

Management strategy evaluation Fisheries decision-making



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What is Management Strategy Evaluation (MSE) ?

- A simulation-based numerical framework designed to evaluate the performance of candidate management procedures (MPs) against predefined fisheries management objectives
- MSE allows us to identify management procedures that best achieve the pre-agreed objectives while avoiding unacceptable risks.

KEY COMPONENTS OF AN MSE



**OPERATING
MODEL**



**MANAGEMENT
PROCEDURE**



**PERFORMANCE
METRICS**

OPERATING MODEL (OM)

A mathematical-statistical model used to simulate a representation of the fishery system and its monitoring programs.

MANAGEMENT PROCEDURE (MP)

A management procedure is a pre-agreed process defining how a fishery will be managed, with the primary role being to take fishery information and return a management recommendation.

PERFORMANCE METRICS

Statistics that summarize different aspects of the results of MSE to illuminate how well an MP achieves some or all of the management objectives.

Why conduct a Management Strategy Evaluation (MSE)?

MSE provides a structured framework for evaluating management procedures (MPs) prior to real-world implementation.

MSE is used to simulate the interconnections between data collection, data analysis, and fishery regulations

Doing so highlights whether these interacting parts are likely to achieve fishery management objectives.



MSE enables decision-making in the face of scientific uncertainties.

Typically, MPs are sought that are resilient to pervasive uncertainties



Uncertainties can fish biology & population dynamics, fishery characteristics, climate variability, and implementation challenges



MSE exists at the interface of science and policy.

MSE leads to informed choices.



Stakeholder engagement is often central to successful MSE.

Engagement fosters trust and transparency, and inclusion.



Understanding what matters: client needs and priorities

Before initiating an MSE, it is crucial to describe the unique circumstances of your organization and fishery. This ensures the development of a tailored and effective MSE process.

CAPACITY AND RESOURCES

Does your organization have technical capacity to contribute to an MSE?

To what degree does your organization have the ability to effect change (financial, human, or technical) in fisheries management?

What is the level of stakeholder engagement in the fishery?



DATA LIMITATIONS

What types of data are currently collected (e.g., catch, effort, biological data, fishery-independent surveys)?

Are there any data gaps that are causing fishery management challenges?

How reliable are the available data sources?



VALUE OF THE FISHERY

What is the economic and social importance of the fishery to the community, region, or country?

Are there cultural or traditional values & practices associated with this fishery?

How might changes in management affect stakeholder livelihoods?



MANAGEMENT CONTEXT

What are the current management objectives (if they are defined)?

Are there existing challenges or conflicts among stakeholders?

Is the fishery part of any international or regional agreements (e.g., RFMOs)?



IMPLEMENTATION FEASIBILITY

Are there any obvious barriers to implementing new management strategies?

Are there monitoring or enforcement mechanisms in place?



Stakeholder considerations

When preparing to conduct an MSE, it is important to recognize key considerations and limitations to ensure realistic expectations and effective outcomes.

DEFINING OBJECTIVES



A key challenge in MSE is defining what is important and acceptable to all stakeholders. Investment in identifying stakeholder values, cultural considerations, and agency concerns should not be overlooked.

ROLES OF PARTICIPANTS



The roles and expectations of each participant (i.e., scientists, stakeholders, Indigenous peoples, and academia) should be clearly defined and understood.

THE SOONER THE BETTER



Early and ongoing involvement integrates diverse perspectives, local ecological knowledge, and otherwise unforeseen concerns.

STAKEHOLDER INCLUSION AND REPRESENTATION



Deciding who to involve in the MSE process is critical. Facilitators should ensure the process remains inclusive and diverse, encouraging meaningful contributions from all stakeholders.

EFFECTIVE COMMUNICATION AND FACILITATION



Constructive dialogue among stakeholders and scientists is key to MSE success. Use clear, accessible language, minimize technical jargon, and bridge knowledge gaps using visual aids and interactive tools.

Varieties of MSE

MSE approaches vary in degrees of stakeholder involvement, complexity, and role in informing management decisions.

FULL STAKEHOLDER-DRIVEN MSE

Full Stakeholder MSEs involve ongoing collaboration between stakeholders and analysts, requiring clear and unambiguous management objectives and aiming to produce actionable management decisions.

WHEN SHOULD A FULL-STAKEHOLDER MSE BE CONSIDERED?

Adoption of binding management advice	<ul style="list-style-type: none">• Decisions lead to enforceable rules.• Decisions based on the MSE have a real impact.
Complex or difficult policy decisions	<ul style="list-style-type: none">• When a policy decision is challenging, complex, or has significant societal implications.• Useful in multispecies, ecosystem interactions, or highly controversial cases (e.g., hydropower vs. salmon conservation), highly valuable species.
Stakeholder conflicts	<ul style="list-style-type: none">• To clarify conflicting objectives transparently (helps decision-makers understand societal trade-offs) .• Examples of stakeholder conflicts include multi-species fisheries with bycatch (technical interactions – choke species; recreational versus commercial objectives; ecosystem impact of harvesting small pelagic).
Disenfranchised stakeholders	<ul style="list-style-type: none">• When stakeholders are excluded from the management process or lack representation.
Scientific Uncertainty	<ul style="list-style-type: none">• When uncertainties can impact the effectiveness of management measures to achieve the stated objectives (e.g., non-stationary environmental dynamics are expected to change productivity).
Unclear Future Projections	<ul style="list-style-type: none">• Useful for uncertain climate scenarios (e.g., ENSO)• Combines ecological/ environmental information and stakeholder inputs to define alternative hypotheses.
Time commitment	<ul style="list-style-type: none">• Highly resource intensive, requiring at least a 6–36 month time commitment.

INTERMEDIATE MSE

Intermediate MSEs offer a middle ground between desk and full stakeholder MSEs, balancing stakeholder input with cost-efficiency. They are particularly useful for informing decision-making, refining existing strategies, and exploring potential improvements, even if they do not always result in the immediate adoption of new management actions.

WHEN SHOULD AN INTERMEDIATE MSE BE CONSIDERED?

Full stakeholder engagement is not feasible	<ul style="list-style-type: none">• Apply intermediate MSEs when a balance is needed between stakeholder input and resource constraints.• Online engagements or scheduling in-person meetings alongside other events (e.g., fishery management body meetings) can reduce costs while still facilitating meaningful input.• The process can benefit from integration into existing management frameworks (e.g., Fishery Management Council meetings), which helps facilitate stakeholder participation and implementation while keeping costs manageable.
Time commitment	<ul style="list-style-type: none">• Varies depending on the extent of stakeholder engagement and the complexity of the analysis.

DESK MSE

Desk MSEs are cost-effective, computer-based exercises with minimal stakeholder input. They are particularly useful for exploratory research, when management objectives are already defined, and for addressing moderate uncertainties in the system. This approach provides valuable insights, even if it does not always lead to immediate management action.

WHEN SHOULD A DESK MSE BE CONSIDERED?

Exploratory research	<ul style="list-style-type: none">Investigating research questions aimed at enhancing understanding of the system or exploring potential management scenarios, without the immediate intention of informing management advice.
Pre-defined management objectives	<ul style="list-style-type: none">Used when objectives are already established, reducing the need for stakeholder input.
Moderate uncertainty	<ul style="list-style-type: none">Suitable when system uncertainties are manageable and complex simulations are unnecessary.
Resource and time constraints	<ul style="list-style-type: none">A cost-effective option when resources are insufficient for full or intermediate MSEs.
Informative, not directive	<ul style="list-style-type: none">Provides valuable insights for decision-making without directly leading to new management practices
Other specific applications	<ul style="list-style-type: none">Useful for exploring tactical decisions on surveys and scientific resources, providing information for external purposes (e.g., industry assessments to show compliance with best practices), or adopting/modifying generic MPs when time and resources are limited.
Time commitment	<ul style="list-style-type: none">Typically 2-12 months, depending on complexity. Requires one to two full-time analysts.

Alternatives to MSE

NOT MSE






Alternatives include numerical or simulation methods or research that could sufficiently address scientific questions or support management decisions without requiring MSE.

WHEN SHOULD MSE NOT BE CONSIDERED?

Research questions can be addressed without MSE	<ul style="list-style-type: none">• Simpler methods (e.g., risk analysis, sensitivity analysis) can be enough to answer research questions.
Lack of data or resources	<ul style="list-style-type: none">• Not enough data to develop an MSE of the desired complexity.• If the system's limitations align better with data-limited approaches that are simpler and more cost-effective than MSE.
Redundant efforts	<ul style="list-style-type: none">• If existing studies or analyses can adequately inform management decisions.
Unclear objectives	<ul style="list-style-type: none">• When management objectives are not well-defined or agreed upon.• Insufficient clarity on the research goals or the management questions the MSE is intended to address.
Not intended for management action	<ul style="list-style-type: none">• The outcomes will not influence a management action.• For exploratory research where the primary goal is scientific understanding rather than direct management application.






Scientist roles at each stage of the MSE process

The MSE process can be divided into three main categories: scoping, technical, and evaluation.

Category	MSE steps	Scientist Roles	
Scoping 	1 Identify the participants 2 Identify objectives and performance metrics 3 Identify uncertainties	Choose modeling and subject matter experts to form the technical team for the MSE. Assist in facilitating workshops and describing the process and performance metrics. Present key uncertainties to managers and stakeholders for review and input.	
	Technical 	4 Develop operating models (OMs)	Develop analytical tools and be prepared to provide plain language descriptions of general details. Provide technical expertise to parameterize models aligned with the system and strategies under evaluation.
	Scoping 	5 Identify candidate management procedures (MPs)	Provide guidance on the range of options that can be tested within the available time and resources.
Technical 	6 Simulation test each MP	Conduct analyses and provide status updates periodically.	
Evaluation 	7 Summarize performance evaluation (revisit prior steps if needed)	Develop summaries and graphics in collaboration with managers and stakeholders.	
	8 Adopt desired management approach	Answer questions and re-evaluate results as needed to clarify quantitative trade-offs among management actions.	

Manager & stakeholder roles at each stage of the MSE process

The MSE process can be divided into three main categories: scoping, technical, and evaluation.

Category	MSE steps	Manager & stakeholder Roles	
Scoping 	1 Identify the participants 2 Identify objectives and performance metrics 3 Identify uncertainties	Work with outreach coordinators to ensure a diverse, representative group of participants. Participate in workshops to provide feedback on objectives and performance metrics. Provide feedback on uncertainties and make recommendations if key factors are missing.	
	Technical 	4 Develop operating models (OMs)	Evaluate the general configuration of operating and implementation models and engage in discussions and Q&A sessions with scientists.
	Scoping 	5 Identify candidate management procedures (MPs)	Propose a set of realistic management strategies to be evaluated.
Technical 	6 Simulation test each MP	Provide feedback when scientists face challenges or need to adjust methods or assumptions.	
Evaluation 	7 Summarize performance evaluation (revisit prior steps if needed)	Collaborate with scientists to create useful and relevant formats for presenting results.	
	8 Adopt desired management approach	Weigh trade-offs and implement the desired management action that meets performance criteria and satisfies all parties.	

Setting expectations

Before starting an MSE, establish clear expectations, scope of work, limitations, and expected outcomes

SETTING CLEAR EXPECTATIONS

- It is important to clearly define the scope of the MSE to all parties involved and discuss time-frames, technical capacity expectations, and data sharing arrangements.
- Establishing clear expectations from the start of the MSE process fosters ownership, acceptance, and success.

MAINTAINING TRUST

- Reiterate the project scope, outcomes, and stakeholder needs to ensure consistency and focus.
- Build trust through mutual knowledge sharing and clear communication of purpose.

TIME-FRAME AND COMPLEXITY

- MSE timelines are similar to stock assessments but can involve added complexity. Experts can scope projects to balance timelines with priority outcomes.

ACKNOWLEDGING LIMITATIONS

- MSE has technical constraints and is not a universal solution for marine resource management issues. It is important to discuss what is and what is not achievable.
- In reality, MPs may underperform outside the range of scenarios defined in operating models, as not all system uncertainties are foreseeable. It is advisable to couple MSE with a policy for exceptional circumstances.

ENCOURAGE LONG-TERM THINKING

- MSE requires shifting focus from short-term outcomes to evaluating the long-term performance of management strategies. While stakeholders often prioritize near-term impacts, MSE provides valuable insights into how decisions perform over time, ensuring sustainable outcomes.
- Balancing short- and long-term perspectives is essential but can be challenging, requiring careful consideration of both immediate needs and future goals

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