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## Goals, Objectives, and Performance Metrics for the IPHC Management Strategy Evaluation (MSE)

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### 1 PURPOSE

To review the Management Strategy Advisory Board (MSAB) goals and objectives, including the objectives refined by the MSAB ad-hoc working group. Consider the directives from the Commission, including the consideration of additional objectives related to distributing the TCEY. Link goals and objectives with performance metrics, and define a set of performance metrics to use for evaluation.

#### 1.1 INTRODUCTION

Defining goals and objectives is a necessary part of a management strategy evaluation (MSE) which should be revisited often to make sure that they are inclusive and relevant. The MSAB currently has four goals with multiple objectives for each. The four goals are

- biological sustainability,
- fishery sustainability, access, and stability,
- minimize discard mortality, and
- minimize bycatch and bycatch mortality

Performance metrics have also been developed from these objectives by defining a measurable outcome, a probability (i.e., level of risk), and time-frame over which it is desired to achieve that outcome.

In this document, we first present the MSAB ad-hoc working group (para 20, IPHC-2018-MSAB011-R) refined goals and objectives and provide reasoning behind the refinements. Performance metrics are linked to these objectives. We then present the distribution objectives proposed by the U.S. Commissioners at IM093 and the classification of each objective provided at MSAB011 for further discussion.

### 2 MSAB GOALS AND OBJECTIVES REFINED BY THE AD-HOC WORKING GROUP

The ad-hoc working group, consisting of Peggy Parker, Chris Sporer, Dan Falvey, and Michelle Culver from the MSAB (Glenn Merrill was not available), and Allan Hicks and Steve Keith from IPHC Secretariat met via webinar on June 26 to discuss and refine the MSAB goals and objectives. Subsequent email exchanges occurred before the publication of this document to make further refinements. The four goals were retained and the focus of the refinements was on identifying the main objectives and phrasing them in a useful manner. For each goal there are general objectives, which are broad and aspirational. Measurable objective(s) are related to these general objectives, and where possible a measurable outcome, time-frame, and tolerance are defined. A performance metric is then linked to each measurable objective. Some objectives are measurable, but a tolerance is not defined. These objectives are informational in that they are useful to consider, but are not a main factor when evaluating the management procedures. They can help to identify some of the properties of a management procedure and may be used to discriminate between a smaller set of management procedures.

#### 2.1 BIOLOGICAL SUSTAINABILITY

A harvest policy should be internally consistent, meaning that the reference points defined should have mathematically defined relationships with each other. For example, if an objective was to fish at a level that resulted in Maximum Sustainable Yield (MSY), the harvest policy should define either a fishing mortality that would result in MSY, or an MSY that would determine a fishing mortality rate ( $F_{MSY}$ ), because one leads to the

other. Independently defining both of these reference points will likely result in inconsistencies and difficulty in meeting objectives. The harvest policies of many fisheries management agencies define a proxy target fishing mortality rate, a proxy biomass target, and a harvest control rule that reduces fishing intensity at low biomass levels (a biomass trigger). However, defining two of these quantities determines the third. For example, defining the proxy fishing mortality rate and a harvest control rule will determine the target biomass (the median biomass expected to be achieved).

A similar point can be made with respect to conservation objectives. A very important conservation objective for fisheries management is to avoid low stock sizes that may result in a lack of sustainability for the stock. Therefore, the main objective related to biological sustainability should be to avoid that minimum stock size with a high probability (many harvest policies use a biomass limit of 20% of  $B_0$  and a probability of 90% to be above that biomass limit). A second conservation objective for a biomass threshold (an upper reference point) can be defined, but is not necessary because reporting the biomass target that would be achieved (along with fishery objectives related to stability and yield) would be sufficient to determine an appropriate harvest control rule while minimizing the risk of very low stock sizes. Defining a limit and a threshold to achieve will likely result in one being met before the other, thus making one moot. A single measurable conservation objective related to avoiding a biomass limit is all that needs to be defined as an objective.

For simplicity and the reasons noted above, the ad-hoc working group has suggested moving to a single conservation objective related to avoiding a biomass limit (MSAB could add other conservation objectives in the future if needed or as we move to the spatial scale). The conservation/biological sustainability objective to avoid low stock sizes, as defined by the MSAB, is to maintain a minimum female spawning stock biomass above a biomass limit reference point ( $SB_{Lim}=20\%$  spawning biomass) at least 90% of the time. The management procedure is a harvest control rule defined by a fishing mortality related to SPR ( $F_{SPR}$ ), an upper control point (i.e., fishery trigger), and a lower control point (i.e., fishery limit). The biomass limit reference point is also serving as the lower control point of the harvest control rule, although they can be defined independently.

This leaves the  $F_{SPR}$  and the trigger as elements of the management procedure to be investigated. The MSAB is now investigating these two elements of the harvest control rule to determine how they may meet the objectives defined by the MSAB and Commissioners.<sup>1</sup> As noted in the report of the May 2018 MSAB meeting (IPHC-2018-MSAB011-R) SPR values to be evaluated range from 30% to 56% (with higher resolution at values where change occurs in the performance metrics), and the control points to be evaluated are 30%:20% of spawning biomass, 40%:20% of spawning biomass, and if time permits 45%:20% of spawning biomass.

Additional objectives can be defined for informational purposes that may have a secondary influence on the evaluation of management procedures. These are called “Statistics of Interest” here and can be objectives such as the reporting an absolute measure of spawning biomass or even reporting probability of being below a spawning biomass other than 20% of unfished equilibrium spawning biomass (the biomass limit defined in the objective). In this case, the informational probability of being below a specified biomass would not have a tolerance associated with it, but would be informative nonetheless. Additionally, reporting the median biomass that would be achieved with the management procedure is useful to understand how close to the limit the biomass is likely to be.

The objectives and performance metrics refined by the ad-hoc working group are shown in Table 1. Note that there is only one objective related to the coastwide biomass, which the SRB felt was reasonable (paragraph 29 of IPHC-2018-SRB012-R). Additional conservation objectives could be defined to meet region-specific objectives.

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<sup>1</sup> The upper control point is sometimes referred to as a trigger value or trigger, as they “trigger” a management response if they are breached (e.g., the fishing intensity begins to be reduced under the harvest control rule).

### **2.1.1 A note on biocomplexity**

Paragraph 30 of IPHC-2018-SRB012-R stated that “[t]he SRB ... recognized that biocomplexity is not an appropriate concept because it is poorly defined and not understood for Pacific halibut, especially over large spatial scales. Further, the terms “preserve” and “preservation” should be “conserve” and “conservation” as most fisheries management is about conservation.” However, in paragraph 31 of IPHC-2018-SRB012-R, “the SRB AGREED that the defined Bioregions (i.e. 2,3,4, and 4b described in paper IPHC-2018-SRB012-08) are presently the best option for implementing a precautionary approach given uncertainty about spatial population structure and dynamics of Pacific halibut.” Therefore, objectives should be defined that relate to conserving some level of spatial population structure, and these can be included under the Biological Sustainability goal. Given the uncertainty about spatial population structure and dynamics of Pacific halibut, these objectives may be more difficult to define. The ad-hoc working group did not address spatial biomass objectives.

### **2.2 OPTIMIZE DIRECTED FISHING OPPORTUNITIES**

The goal previously called “fishery sustainability, access, and stability” was refined to be “optimize directed fishing opportunities” to better reflect the desires of the directed fishery. It is felt that the goal is to optimize fishery yield with respect to stability and sustainability, and optimizing the fishing opportunities ensures access.

Two general objectives fall under this goal: 1) Limit catch variability (Table 2) and 2) maximize directed fishery yield (Table 3). They are listed in this order because the stability objectives directly relate to the ramp in the harvest control rule, and it is not meant to prioritize stability objectives over yield objectives (although that could be done if desired), but is a natural progression to evaluating the objectives. For example, a final step may be to maximize the yield subject to meeting conservation and stability objectives. Or, the trade-offs between stability and yield could be examined and these two fishery objectives be evaluated simultaneously. However, with only one conservation objective, it seems natural to prioritize that one such that fishery objectives are not evaluated unless that conservation objective is met.

Under each general objective, there are coastwide TCEY measurable objectives and IPHC Regulatory Area measurable objectives. The IPHC Regulatory Area measurable objectives are placeholders for now to be discussed in more detail at future MSAB meetings. For the coastwide evaluations of fishing intensity, there is one objective related to catch variability that is not a statistic of interest: the average annual variability (AAV) is no more than 15%. For the general objective of maximizing the directed fishery yield, there is also one measurable objective that is not a statistic of interest: maintain the TCEY above a minimum level. Other statistics of interest provide insight into the behavior of various management procedures.

The ad-hoc working did not discuss the goals related to discard mortality and bycatch mortality, but the objectives related to those (if defined) are shown in Table 4 and Table 5.



**Table 1.** Objectives and performance metrics for the Biological Sustainability goal.

<b>GENERAL OBJECTIVE</b>	<b>MEASURABLE OBJECTIVE</b>	<b>MEASURABLE OUTCOME</b>	<b>TIME-FRAME</b>	<b>TOLERANCE</b>	<b>PERFORMANCE METRIC</b>
1.1. KEEP BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES  Biomass Limit	Maintain a minimum female spawning stock biomass above a biomass limit reference point at least 90% of the time	$SB < \text{Spawning Biomass Limit } (SB_{Lim})$  $SB_{Lim}=20\%$ spawning biomass	Long-term	0.10	$P(SB < SB_{Lim})$
<i>REPORT A METRIC THAT IS BASED ON NUMBERS OF PACIFIC HALIBUT</i>	<i>An absolute measure</i>	<i>Number of mature female halibut</i>	<i>Long-term</i>	<i>STATISTIC OF INTEREST</i>	<i>Median Number of Mature Females</i>
<i>REPORT A METRIC INDICATING THE SPAWNING BIOMASS EXPECTED TO BE ABOVE 50% OF THE TIME (I.E., AN IMPLIED TARGET)</i>	<i>An absolute measure</i>	<i>Spawning Biomass</i>	<i>Long-term</i>	<i>STATISTIC OF INTEREST</i>	<i>Median <math>\overline{SB}</math></i>

SB = dynamic relative (unfished equilibrium) spawning biomass, also noted as dRSB.

Short-term: immediate future 3 years (metrics reported for each year)

Long-term: time period needed to represent equilibrium conditions, i.e., 100+ time-steps (metrics reported for the last 10 time-steps of the long term time period)

P( ): Probability (times out of 100) that the event occurs

Statistic of Interest: A metric that will be reported, but is not to be evaluated as meeting a specific criteria.



**Table 2.** Objectives and performance metrics related to stability in quotas.

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME-FRAME	TOLERANCE	PERFORMANCE METRIC	
2.1. LIMIT CATCH VARIABILITY	Limit annual changes in the coastwide TCEY	Average Annual Variability (AAV) > 15%	Long-term	0.25	$P(AAV > 15\%)$	
		AAV	Long-term	STATISTIC OF INTEREST	AAV and variability	
		Change in TCEY > 15% in any year	Short-term	STATISTIC OF INTEREST	$\frac{TCEY_{i+1} - TCEY_i}{TCEY_i}$	
	Limit annual changes in the TCEY for each Regulatory Area	Average Annual Variability by Regulatory Area (AAV <sub>A</sub> ) > 15%	Long-term	0.25	$P(AAV > 15\%)$	
		AAV <sub>A</sub>	Long-term	STATISTIC OF INTEREST	AAV and variability	
		Change in TCEY by Regulatory Area > 15% in any year	Short-term	STATISTIC OF INTEREST	$\frac{TCEY_{i+1} - TCEY_i}{TCEY_i}$	
	Gain insight into the additional variability in the TCEY when on the ramp	AAV while on the ramp	Long-term	STATISTIC OF INTEREST	AAV given estimated SB < SB <sub>Trig</sub>	
		Percent of time “on the ramp” (estimated stock status is below the fishery trigger; SB <sub>trig</sub> )	Long-term	STATISTIC OF INTEREST	$P(\widehat{SB} < SB_{Trig})$	
		SB <sub>Trig</sub> to be evaluated (e.g., 30% or 40%)				

Average Annual Variability (AAV): The average percentage change in TCEY from year to year. Note, that the TCEY may change by a higher percentage or a lower percentage, but would be this value on average.

Fishery trigger (SB<sub>Trig</sub>): The value that triggers a reduction in fishing intensity when the stock is estimated to be below this spawning biomass

“On the ramp”: The state of reduced fishing intensity because the biomass is estimated to be below the fishery trigger. The “ramp” refers to the reduction of fishing intensity in the harvest control rule.

Statistic of Interest: A metric that will be reported, but is not to be evaluated as meeting a specific criteria.

TCEY: For the coastwide operating model this is the sum of commercial landings, commercial discard mortality, recreational mortality, and subsistence mortality.

**Table 3.** Objectives and performance metrics related to directed fishery yield.

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME-FRAME	TOLERANCE	PERFORMANCE METRIC
2.2. MAXIMIZE DIRECTED FISHING YIELD	<i>Maximize average TCEY coastwide</i>	<i>Median coastwide TCEY</i>	<i>Long-term Short-term</i>	<i>STATISTIC OF INTEREST</i>	<i>Median <math>\overline{TCEY}</math></i>
	Maintain TCEY above a minimum level coastwide	Coastwide TCEY < TCEY <sub>min</sub>	Long-term Short-term	?? ??	$P(TCEY < TCEY_{min})$
	<i>Maximize high yield (TCEY) opportunities coastwide</i>	<i>Coastwide TCEY &gt; 46 Mlbs (70% of 1993-2012 average)</i>	<i>Long-term Short-term</i>	<i>STATISTIC OF INTEREST</i>	$P(TCEY < 46 \text{ Mlbs})$
	<i>Present the range of coastwide TCEY that would be expected</i>	<i>Range of coastwide TCEY</i>	<i>Long-term Short-term</i>	<i>STATISTIC OF INTEREST</i>	<i>5<sup>th</sup> and 75<sup>th</sup> percentiles of TCEY</i>
	<i>Maximize average TCEY by Regulatory Area</i>	<i>Median coastwide TCEY</i>	<i>Long-term Short-term</i>	<i>STATISTIC OF INTEREST</i>	<i>Median <math>\overline{TCEY}</math></i>
	Maintain TCEY above a minimum level by Regulatory Area	TCEY <sub>A</sub> < TCEY <sub>A,min</sub>	Long-term Short-term	?? ??	$P(TCEY < TCEY_{min})$
	<i>Maximize high yield (TCEY) opportunities by Regulatory Area</i>	<i>TCEY<sub>A</sub> &gt; 46 Mlbs (70% of 1993-2012 average)</i>	<i>Long-term Short-term</i>	<i>STATISTIC OF INTEREST</i>	$P(TCEY < 46 \text{ Mlbs})$
	<i>Present the range of TCEY by Regulatory Area that would be expected</i>	<i>Range of TCEY by Regulatory Area</i>	<i>Long-term Short-term</i>	<i>STATISTIC OF INTEREST</i>	<i>5<sup>th</sup> and 75<sup>th</sup> percentiles of TCEY</i>

**Table 4.** Objectives and performance metrics related to discard mortality (note that the ad-hoc working group did not discuss these).

<b>GENERAL OBJECTIVE</b>	<b>MEASURABLE OBJECTIVE</b>	<b>MEASURABLE OUTCOME</b>	<b>TIME-FRAME</b>	<b>TOLERANCE</b>	<b>PERFORMANCE METRICS</b>
3.1. HARVEST EFFICIENCY	Discard mortality is a small percentage of the longline fishery annual catch limit	>10% of annual catch limit	Long-term Short-term	0.25	$P(DM > 10\%FCEY)$
<i>ABSOLUTE MEASURE</i>	<i>Absolute</i>	<i>Discard Mortality (DM)</i>	<i>Long-term Short-term</i>	<i>NA</i>	<i>Median <math>\overline{DM}</math></i>

**Table 5.** Objectives and performance metrics related to bycatch mortality (note that the ad-hoc working group did not discuss these).

<b>GENERAL OBJECTIVE</b>	<b>MEASURABLE OBJECTIVE</b>	<b>MEASURABLE OUTCOME</b>	<b>TIME-FRAME</b>	<b>TOLERANCE</b>	<b>PERFORMANCE METRICS</b>



### 3 COMMISSION REVIEW OF GOALS AND OBJECTIVES

The Commission provided the following guidance at AM094 related to goals and objectives.

**AM094-R, para 32.** The Commission **NOTED** the current fishery goals, objectives, and performance metrics identified by the MSAB for the MSE process, as detailed in Appendix IV of the MSAB10 report (IPHC-2017-MSAB10-R).

**AM094-R, para 33.** The Commission **NOTED** the summary presentation which was in response to Circular IPHC-2017-CR022 requesting stakeholder feedback on objectives proposed by a USA Commissioner related to distributing the TCEY presented at IM093. These objectives were categorized under the overarching goals defined by the MSAB for AM094.

**AM094-R, para 34.** The Commission **NOTED** the other concepts proposed by a USA Commissioner related to distributing the TCEY were not stated as measurable objectives but may be useful when developing management procedures to evaluate.

**AM094-R, para 35.** The Commission **NOTED** that:

- a) the Commission objectives related to distributing the TCEY may be presented at MSAB11 for further stakeholder feedback.
- b) the intent of the “other Commission concepts” could be further clarified and incorporated into the MSAB process, and can be converted to measurable objectives.
- c) the MSAB may develop measurable outcomes and performance metrics associated with these Commission objectives.

**AM094-R, para 36.** The Commission **RECOMMENDED** that the draft goals, objectives, and performance metrics, as detailed in Appendix IV, IPHC-2017-MSAB10-R be used for ongoing evaluation in the MSE process, and that they may be refined in the future. The objectives should be evaluated in a hierarchical manner, with conservation as the first priority.

**AM094-R, para 37.** The Commission **REQUESTED** that the objectives related to distributing the TCEY, as detailed in Circular IPHC-2017-CR022, be presented at MSAB11 for further stakeholder feedback.

The guidance from Commissioners had one request: that the objectives outlined in IPHC-2017-CR022 be presented at MSAB11 for discussion (IPHC-2018-AM094-R, para 37). These are the objectives related to distribution that were proposed by U.S. Commissioners at IM093, and are shown in Table 6. This table also shows response of the MSAB at MSAB011 to each objective. The MSAB felt that two of the objectives are already covered in the current objectives, one should be dropped because it is not pertinent to the current MSE work, and more discussion is needed for the others.

The Commission also had one recommendation: to endorse the current MSAB goals and objectives and to continue to refine them as necessary. An important piece of the guidance was to evaluate the objectives in a hierarchical manner with conservation as the first priority. This could mean that specified conservation objectives must be met for a management procedure to be considered any further. Or, it may mean that conservation objectives are given a higher weighting when evaluating the management procedures. With one objective under the biological sustainability goal, it is natural to not consider management procedures that do not meet that conservation goal.

**Table 6.** Pacific halibut TCEY distribution goals and objectives presented by U.S.A. Commissioners at IM093. Table reproduced from IPHC-2017-IM093-R. The column labeled MSAB011 shows the response of the MSAB at MSAB011 to each objective.

<b>Goal</b>	<b>Objective</b>	<b>MSAB011</b>
<b>Biological sustainability:</b> Preserving bio-complexity	1. Maintaining diversity in the population across IPHC Regulatory Areas.	More discussion
	2. Prevent local depletion at IPHC Regulatory Area scale.	More discussion
<b>Fisheries Sustainability:</b> Maintain access and serve consumer needs.	1. Maintain commercial, recreational and subsistence fishing opportunities in each IPHC Regulatory Area.	Covered
	2. Maintain processing opportunities in each IPHC Regulatory Area.	Dropped
<b>Fisheries Sustainability:</b> Maximize yield by regulatory area	1. Distribution is responsive to IPHC Regulatory Area abundance trends and stock characteristics (ex. Fishery WPUE, age structure, size at age etc.).	More discussion
	2. Distribution is responsive to management precision in each IPHC Regulatory Area.	More discussion
	3. Minimize impact on downstream migration areas.	More discussion
	4. Minimize discard mortality and bycatch.	Parking lot
<b>Fisheries Sustainability:</b> Minimize variability,	1. Limit annual TCEY variability due to stock distribution in both time and scale.	Covered
	2. Avoid zero sum distribution policy.	More discussion

#### 4 RECOMMENDATION/S

That the MSAB:

- 1) **NOTE** paper IPhC-2018-MSAB012-06 which provides a review of the goals and objectives previously defined by the MSAB and refined by the MSAB ad-hoc working group, associated performance metrics, and outcomes of AM094 as they relate to objectives.
- 2) **CONSIDER** the refined MSAB goals, measurable objectives and associated performance metrics, and the prioritizing of conservation objectives.
- 3) **CONSIDER** the statistics of interest to supplement the evaluation of management procedures.
- 4) **CONSIDER** the objectives identified by the US Commissioners at IM093 for distributing the TCEY.
- 5) **RECOMMEND** goals and objectives for evaluation of the Scale component of the harvest strategy policy.
- 6) **RECOMMEND** a practical set of performance metrics, including statistic of interest, to report for the evaluation of future simulations.
- 7) **SUGGEST** methods (e.g. tables and figures) to report the performance metrics listed here for the evaluation of future results from the simulations.

## 5 ADDITIONAL DOCUMENTATION / REFERENCES

- IPHC. 2017. Management Strategy Evaluation Goals and Objectives. 18 December 2017. IPhC Circular 2017-022. <https://iphc.int/library/documents/circulars/management-strategy-evaluationmse-goals-and-objectives> 2pp
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- IPHC. 2018. Report of the 12<sup>th</sup> Session of the IPhC Scientific Review Board (SRB012). Seattle, Washington, United States of America, 19-21 June 2018. IPhC-2018-SRB012-R. <https://iphc.int/uploads/pdf/srb/srb012/iphc-2018-srb012-r.pdf> 17 pp.