



Management Strategy Evaluation Program of Work (2021–23)

PREPARED BY: IPHC SECRETARIAT (29 JUNE 2021)

PURPOSE

To provide the Commission with a Management Strategy Evaluation (MSE) Program of Work (2021-23) for the IPHC Secretariat.

BACKGROUND

An MSE Program of Work has been developed based on the request from the Report of the 97th Session of the IPHC Annual Meeting (AM097; [IPHC-2021-AM097-R](#))

IPHC-2021-AM097-R (para. 70) *The Commission REQUESTED that the IPHC Secretariat consider and develop a draft MSE Program of Work for review by the Commission. The MSE Program of Work should describe technical versus policy-oriented issues, linkages between/among specific work products, and sequencing considerations between/among items. The MSE Program of Work should describe the resources required to complete items.*

and the Report of the 11th Special Session of the IPHC (SS011; [IPHC-2021-SS011-R](#))

IPHC-2021-SS011-R (para 7) *The Commission RECOMMENDED that the IPHC Secretariat:*

- a) prioritize tasks F.1, F.2, F.3 and F.5 to support the development of a robust framework, and E.3 to work with stakeholders and the Commission to improve the methods of presenting MSE results.
- b) continue to work on task M.3 to understand the trade-offs with multi-year stock assessments.
- c) continue investigation of size limits (M.1) to understand the long-term effects of a change in the size limit, including under different realizations of population dynamics such as size-at-aged

This program of work describes these tasks, the relationships between them, and the potential outcomes of each task. The complete set of potential tasks provided to the Commission before SS011 is provided in [Appendix I](#) and in document [IPHC-2021-SS011-03](#).

It is important to have a set of working definitions, and this is especially true to the MSE process since it involves many technical terms that may be interpreted or used differently by different people. A set of working definitions are provided in the IPHC Glossary of Terms and abbreviations: <https://www.iphc.int/the-commission/glossary-of-terms-and-abbreviations>

Management Strategy Evaluation (MSE)

Management Strategy Evaluation (MSE) is a process to evaluate alternative management procedures (MPs) and identify those that are robust to uncertainty and meet the defined objectives. This process, in general, involves the following:

1. defining fishery goals and objectives with the involvement of stakeholders and managers,
2. identifying management procedures to evaluate,
3. simulating a population with application of the management procedures,
4. evaluating and presenting the results in a way that examines trade-offs between objectives,
5. applying a chosen management procedure, and
6. repeating this process in the future to address changes in objectives, assumptions, and expectations.

Figure 1 shows these different components and that the process is not necessarily sequential but may iterate between components as learning progresses.

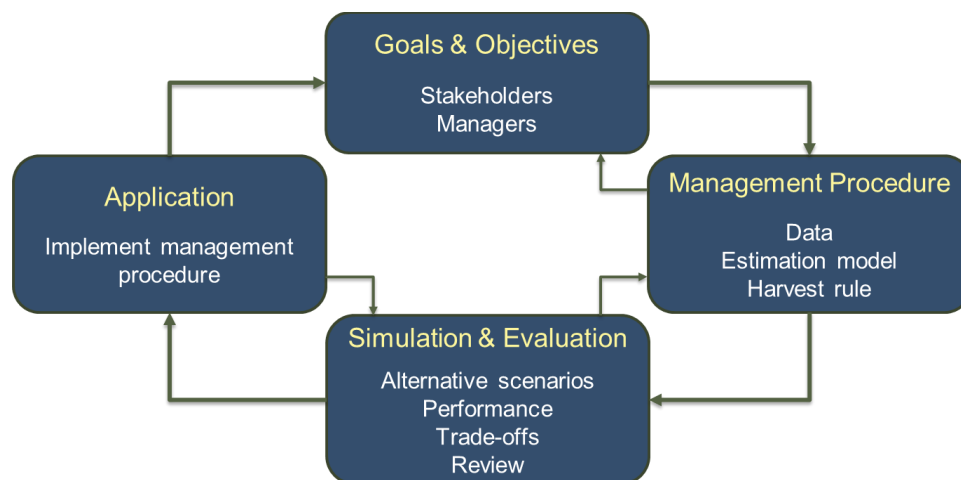


Figure 1. A depiction of the Management Strategy Evaluation (MSE) process showing the iterative nature of the process with the possibility of moving either direction between most components.

A complete MSE for Pacific halibut (*Hippoglossus stenolepis*) was delivered to the Commission at the 97th Session of the IPHC Annual Meeting (AM097) (see [IPHC-2021-AM097-11](#)). MSE is a process that can develop over many years with iterations to investigate different aspects of a harvest strategy with the goals of identifying robust management procedures as well as understanding the dynamics of Pacific halibut. It is also a process that needs monitoring and adjustments to make sure that management procedures are performing adequately. Therefore, the MSE work for Pacific halibut will be ongoing as new objectives are defined, more complex

models are built, new management procedures are defined, results are updated, and defined exceptional circumstances are observed. Embracing this iterative process, this program of work identifies the tasks that are a continuation of past work and those that are new. Past accomplishments include the following:

- Stakeholder familiarization with the MSE process.
- Defined conservation and fishery goals and objectives.
- Defined performance metrics for those objectives.
- Coast-wide (single-area) and spatial (multiple-region) operating models and frameworks.
- Detailed management procedures for the coastwide fishing intensity and distributing the TCEY to IPhC Regulatory Areas.
- Results investigating coastwide fishing intensity ([IPHC-2020-AM096-12](#)) and results incorporating MPs to distribute the TCEY to IPhC Regulatory Areas ([IPHC-2021-AM097-11](#)).

DESCRIPTION OF TASKS IN THE PROGRAM OF WORK

Tasks can be divided into five general categories, which are related to Figure 1.

1. **Objectives:** The goals and objectives that are used in the evaluation.
2. **Management Procedures (MPs):** Specific, well-defined management procedures that can be coded to produce simulated TCEYs for each IPhC Regulatory Area.
3. **Framework:** The specifications and computer code for the closed-loop simulations including the operating model (OM) and how it interacts with the MP.
4. **Evaluation:** The performance metrics and presentation of results. This includes how the performance metrics are evaluated (e.g. tables, figures, and rankings), presented to the Commission and its subsidiary bodies, and disseminated for outreach.
5. **Application:** Specifications of how a MP may be applied in practice and re-evaluated in the future.

The Commission recommended ([IPHC-2021-SS011-R](#), para 7) to include tasks related to the framework, MPs, and evaluation in this program of work (Table 1).

Table 1. Tasks recommended by the Commission at SS011 ([IPHC-2021-SS011-R](#) para 7) for inclusion in the IPhC Secretariat MSE Program of Work for 2021–2023.

ID	Category	Task	Deliverable
F.1	Framework	Develop migration scenarios	Develop OMs with alternative migration scenarios
F.2	Framework	Implementation variability	Incorporate additional sources of implementation variability in the framework
F.3	Framework	Develop more realistic simulations of estimation error	Improve the estimation model to more adequately mimic the ensemble stock assessment
F.5	Framework	Develop alternative OMs	Code alternative OMs in addition to the one already under evaluation.
M.1	MPs	Size limits	Identification, evaluation of size limits
M.3	MPs	Multi-year assessments	Evaluation of multi-year assessments
E.3	Evaluation	Presentation of results	Develop methods and outputs that are useful for presenting outcomes to stakeholders and Commissioners

Framework tasks

The tasks to improve the MSE framework include investigating and incorporating implementation variability (F.2), improving the simulation of estimation error (F.3), and development of migration scenarios (F.1) leading to alternative operating models (F.5).

F.1. Develop migration scenarios

Migration of Pacific halibut is complex, and some aspects are still uncertain. Including multiple migration models in the simulations would assist in identifying MPs that are robust to this uncertainty. For example, paragraph 46b of [IPHC-2020-MSAB016-R](#) noted “*it is uncertain if this MP is robust to alternative assumptions about movement, recruitment distribution, and productivity.*” Additionally, this investigation will help identify reasonable methods to model the movement of Pacific halibut. Overall, this work is essential to the robust investigation of all management procedures.

Outcomes from this task will lead to operating models incorporating a range of migration hypotheses. These may be individual models with uncertainty in migration parameters, multiple models with specific hypotheses about migration/movement, or a combination of both. Completing this task will involve some non-priority tasks such as incorporating time-varying parameters (F.4) and improving the framework code (F.6). This task is necessary for the evaluation of all MP tasks (MP.1 through MP.5) and will help to identify exceptional circumstances (A.1).

F.2. Incorporate additional sources of implementation variability

It is important to simulate implementation variability, the deviation of realized mortality limits from the limits determined by the MP, to identify MPs that are robust to all sources of variability. The

current framework would benefit from adding other sources of implementation variability such as the final mortality limits departing from the MP determined mortality limits. This was a priority recommendation from the [independent peer review of the MSE](#).

This task will be helpful for the robust evaluation of all MP tasks (MP.1 through MP.5) and will help to identify exceptional circumstances (A.1). The task to improve the framework code (F.6) would be partially completed after incorporating implementation variability.

F.3. Develop more realistic simulations of estimation error

The current results are based on simulating estimation error, which is a useful assumption but may not represent the behavior of the ensemble stock assessment. A more realistic approach would be to use a simplified version of the current ensemble stock assessment. Work has already been completed for this task, but it will take some additional time to ensure a complete and accurate method.

This task will be helpful for the robust evaluation of all MP tasks (MP.1 through MP.5) and will help to identify exceptional circumstances (A.1). The task to improve the framework code (F.6) would be partially completed after incorporating implementation variability.

F.5. Develop alternative Operating Models

The OM represents the Pacific halibut population and fisheries, and incorporates uncertainty, variability, and alternative hypotheses. The coastwide MSE used two models to represent multiple hypotheses (a long and a short coastwide model), while the current multi-regional MSE incorporates a single model with variability in specific parameters. Improvements would include expanding the options for variability in a single model and developing additional OMs based on alternative hypotheses to use in the simulations.

Developing migration scenarios (F.1) is essential for the completion of this task. This task will be helpful for the robust evaluation of all MP tasks (MP.1 through MP.5) and will help to identify exceptional circumstances (A.1).

Management Procedures (MPs)

Two types of MPs were recommended by the Commission for inclusion in the Program of Work: investigation of multi-year assessments (M.3) and the investigation of size limits (M.1).

M.3. Multi-year assessments

The 2nd Performance Review of the IPHC ([PRIPHC02-Rec.10](#), para 82) recommended the investigation of multi-year decision-making. Yearly revisions of harvest policies lead to fluctuation in quota, which in turn affects harvest and investment decisions of fishers. Multiannual quotas, on the other hand, increases the risk of periodical substantial adjustments to quota. The current MSE has performed preliminary evaluations of a MP setting mortality limits every fifth year. This type of MP would allow time for more in-depth research on the assessment and MSE. Continued investigation of this topic would be easy to do, although it would benefit from

completion of any of the framework tasks and developing performance metrics more meaningful to this type of MP.

Completing this task would require identifying the specifics of MPs with a stock assessment occurring biennially or triennially. This involves specifying the procedure when a stock assessment occurs and for the years without a stock assessment. Also identifying performance metrics (E.1 and E.2) that are informative for the evaluation of multi-year assessment MPs would be needed.

M.1. Size limits

The Commission has identified size limits as a potential topic to investigate using a MSE approach to evaluate long-term effects of different size limit options, as noted in paragraphs 51 of [IPHC-2021-AM097-R](#).

para 50. The Commission NOTED that the evaluation provided decision-making information for consideration of the current MinSL and/or a MaxSL. The focus is on short-term yield, fishery and stock performance while retaining all other aspects of the IPHC's interim management procedure. It is not intended to provide a comparison of long-term performance of size limits as one part of a comprehensive management procedure. Such a comprehensive analysis may be done through management strategy evaluation (MSE). Questions regarding long-term change in spatial distribution and scale of recruitment and spawning biomass require the full 'closed-loop' approach used in the MSE.

para. 51. The Commission NOTED the new results provided since IM096, making the reference projections for 2021 in the absence of a minimum size limit for the directed commercial fishery and comparing these results to the standard reference projections. This comparison indicated that the coastwide and IPHC Regulatory Area TCEYs could be increased by 3%, which would result in a 7% increase in directed commercial fishery landings coastwide for 2021, though the impact on long-term biomass and associated available yield, is unknown

Recent studies of size limits have focused on short-term effects based on current conditions of the population and fishery. Investigations with the MSE will highlight the long-term effects of changing the size limit over a wide range of conditions.

To conduct an accurate and effective evaluation of size limits, some additional work on the framework is necessary. Incorporation of alternative OMs (F.5) would provide for a robust evaluation and modelling length-age and length-weight relationships (F.7) would provide a more accurate depiction of the interaction of a size limit with the population. Length-age and length-weight relationships are not currently modelled in the stock assessment because of the variability, and it would take a considerable amount of time to implement it in the MSE framework. However, research is currently being done that would inform these processes. Additionally, it may be useful to consider any fishery objectives (O.2) and performance metrics (E.1 and E.2) that are currently not defined but would be related to size limits.

Evaluation

The evaluation of simulation results is done by stakeholders, managers, and scientists by examining various performance metrics and other outputs. It is crucial that all individuals involved in the evaluation understand the results being presented, are able to view metrics that are meaningful to them, and can examine trade-offs between metrics of interest.

E.3. Presentation of results

Presenting results in a way that can be easily interpreted will assist with evaluation, as well as increase understanding and acceptance of MSE results. Identifying useful ways to communicate results to stakeholders and the Commission will help identify candidate MPs for a harvest strategy policy. This task includes figures and tables for reports, oral presentation methods, distributed media, and interactive tools such as [MSE Explorer](#). Interaction with stakeholders and Commissioners will be essential to determine the best methods to present the MSE results.

Defining objectives (O.1 and O.2) is necessary for the determination of performance metrics to be used for evaluation. However, some performance metrics may also be defined (E.1 and E.2) that are of interest but do not have a well defined objective, or assist in understanding the results. These tasks are integral to the presentation of results and the Management Strategy Advisory Board (MSAB) and Commission have already provided a set of priority objectives and informative performance metrics. The Secretariat will continue to work on the best methods for presentation of results to inform decision making.

APPENDICES

Appendix I: Descriptions of potential tasks for the IPHC MSE

APPENDIX I

TABLE OF ALL TASKS CONSIDERED FOR THIS PROGRAM OF WORK

Table A1. Tasks for consideration in the development of an IPhC Secretariat Program of Work for MSE. Time is an estimate of the amount of time to complete that task without any prerequisites. The Total Time includes the time to complete (or partially complete) prerequisite tasks (where 10 indicates a full schedule up to IM097 in November 2021 and 20 a full schedule up to IM098 in November 2022).

ID	Category	Task	Deliverable	Time	Total Time
O.1	Objectives	Revisit sustainability objectives	Updated coastwide and regional objectives	1–2	1–2
O.2	Objectives	Revisit fishery objectives	Updated coastwide and regional objectives	2–4	2–4
M.1	MPs	Size limits	Identification, evaluation of size limits	2–3	10–20
M.2	MPs	Survey-based MPs	Identification, evaluation of empirical MPs using FISS data directly	2–4	4–6
M.3	MPs	Multi-year assessments	Evaluation of multi-year assessments	1–2	2–4
M.4	MPs	Non-directed discard mortality	Evaluation of management procedures related to non-directed discard mortality.	2–4	3–6
M.5	MPs	Additional MPs with scale and distribution components	Evaluation of additional MPs incorporating scale and distribution elements	1–5	3–8
F.1	Framework	Develop migration scenarios	Develop OMs with alternative migration scenarios	3–7	3–7
F.2	Framework	Implementation variability	Incorporate additional sources of implementation variability in the framework	2–4	2–4
F.3	Framework	Develop more realistic simulations of estimation error	Improve the estimation model to more adequately mimic the ensemble stock assessment	3–8	3–8
F.4	Framework	Time-varying parameters	Code into the OM the option for more time-varying parameters.	2–4	2–4
F.5	Framework	Develop alternative OMs	Code alternative OMs in addition to the one already under evaluation.	3–4	5–8
F.6	Framework	Improve framework code	A more usable framework	1–10	1–10
F.7	Framework	Model length-at-age	OM that can model length specifically	6–10	6–10
E.1	Evaluation	Develop conservation and fishery performance metrics	Performance metrics linked to primary objectives. Additional performance metrics for evaluation beyond primary objectives	1	1–2
E.2	Evaluation	Add economic performance metrics	Develop economic performance metrics to link with the economic study and bring the human dimension into the MSE	2-3	2-4
E.3	Evaluation	Presentation of results	Develop methods and outputs that are useful for presenting outcomes to stakeholders and Commissioners	1–2	1–3
A.1	Application	Develop exceptional circumstances	A list of exceptional circumstances that would result in additional MSE evaluations	1–3	1–3