior to the need for substantial action. This assists timely and responsive action when required and avoids the inertia that has often characterised fisheries management historically. Experience in a range of nations and internationally has demonstrated the benefits of this approach thorough improved stock status and returns from fisheries.

17. Management Strategy Evaluation is now widely used to develop and test the relative performance of alternative management strategies and refine them to meet the specific objectives and operational requirements of different fisheries. A preferred strategies is selected based on it's performance in achieving the objectives and having a low probability of resulting in undesirable consequences. As such, it provides a transparent process for the direct implementation of Precautionary Approach.

18. The MSE process is explicitly participatory, iterative process
19. that facilitates dialogue between decision-makers, stakeholders and science advisors and in doing so promotes continuous learning and improvement for management and science. Another important benefit is that it focuses attention on the information that is most important and influential in terms of improving management performance, which informs monitoring and research priorities.

2.4 Perspectives from other MPDs

20. Dr, Campbell Davies and Dr. Toshihide Kitakado gave perspectives from two case studies which have extensively developed MPD's. Both cases illustrate the situations where the stocks were in dire straits before procedures were developed, and implemented for short and long term objectives.

2.4.1 CCSBT

21. Southern Bluefin tuna is a highly migratory tuna species whose range spans three oceans in the southern hemisphere. Historically, the stock has been heavily harvested by longline and surface fisheries and is currently depleted (3-8% SSB). The Commission for the Conservation of Southern Bluefin Tuna was established in 1994, following informal tri-lateral arrangements between Japan, Australia and New Zealand. Subsequent members include Taiwan, Korea, Indonesia and a number of Cooperating Non-Members.

22. Early stock assessments and associated scientific advice was characterised by divergent views of stock status and productivity and conflicting management advice. Appointment of independent Chairs, an Expert Advisory Panel and initiation of a Management Procedure development and evaluation process in 2002 were central to resolving these earlier disputes and providing a framework to evaluate and select a formal rebuilding strategy for the stock. An MP was recommended by the Scientific Committee and adopted by the Commission in 2005. However, revelation of large unreported catches and farming anomaly resulted in suspension of the MP program while the implications of these events were investigated. The MP program resumed in 2009 and a final MP was adopted and implemented by the Commission in 2011.

23. General lessons for other contexts include: MSY (maximum long-term annual catch) is an important policy goal but not necessarily a useful technical objective; Independent chair and technical support, dedicated work plan and appropriately resourced consultation program for Commission and members are essential to successful outcome; Work plan should include agreement on schedule and criteria for conditioning of Operating Model; poorly estimated but influential parameters, in particular M and h, should be included as bracketed ranges in a "reference set", rather than selecting a "best model"; pre-MSE simulation testing of empirical decision rules is valuable for identifying convergence and fitting behaviour of candidate MPs; and continuity of scientists and managers through the development and MP/HS selection process is important to successful implementation. While the SBT experience is particular amongst tuna RFMOs, in that is a single species fishery, it is hoped that the experience and lessons from this process will have value for the reference point, HCR, MSE processes underway in the larger multi-species RFMOs.

2.4.2 IWC

24. Dr. Kitakado, the Chair of Scientific Committee of the International Whaling Commission (IWC/SC), provided the overview of management procedure used in the IWC/SC, which is now known as the Revised Management Procedure (RMP). A generic RMP for baleen whales, which was adopted in 1993 in the IWC commission meeting. The idea was to set biologically safe and practical catch limits on whaling by accounting for key uncertainties (stock sizes, carrying capacity, growth rates, etc).

25. The RMP composes of 1) the so-called "Catch Limit algorithm (CLA)", which is a model-based harvest control rule (HCR) tuned by the target depletion level after 100 years application and requires only past catch series and time series of abundance estimates and their associated coefficients of variation for estimation of parameters in the production model; 2) comprehensive simulation tests with consideration of various uncertainty including key biological parameters and stock structure hypotheses. The CLA in the generic RMP was originally chosen among five candidate algorithms through a framework of current "Management Strategy Evaluation (MSE)" or "Management Procedure Evaluation (MPE)", and this process itself can be regarded as a pioneer work of MSE/MPE. The CLA itself assume that a single stock occurs in a management area. The RMP was then extended to cases of multiple stocks by considering the spatial definition of areas

which the CLA is applied to and spatial allocation of catch to each sub-management area. In this context, such spatial area-definition/catch-allocation is tested as a HCR through simulation trials.

26. Some examples of stocks were provided and complexities of multiple areas, and multiple stocks were discussed. Simple control rules that account for a certain take based on estimated current abundances were demonstrated. Numerous advantages, and disadvantages were discussed, some of which are shown below:
    Advantage
        i) Comprehensive examination of performance and risk for potential MPs (HCRs)
        ii) Incentive to invention of good Harvest Control Rules
        iii) Incentive to summarization of available information through MSE process
        iv) Incentive to continued survey
        v) Transparency of process and decision making
    Disadvantage
        i) Heavy load for construction and conditioning of OMs
        ii) Have to consider various uncertainty
        iii) Need human Resources

27. Finally, having a clearly written specification including a time line would be one of the key measures for getting a practical MP implementation. Other factors to take into account is the conditioning of the Operating Models, and how to weigh equally plausible Operating Models, and finally accounting for variation or changes in the ecosystem would also be a key to pay attention to.

3. Current Status of IOTC MPD

3.1 IOTC Working Party Methods Update

28. An update on the current status of work for the development of MSE simulations for IOTC stocks was presented by the chair of the Working Party on Methods. Work on the development and testing of MSE simulations for albacore and skipjack tuna have been initiated by WPM, and work has progressed in developing Operating Models for both stocks, using slightly different platforms but with a common aim: characterize, to the extend our current knowledge allows, the dynamics of these stocks and the unavoidable uncertainties in their estimation and prediction.

29. A more detailed explanation of the proposed OM for albacore was employed as an example to show participants the structure of an OM. A set of management objectives and performance measures, build for testing purposes around the existing interim target and limits for this stocks, was presented. Finally the future work on the development of both MSE exercises, as well as the planned work on yellowfin and bigeye OMs, was presented and discussed.

3.2 IOTC Scientific Committee Update (How MSE ties into the work of the SC)

30. IOTC Scientific Committee (SC) MSE related recommendations and their progress (process justification) were presented including three aspects: (1) MSE development related recommendation, (2) Commission related recommendation and (3) Workshop and capacity building related recommendation. SC has been recommending various issues on MSE since 2010, i.e., development, evaluation and demonstration through workshops, working parties SC and Commission (annual) meetings. These recommendations have progressed well. SC will continue to make further recommendations to enhance the MSE process. And SC expects good progress for recommendations by hard working and dedicated MSE development scientists.

4. Perspectives from CPC's

31. The EU and Maldives presented perspectives from the distant fleets, and the coastal states respectively. Their perspectives both focused on insuring the long term sustainability of the stock and the fishery, and to insure that social and economic objectives are also dealt with in the long term.

4.1 Objectives for management as provided in guidelines in Res 13/10 and what trade-offs can be made

32. Mr. Patrick Daniel gave an overview of Resolution 13/10 (see Appendix III for more details) and put it in context with other conventions that dealt with high seas migratory species, UNCLOS, and the Precautionary Approach to Fisheries Management. In order to achieve these sustainable rates (optimum utilization of stocks as specified in the IOTC), one should know where we are with respect to the biomass and fishing mortality, as well as be able to have clear target and limit reference points for management purposes. For that purpose, a suit of target ad limit reference points were discussed and which approach would be most useful were presented. Other synoptic indicators like CPUE and recruitment were also discussed, and put into perspective with the management objectives. Finally, specifying clearer guidelines with respect to how we achieve "high probability" and as "short a period as possible" was specified.

33. Ultimately, before designing possible new and more efficient management frameworks, strategies or measures, several questions would need to be further discussed, particularly:
    - Which Biological Reference Points should be taken as TRPs and what specific management objectives would be needed to be achieve them ?
    - What supporting information should be used to fixed the LRPs ?
    - How to fix precautionary buffers which should reflect uncertainties attached to the assessment of LRPs ?
    - Would the year 2020 be considered as the generic and explicit deadline to achieve agreed mangement objectives ?
    - What would be the acceptable level of risks of exceeding either precautionary and "absolute" LRPs ?
    - Which probability ceiling should be associated to the acceptable level of risk ?

4.2 Objectives for management: Some perspectives from ABNJ Workshop in Sri Lanka

34. The historical perspective of how IOTC was created out of work done by IPTP through 1982-1996. At that time, most participation by coastal states was low, and this was the case even in the early years of the IOTC. This changed in the Commission Meeting in 2010 when some resolutions were made to start an allocation criteria for some of the tropical tuna, and then further resolutions in 2012 and 2013 were passed to insure the precautionary approach to management in fisheries in the IOTC area of competence.

35. The coastal states objectives are very varied, but can be categorized into 3 main points; i) maintenance of livelihoods and food security, ii) securing and maintenance of employment opportunities, and iii) economic, either through fishing licenses/access fees or through transshipment services. In contrast distant water fishing nations that operate in the Indian ocean are primarily driven by economic drivers directly related to catch and/or finished products.

36. Some examples of objectives for the coastal states would need to insure sustainability of the stock as well as sustainability of the fishery, as well as insure assurance of access (minimizing fish closures),

and meet consumer needs. A possible clear objective could be stated as "maintaining spawning stock biomass at or above SSB_{MSY} with a probability of at least 80%".

37. Finally, issues related to capacity building are critical for the coastal states, and more focused trainings are required so that the coastal states do not fear that additional resolutions would limit their fisheries. The allocation issue also needs to be resolved so that no one party would bear the onus of the constraints.

5. MPD WORKSHOP RECOMMENDATIONS AND WORKPLAN

5.1 Major recommendations of the IOTC MPD Workshop

5.1.1 Capacity Building

38. ABNJ has undertaken a specific objective of levelling the playing field with trainings for coastal CPC's. One such workshop has already been conducted in 2014, but a lot more hands on training will need to take place over the next few years, with clear guidance/direction from the Commission. This was continually heard by participants at the Commission, and was a need not only for coastal CPC's but also the far seas fleets.

5.1.2 Defining Objectives

39. Given, 31 countries (32 with Somalia) are represented in the IOTC different user/stakeholder have different objectives. Some of them were discussed and shown below (Table 1), but explicitly tying this to the IOTC convention objectives, and Resolution 13-10 need to be accounted for and needs to be developed in the dialogue over the next few years. In addition clarifications need to be clarified for reference points (target and limits need to be possibly be revised).

Objective	Indicator
Biological sustainability	Stock assessment Fish size Demersal surveys Social 'happiness' of fishery CPUE [Range contraction]
Economic benefits	Fish size (e.g. mean length) Social 'happiness' of fishery Higher value/quality fish CPUE
Social benefits	Equitable distribution of benefits to communities Higher value/quality fish Social 'happiness' of fishery
[Ecosystem]	Reduced bycatch levels Trophic cascades

Table 1: Possible Objectives and indicator of objective (from ABNJ WWF Workshop April 22-24.

5.1.3 Control Rules for fishing

40. Possible control rules that are empirical (based on CPUE) or model based were discussed. The IOTC is using both approaches in the MSE tests being conducted for Albacore and Skipjack. However, clearer guidelines tied to catches and fishing mortality need to be provided to guide the work of the WPM and SC. In the absence of clear rules, the WPM has developed some conceptual rules for evaluation with the SKJ and ALB assessments, which could be further refined once the Commission starts to actively engage in the dialogue.

Overall Recommendations

- ***Develop rules when the going is good, i.e. be proactive rather than when things are in dire conditions***
- ***Develop rules where the onus of changes is equitable/Olympic TAC***
- ***Objectives need to be explicitly stated for a MP as it relates to Resolution 13-10***

41. Biological sustainability

42. Economic benefits

- ***License revenue?***
- ***Decent CPUE***
- ***Increased employment/onshore port facilities***
- ***Value-added (processing, post-harvest)***
- ***Foreign exchange***

43. Social

- ***Food security***
- ***Increased employment***
- ***Given fisheries frequently artisanal***

- ***Clear communication/dialogue between scientists and managers, possibly through a WG, as it is a multi-stage process and dialogue.***
- ***Lack of information is not a reason to stall the process***
- ***Passing a resolution is easy, implementing it is hard (Resolution 13-10)***

d. Need for common and consistent application

e. Clear objectives are required for implementation with probabilistic targets

f. Consistent means of evaluating a measure that relates to a harvest control rule

Possible TOR's Noted for Action

- ***Capacity building***
  - ***Level the playing field of understanding***
  - ***Managers/scientists/fishers/other stakeholders***
    - ***Communicate in understandable language***
- ***Better information on catch levels (reduce uncertainty)***
- ***IUU fishing-Issues for Compliance***
- ***Stock sustainability in the face of increasing capacity/effort***
- ***Effort creep and accounting for that in OM's and Control rules***

ADOPTION OF THE REPORT

41. The Report of the 1st MPD conducted by IOTC was adopted on 19th June, 2014 through email.

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APPENDIX II: Agenda for IOTC Management procedure Dialogue.

TOPIC	Time
1. Opening and Welcome Address (Mr. Rondolph Payet, Executive Secretary, IOTC)	9:00-9:10
2. Logistics of Workshop (Dr. Scott)	9:10-9:15
3. Concepts of stock assessments, and sustainable rates of fishing: what we know and how we work with that uncertain knowledge (Dr. Scott)	9:15-9:30
4. Introducing the notion of overfishing, overfished and risk to the fishery and the resource: an evaluation of the interim reference points using these concepts (Dr. Sharma)	9:30-9:45
5. Conduct of management procedure evaluations through the use of operating models. Are the technicalities of how they are done needed to understand the why? (Dr. Davies)	9:45-10:10
6. Perspectives on evaluating management procedures (IWC and CCSBT) a) CCSBT (Dr. Davies) b) IWC (Dr. Kitakado)	10:10-10:30 11:00-11:20
Coffee Break	**10:30-11:00**
7. Overview of the evaluation of management procedures in the iotc and other tRFMOs (Dr. Mosqueira)	11:20-11:40
8. IOTC Scientific Committee recommendations and process justification (Dr. T. Nishida)	11:40-12:00
9. Objectives for management as provided in guidelines in Res 13/10 and what trade-offs can be made (Mr. Daniel)	12:00-12:15
10. Objectives for management: Some perspectives from ABNJ Workshop in Sri Lanka (Dr. Shainee)	12:15-12:30
11. Group discussion on what objectives we could define for management procedures (Dr. Scott)	12:30-13:00
LUNCH	**13:00-14:30**
12. Group exercises (Dr. Scott) a) Understanding concepts of "high probability" and "as short as possible", as reflected in Res. 13/10: An exercise on how to read Kobe Plots and Matrices and its implications for decision-making b) Setting management objectives using an IOTC-like example	14:30-15:30
13. Wrap Up (Dr. Scott)	15:30-16:00

APPENDIX III: Objectives for management as provided in guidelines in IOTC Resolution 13/10, a view for the future

Any fisheries management framework needs to be supported by clear management objectives to be expressed by the policy makers through a specific decision-making process.
At international levels, several texts might be referred to when adopting such management objectives.
No doubt that the first ones was the 1958 Geneva Convention on Fishing and Conservation of Living Resources of the High Seas, mentioning as an objective to render the optimum sustainable yield possible. This text opened therefore the way to MSY approaches, which later were clearly mentioned in article 61 of the United Nation Convention on the Law of the Sea (UNCLOS), through the objective of maintaining or restoring populations of harvested species at levels which can produce the maximum sustainable yield. This MSY objective has been reiterated in the Johannesburg Declaration of the World Summit on Sustainable Development (WSSD – 2002).

Later on, other texts opened avenues for additional and complementary approaches to fisheries management.
The Precautionary Approach was more particularly discussed and fixed in several Conferences, Agreements or Conventions like in the United Nations Conference on Environment and Development (UNCED - 1992), in the United Nations Straddling Fish Stocks Agreement (UNFSA – 1995) or in the FAO Code of Conduct for Responsible Fisheries (1995). The precautionary approach aims at constraining harvesting within safe biological limits.
The Ecosystem Approach also arose during the same time period and was established in other international Conferences or Conventions, like in the United Nations Convention on Biological Diversity (CBD – 1992) or in the WSSD.

MSY Approach and Objectives and the two complementary Precautionary and Ecosystem Approaches have been included to different extend and different forms in fisheries policies and management frameworks of both RFMOs and Coastal States.

Once general objectives of the fisheries management framework have been fixed, there remains a need for specific and operational objectives and for management strategies. Therefore, indicators have to be used to assess the evolution of the fish stocks and of the fishing activities with regards management measures already in force or to be implemented. Such indicators are often quantitative ones and are chosen according to the MSY, precautionary or

Ecosystem approaches.
Concerning the MSY and precautionary approaches, indicators may also depend on the type of available fisheries dependent or independent data and on the type of mathematical models used to carry out the assessments. Two types of indicators are commonly selected in fisheries management framework as to be used under the MSY and the precautionary approaches, fishing mortality rates (F) and the levels of biomass (B). In some cases, particularly when facing scarcity of data, other indicators might be used, like trends of catches, of fishing efforts or of catch per unit of effort (CPUE).

The assessment process, both of the current status of fish stocks and fisheries or of impacts of possible new or updated management measures, requires the definition of specific benchmark values, the so called Reference Points, for each of these indicators associated either to the MSY and Precautionary Approaches or even to the Ecosystem approach.
Reference points might then refer either to a specific objective the policy makers and managers want to achieve or to specific circumstances they want absolutely to avoid. Therefore, the may be fixed as targets, as limits or even as different values like a specific thresholds, which may trigger the implementation of specific management measures. Reference points are therefore core elements allowing for the design, the adoption and the implementation of Harvest

Control Rules (HCRs).

By implementing the MSY Approach, policy makers have adopted specific and well known Reference Points based on either the fishing mortality indicator or a Biomass indicator, like F_{MSY} or its proxies and B_{MSY}.
In a lot of management frameworks, the Precautionary Approach has led to the introduction of additional and complementary reference points, considered as absolute thresholds, like F_{LIM} and B_{LIM}, or as precautionary thresholds, like F_{PA}, B_{PA}.

F_{LIM} and B_{LIM} are absolute thresholds that shouldn't be overpassed at any price, B being maintained over B_{LIM} and F below F_{LIM}. These two LRPs are most usually adopted according to biological information on the dynamics of the

recruitment, B_{LIM} matching Biomass levels associated to very low, quite erratic or even unknown levels of recruitment.
Consequently, F_{PA} and B_{PA} are sometimes adopted to limit the risk for the stock biomass and the fishing mortality rate of being too close to F_{LIM} and B_{LIM}, considered as absolute thresholds. By adopting such a precautionary buffer, managers and policy-makers seek to maintain fish stocks within safe biological limits.

IOTC Resolution 13/10 contributes to the definition of such Target and Limit Reference Points for most of tuna and tuna-like stocks covered by the IOTC agreement and to be used in the assessment process.

However, even when considering the MSY and the Precautionary approaches only, some limits have still to be pointed. The two main limits are related to timelines and to the status of the selected Reference Points.
Unfortunately, IOTC Resolution 13/10 does not yet contribute to overcome and to solve such limits.

On timelines, a major question is to know by when the management objectives should be achieved. With regards the MSY approach and the associated Precautionary approach, a date was agreed in 2002 in the WSSD: 2015. Even if 2015 has not be the kept deadline in most of the fisheries management frameworks around the world and even if 2020 (or even a bit later) is now frequently taken into account, most of the management framework now tackles quite properly this question of timelines and associates specific management objectives to specific deadlines.

A difficulty also remains with the status of the selected reference points, particularly those used to implement the main objective agreed at international levels: to maintain or restore populations of harvested species at levels which can produce the MSY. Where F_{LIM}, B_{LIM} F_{PA}, B_{PA} are clearly considered as Limit Reference Points (LRPs), the status of F_{MSY} and B_{MSY} is far less clear when differentiating between LRPs and Target Reference Points (TRPs).

LRPs might be then taken as precautionary reference allowing fisheries policy makers and managers to apply specific management measures with the aim to achieve management objectives expressed as TRPs. Some international agreements guide the fisheries policy makers and managers' choices when considering LRPs and TRPs. UNFSA is most likely the clearer text on how F_{MSY} and B_{MSY} should be considered and handled: "The fishing mortality rate which generates maximum sustainable yield should be regarded as a minimum standard for a Limit Reference Point. For stocks which are not overfished, fishery management strategies shall ensure that fishing mortality does not exceed that which corresponds to maximum sustainable yield, and that the Biomass does not fall below a predefined threshold. For overfished stocks, the Biomass which would produce maximum sustainable yield can serve as a rebuilding target".

Although UNFSA seems to consider F_{MSY} as a LRP, a lot of fisheries management frameworks implicitly or explicitly take F_{MSY} as a TRP.

It's interesting to notice that B_{MSY} may be considered as a TRP during the rebuilding phase (rebuilding plans) and as a LRP (management plans). The FAO Code of Conduct, which states that fisheries management should contribute "*to maintain or restore stocks **at** levels capable of producing MSY*", seems therefore to consider B_{MSY} as a target.

If a metric of a specific indicator is taken as a threshold to fix a LRP, it means that this indicator is expected to overpass this metric with a low or even a very low probability (e.g. less than 5 %). For instance, if F_{LIM}, B_{LIM}, F_{PA} and B_{PA} were taken as a set of LRPs, management measures might be discussed by fisheries policy makers and managers in the light of a probability of less than 5 % for F being over F_{LIM} or for B to being below B_{LIM} and of a probability of less than 25 % for F being over F_{PA} or for B being below B_{PA}.

In the same vein, if a metric of a specific indicator is taken as a threshold to fix a TRP, it means that this indicator is expected to overpass this metric with a probability of at around 50 %. For instance, if F_{MSY} and B_{MSY} were taken as TRPs, management measures might be discussed by fisheries policy makers and managers in the light of a probability of 50 % at least for F being over F_{MSY} or for B being below B_{MSY}.

Through the adoption of the Resolution 13/10, IOTC explicitly decided to consider both F_{MSY} and B_{MSY} as TRPs and agreed on specific formulas to fix LRPs, F_{MSY} and B_{MSY}. The IOTC Resolution 13/10 also specifies that management measures shall be designed to result in a high probability of ending overfishing and rebuilding fish stocks in as a short period as possible and of maintaining stocks in the green quadrant of the Kobe plot/chart.

However, two problems might be reported when applying the IOTC Resolution 13/10.

Indeed, the current text does not clarify how the wording of "high probability" should be considered and translated into a numeric value. In addition, the green quadrant the Kobe plot/chart was designed as the area of the Kobe plot/chart where $F<F_{MSY}$ and $B>B_{MSY}$. Consequently, when establishing the Kobe plot/chart, it seems that both F_{MSY} and B_{MSY} were taken as boundaries – so to say as limits – to fix the area where the most likely value of F and B should be observed or maintained.

Therefore and as highlighted above, two limits remain in this IOTC Resolution 13/10: the timeline and the status of some Reference Points. In other words, what policy makers consider when asking for 'as a short period as possible' and what do they mind when mentioning 'a high probability' ?
Solving the current loopholes identified in the IOTC Resolution 13/10 would therefore need to possibly discuss and answer the following questions:

- Which Biological Reference Points should be taken as TRPs to express in metrics specific management objectives to be achieved ?
- Which supporting information should be used to fixed the LRPs ?
- How to fix precautionary buffers which should reflect uncertainties attached to the assessment of LRPs ?
- Would have 2020 to be considered as the generic and explicit deadline to achieve agreed management objectives, suffering -or not- possible exemptions ?
- What would be the acceptable level of risks of exceeding either "precautionary" and "absolute" LRPs ?
- Which probability ceiling(s) should be associated to the accepted level of risks ?

Answering such questions might require enhancing the dialogue process between scientists and managers.