PREPARATORY CONFERENCE FOR THE COMMISSION FOR THE CONSERVATION AND MANAGEMENT OF HIGHLY MIGRATORY FISH STOCKS IN THE WESTERN AND CENTRAL PACIFIC
Seventh session
Pohnpei, Federated States of Micronesia
6 - 7 December 2004

WCPFC/PrepCon/41
16 September 2004

REPORT OF THE THIRD MEETING OF THE SCIENTIFIC COORDINATING GROUP

1. In accordance with the terms of reference agreed by the Preparatory Conference in its second session (WCPFC/PrepCon/15, Annex V), the third meeting of the Scientific Coordinating Group took place at Majuro, Marshall Islands from 19 to 21 August 2004, immediately following SCTB17. The list of participants is attached as Annex I. A list of abbreviations and acronyms used in this report is attached as Annex VI. The meeting was chaired by Dr Yuji Uozumi (Japan).

2. The agenda is attached as Annex II. The matters considered by SCG 3 included:

(a) Stock status statements for the major target species (bigeye, yellowfin, skipjack, South Pacific albacore)

(b) Review of the scientific feasibility of providing analyses of management options.

(c) Management strategy evaluation approaches using operational models

(d) Ecosystem, bycatch and other scientific issues - including stock assessment research priorities.

(e) Data standards and other data related issues; and

(f) Identification of Specialist Working Groups of the Scientific Committee.

Agenda item 2. Stock status of major tuna species

3. SCTB17 produced stock status statements (Annex III) in accordance with the format established at SCG1. SCG3 independently considered management implications and these were added to the stock status summary statements that appear below.

4. The SCG recognised that the stock assessments used to provide advice on the status of the WCPO stocks are subject to uncertainty in the inputs and model specification and structure. It was noted that there are critical gaps in the data that are producing significant uncertainty in the assessments. Quantification of the uncertainty associated with stock structure is complex, but is a high priority.

5. The SCG acknowledged the ongoing need for development, testing and review of assessment methods. Several processes are in place to ensure that these development, testing and review activities continue, including the work of the methods working group of the SCTB, peer review through cooperation with other organizations involved in stock assessment and formal peer review and publication in the international scientific literature.

6. In discussing the stock assessments for yellowfin and bigeye stock in particular, the issue of uncertainty is significant in that the true status of stocks may be over estimated or underestimated by current assessments. Significant management implications flow from this uncertainty. Nevertheless, the following advice on stock status and management implications was formulated by SCG on the basis of the best available scientific information.

7. In the 2004 stock assessments, and in the statements below, $F_{current}$ and $B_{current}$ refer to the average fishing mortality and biomass over the period 1999-2001 respectively. The final year for which complete fishery data are available (2002) is not included in the average because fishing mortality estimates in the terminal data year are highly uncertain.

8. Chinese Taipei provided the following statement: Chinese Taipei raised particularly that any action in terms of measure to be recommended by SCG meetings should be reasonable to management use, which is contingent upon the approval of the Commission. However, with respect to $F_{current}$ and $B_{current}$ referred, from the previous paragraph, to the average fishing mortality and biomass over the period 1999-2001, for the purpose of comparison study, Chinese Taipei suggested that other period 2000-2002, or others could be undertaken and no implication should be used for management purposes at this stage.

Bigeye tuna

Stock status

9. The 2004 stock assessment is generally consistent with the result of the 2003 assessment, although the point estimates of four out of five reference points are slightly more optimistic. In particular, while the 2003 assessment indicated that overfishing was occurring ($F_{current}/F_{MSY} > 1$) in the WCPO, the 2004 assessment indicates that $F_{current}/F_{MSY} \sim 1$. Both assessments indicate that the stock is presently not in an overfished state ($B_{current}/B_{MSY} > 1$) because of high levels of estimated recruitment since 1990. The 2004 assessment also indicates that current levels of fishing mortality carry high risks of overfishing (*Probability*($F_{current}/F_{MSY} > 1$) ~ 67%). A decrease in total catch would be likely to be necessary in order to maintain the stock at sustainable levels if there is a future decrease in recruitment.

Management implications

10. The SCG recommends that, as a minimum measure, there be no further increase in fishing mortality for bigeye tuna from $F_{current}$. In addition, the SCG noted that more recent effort data is urgently needed to properly estimate the actual fishing mortality since 2001. Given this situation, the SCG also recommends that more timely provision of catch and effort data from DWFN longline vessels as well as estimates of catch and catch composition from Indonesian and Philippine fisheries be obtained to address this issue. The SCG also notes the recent decrease in bigeye recruitment in the EPO and the need for more stringent management actions if such a decrease was mirrored and verified in the WCPO.

Yellowfin tuna

Stock status

11. The 2004 stock assessment is consistent with the result of the 2003 assessment that the yellowfin stock in the WCPO is probably not being over-fished (*Probability*($F_{current}/F_{MSY} > 1$) ranged from 15-40%) and the stock is not in an over-fished state ($B_{current}/B_{MSY} > 1$). However, the stock is likely to be nearing full exploitation and any further increases in fishing mortality would not result in any long-term increase in yield and may move the yellowfin stock to an over-fished state. The assessment also indicates that the equatorial regions are likely to be fully exploited. Recruitment is estimated to have been high in recent years and a decrease in total catch is likely to be necessary in order to maintain the stock at sustainable levels if future recruitment levels return to those closer to the long-term average.

Management implications

12. Although uncertain, fishing mortality rates in recent years may have exceeded $F_{current}$, and while spatial patterns of exploitation remain uncertain, some areas in the equatorial WCPO may be heavily fished and in these areas management actions may be required. While recognizing continuing uncertainties with the current yellowfin stock assessment – especially due to inadequate data on Indonesian and Philippine catches, the SCG recommends that to reduce the risk of the yellowfin stock becoming over-fished further increases in fishing mortality (particularly on juvenile yellowfin) in the WCPO should be avoided. Given the need to understand recent changes in the fishery, the SCG also recommends that fishery statistics be made available for stock assessment purposes in a more timely manner.

Skipjack tuna

Stock status

13. No new assessment was undertaken for skipjack during 2004 therefore the current stock status is based on the assessment undertaken in 2003. The 2003 stock assessment indicates that the skipjack stock in the WCPO is not being overfished ($F_{current}/Fmsy < 1$) and that the stock is not in an overfished state ($B_{current}/B_{MSY} > 1$) owing to recent high levels of recruitment and modest exploitation relative to the stock's biological potential.

Management implications

14. Continued catches at the 1.2 million mt level are sustainable if high recruitment levels (believed to be determined by environmental factors) continue. However, any increases in purse-seine catches of skipjack may result in a corresponding increase in catches of yellowfin and bigeye tunas which recent SCG recommendations advise against - refer to discussions under Interactions section below.

South Pacific albacore

Stock status

15. No new assessment was undertaken during 2004 therefore the current stock status is based on the assessment undertaken in 2003. An examination of catch trends in 2004 indicated that total catches of albacore were relatively stable over the period from 1960 to 1995, but they have increased markedly in recent years. The 2003 assessment gave similar results to the 2002 assessment, and estimated a low impact of fishing on biomass and that the current biomass is at about 60% of initial levels largely due to a decline in recruitment. It is therefore unlikely that the stock is in an over-fished state. However, it is noted that assessments conducted on stocks such as South Pacific albacore that, apparently, have been subject to low exploitation rates provide little information on the biomass of the stock. Declines in CPUE observed in some Pacific island fisheries in recent years (particularly in 2003) appear to be a consequence of changed oceanographic conditions, though high levels of localised effort may also be impacting on CPUE in these fisheries.

Management implications

16. Current catch levels from the South Pacific albacore stock appear to be sustainable. However, CPUE may be susceptible to changes in oceanographic conditions and, in localised areas, high levels of localized effort, and these changes may impact on the performance of more localised fisheries, particularly for developing small island states dependant on these resources. It is recommended that further research is undertaken to clarify the possibility of localized depletions in these fisheries.

Interactions

17. Stock assessments, including those conducted for the SCTB, are typically done in the context of the impact of fishing on the target stock with the potential impacts on other catch components considered

qualitatively. SCG noted that for at least two gear types, longline and purse seine setting on floating objects (FADs and logs), there is a potential for considerable impacts on non-target species even if the target stock is not being adversely affected. Of particular concern is the bycatch of bigeye tuna in the purse seine fishery for skipjack and yellowfin. Further increases in catches of skipjack may have severe consequences for the status of the bigeye and yellowfin tuna stocks.

18. SCG agreed that any increase in purse seine fishing on floating objects would increase the fishing mortality on both bigeye and yellowfin tunas in the WCPO. In addition, there is a substantial impact of the domestic fisheries of Indonesia and the Philippines on yellowfin. In the case of bigeye, the assessment indicated that the biggest impacts[1] are due to longline fishing targeting bigeye. The multi-species nature of the purse seine and longline fishery means that the impacts of fishing on stock status cannot be simply addressed by reference to the target species without addressing the other species caught.

19. The SCG recommended that PrepCon should consider how to implement management measures to address overfishing and alleviate overfished stock conditions. To this end, SCG 3 has identified a number of analyses that are feasible, given available data, that would help the WCPFC assess these management options. Similar issues have faced other tuna Commissions and the approaches they have taken may also serve to guide the Commission's considerations..

Impact is defined as the extent by which the biomass is estimated to be reduced from unexploited levels due to fishing.

Agenda item 3. Advice on technical feasibility of analysing management options

20. The SCG addressed a request from PrepCon VI to "Advise on the further analyses to support the consideration by PrepCon VII and the first session of the Commission of management options and how these analyses can carried out in a timely and effective manner." The analyses were guided by the management options described in the document entitled *Management options for bigeye and yellowfin tuna in the western and central Pacific Ocean* (WCPFC/PrepCon/WP.24).

21. The approach taken by the SCG was to identify the data requirements and likely analyses that could be used to evaluate each management option. The assessment of the feasibility of such analyses was based on the availability of data and the scientific achievability of the analyses. Implementation issues relating to each management option were not considered by the SCG (these will need to be considered by the Commission).

22. Of the 17 management options examined, analyses for nine options were considered to be not feasible given current data availability. However, some options could be analysed by making certain assumptions where data are not available. These analyses maybe more feasible in the long term if the necessary data are collected . A summary of the feasibility of the analyses is given below. The full table of results (including extra comments) is given in Annex IV.

23. SCG highlighted that the following matters need to be considered in conjunction with the advice:

(a) The table describes the data/information and analyses required to quantitatively evaluate the possible effects of various management options described in WCPFC/PrepCon/WP.24. **The operational and implementation aspects of these options were not considered in this paper**.

(b) Many of the analyses require management direction before they can be undertaken. Furthermore, quantitative evaluation of the effectiveness of a given management option will require

determination of benchmarks/targets/reference points against which to evaluate the effectiveness of the management option, e.g. future biomass, fishing mortality against some value.

(c) While many analyses are feasible some are not due to data limitations. These could be analysed by making certain assumptions where data are not available, but the outcomes of such analyses could be associated with greater uncertainty. Nevertheless, these analyses maybe feasible in the long term if the necessary data are collected. The following feasibility statements are used in this paper:

1. Analysis is feasible
2. Analysis is feasible contingent on management advice
3. Analysis is not feasible due to data limitations, but maybe feasible in the long term.

(d) Many management options could cause changes in fishing behaviour that may be difficult to predict and therefore quantify.

(e) Analyses should be undertaken using a model-based approach to allow integration of population dynamics into the evaluation of management options. A range of models could be considered, but the analysis of some options will require particular model structures, e.g. spatial stratification or age-structure. A critical assumption for such analyses will be future levels of recruitment; this and other important modelling assumptions are described in the "No controls" section. It should be noted that currently, estimates of stock status for most of the species are obtained from MULTIFAN-CL (MFCL), but while there are obvious benefits in using the same model to evaluate management options, analyses using MULTIFAN-CL can be time consuming.

(f) No distinction is made between purse-seine and longline management options except where such options can only apply to a single fishery. Many of the options could be also applied to other gear types.

(g) Though the management measures are directed at bigeye and yellowfin, analyses may include estimates of the effects of measures on catches of other important species (e.g. skipjack, species of special concern).

(h) Some useful analyses, for example, an analysis of the characteristics (e.g. vessel details, fishing strategies) of top bigeye or yellowfin-catching vessels, could provide information in support of the analysis of a range of management options.

Control Type	Management Option	Feasibility Statement
NO CONTROLS	Status-quo: No attempt is made to control fishing mortality	Analysis is feasible in the immediate term and could represent an analysis against which other analyses are compared.
OUTPUT CONTROLS	Catch limits (a): Competitive overall or regional catch limits.	Analysis is feasible in the immediate term contingent on management advice: overall or regional catch limits.
	Catch limits (b): Allocated overall or regional catch limits.	Analysis is feasible in the immediate term contingent on management advice: overall or regional catch limits.
	Catch limits (c): Vessel Limits	Analysis is feasible in the immediate term contingent on management advice: vessel catch limits.
INPUT CONTROLS	Capacity (a): Limit/restriction on the number of vessels. This could be general reductions or directed at those fleets catching most bigeye and yellowfin.	Analysis is feasible in the immediate term contingent on the provision of information on: overall or regional catch limits.
	Capacity (b):	Analysis is not feasible in the immediate term due

	Limit size or power of vessels	to data limitation, but maybe feasible in the long term.
	Capacity (c): Limit size of fish hold.	Analysis is not feasible in the immediate term due to data limitation, but maybe feasible in the long term.
	Total effort limits: Setting overall or regional limits for some measure of effort (e.g. sets, hooks, days fished).	Analysis is feasible in the immediate term contingent on management advice: overall or regional effort limits.
	Area/seasonal closures: Restricting fishing effort in particular area/seasonal strata	Analysis is feasible in the immediate term contingent on management advice: the area/seasonal closures.
TECHNICAL MEASURES	Gear restrictions (a): Restrictions on various gear configurations (e.g. net size/depth, longline length)	Analysis is not feasible in the immediate term due to data limitation, but maybe feasible in the long term.
	Gear restrictions (b): Method restrictions (e.g. time of set, soak time)	Analysis is not feasible in the immediate term due to data limitation, but maybe feasible in the long term.
	Size restrictions: Limits on the sizes of fish that can be retained. Compulsory retention (no discards allowed).	Analysis is feasible in the immediate term contingent on management advice: size limits and species and fleets to which they apply.
	Restrictions on operational efficiency (a): Banning or limiting power of vessel electronics.	Analysis is not feasible in the immediate term due to data limitation, but maybe feasible in the long term.
	Restrictions on operational efficiency (b): Restrictions on auxiliary vessels, e.g. tender vessels or light vessels. Regulations on transhipment.	Analysis is not feasible in the immediate term due to data limitation, but maybe feasible in the long term.
	FAD restrictions (a): Prohibition of FAD sets on a time and/or area basis. Restrictions of the number of sets allowed on FADs.	Analysis is feasible in the immediate term contingent on management advice: areas/seasons where FAD sets will be restricted and the specific FAD types.
	FAD restrictions (b): Limit number of FADs deployed	Analysis is not feasible in the immediate term due to data limitation, but maybe feasible in the long term.
	FAD restrictions (c): Regulations on the design of FADs	Analysis is not feasible in the immediate term due to data limitation, but maybe feasible in the long term.

Agenda item 4. Discussions on a Management Strategy Evaluation Approach using Operational Models

24. The SCG held preliminary discussions on this topic after a brief presentation of an introductory document entitled *A management strategy evaluation approach using operational models* (Annex V).

25. Operational models are models that combine species population dynamics models with fishery models. Management scenario evaluation models (MSEMs) overlay operational models with stock assessment models and management action models. Well-defined management goals are a critical prerequisite for implementation of MSEMs. In practice, establishment of management goals requires a lengthy process of stakeholder consultations, and full implementation of a MSEMs could require an effort extending over a period as long as five years. If MSEMs are to be implemented by the WCPFC, the Commission will need to develop and articulate management goals, possibly including reference points and control rules. The involvement of stakeholders at an early stage of implementation is also important.

26. The SCG recommended that the Commission conduct a review of existing operational and management strategy evaluation models.

Agenda item 5. Advice on ecosystem, bycatch and other scientific issues

Ecosystems and bycatch

27. SCG reviewed the document entitled *Review of Ecosystem and Bycatch Issues for the Western and Central Pacific Region* (WCPFC/PrepCon/WP.9). The document is very comprehensive and provides relevant information on ecosystem and bycatch issues. SCG noted that the report summarizes current thinking on the scientific basis for taking an ecosystem approach to fisheries management with focus on pelagic fisheries in the WCPO.

28. SCG identified the following elements of ecosystem research required for fishery management by the Commission:

4. Impacts of the environment on pelagic fisheries and stocks
    - e.g., large scale work on pelagic ecosystem modelling
    - more local scale ecosystem modelling at national level
5. Impacts of pelagic fisheries on the pelagic ecosystem
    - e.g., SEAOPODYM model, ECOSIM/ECOPATH
    - Noting, these require substantial commitment to collection and analysis of time series data (e.g., stomach contents) on species interactions across WCPO
    - development of new modelling approaches
    - impacts on seamounts
    - marine debris impacts
6. By-catch issues
    - By-catch estimation and fishery impacts relative to other human impacts
    - By-catch mitigation research

29. SCG noted a number of scientific issues related to assessing the effects of the environment on pelagic fish stocks, and the effects of fishing on the environment. SCG advises the Commission to consider specific work plans, and associated costs, to address these issues. In the short-term, the Commission, through its Scientific Committee, should identify data deficiencies that exist to address these issues, and make plans to rectify them. Priorities of ecosystem research need to be reconciled with the need to assess the major tuna stocks.

30. The SCG recognizes the complexity of understanding and modelling the effects of changes in climate and fisheries on pelagic ecosystems, and that the Commission is unlikely to be in position to conduct such research in the near future. The SCG therefore welcomes the new GLOBEC (GLObal OCEan ecosystem Dynamics) initiative in this scientific field, and recommends that the Commission formally express support of this programme (CLIOTOP, e.g. CLimate Impacts on Oceanic TOp Predators).

31. SCG identified the following ecosystem and bycatch related research that is currently underway: Spatial ecosystem and population dynamics modelling (SEAPODYM); tuna meta-population abundance and size structure as indicators of ecosystem impacts of fishing; individual/agent-based modelling of fish, fishers and turtles; regime shifts in the WCPO and its tuna fisheries; fish bycatch in tuna longline fisheries; incidental catch of sharks, seabirds and sea turtles in tuna longline fisheries.

Stock assessment research

32. SCG discussed stock assessment planning for 2005, and noted the desirability for having stock assessment available for all tuna species in 2005. In the event that this is precluded by limited resources, the SCG recommends the following priority for the major tuna assessments 2005: 1. Bigeye – including a Pacific wide assessment in collaboration with IATTC; 2. South Pacific Albacore and/or Yellowfin; and 3. Skipjack.

33. SCG recognizes that biological studies and assessing the status of billfish stocks within the Pacific are important issues for the Commission. Blue marlin is considered as a high priority to be assessed because of concerns about the stock being fully exploited and as it thought to be a single stock in the Pacific. The SCG notes the existence of multiple stocks of some billfish species within the Pacific and regional differences in the priorities among member states makes it difficult to determine a single set of priorities for assessing billfish species at this time. Nevertheless, the SCG encourages member states to cooperate on carrying out billfish assessments.

Agenda 6. Advice on data standards and other data related issues for the Western and Central Pacific region

34. The report of a meeting of the SCTB17 Statistics Working Group to consider anticipated data-related tasks for the Commission's Scientific Committee, and two working papers presented at the meeting, were presented to SCG.

34. SCTB17 WP SWG-8, entitled *Legal aspects governing fisheries data*, describes the international legal obligations in respect of the collection, compilation and dissemination of fisheries data by the Commission. These include the obligation on members of the Commission to collect and provide certain specified data to the Commission, consistent with Annex I of the UN Fish Stocks Agreement and as required by the Commission (under Article 23). The roles of the Commission, the Secretariat and the Scientific Committee in respect of data are discussed. Other considerations include the capacity of small island developing States and territories to meet their obligations and the role of the Commission in respect of this under Article 30(4); the area of application of data standards; and the obligation to cooperate with other organizations.

35. SCTB17 WP SWG-6, entitled *Information regarding anticipated data-related tasks for the WCPFC Scientific Committee*, discusses data standards and other data-related issues. The working paper, which contains seven appendices containing relevant texts and a comprehensive list of references, with web links, is intended to be a reference document for use by the Scientific Committee, based on the experience accumulated by the SCTB over the 17 years of its existence. The list of tasks was developed with the Scientific Committee in mind; however, certain of the tasks could be addressed by the Commission's secretariat or the scientific experts engaged under Article 13, rather than the Scientific Committee. The manner in which the tasks could be addressed, such as by resolutions of the Commission or otherwise, will be determined by the Commission.

36. SCG noted that many of the data-related tasks for the Commission's Scientific Committee are listed in WP SWG-6, specifically:

- Draft the terms of reference of the Statistics Working Group
- Draft a resolution on the scientific data to be provided by members of the Commission under Article 23 of the Convention
- Draft a resolution on the principles and procedures for the dissemination of scientific data by the Commission
- Advise the Commission regarding the contents of an annual report on the status of the collection, compilation and dissemination of data to be provided by the Commission's data managers

- Monitor the status of data collection in the Philippines and the Pacific Ocean waters of Indonesia
- Develop a strategy for improving the capacity of members to meet the data requirements of the Commission
- Establish standards for the collection of scientific data, including operational catch and effort data, port sampling data and observer data
- Advise the Commission regarding the scientific aspects of the regional observer programme to be developed under Article 28 of the Convention
- Establish procedures for evaluating the quality of the scientific data compiled by the Commission
- Harmonies data collection standards for the Western and Central Pacific Ocean and the Eastern Pacific Ocean in collaboration with the Inter-American Tropical Tuna Commission
- Establish an agreement on the exchange of tuna fisheries data between the Inter-American Tropical Tuna Commission and the Commission
- Harmonies the procedures for the compilation and dissemination of data by the Commission and the Interim Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean
- Recommend that the Commission become a member of the Coordinating Working Party on Fishery Statistics
- Recommend that the Commission become a partner in the Fisheries Resources Monitoring System

37. Other major issues raised during the Statistics Working Group discussions concerned:
- The criteria defining public domain data and the confidentiality of data,
- The use of catch verification schemes to check and improve the quality of fisheries data;
- The treatment of joint-venture of charter vessels in regard to the nationality of the catch and obligations for the provision of catch data.

38. The major issues raised during SCG discussions included criteria defining public domain data; confidentiality of data; the geographic area for which data should be compiled by the Commission; the need for the best scientific data; the use of data by the Commission for compliance purposes; and the need to avoid burdening developing states in regard to data.

39. The major issues raised during SCG discussions concerned:
- The criteria defining public domain data and the confidentiality of data;
- The geographic area for which data should be complied by the Commission;
- The need for the best data achieved through improved data management and data collection processes~~;~~
- The need to avoid burdening developing states in regard to data requirements;
- The need to improve the status of data collection in the Philippines and Indonesia;

40. The SCG3 recommended that the Commission take into consideration the following when it establishes data-related policies and develops work programmes:
- SCTB17 WP SWG-8 (legal aspects governing fisheries data);
- SCTB17 WP SWG-6 (information regarding anticipated data-related tasks for the WCPFC Scientific Committee);
- The report of the Statistics Working Group meeting to consider anticipated data related tasks for the Commissions Scientific Committee;
- This report of SCG 3.

Agenda item 7. Identification of Specialist Working Groups of the Scientific Committee

41. At PrepCon VI, WG.II noted (WCPFC/PrepCon/38) that the Scientific Committees' Specialist Working Group's are expected to be similar to those of the current SCTB working groups. This issue was discussed by SCTB17 and further reviewed by SCG 3.

42. The SCG agreed that the current structure of WGs used in SCTB17 is very effective and was an improvement over previous structures. To minimize costs and promote effective participation of developing states and territories, meetings of the SWGs should be held in conjunction with SC meetings. SCG also noted that the process works best when the chairs of the WGs work as a team in steering and coordinating their activities during the period between meetings.

43. The SCG recommended that the following SWGs be established as subsidiary bodies of the Scientific Committee. A brief outline of the types of work each group might cover is given below, acknowledging that the SC is responsible for the development of the terms of references of the SWGs.

- Stock assessment - reviews recent developments in fisheries including trends in catch and effort, with emphasis on four major tuna species, including key attributes of the stock, trends in catches, CPUE, fish size, and information on recruitment, biomass, fishing mortality and stock status
- Statistics - to coordinate the collection, compilation and dissemination of fishery data for all major gear types and fleets.
- Methods - reviews statistical, analytical and modelling approaches and seeks to identify ways to improve stock assessments.
- Fishing Technology - reviews developments with respect to fishing vessel, gear and operational procedures in order to characterize changes in fleets and gear and to provide data to inform a range of topics such as the standardization of CPUE, and evaluating changes in fishing efficiency.
- Biology - reviews studies of basic biology (including growth, mortality, etc) of the key stocks of tuna, billfish, other highly migratory species, especially with respect to biological studies supporting stock assessment.
- Ecosystem and Bycatch - includes ecosystem modelling and bycatch research, with particular attention to bycatch mitigation, effects of fishing on species other than the main tuna target species as well as studies of the effect of environment on highly migratory fish stocks.

44. The SCG recognised the important scientific contributions of the SCTB over the past 17 years to the development of an understanding of the fishery resources of the Western and Central Pacific Ocean, and the contribution made by the SCTB to the PrepCon.

45. The delegation of Korea, on behalf of the SCG, thanked the Chairman (Dr. Yuji Uozumi) and Secretariat (Chris O'Brien) for their work in the SCG process. Thanks were also conveyed to the Marshall Islands for their generosity, hospitality and tireless support over the course of the meeting.

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Annex I

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Annex II

AGENDA

1. Introductory remarks
2. Review of the updated stock status statements for the major target species
3. Response to the requests from PrepCon VI.
4. Discussion of the nature and extent of work required to develop management scenario models, for example development of operating models.
5. Provision of advice on ecosystem, bycatch and other scientific issues.
6. Advice on data standards and other data related issues for the Western and Central Pacific Region
7. Identification of Specialist Working Groups of the Scientific Committee.
8. Adoption of the report of SCG 3
9. Adjournment.

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Annex III

SCTB17 STOCK STATUS SUMMARIES

Given the length of the SCTB17 Executive Summary it is not attached to this (SCG 3) report. Readers can obtain a copy of the SCTB17 Executive Summary from
http://www.spc.org.nc/oceanfish/Html/SCTB/SCTB17/Execsum.pdf

In the summary, the relevant excerpts are:

Annex IV

REVIEW OF THE TECHNICAL FEASIBILITY OF PROVIDING ANALYSES OF MANAGEMENT OPTIONS

INTRODUCTION

This paper provides information to be considered by SCG 3 under Agenda item 3 *Response to the requests from PrepCon VI*. Based on the annotated Agenda for SCG 3, the specific task under this agenda item is:

"Advise on the further analyses to support the consideration by PrepCon VII and the first session of the Commission of management options and how these analyses can carried out in a timely and effective manner.

> Following a discussion of the paper entitled Management options for bigeye and yellowfin tuna in the western and central Pacific Ocean (WCPFC/PrepCon/WP.24), PrepCon VI, had decided that further analysis to support consideration by PrepCon VII and the first meeting of the Commission of management options in two broad groups (national capacity, catch and effort limits and a range of technical measures) should be undertaken. Therefore, PrepCon VI requested SCG 3 to provide advice, through the Interim Secretariat, on the analyses that should be undertaken and how these analyses can be carried out in a timely and effective manner [emphasis added]. Based on the updated stock status of these two species which will be obtained thorough SCTB17, SCG 3 will discuss the technical points of the further analyses which will provide information for consideration of management options (see Appendix)."

EXPLANATORY NOTES

1 This paper describes the data/information and analyses required to quantitatively evaluate the possible effects of various management options described in WCPFC/PrepCon/WP.24. **The operational feasibility of these options in not considered in this paper**.

2 Many of the analyses require management direction before they can be undertaken. Furthermore, quantitative evaluation of the effectiveness of a given management option will require determination of benchmarks/targets/reference points against which to evaluate the effectiveness of the criteria, e.g. future biomass, fishing mortality against some value.

3 While many analyses are feasible in the immediate term some are not due to data limitations. For those options for which analyses are not immediately feasible, analyses could be undertaken using estimated data, but the reliability of such analyses would be lower. Nevertheless, these analyses maybe feasible in the long term if the necessary data are collected. The following feasibility statements are used in this paper:

- Analysis is feasible in the immediate term
- Analysis is feasible in the immediate term contingent on management advice
- Analysis is not feasible in the immediate term due to data limitations, but maybe feasible in the long term.

4 Many management options could cause changes in fishing behaviour that may be difficult to predict and therefore quantify. Notwithstanding this, analyses should include a scenario reflecting non-compliance.

5 Analyses should be undertaken using a model-based approach to allow integration of population dynamics into the evaluation of management options. A range of models could be considered, but the analysis of some options will require particular model structures, e.g. spatial stratification or age-structure. A critical assumption for such analyses will be future levels of recruitment, this and other important modelling assumptions are described in the "No controls" section. It should be noted that currently, estimates of stock status for most of the species are obtained from MULTIFAN-CL (MFCL), but while there are obvious benefits in using the same model to evaluate management options, analyses using MULTIFAN-CL can be time consuming.

6 No distinction is made between purse-seine and longline management options except where such options can only apply to a single fleet. Many of the options could be also applied to other gear types.

7 Though the management measures are directed at bigeye and yellowfin, analyses may include estimates of the effects of measures on catches of other important species (e.g. skipjack, species of special concern).

8 Some useful analyses, for example, an analysis of the characteristics (e.g. vessel details, fishing strategies) of top bigeye or yellowfin-catching vessels, could provide information in support of the analysis of a range of management options.

9 The definition of FADs is taken from WCPFC/PrepCon/WP.24. "*Unless otherwise indicated a reference to FADs includes all types of floating objects, natural and artificial*."

NO CONTROLS
No attempt to control fishing mortality

Management option	**Data/Information required**	**Analyses required**	**Comments**
Status-quo: No attempt is made to control fishing mortality **Analysis is feasible and could represent an analysis against which other analyses are compared.**	Recent estimates of catch and effort for each fishery.	The current MFCL assessment can provide projections based on recent catch/effort levels. Other model(s) could be used and not necessarily be restricted to the current fishery definitions in the MFCL assessment	Full catch and effort data can take up to 18 months to be submitted. Complete catch and effort data are currently available up to 2002. MFCL may need to be modified to allow evaluation of catch projections. Important considerations will include: • Will catch/effort remain at recent levels or follow recent trends, • Will future recruitment be at recent, average, or some other level. • Selectivity/catchability assumptions • Biological parameters.

OUTPUT CONTROLS

Output controls aim to control the total catch directly by setting an upper limit on catch.

Management option	**Data/Information required**	**Analyses required**	**Comments**
Catch limits (a): Competitive overall or regional catch limits. **Analysis is feasible in the immediate term contingent on the provision of information on: overall or regional catch limits.**	Distribution of the catches among fisheries, i.e. methods and regions. Definition of regions if necessary, e.g. MFCL region, 10x10° grid etc. Proposed overall or regional catch limits	Undertake projections with MFCL with the revised catch/effort levels. Other models could be used and not necessarily be restricted to the current fishery definitions in the MFCL assessment, but such a model would require spatial stratification to accommodate regional catch limits	The spatial stratification of the MFCL model may need to be revised to reflect regional limits. Modification of the spatial stratification of the MFCL model would require rerunning the model and the stock assessment results (i.e. estimates of stock status) could change. Scenarios should be evaluated against similar spatial stratifications.
Catch limits (b): Allocated overall or regional catch limits. **Analysis is feasible contingent on the provision of information on: overall or regional catch limits.**	As above	As above	As above
Catch limits (c): Trip/Vessel/Country Limits **Analysis is not feasible** but maybe feasible in the long term.**.**	Annual catches by vessel. Proposed catch limits.	Estimate, for a given limit, how catches could be reduced for each fishery, i.e. how much catch was taken historically taken in excess of the annual catch limit. Undertake projections with MFCL with the revised catch/effort levels. Other models could be used and such models could require the specification of fleets and age/size structure.	Data is limited by logsheet return rates and observer coverage. Analyses relating to Trip level limits are described in the section on Fish Hold Limits. Analyses relating to Country Limits are described in the above sections.

INPUT CONTROLS

Input controls directly restrict one or more of the group of inputs (e.g. vessels, gear, fishing time) which, in combination, produce total fishing effort and, ultimately, catch.

Management option	Data/Information required	Analyses required	Comments
Capacity (a): Limit/restriction on the number of vessels. This could be general reductions or directed at those fleets catching most bigeye and yellowfin. **Analysis is feasible contingent on the provision of information on: number and type of vessels**	Estimates of annual catches, effort, and areas fished by each vessel, particularly those vessels that may, as a result of such restrictions, no longer fish in the WCPO. Proposed number of vessels.	Estimate, based on historical data for a relevant period, reductions in catch/effort by the exclusion of a given number of vessels of a given class. Undertake projections with MFCL with the revised catch/effort levels. Other models could be used and such models could require fleet stratification.	Data is available for many vessels from the FFA regional vessel register: • All DWFN purse-seine and longline vessels fishing in FFA member countries waters. • Does not include all domestic longline vessels • Does not include vessels fishing in the waters of non-FFA member countries or the high seas. Domestic vessel registries exist for many Pacific Island Countries and Territories, but the data content is often less than the FFA register.
Capacity (b): Limit size or power of vessels **Analysis is not feasible due to data limitations, but maybe feasible in the long term.** **.**	Estimates of the number of vessels by size/power class. Estimates of CPUE by vessel size/power classes. Proposed vessel classes and limits.	Estimate, based on historical data for a relevant period, the reductions in effective effort that would have occurred based on the exclusion of certain classes of vessels. Undertake projections with MFCL with the revised catch/effort levels. Other models could be used and such models could require fleet stratification.	See above for details of availability of vessel data. CPUE data is limited by logsheet return rates and observer coverage.
Capacity (c): Limit size of fish hold. **Analysis is not feasible due to**	Estimates of the number of vessels by fish hold size class. Estimates of trip-level catches by vessel, in particular comparisons of trip-level	Estimate, for a given limit, how catches could be reduced for each fishery, i.e. how much catch was taken historically taken in excess of the fish hold limit.	Trip-level catch data are limited by logsheet return rates, observer coverage, and port sampling. There is currently limited data for

Management option	Data/Information required	Analyses required	Comments
data limitation, but maybe feasible in the long term.	catches to fish hold size. Proposed fish hold limits	Undertake projections with MFCL with the revised catch/effort levels. Other models could be used and such models could require the specification of fleets and age/size structure.	fish hold capacity. This analysis might consider whether vessels can maintain catches through increasing the number of trips. This analysis of this measure is essentially the same as required to analyse trip limits.
<u>Total effort limits:</u> Setting overall or regional limits for some measure of effort (e.g. sets, hooks, days fished). **Analysis is feasible contingent on the provision of information on: overall or regional effort limits.**	Estimates of the current distribution of effort (in the same units as proposed). Proposed overall or regional effort limits.	Calibration of effort used in the assessment model to units of effort proposed for the limit. Undertake projections with MFCL with the revised catch/effort levels. Other models could be used but would require fleet stratification and spatial stratification to accommodate regional effort limits.	Data is limited by logsheet return rates and observer coverage. Require details of overall or regional effort limits. The spatial stratification of the MFCL model may need to be revised to reflect regional limits.
<u>Area/seasonal closures:</u> Restricting fishing effort in particular area/seasonal strata **Analysis is feasible contingent on the provision of information on: the area/seasonal closures.**	Catch and effort data by area/season strata. Proposed areas/seasons where fishing effort will be restricted.	Calculate the effort that would occur in each area/season strata in the presence of a given closure, e.g. no effort in closed areas and perhaps increased effort in other regions. Exploratory analyses of catch hotspots including the consistency of such regions from year to year, particularly incorporating information on broad-scale environmental effects. Undertake projections with MFCL with the revised effort levels. Other models could be used but would require spatial stratification.	Data is limited by logsheet return rates and observer coverage. The spatial stratification of the MFCL model may need to be revised to reflect area closures. Important considerations will include the reallocation of effort. Options include: • No reallocation of effort, • Effort reallocated to open areas Such an analysis could include other species (e.g. skipjack, species of special concern).

Management option	Data/Information required	Analyses required	Comments
			Details of licence/access agreements could be useful in determining how fleets could reallocate their effort to other regions.

TECHNICAL MEASURES

Technical measures are used to regulate the output that can be obtained from a specific amount of effort. Such measures generally attempt to influence the way fishing is conducted and the efficiency of the fishing gear (FAO 1997) to achieve a specific purpose in a given fishery.

Management option	Data required and availability	Analyses required	Comments
Gear restrictions (a): Restrictions on various gear configurations (e.g. net size/depth, longline length) **Analysis is not feasible due to data limitation, but maybe feasible in the long term.**	Estimates of the proportion of the fleets using various gear configurations. Estimates of the CPUE attained by vessels using various gear configurations. Proposed gear configuration restrictions.	Estimate the proportional reduction in effective effort for various fisheries due to this restriction based on an analysis of historical data for a relevant period. Undertake projections with MFCL with the revised effort levels. Other models could be used but would require fleet stratification.	Data is limited by logsheet return rates and observer coverage. These data are less complete than simple catch and effort data.
Gear restrictions (b): Method restrictions (e.g. time of set, soak time) **Analysis is not feasible due to data limitations, but maybe feasible in the long term.**	Distribution of sets by time of day. Estimates of catch per set for different time periods. Proposed gear configuration restrictions.	Estimate the proportional reduction in catches that would occur by setting at different times based on an analysis of historical data for a relevant period. Convert this catch reduction to an effort reduction. Undertake projections with MFCL with the revised effort levels. Other models could be used but would require fleet stratification.	Data is limited by logsheet return rates and observer coverage. These data are less complete than simple catch and effort data. Data could be uncertain due to alternative interpretations of set time.
Size restrictions: Limits on the sizes of fish that can be retained. Compulsory retention (no discards allowed). **Analysis is feasible contingent**	Estimates of the sizes of fish caught by different fleets. Including the size distribution of fish in individual sets/fishery operations. Estimates of catch rates of all species to which retention could apply.	The selectivity of the fisheries estimated within the model can be modified to reflect the effects of changes in the sizes of fish caught. Undertake projections with MFCL with the revised selectivity curves fixed levels. Other models could be used but would require age/size and fleet stratification.	Data is limited by logsheet return rates, observer coverage, and port sampling. Data are sometimes confounded due to moving of the catch among holds within a trip. This analyses would require the definition of new fisheries in the MFCL assessment.

Management option	Data required and availability	Analyses required	Comments
on the provision of information on: size limits and species and fleets to which they apply.	Estimates of the survival probabilities of fish of different sizes caught by different methods. These estimates are dependent on observer estimates and coverage. Proposed size limits and species and fleets to which they apply.		Compulsory retention could be expected to change behaviour which could be difficult to anticipate and incorporate into an analysis. Though it may be possible to measure. Survival probabilities could be obtained from various sources: observer data, studies reported in the literature, informed guesses.
<u>Restrictions on operational efficiency (a):</u> Banning or limiting power of vessel electronics. **Analysis is not feasible due to data limitation, but maybe feasible in the long term.**	Details of the types of electronics used by individual vessels. Catch and effort data for individual vessels. Database to allow characterisation of the capabilities of different electronics. Proposed restrictions on vessel electronic characteristics.	Estimate the "effect" of various measures on CPUE using historical data for a relevant period – perhaps using GLM approaches. Use the estimated effects to determine the reduction in effective effort. Undertake projections with MFCL with the revised effort levels. Other models could be used but would require fleet stratification.	Some relevant data is available for vessels on the FFA regional vessel register and from observer data. Data is often collected by make/model rather than capability. Would require assumptions about the types of electronics that would be used instead.
<u>Restrictions on operational efficiency (b):</u> Restrictions on auxiliary vessels, e.g. tender vessels or light vessels. Regulations on transhipment. **Analysis is not feasible due to data limitation, but maybe feasible in the long term.**	Details on which vessels use auxiliary vessels and over which periods. Catch and effort data for individual vessels. Proposed restrictions on auxiliary vessels.	Estimate the "effect" of auxiliary vessels on CPUE or catches using historical data for a relevant period. Use this to determine the reduction in effective effort. Undertake projections with MFCL with the revised effort levels. Other models could be used but would require fleet stratification.	Limited information could be obtained from observers. Data availability probably poor.
<u>FAD restrictions (a):</u> Prohibition of FAD sets on a time	Estimates of the number of FAD sets by type and area.	Undertake projections with MFCL with the revised effort levels for the FAD fisheries reflecting these restrictions.	Data is limited by logsheet return rates and observer coverage.

Management option	Data required and availability	Analyses required	Comments
and/or area basis. Restrictions of the number of sets allowed on FADs. **Analysis is feasible contingent on the provision of information on: areas/seasons where FAD sets will be restricted and the specific FAD types.**	Proposed areas/seasons where FAD sets will be restricted and the specific FAD types.	Other models could be used but would require fleet and possibly spatial stratification.	This analysis will be similar to analyses examining general time/area closures. Important considerations will include the reallocation of effort. Options include: • Effort reallocated to open areas • Changes from FAD sets to other set types
<u>FAD restrictions (b):</u> Limit number of FADs deployed **Analysis is not feasible due to data limitation, but maybe feasible in the long term.**	Details of the numbers of and FADs deployed by individual vessels. Catch and effort for individual vessels. Proposed definitions for what constitutes a FAD deployment.	Estimate the "effect" of the number of FADs deployed on CPUE or catches using historical data for a relevant period. Use this to determine the reduction in effective effort. Undertake projections with MFCL with the revised effort levels. Other models could be used but would require fleet stratification.	Data is limited by logsheet return rates and observer coverage. Very little data is available, but some is held by individual countries.
<u>FAD restrictions (c):</u> Regulations on the design of FADs **Analysis is not feasible due to data limitation, but maybe feasible in the long term.**	Details on characteristics of FADs by individual vessels. Catch and effort data for individual vessels. Proposed restrictions on FAD design.	Estimate the "effect" of FAD characteristics on CPUE using historical data for a relevant period – perhaps using GLM approaches. Use this to determine the reduction in effective effort. Undertake projections with MFCL with the revised effort levels. Other models could be used but would require fleet stratification.	Almost no information on the characteristics of FADs used.

Annex V

A MANAGEMENT STRATEGY EVALUATION APPROACH USING OPERATIONAL MODELS

A harvest strategy or management procedure is a set of rules used to determine a management action (Butterworth et al. 1997, Cooke 2003). The set of rules should define the data to be collected from the fishery, how those data are to be analysed, and how the results of the data analyses are to be used to determine actions (Cochrane et al. 1998). Harvest strategies may be very simple (e.g. a constant catch/effort strategy) or extremely complicated (such as the determination of annual *TACs* based on the outcomes of a stock assessment and a set of performance based decision rules).

Before any harvest strategy is adopted it should be evaluated against how well it is able to satisfy the management objectives for the fishery. An approach that has been developed to do this is known as Management Strategy Evaluation (MSE; Smith 1994, Punt et al. 2001). The primary goal of the MSE approach is to identify, in an objective and quantifiable manner, the trade-offs among the management objectives across a range of management actions.

The MSE approach involves the following five basic steps:

1) Identification of the management objectives and representation of these using a set of quantitative performance measures (see note below).

2) Identification of alternative harvest strategies and decision rules.

3) The development and parameterization of a set of alternative operating models which have the following components.
   a. Models that simulate the fish population and fishery dynamics. These models can be used to simulate various hypotheses about the spatial structure, movement dynamics and biology of the resource and, as such, are used to represent the alternative realities in the calculations. A component is also required to determine a range of initial starting values for the operating model that are consistent with the available historical information on the resource. This process is referred to as conditioning.
   b. A sampling model that generates the time series of future data (catch, size, tag returns, etc) which is then used for assessing the status of the resource from the 'true' state of the resource as simulated in the operating model.
   c. An assessment model that uses the data from the sampling model to provide estimates of resource status.
   d. A harvest strategy component that determines management actions (e.g. setting a TAC or TAE) based on the results of the assessment model and the specified decision rules.

4) Simulation of the future using each harvest strategy to manage the system and each set of assumptions about the dynamics of the resource.

5) The development of summary measures to quantify the performance of each harvest strategy relative to the management objectives of the fishery.

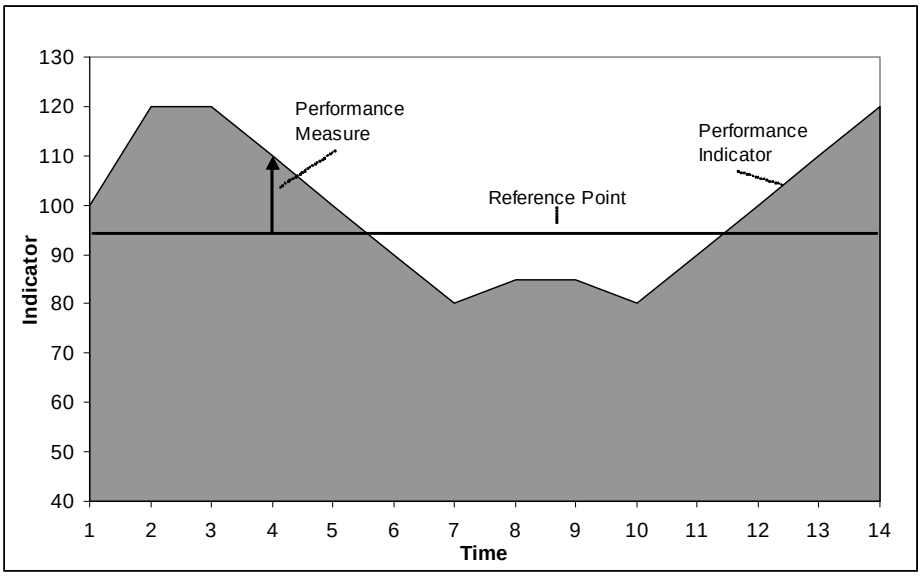
The operating model, which is central to the MSE approach, is a mathematical or statistical representation of the population dynamics of the fishery being studied. The operating model is used to generate

observations in the form of pseudo catch, effort and catch-at-size data sets which are then used in the management procedure. Several operating models are usually considered because the true situation for any fishery is never well known, and a broad range of input parameter values thus needs to be examined to ensure the full range of possible resource and fleet dynamics are covered. In this manner, each operating model can be considered as reflecting an alternative (yet plausible) representation of the status and productivity of the resource and the fishing dynamics of the fleets.

Another key feature of the MSE approach is that it can be used to identify robust harvest strategies in light of the uncertainties in the information available for managing fish resources. This is achieved by incorporating into the operational models not only the uncertainty in the underlying dynamics of the resource in response to management actions, but also the uncertainty in the methods and data used to assess the status of the resource, and uncertainty in the ability to implement management actions. As such, the approach is based on recognition that it is the combination of the uncertainties about the dynamics of the system being managed, plus the ability to measure relevant information about the system, that determines the performance and robustness of a management decision-making framework.

Note: Performance Indicators and Measures
A performance indicator conveys information about some aspect of the system under study (e.g. the biomass of the swordfish population in the SW Pacific) while a performance measure conveys information about how well the system is performing relative to some management objective (e.g. it compares the performance indicator with some reference value or benchmark, say 30%B_o). Performance indicators are usually based on quantities estimated during the assessment and are generally useful only if a stock assessment method can estimate them reliably.

Figure 1. *Schematic representation of the relationship between a performance indicator and associated performance measures and reference point.*



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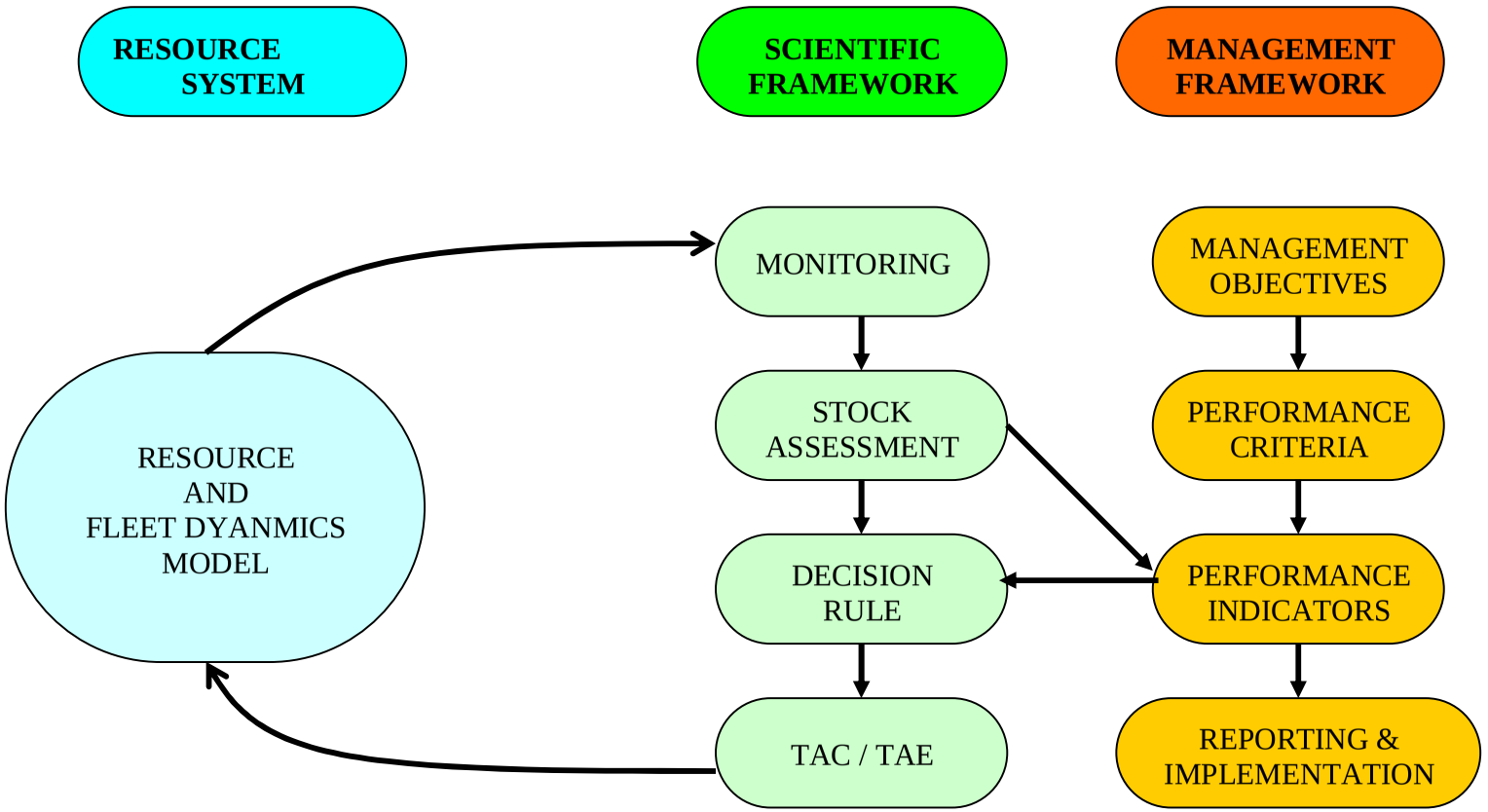
RESOURCE SYSTEM
SCIENTIFIC FRAMEWORK
MANAGEMENT FRAMEWORK
MONITORING
STOCK ASSESSMENT
DECISION RULE
TAC / TAE
RESOURCE AND FLEET DYANMICS MODEL
MANAGEMENT OBJECTIVES
PERFORMANCE CRITERIA
PERFORMANCE INDICATORS
REPORTING & IMPLEMENTATION

Annex VI

ABBREVIATIONS AND ACRONYMS USED IN THIS REPORT

$B_{current}$	Current biomass
B_{MSY}	Biomass that will support the maximum sustainable yield
CPUE	Catch Per Unit Effort
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
EEZ	Exclusive Economic Zone
FAD	Fish Aggregating Device
$F_{current}$	Current Fishing Mortality
F_{MSY}	Fishing Mortality that will support the maximum sustainable yield
mt	Metric tonnes
OFP	Oceanic Fisheries Programme Fishing Programme (run by SPC)
PrepCon	Preparatory Conference
SCTB	Standing Committee on Tuna and Billfish
SCG	Scientific Coordinating Group
SPC	Secretariat of the Pacific Community
WG	Working Group
WG.II	Working Group II of the PrepCon
WCPFC	Western Central Pacific Fisheries Convention
WCPO	Western Central Pacific Ocean
MSY	Maximum Sustainable Yield
UNFSA	United Nation Fish Stocks Agreement