Annex 8

REPORT OF THE ALBACORE WORKING GROUP WORKSHOP

International Scientific Committee for Tuna and Tuna-like Species
In the North Pacific Ocean

20-22 April 2015
National Research Institute of Far Seas Fisheries
Shimizu, Shizuoka, Japan

1.0 OPENING OF THE WORKSHOP

An intersessional workshop of the Albacore Working Group (ALBWG or WG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was convened at the National Research Institute of Far Seas Fisheries (NRIFSF), Shimizu, Shizuoka, Japan. The ALBWG has been tasked with developing a management strategy evaluation (MSE) process for north Pacific albacore tuna (NPALB) to address both scientific and management questions. The goal of this workshop is to undertake discussions supporting the development of a framework for the MSE process. Specific objectives of this workshop were: (1) What are we planning to do? Define the MSE process (aspirational goals and operational objectives) and preliminary design considerations; (2) How do we implement the plan? For example, software environment; (3) Who does what? Work assignments, discussion of who will do the work (e.g., post-doc); (4) When are we doing it? Timelines and milestones; and (5) What do we need from managers? Engagement with managers on goals for the stock, harvest strategies, reference points (and certainties), etc.

Dr. Hideki Nakano, Deputy Director-General of NRIFSF, welcomed nine participants (Attachment 1) to NRIFSF and wished them a productive meeting. He noted that this meeting was occurring at NRIFSF in parallel with a Pacific Bluefin Tuna Working Group (PBFWG) pre-assessment workshop. Scientists from Canada, Chinese Taipei, Japan, the United States of America (USA), and the Secretariat of the Pacific Community attended the workshop. Members from Mexico, Korea, and the Inter-American Tropical Tuna Commission sent their regrets.

This report is a record of discussions and proposals of the ALBWG during the first of many workshops aimed at the development a management strategy evaluation (MSE) process for north Pacific albacore tuna (NPALB). The resulting proposals are an initial attempt by the ALBWG to provide some definition to management objectives, performance criteria and key areas of uncertainty for the MSE process. These proposals (see Appendix 4) are intended to facilitate discussion and engagement with stakeholders (managers, industry and others) and are a necessary precursor for the development of consensus on the scope of the MSE process under development.

2.0 MEETING LOGISTICS

2.1 Meeting Protocol

The ALBWG Chair briefly described the goals of the meeting and the expected outcomes. He noted that this mini-workshop was the first in series of workshops supporting the MSE process. The primary output from this workshop are the proposals for consideration in Attachment 4.

2.2 Review and Adoption of Agenda

The draft agenda was revised and adopted at the workshop (Attachment 2).

2.3 Assignment of Rapporteurs

Rapporteuring duties were assigned to Chiee-Young Chen, John Holmes, Hirotaka Ijima, Hidetada Kiyofuji, Sam MacKechnie, Keisuke Satoh, Robert Scott, Steve Teo, and Vidar Wespestad. John Holmes had the overall responsibility for assembling the report.

2.4 Distribution of Documents and Working Paper Availability

An information paper describing some of the issues that will need to be addressed by the ALBWG in developing an MSE process, was submitted by Japan (Attachment 3). This paper will be publicly available through the ISC website (http://isc.ac.affrc.go.jp/).

3.0 WHY ARE WE DEVELOPING AN MSE PROCEDURE?

The WG discussed the context behind the task to develop an MSE procedure. It was noted that a proposal submitted to the 87th meeting of the IATTC by the US (IATTC-87-PROP-J-1) formed the basis for WG discussion on MSE in July 2014. The benefits and costs of conducting MSEs were also discussed by the 14th Plenary Session of the ISC, which recognized that MSE was a useful tool for addressing a range of scientific and management questions, that NPALB might be a good candidate for MSE, and that all WGs should consider developing an MSE framework. However, it was noted that developing and implementing MSE requires close collaboration between scientists, managers, industry, and other stakeholders.

A management framework for NPALB that specifies fishery goals, a limit reference point (LRP), and a harvest rule when the LRP is breeched, was adopted during the 10th Regular Session of the Northern Committee (NC 2014). NC10 requested that the ISC evaluate suitable target reference points for north Pacific albacore tuna, using MSE if appropriate. The ALBWG is expected to present a progress report on MSE development and request input from managers at NC11.

Finally, the WCPFC has adopted CMM-2014-06 which specifies that a harvest strategy approach will be developed and implemented for each of the key fisheries or stocks under the purview of the Commission, including north Pacific albacore tuna. The Northern Committee will develop and recommended timeframes and harvest strategies for stocks which occur mostly in the area north of 20°N. CMM 2014-06 defines a harvest strategy as a framework that specifies pre-determined management actions in a fishery for defined species (at the stock or management unit level) necessary to achieve agreed biological, ecological, economic and/or social management objectives. Each harvest strategy is expected to contain, wherever possible and where appropriate, six elements including management objectives, reference points, acceptable levels of risk, a monitoring strategy, harvest control rules, and management strategy evaluation. Thus, the MSE process developed by the ALBWG will support the development of a harvest strategy approach for NPALB.

Although MSE is a tool to evaluate management questions and strategies, it was observed that the ALBWG could use MSE to address scientific questions as well. Three potential scientific issues that could be explored in an MSE framework were identified as key uncertainties in the 2014 assessment: (1) spatial structure in the stock, (2) regional and or sex-specific differences in growth, and (3) the use of out-dated estimates of natural mortality and maturity.

Management questions that could be addressed by MSE include the identification of suitable target and limit reference points, the definition of current effort (e.g., as used in existing NPALB CMMs), the impact of information gaps on achieving objectives (e.g., assuming size of fish caught in some fisheries), and directed or albacore-targeting fisheries versus bycatch fisheries.

4.0 WHAT ARE WE DOING?

The ISC charged the ALBWG with developing an MSE framework for NPALB at ISC14 and this charge was endorsed by NC10, which requested that the ISC use MSE, if appropriate, to evaluate potential target reference points. IATTC scientists have ongoing MSE projects for bigeye tuna and dorado and are interested in collaborating with the ISC on MSE process for Pacific bluefin tuna and north Pacific albacore tuna.

The ALBWG discussed a MSE framework with the goal of developing a process for evaluating the performance of alternative management procedures (MPs) for NPALB against a range of scenarios that encompass observation (data) and process uncertainty in stock assessments and management, and alternative hypotheses about stock dynamics and structural assumptions. This framework is intended to provide direction in the development and implementation of the MSE.

The WG briefly discussed the aspirational goals and operational objectives for north Pacific albacore tuna. Aspirational goals are relatively broad, qualitative policy statements about overall management and tend to reflect broad regional, national, or international goals. For example, a statement such as manage north Pacific albacore using the best available science in a precautionary manner, is an aspirational goal. It provides direction to scientists but does not specify how to achieve these aims. Operational objectives translate broad policies statements into a quantifiable criteria that define acceptable fishery performance. Operational objectives are comprised of three components:

1. a target or threshold value for a given quantity (e.g., abundance, inter-annual variation in catch, etc.);
2. a time horizon over which to measure the value; and
3. an acceptable probability of either achieving the target or avoiding a threshold.

The WG noted that existing CMMs and other documents from the IATTC and WCPFC provide some information on aspirational goals for the NPALB stock. Translating these statements into operational objectives for MSE will require engagement with all stakeholders (scientists, managers, industry, others).

The WG also discussed harvest control rules (HCRs). The existing rule in place, based on the CMMs, is "no increase in effort beyond current levels". It was noted that NC has defined current level as the average of effort in a fishery from 2002-2004. The US MSE proposal to the IATTC also contained some HCRs that should be evaluated by the WG. Discussion focused on alternative HCRs such as one based on catch-per-unit-effort (CPUE) as implemented for other species such as southern bluefin tuna. This kind of HCR would speak to socio-economic objectives. However, it was pointed out that CPUE does not necessarily guarantee economic benefits if the amount of catch is greater than demand. The WG noted that CPUE is difficult to use as an objective.

The WG will use MSE to examine alternative inputs, measurement error, and parameters used in the stock assessment model and will develop an operating model that will evaluate responses to changes in model assumptions and test the robustness of the performance of reference points and harvest control rules in meeting management objectives for the stock and fishery. In the course of the MSE the various proposed harvest control rules will be examined in light of management objectives and uncertainties in data and parameter estimates.

4.2 Executive considerations of a management strategy evaluation for the north Pacific albacore tuna (*Thunnus alalunga*) stock. Hirotaka Ijima, Hidetada Kiyofuji and Keisuke Satoh ISC/15/ALBWG-01/01.

Summary – We summarized executive considerations for a management strategy evaluation (MSE) of the north Pacific albacore tuna (*Thunnus alalunga*) stock. MSE requires cooperation between managers and scientists, and they have a different roles in the MSE process. One of the roles of albacore working group (ALBWG) in the process is to develop operation models, which covers fish dependent uncertainties.

Recognition of conceptual overview of the MSE process for the stock, including clarification of definition of technical terms (TRP, LRP and HCR), is important to execute the process.

Discussion – A question was raised as to whether the ALBWG needed to construct a bio-economic model of the north Pacific albacore stock. The management framework recommended by NC10 notes that socio-economic factors will be considered when evaluating target reference points. During the discussion environmental changes and recruitment regime as well as target switching between albacore and skipjack were identified as important uncertainties for the MSE process. It was noted that the flow-chart figure of the MSE process in the working paper was missing the assessment and harvest control rule components and feedbacks. The authors noted that this figure is based on management understanding of the process and that the necessary components would be added to the figure to make it complete.

5.0 KEY ELEMENTS OF AN MSE FRAMEWORK

The WG discussed four key needs for MSE development:

1. a clearly defined set of management objectives;
2. a set of performance criteria for measuring the objectives;
3. management strategies or options for consideration (e.g., harvest control rules); and
4. A method of calculating performance criteria for each strategy or option.

At present, some broad policy goals and proposed harvest control rules have been articulated for the NPALB stock by the IATTC and the WCPFC, but these goals need to be translated into specific, measureable operational objectives for MSE. The WG focused on developing proposals for operational objectives, performance measures for those objectives, and harvest control rules (HCR) as well as identifying important uncertainties for scenario generation and the broad outline of a workplan for MSE development and implementation. A list of uncertainties for scenario generation against which objectives and HCRs will be tested was developed and filtered using plausibility as a criterion to reduce the list to those issues believed to be most influential. These proposals are the first step in seeking feedback from stakeholders to clarify these issues (see Attachment 4).

6.0 IMPLEMENTING THE MSE FRAMEWORK

WG members identified two principles guiding MSE workplan development and framework implementation:

1. Delivering the next stock assessment of NPALB in 2017 is a priority for WG members. Scheduling of the MSE process is a secondary priority; and
2. Present resources are not sufficient to develop and conduct an MSE process and the stock assessment process in parallel. If the MSE process is deemed a high priority by managers and stakeholders, then an ISC member country will have to support the hiring or contracting of a scientist to deliver on MSE commitments in collaboration with the ALBWG.

The details of the MSE framework proposed by ALBWG members will be reported to NC11 using Attachment 4. The WG will request formal feedback from NC/managers at NC11 by March 2016 to give them time to evaluate the WG's proposal and formulate responses. It was noted that during the period between September 2015 and March 2016 it will be difficult to tie down objectives, performance measures, and HCRs for the operating model. There was discussion of how to ensure that the WG receives feedback and that this feedback is received in a usable form. It was suggested that a 1-day workshop be put on at NC11 to avoid the possibility that NC11 will largely ignore the MSE framework paper. In addition, organizing a workshop of scientists and managers in spring 2016 specifically focused on objectives and HCRs for north Pacific albacore was suggested. In both cases, the workshop was

suggested as a tool that might necessitate engagement by managers to provide the feedback needed to make progress on the MSE.

It was noted that an MSE analyst was unlikely to be hired before Jan 2016. The timing of this hiring (or contracting) is one of the biggest risks to the MSE project in terms of finishing in a timely manner. There was also discussion that the prototype operating model (OM) could be available by Jan 2017, which would be ideal, but will depend on when the MSE analyst is hired.

The WG expressed concern about engaging stakeholders in the IATTC for their feedback. This MSE project is pan-Pacific in scope so both RFMOs need to be consulted. It was noted that Carolina Minte-Vera is a WG member and so can provide the views of the IATTC Secretariat. It was suggested that information papers/progress reports be provided to the IATTC Scientific Advisory Committee meetings. The ALBWG Chair was tasked with discussing the issue with the ISC Chair.

7.0 TIMELINES AND MILESTONES

The WG scoped out two timelines for the MSE process: (1) an optimistic timeline, assuming that an MSE analyst will be in place by the beginning of 2016, and (2) a less optimistic timeline, based on the expectation that the arrival of the MSE analyst is delayed relative to the beginning of 2016 (see Attachment 4). Both timelines have stronger engagement with stakeholders in the WCPFC convention area than those in the IATTC. It should be noted that neither of the proposed timelines reflects WG stock assessment activities (i.e., research, data preparation, and assessment meetings).

The MSE process is expected to take a minimum of three years and involve a series of interactions between the WG and managers, industry, and other stakeholders to establish a program that will meet the management goals and objectives of albacore sustainability at prescribed abundance levels. The timeline is dependent on the hiring of a qualified MSE expert dedicated to development of the analysis needed to produce the required models.

8.0 ADMINISTRATIVE MATTERS

8.1 Workplans for 2015-16

1. Fishery update meeting prior to ISC15 Plenary; July 12, 2015, Kona, Hawaii
2. NC11 meeting; 31 August-3 Sept 2015, Sapporo, Japan; ALBWG proposals for MSE presented and feedback requested
3. MSE Workshop on objectives/HCRs; April 2016, Nanaimo, Canada; Assessment model review and preparation for next assessment
4. Data preparation Workshop for 2017 stock assessment; November 2016, La Jolla, USA

8.2 Other Matters

Steve Teo reported that his proposal to develop genetic sex identification markers for albacore tuna was successful in getting funding and is funded for 2 years. This is a collaborative proposal involving WG members from both sides of the Pacific collecting tissues from known sex fish.

Steve Teo also noted that the US recovered an archival tag after 2-3 years at sea. Preliminary analysis shows that this fish, which was tag as a juvenile in the eastern Pacific Ocean, eventually moved to and stayed in tropical waters, presumably to spawn.

9.0 WORKSHOP REPORT CLEARING PROCEDURES

The WG Chair noted that he would prepare a draft report of this mini-workshop a week or two afterwards and would forward it to WG members for review. He asked rapporteurs to forward their notes to him by Friday April 24, 2015. The workshop report will include a document, as an attachment, with proposals on MSE for NC11 intended to begin the feedback process. This document will be finalized in July 2015.

10.0 ADJOURNMENT

The ALBWG meeting was adjourned at 13:30 on 22 April 2015. The WG Chair thanked the host (Drs. H. Ijima, H. Kiyofuji, and K. Satoh, NRIFSF) for their hospitality and overall meeting arrangements, which served as the foundation for meaningful scientific discussion and a productive meeting. He also thanked the scientists participating in the workshop for their attendance and contributions.

ATTACHMENT 1

List of Participants

Canada

John Holmes
Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, BC, Canada, V9T 6N7
Email: john.holmes@dfo-mpo.gc.ca

Chinese Taipei

Chiee-Young Chen
National Kaohsiung Marine University
Department of Marine Environmental Engineering
No. 142, Hai-Chuan Road
Kaohsiung, Taiwan
Email: chency@mail.nkmu.edu.tw

Japan

Hirotaka Ijima
National Res. Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka
Japan, 424-8633
Email: ijima@affrc.go.jp

Hidetada Kiyofuji
National Res. Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka,
Japan 424-8633
Email: hkiyofuj@affrc.go.jp

Keisuke Satoh
National Res. Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka
Japan, 424-8633
Email: kstu21@affrc.go.jp

Secretariat of the Pacific Community

Sam McKechnie
Oceanic Fisheries Programme
CPS,
BP D5
Noumea, New Caledonia, 98848
Email: SamM@spc.int

Robert Scott
Oceanic Fisheries Programme
CPS,
BP D5
Noumea, New Caledonia, 98848
Email: robertsc@spc.int

United States of America

Steven Teo
NOAA/NMFS
Southwest Fisheries Science Center
8901 La Jolla Shores Drive
La Jolla, CA 92037-1508 USA
Email: steve.teo@noaa.gov

Vidar Wespestad
American Fishermen's Research Foundation
American Albacore Fishing Association
21231 8th Pl. West
Lynnwood, WA 98036, USA
Email: vidarw@frontier.com

ATTACHMENT 2

ALBACORE WORKING GROUP (ALBWG)
INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN
INTERSESSIONAL Mini-WORKSHOP

20-22 April 2015

NRIFSF, Shimizu, Shizuoka, Japan

REVISED Agenda

1. Opening of Albacore Working Group (ALBWG) Management Strategy Evaluation (MSE) mini-workshop
    i. Welcoming remarks
    ii. Introductions
    iii. Scheduling
2. Adoption of Agenda and Assignment of Rapporteurs for Workshop Report
3. Why are we developing an MSE procedure?
    i. Tasked by NC/IATTC
    ii. Address scientific questions
    iii. Address management questions
4. What are we doing?
    i. Developing a Management Strategy Evaluation (MSE) Framework for North Pacific Albacore Tuna
    ii. Framework Goal
5. Key Elements of an MSE Framework
    i. Fishery Objectives (e.g., based on IATTC and WCPFC-NC documents)
    ii. Management Procedures (data, assessment, decision rules, e.g., US proposal to IATTC)
    iii. Evaluation (scenarios, simulations, performance criteria/metrics)
    iv. Communication (trade-offs, uncertainty, risk)
6. Implementing the Framework (who and how)
7. Timelines and Milestones for Implementation
8. Administrative Matters
    i. Workplan for 2015-16
    ii. Time and place of next meeting
    iii. Other matters
9. Drafting of workshop report and clearing procedures
10. Adjournment

ATTACHMENT 3

List of Working Papers

WP Number	Title and Authors	Availability
ISC/15/ALBWG-/01	Executive considerations of a management strategy evaluation for the north Pacific albacore tuna (*Thunnus alalunga*) stock. Hirotaka Ijima, Hidetada Kiyofuji and Keisuke Satoh.	ISC Website

ATTACHMENT 4

Proposed Framework for Management Strategy Evaluation

for North Pacific Albacore Tuna

Framework Goal: To develop a process for evaluating the performance of alternative management procedures for north Pacific Albacore Tuna (NPALB) against a range of scenarios that encompass observation (data) and process uncertainty in stock assessments and management, alternative hypotheses about stock dynamics and structural assumptions.

The key components of the framework are: (1) operating models that reflect a range of hypotheses concerning future states of nature, stock dynamics, and biology, (2) alternative management procedures (MP) comprised of data, stock assessment, and harvest control rules (HCR) including the rules in the proposed IATTC resolution and alternatives proposed by the Albacore Working Group (ALBWG), and (3) operational objectives and performance criteria to measure them, including fishery target reference points (TRP) and biological limit reference points (LRP), used to explore the expected performance of alternative management procedures.

Background: The USA submitted a draft resolution in July 2014 for the 87th Meeting of the IATTC (IATTC-87-PROP-J-1-USA-MSE). The resolution proposed that IATTC scientific staff, in collaboration with the ALBWG, evaluate several candidate target and limit reference points and harvest control rules using management strategy evaluation (MSE). This proposal was also discussed by the ISC14 Plenary, which recognized that MSE was a useful tool for addressing a range of scientific and management questions, that NPALB might be a good candidate for MSE, and that all WGs should consider the benefits of developing an MSE framework. Although the US proposal on MSE was withdrawn from consideration at the IATTC meeting, IATTC scientific staff have been engaged in MSE processes for bigeye tuna and dorado and there is ongoing interest in collaborating with the ISC on MSEs for Pacific bluefin tuna and north Pacific albacore tuna.

NC10 recommended the adoption of a management framework for north Pacific albacore tuna that includes some management goals, a limit reference point (LRP), and some decision rules, and requested that the ISC evaluate suitable target reference points for north Pacific albacore tuna, using MSE if appropriate. The Dec 2014 meeting of the WCPFC adopted CMM-2014-06 on developing and implementing harvest strategy approaches for key fisheries or stocks within the purview of the Commission, including NPALB. Key elements of a harvest strategy should include, wherever possible and where appropriate, operational objectives, decision rules, reference points, risk associated with exceeding reference points, and an evaluation of alternative management procedures (MPs) using MSE. Draft timeframes and harvest strategies for stocks which occur mostly in the area north of 20°N will be developed and recommended by the Northern Committee. Thus, the MSE process under development by the ALBWG will support the harvest strategy approach that specifies the pre-determined management actions necessary to achieve biological, ecological, economic and/or social management objectives.

Strengths and Weaknesses of MSE: Management strategy evaluation involves using simulation to compare the relative performance of alternative management procedures (including data collection schemes, analysis and assessment methods and subsequent procedures for management action) in achieving management objectives. In recent years MSE has been widely used in numerous management settings to try to identify management procedures that both achieve management objectives for fish stocks and are robust to the uncertainty in the system being managed. In this respect MSE is a tool for evaluating management strategies that explicitly accounts for the uncertainty in the underlying system, acknowledges the linkages between each of the components in the management system (stocks, fleets, assessments, management rules, etc.) and can account for time lags in the management process.

Furthermore, and perhaps more importantly, the MSE process creates a structured framework for discussion and collaboration between the key stakeholders (fishing industry, managers, scientists, others). It formalizes management objectives and specifies the performance criteria upon which candidate management strategies can be assessed and compared. The most successful management strategy may not be the one that maximizes long term yield or optimizes revenue, or maximizes any other criteria if it does not have the full support of all stakeholders. MSE is a process by which candidate management procedures can be evaluated and discussed to achieve the full consensus of all stakeholders in the management approach.

Discussion and consultation are fundamental components of the MSE approach and this alone can be a lengthy process. In addition the simulations that need to be run are often complicated, time consuming and require specialist skills to develop and analyse. Previous applications of the MSE approach have invariably found that the stock assessment and analysis workload is not decreased. The role of the ALBWG scientists in developing the MSE framework is to:

- Quantify the objectives of decision-makers and determine how to measure them;
- Identify the range of management strategy choices;
- Identify and quantify uncertainties (in the assessment, data, and management systems) to represent in the operating model(s);
- Evaluate outcomes, and
- Communicate results, highlighting trade-offs.

The role of managers (and other stakeholders) in the MSE process is to:

- Identify objectives for the stock and fishery;
- Articulate management procedures and relevant performance measures to evaluate MPs; and
- Make decisions on the final management procedure.

The purpose of this document is identify some of the key components needed to apply MSE to NPALB and seek feedback from managers and other stakeholders on these issues. This feedback process is iterative and will be an ongoing feature on the MSE process.

The ALBWG has developed a series of proposals on operational objectives, performance criteria, harvest control rules, and key uncertainties for the operating model along with two proposed workplans and timelines. Some of these proposals may be appropriate, some may not be appropriate. The goal of this document is to elicit feedback to eliminate some proposals, modify others, and identify new proposals.

1. Operational Objectives and Performance Criteria

The ALBWG examine existing CMMs, the management framework adopted by NC10 for the NPALB stock, the draft resolution on MSE to the IATTC, and other management statements to develop proposed operational objectives. Operational objectives quantify the policy statements in high level aspirational goals such as "conserve the stock." Objectives identify things that matter to different stakeholders:

- Ecological – spatial distribution, stock structure;
- Biological – e.g., biological sustainability, abundance, age composition;
- Socio-economic –fishery sustainability, e.g., average annual catch, catch stability; and
- Cultural – e.g., availability of fishing opportunities, traditional use.

Article VII of the Antigua Convention of the IATTC identifies several functions of the Commission that contain statements concerning management objectives for tuna stocks within the Convention Area. These statements include:

- to ensure the long-term conservation and sustainable use of the fish stocks … *and to maintain or restore the populations of harvested species at levels of abundance which can produce the maximum sustainable yield …*"
- "… adopt, as necessary, conservation and management measures and recommendations for species belonging to the same ecosystem … *with a view to maintaining or restoring populations of such species above levels at which their reproduction may become seriously threatened*;"
- "apply the precautionary approach … promote the application of any relevant provision of the Code of Conduct …"

These statements provide insight into management objectives for fishery sustainability, i.e., maintain populations at levels of abundance that produce maximum sustained yield, and biological sustainability, i.e., maintain populations above levels at which their reproduction is seriously threatened. Historically, conservation recommendations from the Science Advisory Committee and the IATTC scientific staff have been based on an informal decision rule of whether current fishing mortality F_{cur} is higher than the F corresponding to the maximum sustainable yield (F_{MSY}). If $F_{cur}/F_{MSY} > 1$, then effort is adjusted. This rule implies that F_{MSY} is a target reference point. In contrast, there is little guidance regarding a limit reference point (LRP), other than the idea that a LRP is needed for the biological sustainability objective.

Both IATTC Resolution C-05-03 and WCPFC CMM 2005-03 on north Pacific albacore specify that no increase in [fishing] effort beyond current levels should occur. Neither measure defined the meaning of "current levels" when they were adopted, although the NC later clarified that current level is the average of 2002-2004 fishing effort in each fleet (country and gear combination). Although these measures have not been actively enforced, limit reference points have not been exceeded and, at least theoretically, a limit on vessel fishing effort targeting albacore (i.e., full and effective implementation of the measures) could be somewhat effective in constraining increases in catch and fishing mortality of the north Pacific albacore stock.

The precautionary management framework adopted by NC10 has as its management objective for North Pacific albacore tuna:

> *"... to maintain the biomass, with reasonable variability, around its current level in order to allow recent exploitation levels to continue and with a low risk of breaching the limit reference point."*

These policy statements provide information on the desired status and condition for the stock in broad terms, which the ALBWG summarizes as stabilizing catches and effort at historical levels to control exploitation.

Translating these broad policy goals into operational objectives for use in an MSE process requires three components:

1. a target or threshold value that can be represented in an operating model (e.g., abundance, inter-annual variation in catch, etc.);
2. a time horizon over which to measure the value (e.g., abundance might be measured over 2-3 generations, while catch or catch variability might be measured over shorter timeframes such as 5-10 years); and
3. an acceptable probability of either achieving the target or avoiding a threshold (e.g., 50% chance of being above a target, 95% chance above a threshold).

Based on the various policy statements and the above criteria, the ALBWG proposes the operational objectives shown below. Each objective has the components identified above plus several potential quantitative choices for each component in square brackets[ ]. This list is not exhaustive nor final. The ALBWG is using these proposals to elicit feedback on appropriate operational objectives, consistent with management goals.

Biological Sustainability

1. Maintain [spawning] biomass at its current level [e.g., B2012, recent average of 2008-2012; long-term average 1981-2010] with some variability [± 10%, 25%], in [50%, 95%] of the years measured over two albacore generations (30 years; or some other period); and
2. Maintain spawning biomass above the limit reference point LRP = $0.2SSB_{current\ F=0}$ (or other choice) in 95% of years measured over two albacore generations (30 years or some other time period).

Fishery Sustainability

3. Maintain catch at recent levels (2012, recent average of 2008-2012; long-term average 1981-2010) ± 10%, 25% over a 5-year, 10-year period subject to achieving Objectives 1 and 2.

Based on MSE applications to other fisheries and fish stocks, a good set of objectives has the following qualities:

1. Complete – nothing important is left out;
2. Concise – no more than 6-10 unambiguous objectives with no duplication is ideal;
3. Understandable – clearly written and understood by all stakeholders and connected to things that matter; and
4. Sensitive – useful in distinguishing between alternative MPs.

2. Reference Points

A limit reference point (LRP) is a threshold state of a stock (or fishery) established scientifically, based on biological information, that is undesirable and avoided with a high probability. LRPs can be established to prevent stock collapse, weak recruitment, undesirable genetic selection, irreversible fishing impacts, uneconomical fishing or other undesirable states. Since the risk of serious harm to the stock is high below the LRP, then the probability of the stock declining below this point should be low but not zero (0) and, importantly, if it does go below the LRP, then a harvest control rule is implemented, such as terminating fishing, to prevent further compromises to the resiliency and productivity of the stock (Figure 1). The most common risk metric used for LRPs in the scientific literature is 5%, that is, when stock status is estimated relative to the limit reference point there is a 5% probability or less, that it is below the LRP or there is at least a 95% probability that it is above the LRP. LRPs are accompanied by operational control points (OCP) which specify a rule to reduce fishing rates as the stock approaches, but is above, the LRP

In contrast, based on the proposed IATTC resolution and the NC10 management framework for NPALB, managers appear to be interpreting a LRP as the biomass level (usually) at which fishing must be reduced in order to rebuild the stock to the target level (Figure 2). This interpretation uses the LRP as an OCP and is consistent with depictions of stock status in Kobe plots and determinations of overfishing or overfished states (Figure 2), but it does not recognize the potential harm to the stock that may occur below this level. Fishing levels are continuously reduced as biomass declines below the LRP, but there is no point at which fishing is terminated to allow the stock to rebuild.

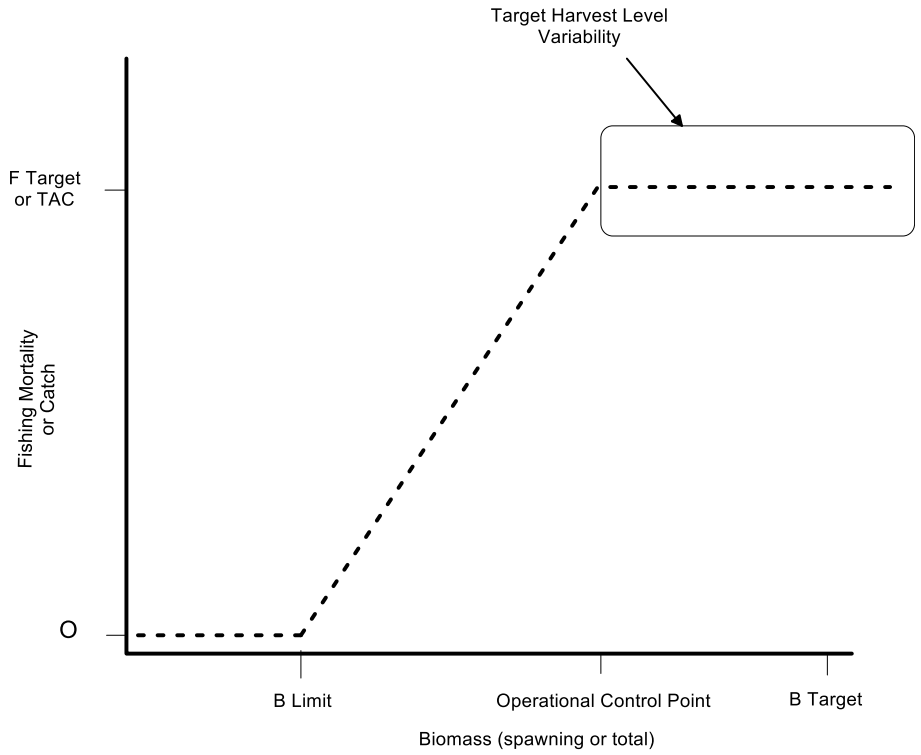

Figure 1. Scientific interpretation of limit reference points and associated harvest control rules in a precautionary framework.

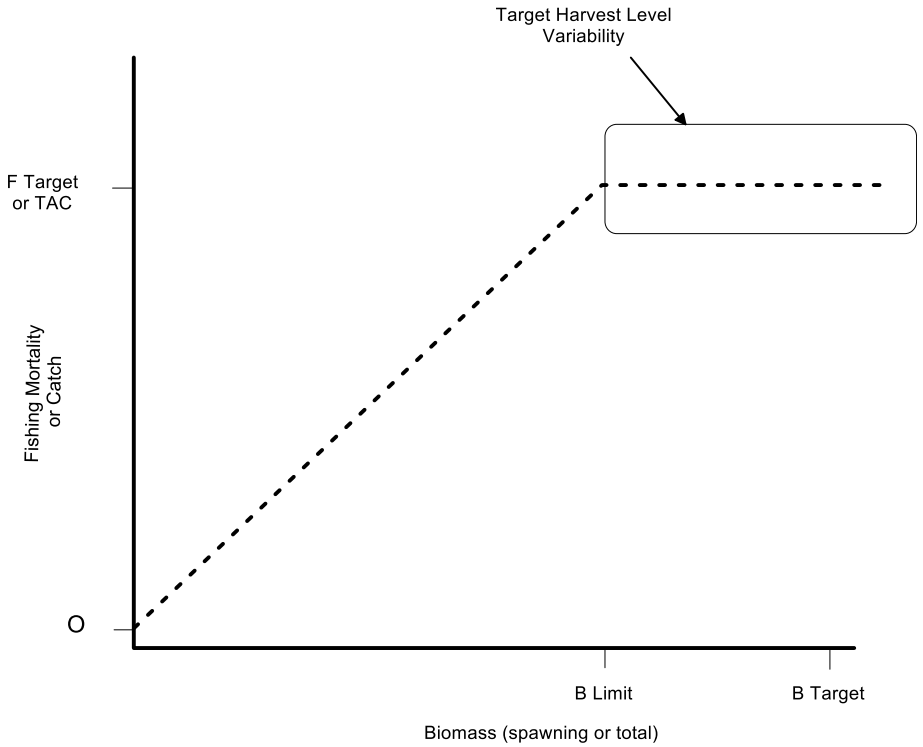

Figure 2. Management interpretation of limit reference points and associated harvest control rules in a precautionary framework.

The scientific interpretation of the precautionary framework includes three stock zones based on a combination of reference points and harvest control rules: Critical (below the LRP) where no fishing is permitted, Cautious (between the LRP and an upper control point set by managers) where fishing is reduced in order to rebuild the stock and avoid further declines to the LRP, and Healthy, when the stock is at the desired level or target set by managers and industry. A target reference point (TRP) is often F-based from which an associated target biomass level can be calculated.

A list of proposed LRPs for the north Pacific albacore stock that could be assessed with MSE was extracted from existing management guidance:

- 20%SSBcurrent F=0 – LRP adopted by NC10
- SB0.5R0, where h = 0.75 – proposed by the IATTC (Maunder and Deriso 2014: SAC-05-14);
- 14% of unfished SB; IATTC-87-PROP-J-1-USA; and
- 20% of unfished SB; IATTC-87-PROP-J-1-USA.

The reference point proposed by Maunder and Deriso (2014: SAC-05-14) is interpreted as the spawning biomass corresponding to a 50% reduction in recruitment assuming a conservative value for the steepness parameter (h=0.75) in the Beverton-Holt stock recruitment relationship.

The ALBWG requests clarification from managers on the following points:

(1) Is this list of proposed LRPs complete?
(2) Is 20% SSBcurrent $_{F=0}$ (NC10) equivalent to 20% unfished SB (IATTC-87-PROP-J-1)?
(3) These LRPs can be calculated as equilibrium reference points, which remain fixed over time or as dynamic reference points, which track changes in productivity over time. As currently specified, the LRP recommended by NC10 is calculated as an equilibrium reference point. What is the preferred calculation method for LRPs: equilibrium or dynamic?
(4) Is interpretation of the LRP consistent with scientific understanding (a lower limit for fishing or management understanding (a threshold below which fishing is reduced to allow stock rebuilding)?

Management is usually implemented to achieve target reference points (TRPs). The list of proposed target reference points extracted from available guidance documents includes:

- $F_{10\%}$
- $F_{20\%}$
- $F_{30\%}$
- $F_{40\%}$
- $F_{SSB\text{-}ATHL}$
- Fcurrent% (estimated as $F_{41\%}$ in 2012 in the 2014 assessment) – inferred from NC10 Precautionary Management Framework

The ALBWG requires clarification from managers on the following issues:

(1) Are there additions/deletions to this list of proposed TRPs?

3. Harvest Control Rules

Management procedures (MPs) or harvest control rules (HCRs) are pre-agreed rules that determine what happens to the fishery and stock based on proximity to reference points or some data-based threshold. Model-based HCRs use a stock assessment model to estimate biomass, fishing mortality or related quantities which are inputs for the harvest control rule. In contrast, empirical or data-based HCRs use

fishery data directly, usually after some summary methods have been applied (e.g., CPUE standardization for catch and effort data) as input to the harvest control rule. Data-based HCRs are easy to test and describe and can be applied annually but the application of a model-based HCRs is dependent on stock assessment frequency, which is 3-years for north Pacific albacore, although this interval can be tested.

Two proposed model-based HCRs based on total allowable catch (TAC) and total allowable effort (TAE) controls in the IATTC draft resolution, where t+3 is a TAC or TAE set for the next 3 years, are:

TAC management:	SBcurr ≥ SB-limit	TAC $_{t+3}$ = $F_{\text{-target}}$ at B_{curr}; (to the right of B-limit in Figure 2)
	SBcurr < SB-limit	TAC $_{t+3}$ = (F_{target} x SB_{curr})/SB-limit at B_{curr}. (left of B-limit in Figure 2)
TAE Management	SBcurr ≥ SB-limit	TAE $_{t+3}$ = $F_{\text{-target}}$; (right of B-limit in Figure 2)
	SBcurr < SB-limit	TAE $_{t+3}$ = ($F_{\text{-target}}$ x SB_{curr})/SB-limit. (left of B-limit in Fig. 2)

The ALBWG proposes the following model-based decision rules for consideration, based on the concepts illustrated in Figure 1 and assuming an assessment model is run every 3 years, where t+3 indicates a TAC or TAE set for the following three years:

TAC Management	Bcurr ≤ LRP	F_{t+3} = 0; (left of B-limit in Fig. 1)
	LRP < Bcurr < B Threshold	F_{t+3} = (F_{target} x SB_{curr})/B-threshold (sloped line in Fig. 1)
	Bcurr ≥ B Threshold	F_{t+3} = F_{target}; (right of B-threshold in Fig. 1)
TAE Management	Bcurr ≤ LRP	TAE_{t+3} = 0; (left of B-limit in Fig. 1)
	LRP < Bcurr < B Threshold	TAE $_{t+3}$ = ($F_{\text{-target}}$ x SB_{curr})/B-Threshold (sloped line in Fig. 1)
	Bcurr ≥ B Threshold	TAE_{t+3} = F_{target} (right of B-threshold in Fig. 1)

As an alternative, the ALBWG proposes the following data-based harvest control rules, which are evaluated annually, where TAC is total allowable catch and RC_Y is realized or actual catch in year Y and for purposes of this proposal TAC is long-term average catch, 1981-2010:

RC_Y < TAC_Y	TAC_{Y+1} = TAC_Y; (below the long-term average in Fig.3
RC_Y > 1.1 x TAC	TAC_{Y+1} = TAC_Y x (TAC_Y/RC_Y) (above the long-term average in Fig. 3)

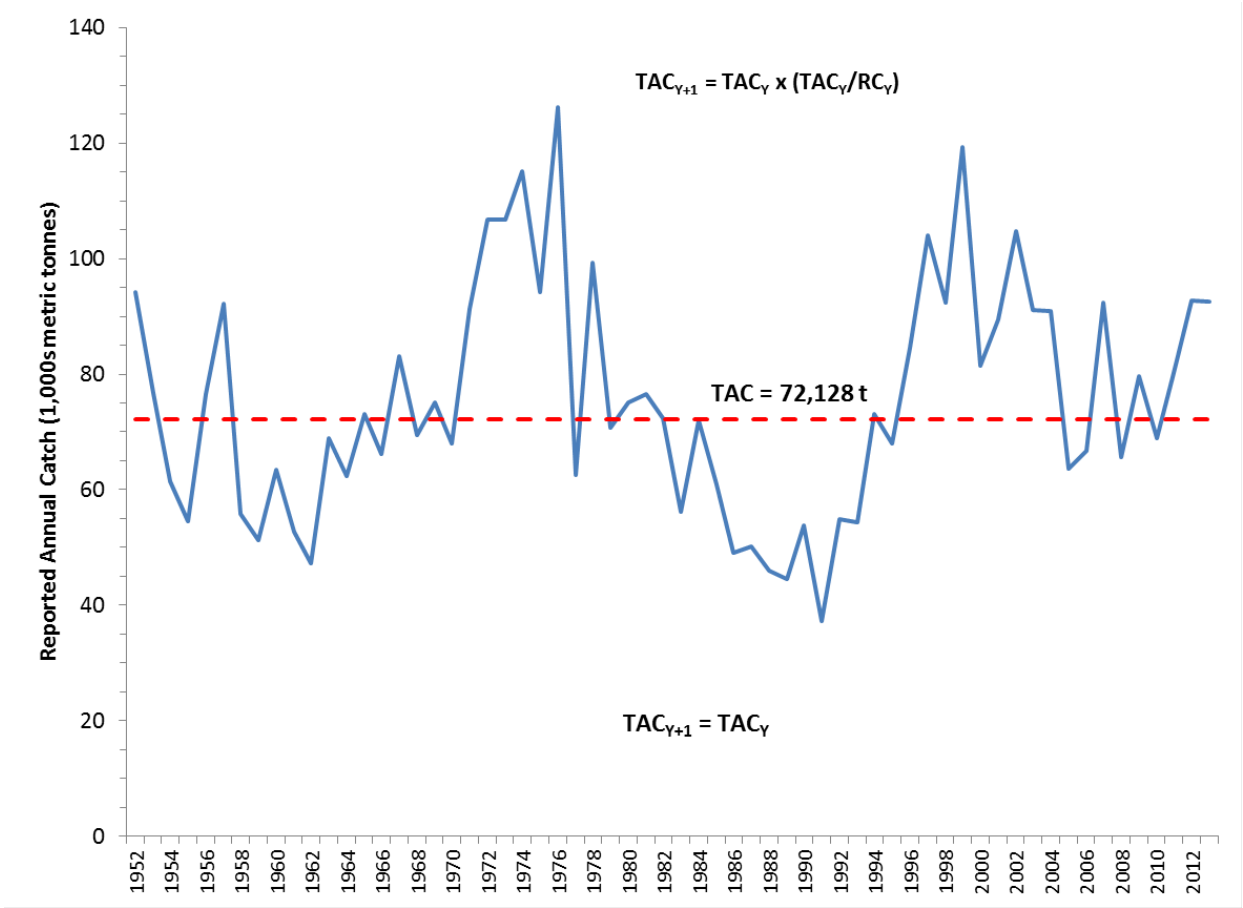

Figure 3. Illustration of data-based decision rule proposed by the ALBWG for north Pacific albacore tuna using the long-term average catch (1981-2010 – dashed red line) to set total allowable catch. When realized catches in year Y are > TAC, then TAC in Y+1 is reduced by TAC/realized catch. When realized catches are < TAC, then TAC is not changed.

The ALBWG requests clarification on the following issues concerning harvest control (decision) rules:

(1) Rules based on total allowable effort imply that there is a relationship between a unit of effort and the fishing mortality (F) on the stock for all fisheries, which are defined as country and gear combinations. Knowledge of these relationships would be important for any MSE employing effort-based rules. At present, the ALBWG is unaware of any such relationships and believes that defining such relationships is a non-trivial task.

(2) Are model-based or data-based decision rules preferred?

(3) If model-based rules are chosen, are the rules extracted from draft IATTC resolution or the alternatives proposed by the ALBWG preferred?

(4) Are there other decision rules that should be considered?

4. Operating Model Uncertainties

The ALBWG identified three categories of uncertainty and noted whether they should be included in evaluation scenarios (1) or not necessary for the first round of evaluations (2).

Biological (1 – important; 2 – not so important)

1. Natural mortality (length-based (Lorenzen))
1. Recruitment (steepness (0.84, 0.95; values from other ALB stocks (SPALB – 0.8, range 0.65-0.95; IALB – 0.7-0.9; AALB - 0.80-0.88), variation (CV, autocorrelation), environmental effects (some prelim research suggests PDO effect on recruitment, simulate decadal scale variation)
1. Growth (regional (eastern, central, western Pacific), sexually dimorphic growth (yes/no); cohort growth (inter-annual variation), form of the growth model – VBGF, Richards)
1. Migration (spatial structure, stock structure, sex and age structure; migration parameters estimated in 2008 CJFAS paper, at least for juveniles)
2. Maturity – form of maturity ogive; earlier or later than anticipated; length-based

Fisheries (or Data)

1. Catchability –variation through time, effort creep, fishery development (new equipment/techniques), relationship between unit of effort and fishing mortality for multiple gears
1. Gear selectivity – variation through time (e.g., LL shallower and deeper sets over time)
1. Fisheries movements – non-random; contraction of JPN LL; troll contraction in range to North America; changes in fishing grounds
1. Target switching (ALB versus SKJ)
2. Targeted versus bycatch fisheries – classifying effort by different types of fisheries, especially when effort control on harvest used. Effort of bycatch fisheries controlled by other factors (e.g., bigeye measures)
1. Unknown fishery operations (China and Vanuatu)
1. Observation error (effective sample size for size composition data, CPUE CVs)
2. IUU – uncertainty in catch/F

Management

1. Estimation error in assessment outputs going into HCR

1. Implementation error on advice from assessment (catch achieved versus TAC/TAE set; targeted vs. bycatch fisheries, managers adjust or ignore science advice)
2. Time lags (between assessment cycle (3 year) and action on advice; between data and assessment)

5. Workplans and Timelines

The ALBWG has addressed two issues in developing proposed workplans and timelines for conducting an MSE process:

1. Present resources and personnel are not sufficient to develop and conduct an MSE process given existing commitments of scientists to domestic issues and internationally to the stock assessment process. Therefore, an MSE analyst will have to hired or contracted to deliver on the MSE process, and
2. The next stock assessment of north Pacific albacore will be conducted and delivered in 2017. The MSE process will not interfere with delivery of the assessment. Thus, if work schedules must be rearranged, the first priority will be the stock assessment.

The WG scoped out two timelines for the MSE process: (1) an optimistic timeline, assuming that an MSE analyst will be in place by the beginning of 2016, and (2) a less optimistic timeline, based on the expectation that the arrival of the MSE analyst is delayed relative to the beginning of 2016 (see Attachment 4). Both timelines have stronger engagement with WCPFC managers, industry, and other stakeholders than those in the IATTC. It should be noted that neither of the proposed timelines reflects WG stock assessment activities (i.e., research, data preparation, and assessment meetings).

OPTIMISTIC TIMELINE

Year	Quarter	Month	Milestone
2015	Q2	April	ALBWG mini-workshop to scope MSE
	Q3	July	ISC15 Plenary – approval of ALBWG MSE planning
		September	NC11 meeting to confirm workplan, request feedback from managers
	Q4	December	WCPFC meeting
2016	Q1	January	MSE analyst hired or contracted by ISC country
	Q2	March/April	Proposed workshop on objectives/HCRs with managers
		May	7th SAC of IATTC; report plans and progress
	Q3	July	ISC16 Plenary – progress report
2017	Q2	April	Prototype OM for MSE developed and reviewed by ALBWG
		May	8th SAC of IATTC; review prototype OM
	Q3	July	ISC17 Plenary – stock assessment reviewed for approval and prototype MSE reviewed and approved
	Q3	September	NC13 – initial evaluation of MSE operating model by managers
2018	Q1	March	Complete first round of MSE for Managers
	Q3	July	ISC18 – report MSE results to ISC
		September	NC14 – report MSE evaluation results and conclusions
2019	Q2	May	9th SAC of IATTC – report MSE evaluation results and conclusions

LESS OPTIMISTIC TIMELINE

Year	Quarter	Month	Milestone
2015	Q2	April	ALBWG mini-workshop to scope MSE
	Q3	July	ISC15 Plenary – approval of ALBWG MSE planning
		September	NC11 meeting to confirm workplan, request feedback from managers
	Q4	December	WCPFC meeting
2016	Q2	April	MSE Analyst hired by ISC country
		May	7th IATTC SAC meeting; MSE plans and progress
	Q3	July	ISC16 Plenary – progress report on MSE
		September	NC12 – 1-day workshop on MSE needs from managers
2017	Q2	May	8th SAC of IATTC; MSE plans and progress
	Q3	July	ISC17 Plenary – stock assessment reviewed for approval and report on MSE progress
		September	Prototype OM for MSE developed and evaluated by ALBWG
		September	NC13 – review prototype OM
2018	Q2	April	MSE OM revisions reviewed by ALBWG
		May	9th SAC of IATTC; report on progress with revisions to MSE
	Q3	July	ISC18 Plenary – revised MSE reviewed and approved
		September	NC14 – evaluation of revised MSE by managers and other stakeholders
2019	Q2	May	10th SAC of IATTC - report first round MSE results and conclusions
	Q3	July	ISC19 – report first round MSE results and conclusions
		September	NC15 - report first round MSE results and conclusions

The ALBWG used these policy statements and the criteria above to develop proposed operational objectives. , along with performance criteria with which to measure them and has used them as examples in Table 1 of the type of feedback that is needed to advance the MSE process. The examples in Table 1 are presented to show the level of detail necessary to craft a useful objective for MSE. Using a value (e.g., SSB_{2012} as a measure of current biomass) in an example should not be construed as ALBWG endorsement of that value. Additional example questions are shown to define other objectives within each category. The example questions and potential objectives shown in the list are not comprehensive nor do they represent the only considerations that could be addressed.

Table 1. Types of objectives and questions to consider when defining operational objectives. Note that the examples in **bold** are presented to show the level of detail necessary to craft a useful objective for MSE.

Category	Question	Potential Objective	Target or Threshold Value	Measurement Time Horizon	Acceptable Probability for Achieving Target/Avoiding Threshold
Biological – biological sustainability	What is the desired status (i.e., abundance) of the stock?	**Maintain biomass above the LRP**	**20% $SSB_{0\ F=0}$**	**2 generations, 30 yr**	**95% of the projected years**
		Maintain SSB at a specified level	**SSB_{2012}**	**2 spawning cycles - 10 yr**	**50% of projected years**
		Maintain a spawning biomass above a minimum unfished biomass level (TRP)	30% $SSB_{0\ F=0}$	3 yr (stock assessment cycle)	0.5
Socio-economic; fishery sustainability	What is the desired level of catch?	**Maintain catch at average levels subject to achieving biological objectives**	**Average catch**	**1981-2010; or 2008-2012**	**50% of projected years; or ±10% of average**
		Maximize average annual catch	Max average	10 years	
		Maximize yield in each region of the north Pacific Ocean			
Socio-economic – fishery stability	What is the maximum change in catch (or effort)?	Limit average annual variability (AAV) in catch (or effort)	10%, 25%	Annual	
	What is the minimum acceptable catch?	Lowest observed catch	Avg of 10 lowest observed; Lowest observed since 2008	Annual	95% of the projected years
Cultural	What is a viable level of resource access?	Maintain current fishing opportunities in targeting and non-targeting (longline) fisheries	Average; median 2008-12	Annual	50% of projected years