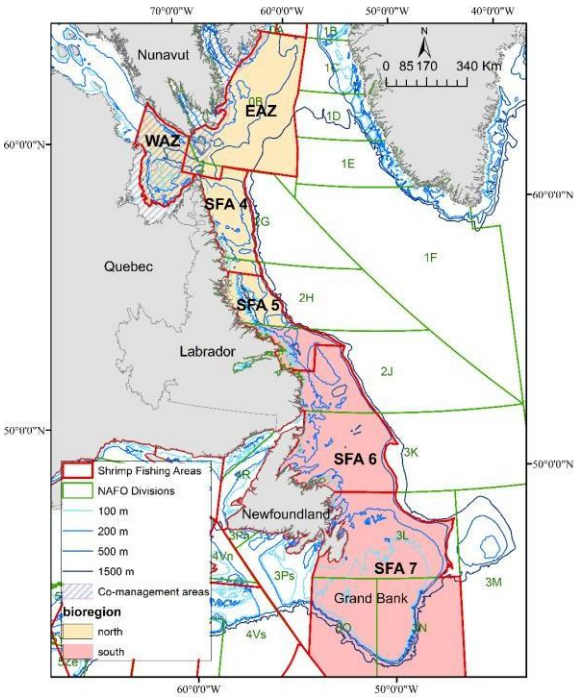
SUBMISSION TO THE
NUNAVUT WILDLIFE MANAGEMENT BOARD
AND NUNAVIK MARINE REGION WILDLIFE BOARD

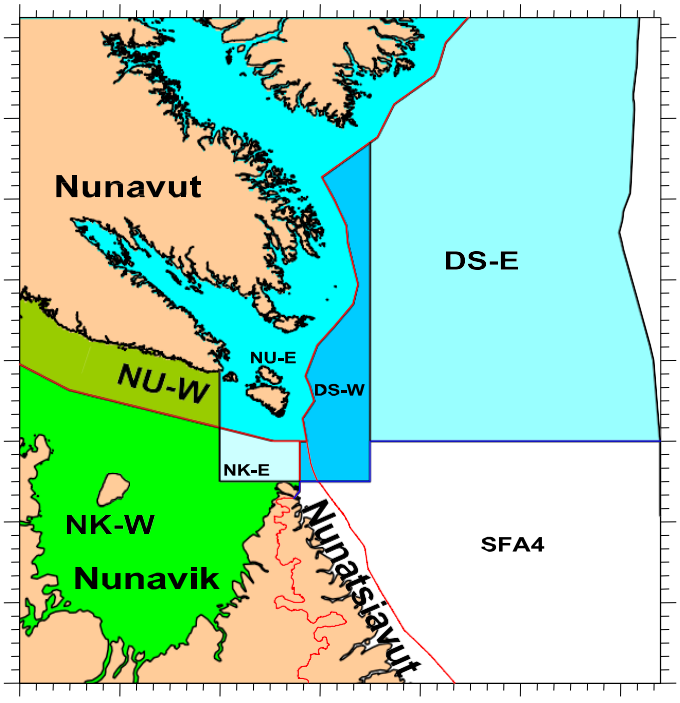
FOR

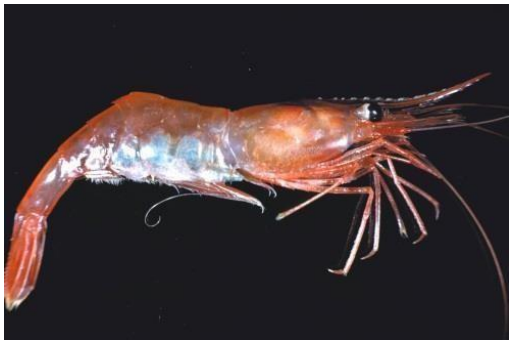
Information: **Decision: X** **Recommendation: X**

Issue: Precautionary Approach Framework for Northern shrimp (*Pandalus borealis*)

Map Left: Yellow – North Stock Assessment Region; Red – South Stock Assessment Region
Map Right: Blue – Eastern Assessment Zone; Green – Western Assessment Zone







Northern shrimp (*Pandalus borealis*)

Background

The Nunavut Wildlife Management Board and Nunavik Marine Region Wildlife Board (the Boards) previously approved Precautionary Approach Frameworks for Northern shrimp (*Pandalus borealis)* in the Western Assessment Zone and Eastern Assessment Zone in 2024. Since then, the Department of Fisheries and Oceans (DFO) has developed a new understanding of how Northern shrimp populations are structured. Rather than assessing Northern shrimp in the Eastern and Western Assessment Zones separately, since 2025 DFO considers them part of a larger biological population, namely the North Stock Assessment Region (map at Appendix 1), which also includes shrimp fishing area 4 and the northern portion of shrimp fishing area 5.

DFO has adopted a new scientific model that uses information from a wide variety of sources to provide an estimate of stock biomass, population growth, natural mortality and harvest rates in the North Stock Assessment Region (Appendix 2). Separate from the population model, a biomass index value is produced using the annual survey data for use in setting harvest levels. Together this information supports more robust and risk-based fisheries management, and is the basis of the proposed Precautionary Approach Framework.

The primary components of the Precautionary Approach Framework are: **Reference points** to define stock status zones (Healthy, Cautious and Critical) and **Harvest Decision Rules**.

The Limit Reference Point, which delineates the Cautious and Critical zones, as well as the proposed Upper Stock Reference point, delineating the Cautious and Healthy zones, are based on the new scientific model and were developed through a Canadian Science Advisory Secretariat peer review process led by DFO Science in 2024 (Appendix 2). The model will be updated every three years during a full stock assessment, which will update the stock status (whether the stock is placed in the Healthy, Cautious, or Critical Zone), Limit Reference Point, and proposed Upper Stock Reference point. The biomass index value, which is produced using survey data, will be updated every year and is used to determine total allowable catch based on the Harvest Decision Rule.

Since 2024, DFO, industry, Indigenous organizations, provincial governments, co-management partners, and technical experts worked together to develop a Management Strategy Evaluation process for Northern shrimp. This Management Strategy Evaluation tested different management options (Harvest Decision Rules) using computer simulations to identify approaches that best balance conservation of the stock and stable fishing opportunities for industry in the North Stock Assessment Region. The Management Strategy Evaluation framework and supporting science were peer-reviewed through the Canadian Science Advisory Secretariat in December 2025 (Appendix 3).

A new Harvest Decision Rule, to determine the harvest limit for the North Stock Assessment Region shrimp population, was endorsed by the Northern Shrimp Advisory Committee and

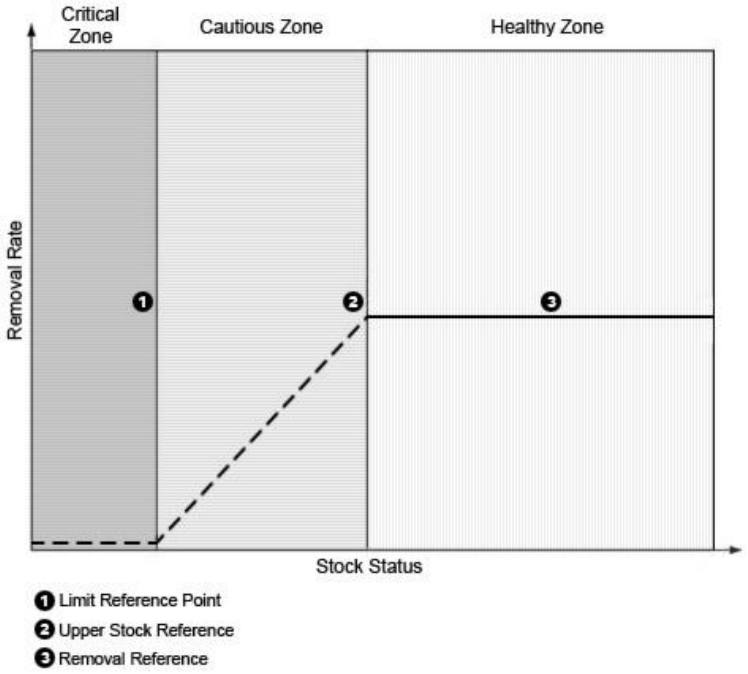
used to inform the 2026-27 total allowable catch levels for the other management areas in the North Stock Assessment Region, as well as DFO's recommendations to the Boards for decisions and recommendations on 2026-27 total allowable catch levels for the Eastern and Western Assessment Zones. The new Harvest Decision Rule will be formally reviewed in 2028 as part of the next full stock assessment.

The Boards' joint decisions and recommendations for the 2026-27 total allowable catches in the Eastern and Western Assessment Zones followed the Harvest Decision Rules previously approved in 2024, but encouraged DFO to submit a separate proposal for the approval of a new Precautionary Approach Framework. The purpose of this briefing note is to seek Board decisions and recommendations, as appropriate, to adopt a new Precautionary Approach Framework for Northern shrimp in the North Stock Assessment Region to guide fisheries management decision making, beginning in the 2027-28 fishing season.

Reference Points

The Limit Reference Point, which defines the boundary between the Cautious and Critical Zones, was established through the scientific peer-review process. The Upper Stock Reference, which defines the boundary between the Healthy and Cautious Zones, is a proposed reference point that is ultimately a management decision. A graphical depiction of the Precautionary Approach framework is shown in Figure 1.

Figure 1. Illustrative example of reference points and stock status zones of the Precautionary Approach framework.



The previous stock assessment frameworks for Northern Shrimp in the Eastern and Western Assessment Zone management areas were based on a biomass index for each management area, which represented only a portion of the absolute biomass of each stock at a single point in time. Under the new stock assessment framework, the scientific model provides an estimate (not an index) of the shrimp population size that scientists believe can support the largest long-term sustainable fishery (see Appendix 2 for more details). This estimated value, referred to as the "biomass target", is based on biological factors including shrimp growth, reproduction, and natural mortality, and is used to calculate the reference points.

Shrimp biomass in the North Stock Assessment Region has never been observed at levels as low as the newly established Limit Reference Point. As a result, there is uncertainty about how the stock would respond if it declined into the Critical Zone or how quickly it could recover. To account for this uncertainty, and because shrimp are an important food source for many marine species, the Limit Reference Point was set at 50% of the biomass target. Setting the Limit Reference Point at the 50% level provides an additional conservation buffer than the commonly used default of 40% of the biomass target (Table 1). The proposed USR at 80% of the biomass target (Table 1) is intended to trigger management action earlier if the stock begins to decline. Unlike fixed biomass numbers that were part of the previous Precautionary Approach Frameworks for the Eastern and Western Assessment Zones, the reference points for the North Stock Assessment Region may change following each full stock assessment because they are recalculated using the newest scientific information and a new estimate of the biomass target. Additional details on reference points are provide in the peer reviewed Science Advisory Report in Appendix 2.

Table 1. Reference points for *Pandalus borealis* in the North Stock Assessment Region.

Reference Point	Description
Limit Reference Point	50% of the biomass target
Upper Stock Reference	*Proposed* at 80% of the biomass target

Harvest Decision Rules

The Harvest Decision Rule uses the biomass index produced from the annual survey data and control points (upper and lower) to determine how much shrimp can be harvested in the North Stock Assessment Region each year. Reference points (and stock status) can only be compared to the full stock biomass from the scientific model, while control points can be compared to the annual biomass index. Control points are linked to the reference points and are estimated during the full assessment every three years. Being above the upper control point functions similar to being in the Healthy Zone, between the upper and lower control points is similar to the Cautious Zone, and below the lower control point is similar to the Critical Zone. The biomass index and placement relative to the control points is calculated every year.

Between 2024 and 2026, DFO, industry, Indigenous organizations, co-management partners, provincial governments, and technical experts tested various Harvest Decision Rules for the

North Stock Assessment Region through a Management Strategy Evaluation process. The objective was to identify an approach that balances conservation with stable fishing opportunities.

The recommended Harvest Decision Rule is based on the previously used 2-step Harvest Decision Rule, previously approved by the Boards in 2024, with some additional elements. The recommended HDR uses:

- a target harvest rate of 20% when the stock is above the upper control point;
- lower harvest rates if stock conditions decline;
- a maximum annual change of 25% to the total allowable catch; and
- a four-year phase-in period (from 2026-27 to 2029-30).

The maximum annual change of 25% of the total allowable catch is a limit of 25% that prevents sudden changes in total allowable catches. It provides greater stability for industry while still allowing management to respond to changes in stock conditions given that the stock can fluctuate from year to year. Without limits in place, year-to-year total allowable catches could increase or decrease sharply, creating uncertainty for harvesters, processors, and communities.

The four-year phase-in period is intended to gradually transition the fishery from the old approach to the new one given that the new harvest decision rule uses a different stock assessment model. This avoids abrupt changes in total allowable catches that could occur when moving to a new management system and allows participants time to adjust. The phase-in does not change the long-term outcome, but provides a more gradual and predictable transition, which would result in full implementation of the proposed harvest decision rule starting in 2030.

The four year phase-in and 25% limit on changes to total allowable catches are additional safeguards that were not included in the previous Harvest Decision Rule. A detailed explanation and example of how the Harvest Decision Rule works is provided in Appendix 4.

Consultation

The proposed Precautionary Approach framework was developed through extensive collaboration with representatives from DFO, industry, Indigenous organizations, provincial governments, co-management boards, and technical experts from 2024 to 2026. Staff from both Boards attended key discussions. Nunavut and Nunavik industry (and/or representatives thereof) participated in both consultation opportunities.

In January and March 2026, the Northern Shrimp Advisory Committee reviewed the proposed Upper Stock Reference point and the Harvest Decision Rule for the North Stock Assessment Region, endorsing the following:

- the proposed Upper Stock Reference at 80% of the biomass target;
- the harvest decision rule with a 20% harvest rate 25% maximum annual TAC change, and a four-year phase-in period.

A summary of discussion is at Appendix 5

The Harvest Decision Rule for the North Stock Assessment Region that was endorsed by the Northern Shrimp Advisory Committee uses a harvest rate above maximum sustainable yield. Science advice indicated that a lower harvest rate would be consistent with maximum sustainable yield and would reduce the risk of the stock entering the Cautious or Critical Zones. However, participants concluded that the selected approach represented an acceptable balance between conservation objectives, harvesting opportunities, and economic stability.

As part of Management Strategy Evaluation implementation, DFO will develop a protocol to define conditions under which the Management Strategy Evaluation approach may no longer be appropriate. In addition, the performance of the selected Harvest Decision Rule will be formally reviewed in 2028 to evaluate how well the Harvest Decision Rule is meeting conservation, yield, and stability considerations.

Recommendation
DFO recommends that the Boards adopt the Precautionary Approach Framework presented herein for Northern shrimp in the North Stock Assessment Region. Adoption of this Precautionary Approach Framework constitutes an amendment to the Integrated Fisheries Management Plan, and would include adoption of the reference points and the Harvest Decision Rule for Northern shrimp in the North Stock Assessment Region:

- Limit Reference Point at 50% of the biomass target;
- proposed Upper Stock Reference at 80% of the biomass target; and,
- Harvest Decision Rule with a 20% harvest rate, 25% maximum annual change in total allowable catch, and a four-year phase-in period.

Summary of the Request

DFO is seeking from the Boards:

1. Decisions to adopt the proposed Precautionary Approach Framework for Northern shrimp in the Nunavut/Nunavik East and Nunavut/Nunavik West management units within the Nunavut Settlement Area and Nunavik Marine Region, respectively.

2. Recommendations to adopt the proposed Precautionary Approach Framework for Northern shrimp in waters adjacent to the Nunavut Settlement Area and Nunavik Marine Region.

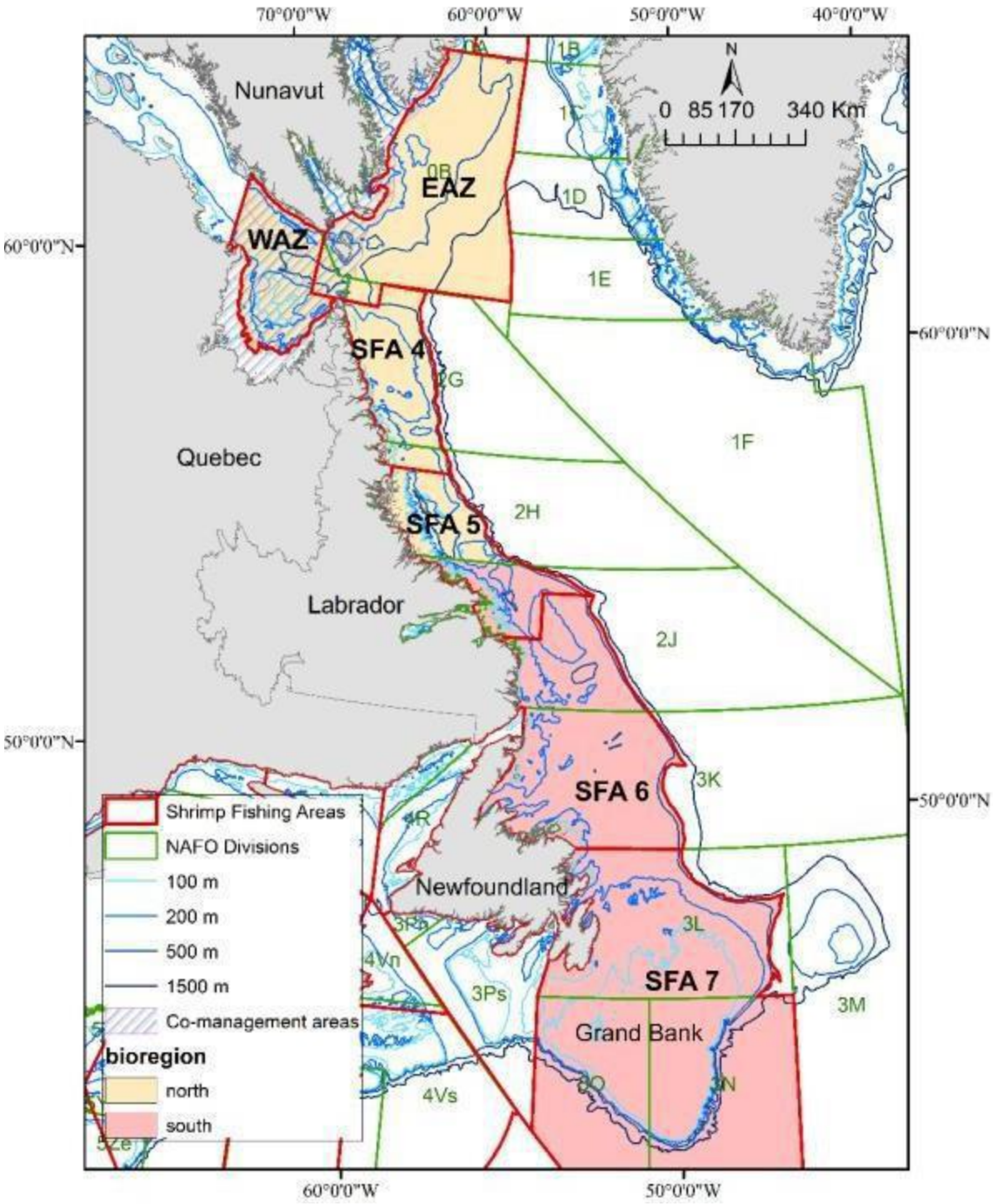
DFO recognizes that the Precautionary Approach Framework(s) serves to guide fisheries management decision making using a precautionary approach, and that Minister and co-management partner discretion would remain in annual decision making (e.g. setting of Total Allowable Catch levels).

Prepared by: Liliya Baranova, Fisheries Resource Management, Fisheries and Oceans Canada

Date: September 16, 2026

Appendix 1

Map of the North and South Stock Assessment Regions
Yellow – North Stock Assessment Region; Red – South Stock Assessment Region

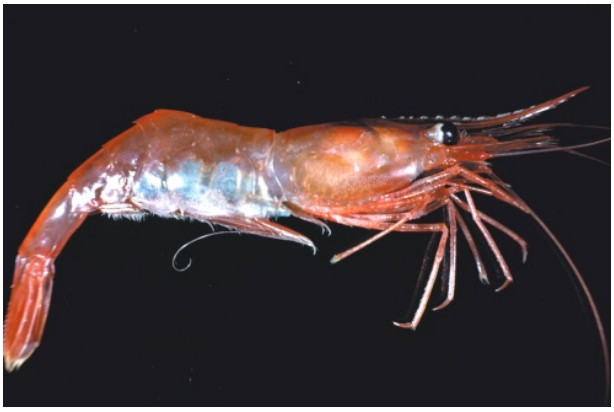


Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Newfoundland and Labrador Region
Arctic Region

Canadian Science Advisory Secretariat
Science Advisory Report 2026/033

DEVELOPMENT OF A PRECAUTIONARY APPROACH FRAMEWORK FOR NORTHERN SHRIMP (*PANDALUS BOREALIS*) IN SHRIMP FISHING AREAS 4–7, EASTERN ASSESSMENT ZONE, AND WESTERN ASSESSMENT ZONE



*Northern Shrimp (*Pandalus borealis*; Fisheries and Oceans Canada [DFO]).*

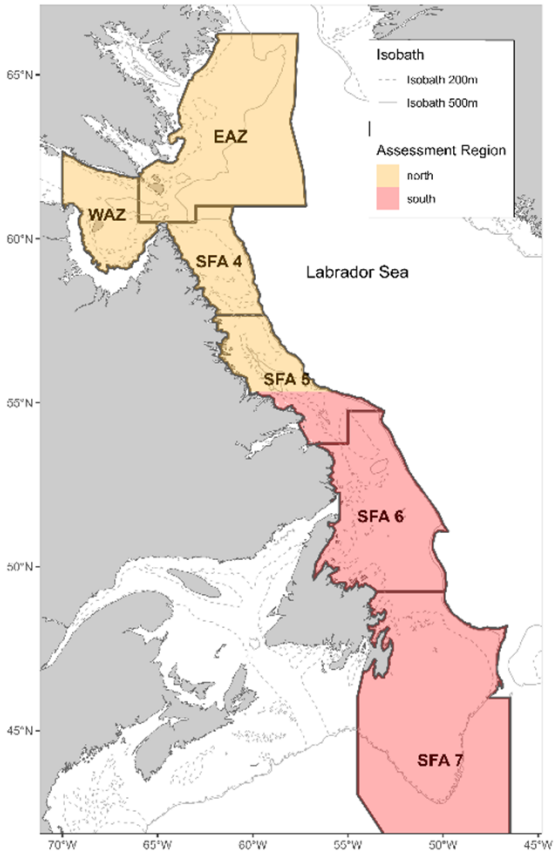


Figure 1. Map showing six current shrimp fishing areas (SFAs) (Eastern Assessment Zone [EAZ], Western Assessment Zone [WAZ], SFAs 4–7) and two new stock assessment regions (north and south) used in the assessment framework.

CONTEXT

It is recognized that Northern Shrimp (*Pandalus borealis*) are distributed broadly over the Northwest Atlantic Ocean, including Shrimp Fishing Areas (SFAs) 4–7, Eastern Assessment

Zone (EAZ) and Western Assessment Zone (WAZ), and that these areas are connected through larval dispersal. For each SFA and assessment zone, stock advice has been based on qualitative evaluations of biomass indices in relation to historical levels and provided in the context of the Precautionary Approach (PA) Framework. However, the biological population is recognized to be distributed over a larger region than the management scale. A population model is needed to align the assessment with the biological population and incorporate environmental and ecosystem understanding into the assessment. Development of a population assessment model for Northern Shrimp facilitates quantitative risk-based science advice, allowing fisheries managers to consider projected changes in stock abundance and yield under alternative management measures considered in the decision-making process. A population assessment model and revised limit reference points (LRPs) also inform future work to update the PA Frameworks in place for Northern Shrimp in SFAs 4–7, EAZ, and WAZ, including harvest decision rules and upper stock reference points (USRs).

For this reason, a multi-regional (Arctic and Newfoundland & Labrador regions) PA Framework meeting was required to peer-review a population model for Northern Shrimp, incorporating information from the species' broader geographic range within current management areas of the EAZ, WAZ, and SFAs 4–7.

This Science Advisory Report is from the multi-regional peer review of December 9–13, 2024, on the Development of a Precautionary Approach Framework for Northern Shrimp (*Pandalus borealis*) in Shrimp Fishing Areas 4–7, Eastern Assessment Zone, and Western Assessment Zone. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- A new understanding of Northern Shrimp population structure, based upon their distribution, dispersal, and life history traits, was adopted. Therefore, the spatial scale of assessment for Northern Shrimp has changed from six to two stock assessment regions (SAR) - North (NSAR) and South (SSAR) - divided by the boundary between Northwest Atlantic Fisheries Organization (NAFO) Divisions 2H and 2J.
- A Bayesian size-structured stock assessment modeling framework was adopted that incorporates fishery and biomass indices from spatiotemporal modeling and size composition to estimate trends in Northern Shrimp biomass, recruitment, natural mortality rates, and exploitation rates for each stock assessment region.
- Model results highlight groundfish predation as an important driver of Northern Shrimp natural mortality in the SSAR, but the role of predation as a driver of population dynamics in the NSAR is unclear. Predation effects are currently represented in the model via time-varying natural mortality.
- A biomass at maximum sustainable yield (B_{msy}) proxy value for each stock assessment region was calculated as 40% of unfished biomass (i.e., B_{msy}-proxy = B_0 x 0.4).
- A Limit Reference Point (LRP) for each stock assessment region was adopted as 0.5 x B_{msy}-proxy.
- An Upper Stock Reference point (USR) of 80% of the B_{msy}-proxy was recommended for each stock assessment region.
- Reference point calculations reflect estimated natural mortality and sex-transition rates from the most recent eight years (i.e., approximately one Northern Shrimp generation).

INTRODUCTION

Northern Shrimp (*Pandalus borealis*) are distributed broadly over the Northwest Atlantic Ocean, including Shrimp Fishing Areas (SFAs; Figure 1) 4–7, the Eastern Assessment Zone (EAZ) and the Western Assessment Zone (WAZ), and these areas are connected through larval dispersal. For each SFA and assessment zone, stock advice has historically been based on qualitative evaluations of biomass indices in relation to historic levels and provided in the context of the Precautionary Approach (PA) Framework (DFO 2024a, 2024b, 2024c, NAFO 2024). However, the biological population is recognized to be larger than the management scale (Baker et al. 2025). To align the assessment with the biological population and facilitate incorporation of environmental and ecosystem variables into the assessment, a population model is needed. Development of a stock assessment model for Northern Shrimp will facilitate provision of risk-based science advice, allowing fisheries managers to consider projected changes in stock abundance and the potential impacts of various management measures in the decision-making process.

For this reason, a multi-regional (DFO's Arctic and Newfoundland & Labrador Regions) PA Framework meeting was held to peer-review a population model for Northern Shrimp that encompasses the current management areas of the EAZ, WAZ, and SFAs 4–7, and incorporates information from the species' broader geographic range.

ANALYSIS

New stock structure

Northern Shrimp has been managed as a series of separate stocks with the general assumption that each stock is supported by local recruitment with an unknown level of connectivity between areas. The magnitude of movement or connectivity between areas was unquantified, but recognized as a significant source of uncertainty in stock assessments (e.g., DFO 2024a). Misalignment between the biological population and assessment and management processes creates unquantified uncertainty which increases the risk associated with management decisions.

To address this ongoing source of uncertainty, spatiotemporal models were used to identify patterns in stock structure, specifically patterns in population density, sex ratio, and female length (Baker et al. 2025). These results were combined with recent genomic and larval dispersal data to quantify Northern Shrimp population structure across SFAs 4–7, the EAZ and the WAZ. Two data clusters were identified throughout the time series, which separated Northern Shrimp into North and South stock assessment areas (NSAR and SSAR). The results were presented as a foundation for developing a new Northern Shrimp stock assessment framework for two stock assessment regions (NSAR and SSAR) to replace the current matrix of six assessment areas (SFAs 4–7, the EAZ and the WAZ). The two regions are divided by the line located at the boundary between Northwest Atlantic Fisheries Organization (NAFO) Divisions 2H and 2J.

Ecosystem Information

Northern Shrimp is a forage species that is consumed by Atlantic Cod (*Gadus morhua*), Greenland Halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes* spp.), and other fishes, birds, and marine mammals. Dramatic changes (regime shifts) in marine ecosystems and communities (Koen-Alonso and Cuff 2018) have altered predator-prey dynamics, with the Newfoundland and Labrador marine community changing from a groundfish-dominated

community to a shellfish-dominated community in the 1990s. Ecosystem productivity has also changed over time; the Northern Shrimp population, particularly in the SSAR, has recently been transitioning to having lower recruitment and/or higher mortality in response to changes in the ecosystem.

To incorporate the effects of predation into Northern Shrimp stock assessments, diet data from predators caught during DFO research vessel surveys, including Atlantic Cod and Greenland Halibut, were examined. Atlantic Cod and Greenland Halibut diet appeared to reliably track Northern Shrimp biomass, with Atlantic Cod showing a better fit.

New model

A new population model for Northern Shrimp was reviewed. The new population model incorporated information from the species' broader geographic range, adopting the NSAR and SSAR identified through recent spatiotemporal and genomic analyses (Baker et al. 2025) in place of the six current assessment areas (SFAs 4–7, EAZ, and WAZ). A size-structured population model was developed using the Spatially Integrated Statistical Catch at Length/Size (SISCALS) model. SISCALS computes growth, survival, and sex transition and other characteristics on a quarterly time step (i.e., four times per year). The effect of incorporating quarterly or annual sex transitions was explored but there was little difference in results between the two model configurations; therefore, sex transition only occurred once each year in the 4th quarter in the final model. Recruitment also occurred in a single quarter each year. Considering diet analysis results, predation effects were incorporated into the model by adding time-varying natural mortality.

The stock assessment model was designed to:

1. Estimate biomass, fishing mortality, natural mortality, growth, and recruitment for NSAR and SSAR, subject to the assumed structure for population dynamics and observation models;
2. Derive model-based reference points from alternative spawning potential ratio (SPR) options;
3. Establish Bayesian posterior probability distributions of current stock status with respect to SPR reference points;
4. Explore possible ecosystem drivers (e.g., predation, growth) of changes in productivity;
5. Establish a framework for testing harvest strategies and decision rules.

The model review included discussions of the relationship between model estimated biomass and biomass indices from surveys, shrimp growth, natural mortality, recruitment, larval dispersal, fishery-derived catch-per-unit-effort, and the male to female sex transition. Examining the model goodness of fit results, SISCALS successfully captured large-scale variations in stock biomass, particularly in the SSAR. Posterior plots of model parameters showed good model performance. The Atlantic Cod diet index was compared to model outcomes; the results overlapped fairly well, with evidence of a time lag in the trend residuals.

The SISCALS model estimated a high survey catchability in the NSAR, meaning that the spatiotemporal model survey index is potentially a positively biased estimate of shrimp abundance. This raised some concerns, as biased survey catchability could affect Science advice regarding harvest levels. After discussion, the conclusion was that the model interprets the trend in biomass in response to the catch and that catchability just scales the survey index to the underlying model biomass in order to compute the likelihood. The catch and survey trend, therefore, determine the productivity of the stock, not catchability. Therefore, overestimating

catchability would not affect the estimate of productivity. Nevertheless, there was also consensus to investigate the cause of the high catchability estimates as part of future research.

The model results were used to assess stock trends in each stock assessment region. Northern Shrimp biomass in the NSAR has been declining, the exploitation rate has been increasing, and fewer shrimp have been surviving to transition into females, which has reduced the spawning stock biomass. Biomass has also declined in the SSAR with a higher exploitation rate, low recent recruitment, and an increasing trend in natural mortality (although stable recently). In the SSAR, natural mortality was highly correlated with Atlantic Cod and redfish separately modelled biomass.

Reference points

Spawning Potential Ratio (SPR) was used to establish a B_{msy}-proxy and PA Framework reference points. Spawning Potential Ratio (SPR) represents the fraction of unfished spawning stock biomass (SSB) that is assumed to coincide with B_{msy}. A B_{msy}-proxy value for each SAR was calculated as 40% of unfished biomass (i.e., B_{msy}-proxy = $0.4B_0$). A LRP for each stock assessment region was adopted as $0.5B_{msy}$-proxy; in determining an appropriate level for the LRP there was notable consideration of the biological capacity for Northern Shrimp population growth, tempered by the importance of Northern Shrimp as a forage species that directly supports key predators (i.e., Atlantic Cod, Greenland Halibut, redfish, marine mammals, seabirds) and is important for overall ecosystem health. An USR point of 80% of the B_{msy}-proxy was recommended for each SAR. Reference point calculations reflect estimated natural mortality and sex-transition rates from the most recent eight years (Expected to be approximately one Northern Shrimp generation).

Sources of Uncertainty

- Immigration of recruits from areas adjacent to the NSAR (e.g., SFAs 0 and 1, inshore waters within the Nunavut Settlement Area, West Greenland). Inclusion of “drift” in the model considers movement of shrimp from the NSAR to the SSAR but presently there is no direct inclusion of external inputs to the NSAR.
- Length frequencies are not standardized via the same spatiotemporal model as survey biomass indices.
- Predation by Atlantic Cod, Greenland Halibut, and redfish was considered during model development but ultimately there was concern that inclusion of predation requires a better understanding of the form of the relationship between predation and mortality (i.e., linear or functional response). The effect of predation on mortality needs to be further examined and should expand to include consideration of predation by marine mammals, seabirds and other fish species (e.g., grenadiers).
- Shrimp growth and mortality rates in the NSAR.
- Need to determine at what population level serious harm occurs to the stock. Data at present do not allow an analytical determination. This information is needed to develop a more informed LRP.

CONCLUSION

- A new understanding of Northern Shrimp population structure, based upon their distribution, dispersal, and life history traits, was adopted. Therefore, the spatial scale of assessment for

Northern Shrimp has changed from six to two stock assessment regions – NSAR and SSAR - divided by the boundary between NAFO Divisions 2H and 2J.

- A Bayesian size-structured stock assessment modeling framework was adopted that incorporates fishery and biomass indices from spatiotemporal modeling and size composition to estimate trends in Northern Shrimp biomass, recruitment, natural mortality rates, and exploitation rates for each SAR.
- Model results highlight groundfish predation as an important driver of Northern Shrimp natural mortality in the SSAR, but the role of predation as a driver of population dynamics in the NSAR is unclear. Predation effects are currently represented in the model via time-varying natural mortality.
- A B_{msy}-proxy value for each stock assessment region was calculated as 40% of unfished biomass (i.e., B_{msy}-proxy = $0.4B_0$).
- A Limit Reference Point (LRP) for each stock assessment region was adopted as $0.5B_{msy}$-proxy.
- An Upper Stock Reference point (USR) of 80% of the B_{msy}-proxy was recommended for each stock assessment region.
- Reference point calculations reflect estimated natural mortality and sex-transition rates from the most recent eight years (i.e., approximately one Northern Shrimp generation).

Research Recommendations

- Standardize survey length-composition data using a spatiotemporal model to reduce potential for natural mortality and catchability bias.
- Further analysis should be done to understand the potential bias caused by partial survey coverage and explore potential “fixes” to address any historical periods with low survey coverage. This includes impacts of partial survey coverage on estimated catchability and sex-transition and growth model bias due to morphological differences for EAZ shrimp.
- Explore alternative sampling design for biomass and length composition data from both fisheries and surveys to optimize information content while minimizing bias.
- Investigate relationships between shrimp population dynamics (e.g., mortality, growth, productivity, density dependence) and environmental and ecological factors, including sea ice cover, ocean currents, predation, and larval transport with consideration given to differences between the two stock assessment regions.
- Improve understanding of the effect of predation on shrimp population dynamics and the integration of predation into future versions of SISCALS, both in terms of natural mortality to inform the model, but also on predators’ dependence on shrimp to inform LRP revisions. Analyses may include the integration of additional data using predator stomach contents and consideration of predation by marine mammals, seabirds and other fish species (e.g., grenadiers).

LIST OF MEETING PARTICIPANTS

Name	Affiliation
Aaron Adamack	DFO, Science, Newfoundland and Labrador Region
Alastair O'Rielly	Northern Coalition

Name	Affiliation
AnnDorte Burmeister	Greenland Institute of Natural Resources
Ben Davis	Torngat Secretariat
Bruce Chapman	Canadian Association of Prawn Producers
Chantelle Sawatzky	DFO, Science, Arctic Region
Chelsea Malayny	DFO, Science, Newfoundland and Labrador Region
Chris Rose	Fish, Food, and Allied Workers Union
Christi Friesen	DFO, Resource Management, Arctic Region
Daniel Enright	DFO, Science, Arctic Region
Darrell Mullowney	DFO, Science, Newfoundland and Labrador Region
Derek Butler	Nunavut Fisheries Association
Dirk Algera	DFO, Resource Management, National Capital Region
Divya Varkey	DFO, Science, Newfoundland and Labrador Region
Elaine Hynick	DFO, Science, Newfoundland and Labrador Region
Erika Parrill	DFO, Science, Newfoundland and Labrador Region
Erin Carruthers	Fish, Food, and Allied Workers Union
Gemma Rayner	Oceans North
Hannah Munro	DFO, Science, Newfoundland and Labrador Region
Joclyn Paulic	DFO, Science, Arctic Region
Jon Fisher	Marine Institute
Jorge Negrin Dastis	DFO, Resource Management, National Capital Region
Julia Pantin	DFO, Science, Newfoundland and Labrador Region
Kaitlyn Charmley	DFO, Science, Newfoundland and Labrador Region
Karen Dwyer	DFO, Science, Newfoundland and Labrador Region
Kathleen Ryan	DFO, Science, Newfoundland and Labrador Region
Kevin Hedges (Co-Chair)	DFO, Science, Arctic Region
Krista Baker	DFO, Science, Newfoundland and Labrador Region
Krista Kenyon (Rapporteur)	DFO, Science, Arctic Region
Mariano Koen-Alonso	DFO, Science, Newfoundland and Labrador Region
Mark Simpson	DFO, Science, Newfoundland and Labrador Region
Nicholas Duprey	DFO, Science, National Capital Region
Nicolas Le Corre	DFO, Science, Newfoundland and Labrador Region
Olga Kiseliova	DFO, Resource Management, National Capital Region
Robert Deering	DFO, Science, Newfoundland and Labrador Region
Sam Johnson	Landmark Fisheries Research
Samantha Coombs	Government of Newfoundland and Labrador
Sean Cox	Landmark Fisheries Research
Susan Thompson	DFO, Science, National Capital Region
Todd Broomfield	Nunatsiavut Government
William Coffey	DFO, Science, Newfoundland and Labrador Region
Wojciech Walkusz	DFO, Science, Arctic Region
Xinhua Zhu	DFO, Science, Arctic Region

Name	Affiliation
Zoya Martin	Government of Nunavut

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NORTHERN SHRIMP (*PANDALUS BOREALIS*) IN THE NORTH AND SOUTH STOCK ASSESSMENT REGIONS - REVIEW OF MANAGEMENT STRATEGY EVALUATION (MSE) OPERATING MODEL AND CANDIDATE MANAGEMENT PROCEDURES

Northern Shrimp (Pandalus borealis) Photo: Fisheries and Oceans Canada.

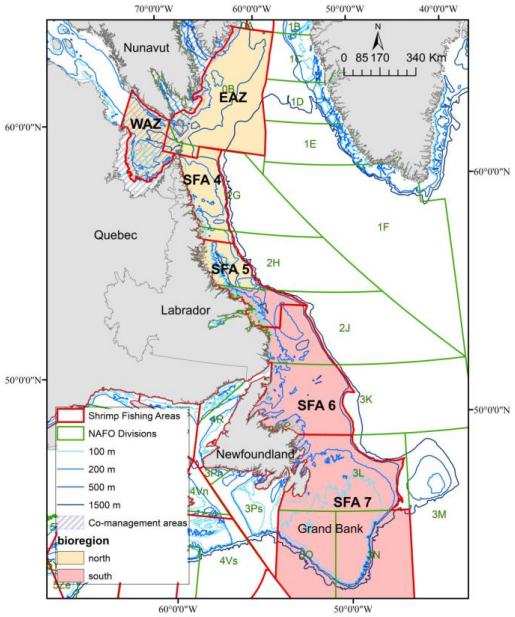

Figure 1. The spatial management areas for Canadian Northern Shrimp, including North (yellow) and South (red) Stock Assessment Regions.

CONTEXT

This Science Advisory Report is from the national peer review of December 2-5, 2025 on the Northern Shrimp - Review of Management Strategy Evaluation (MSE) Operating Model and Candidate Management Procedures. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- The spatially integrated statistical catch-at-length / size (SISCALS) assessment model, developed as part of the December 2024 Northern Shrimp assessment framework, was adopted as the foundation for the operating models used in the Management Strategy Evaluation (MSE).

- For the North Stock Assessment Region, length composition data used in the operating models only includes years 2007-2024. Years prior to 2007 were removed to address the lack of Eastern Assessment Zone survey coverage in these early years.
- Operating models were developed to represent plausible stock dynamics and incorporate uncertainty in recruitment, growth, natural mortality, maturity, and survey indices.
- Two distinct recruitment regimes were identified during the 1996-2019 period and were used to form the two operating model recruitment scenarios used in this MSE:
  - A short time-series of recent low recruitments (the same period used in the March 2025 assessment projections); and,
  - The full time-series that had higher average recruitment with greater variability.
- MSE performance statistics were calculated using a weighted combination of results from each of the two operating models. In the North Stock Assessment Region, operating models were similar and therefore equally weighted (50% each). In the South Stock Assessment Region, the recent low recruitment regime was considered more plausible in the near-term and received a higher weighting (90%) than the full time-series (10%).
- Validation tests confirmed that the 28 harvest decision rules (HDRs) specified based on combinations of harvest control rule types, exploitation rate values, HDR phase-in periods, and maximum allowable Total Allowable Catch changes produced outputs as intended.
- All HDRs are constructed to be run annually using the previous year's Total Allowable Catch, fishable biomass index and spawning stock biomass index. At these annual time-steps, exceptional circumstances (to be developed) would also be examined.
- Twelve (12) performance metrics were used that fall into 3 categories (conservation, yield and stability). Metrics were calculated and applied across all HDRs; trade-off plots demonstrate conservation–yield–stability relationships, indicating that performance metrics are appropriate indicators of performance in relation to objectives.
- Operating model structure and performance metrics were reviewed to support the MSE process; the performance of HDRs for meeting management objectives was not reviewed. Nevertheless, the example HDRs displayed a wide range of performance across conservation, yield and stability metrics as well as stock assessment regions.
- Other uncertainties were identified that should be explored in the future for incorporation in the operating models. It is recommended that the expected performance of any adopted HDR be reviewed periodically (e.g., 3-4 years) as new operating models and performance measures arise unless a formal review is otherwise triggered by exceptional circumstances.

INTRODUCTION (OR BACKGROUND)

The provision of science advice for Northern Shrimp (*Pandalus borealis*) changed fundamentally following the adoption of a statistical model-based assessment framework for the species in December 2024 and a revised population structure from six stock assessment areas (Western Assessment Zone (WAZ), Eastern Assessment Zone (EAZ), Shrimp Fishing Areas (SFAs) 4-6, NAFO Divisions 3LNO) to two stock assessment regions (North Stock Assessment Region (NSAR) and South Stock Assessment Regions (SSAR)). Historically, science advice was provided at the same spatial scale as the management of the fishery; however, with the revised population structure, science advice is now provided for two stocks (NSAR and SSAR) that span six management areas.

Earlier in 2024, a two-step harvest decision rule (2SHDR) using survey data specific to each management area was adopted to calculate the total allowable catch (TAC) in the WAZ, EAZ and SFAs 4-6. The potential effectiveness of the 2SHDR was not tested in simulations because a model-based assessment framework did not yet exist for Northern Shrimp.

The new framework adopted in December 2024 uses a specially designed model for Northern Shrimp called the spatially integrated statistical catch-at-length / size (SISCALS) model. The framework provides model-based estimates of biomass, productivity and stock status with respect to biological reference points for the NSAR and SSAR. Further, alternative formulations of SISCALS are the basis of the operating model(s) used in simulation testing the potential effectiveness of candidate harvest decision rules (HDRs) within the management strategy evaluation (MSE) process for Northern Shrimp.

A Northern Shrimp Advisory Committee MSE Working Group comprised of DFO fishery managers, Northern Shrimp harvesters, provincial and co-management partner representatives, and scientists developed the context, preliminary objectives, and candidate HDRs of the MSE. The science advice herein supports this work by:

1. Ensuring that the operating model(s) used in the MSE align(s) with the modeling framework for Northern Shrimp that was adopted in December 2024 and used in the March 2025 assessment (i.e. the spatially integrated statistical catch-at-length / size (SISCALS) model);
2. Reviewing any changes or deviations in the framework adopted in December 2024 and providing a rationale for these changes;
3. Reviewing all candidate management procedures to ensure their code/design aligns with their intended function in the real world; and,
4. Reviewing the performance metrics calculations to ensure they are the most appropriate calculations to align with the MSE's objectives.

MSE Objectives

Seven (7) preliminary MSE objectives (3 primary and 4 secondary) are under consideration by the MSE Working Group.

ANALYSIS

Operating models

The statistical model used in the Northern Shrimp stock assessment framework (*i.e.*, SISCALS, adopted in December 2024 and used in the March 2025 assessment) was incorporated as the basis for developing the operating model(s) for closed-loop simulations related to the MSE process.

Changes in data or structure from March 2025 assessment

The operating model(s)'s historical period (conditioning) was developed using an updated dataset compared to that used in the March 2025 assessment (Le Corre et al. *in prep.*[1]). This updated dataset excludes NSAR shrimp length composition data before 2007, whereas the dataset used in March 2025 covered 1996-1999 and 2005-2024. This change is viewed as an improvement to the model and was made to address a lack of sampling across the full range of Northern Shrimp size classes before 2007 in the NSAR. In particular, before 2007 there were no usable survey data available in the EAZ (Figure 2), which created a potential bias in shrimp size and mortality because Northern Shrimp in the EAZ are larger than shrimp in the WAZ and SFA 4. This bias (*i.e.*, using the pre-2007 data, without EAZ representation) could skew the model(s)'s estimates of shrimp growth and mortality. While the data from 2007 onwards also has spatial gaps, those gaps were viewed as less problematic (*e.g.*, there is some missing survey coverage in the WAZ, but Northern Shrimp sizes in the WAZ span those observed in SFA 4 and the EAZ, thus this gap is unlikely to introduce bias). In the future, it may be possible to re-incorporate pre-2007 data for the NSAR within a standardization model to address incomplete spatial and temporal coverage across years. However, a standardization model for length composition data was not available at the time of this meeting.

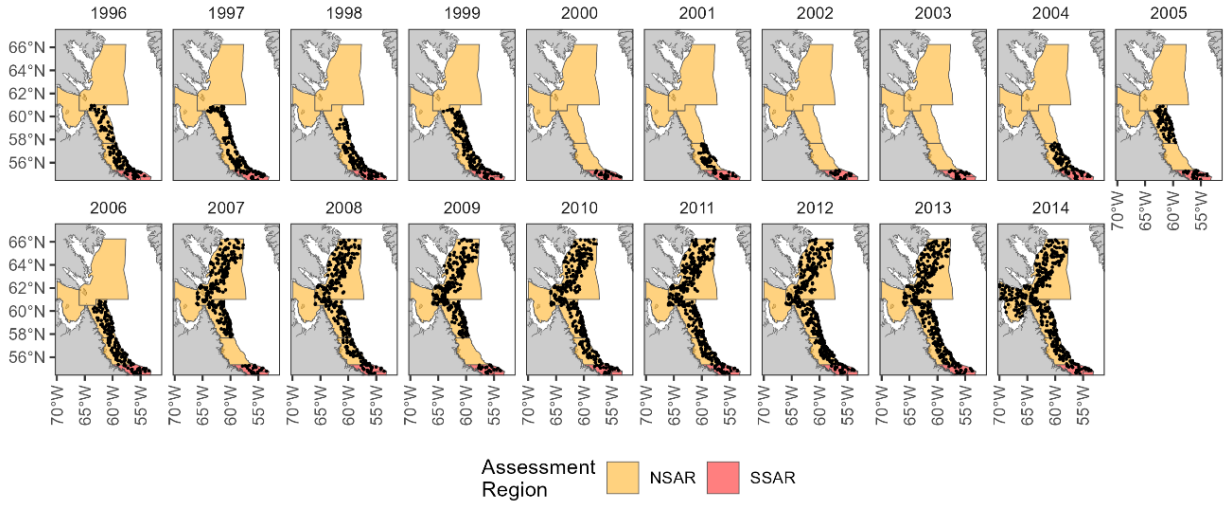

Figure 2. Survey coverage in the NSAR from 1996 to 2014, combining DFO and Northern Shrimp Research Foundation (NSRF) surveys, with each survey set represented by a black dot. In later years (2015 to 2024), survey coverage was complete, similar to 2014.

Operating Model Scenarios

Operating model (OM) scenarios in an MSE context represent plausible hypotheses about fishery and stock dynamics used to test HDRs. In general, OMs are designed to represent both

[1] Le Corre N., Baker K.D., Coffey W., Enright D., Walkusz W., Munro H., Belanger D., Coyne J., Koen-Alonso M., Malayny C., Sullivan D., and Atchison S. (*in preparation*). Assessment of Northern Shrimp (*Pandalus borealis)* in North and South Stock Assessment Regions in 2024. DFO Can. Sci. Advis. Sec. Res. Doc. 2026/nnn. iv + 81 p.

parameter uncertainty and structural uncertainty within stock assessments and management procedure simulations. Parameter uncertainty arises because the true values of model parameters are not known exactly and may include uncertainty in growth rates, natural mortality, maturity schedules, survey catchability, and stock–recruitment parameters such as unfished spawning biomass or spawner productivity in the stock–recruitment relationships. Structural uncertainty, by contrast, arises from uncertainty about the underlying processes and model assumptions used to represent the system. This may include uncertainty in stock–recruitment functional form (e.g., Beverton–Holt versus Ricker), spatial structure of the stock and connectivity between different components of the stock, time-varying productivity, or conflicting data sources.

For Northern Shrimp, future recruitment dynamics currently represent the primary structural uncertainty. Two alternative operating models are therefore used to represent plausible future productivity scenarios. Both are based on Beverton–Holt stock–recruitment relationships fitted to different periods of estimated recruitment:

1. A short time series (2009-2019), consistent with the recruitment regime underlying the March 2025 assessment projections; and,
2. The full estimated recruitment time series (1996-2019).

These alternative OMs are defined as follows:

1. BH-Long (long time-series; 1996-2019): SRR estimated from spawning biomass and recruitment estimates over the full assessment period (excluding 2020-2024). Captures the average productivity over multiple ecosystem states (*i.e.*, higher and lower productivity periods).
2. BH-Short (short time-series; 2009-2019): SRR estimated over the most recent 10-year period (excluding 2020-2024). Captures recent lower productivity, particularly for the SSAR.

The BH-Long and BH-Short scenarios bracket the range of productivity observed during the assessment period, but both include overly precise steepness estimates because the post-fitting approach ignores uncertainty in spawning biomass and recruitment estimates. This issue may be addressed in future assessments and OMs.

Note that recruitment estimates for 2020-2024 are not estimable from the data, so these are simulated from the BH-Short model (DFO 2025, Le Corre et al., *in prep*.).

Operating model weighting

The two operating model recruitment scenarios defined above aimed to represent possible future productivity states for Northern Shrimp. In the SSAR, the BH-Long and BH-Short scenarios implied very different recruitment regimes, mostly due to the change in productivity regime observed within the BH-Long period. The environment for shrimp is ever changing, however predation and the ecosystem are continuing to change and have clear directional movements that are thought to be continuing. Both operating models were retained but were assigned plausibility weights based on expert knowledge. In the SSAR, results from the two operating model scenarios were weighted at 90% for BH-Short and 10% for BH-Long when combining operating model results to generate the set of performance metrics for each HDR.

In the NSAR, recruitment productivity was mostly comparable under the BH-Long and BH-Short scenarios, therefore the contributions of the two operating models were given equal weighting (50%/50% weighting).

Performance Metrics

Performance metrics are statistics that summarize the expected behaviour of a candidate HDR over a specified period of time. They allow different candidate HDRs to be compared and to ascertain how well a candidate HDR aligns with the MSE's objectives. Performance metrics are particularly important in understanding the trade-offs between different dimensions of performance such as the trade-off between higher potential yield and lower probability of avoiding the limit reference point (LRP). Table 1 lists the performance metrics reviewed during the meeting along with their definition and how each metric is calculated.

Table 1. Performance metrics used in the Northern Shrimp MSE with definitions and more detailed information on how the statistics are calculated.

Performance Metrics	Objective Category	Definition	How it is Calculated
pLRP30	Conservation	Probability that spawning biomass remains above limit reference point over 30-year projection period.	a. Count the number of years the spawning biomass is above the LRP over each 30-year projection. b. Sum these counts across the 200 replicates. c. pLRP30 is the sum from (b) divided by 6,000 (the total number of years across the 200 replicates; 30 years multiplied by 200 replicates = 6,000).
pLRP10	Conservation	Probability that spawning biomass remains above limit reference point over first 10 projection years.	a. Count the number of years the spawning biomass is above the LRP over the first 10 years of each projection. b. Sum these counts across the 200 replicates. c. pLRP10 is the sum from (b) divided by 2,000 (the total number of years across the 200 replicates; 10 years multiplied by 200 replicates = 2,000).
pUSR30	Conservation	Probability that spawning biomass remains above upper stock reference over 30-year projection period.	a. Count the number of years the spawning biomass is above the USR over each 30-year projection. b. Sum these counts across the 200 replicates.

Performance Metrics	Objective Category	Definition	How it is Calculated
			c. pUSR30 is the sum from (b) divided by 6,000 (the total number of years across the 200 replicates; 30 years multiplied by 200 replicates = 6,000).
pUSR10	Conservation	Probability that spawning biomass remains above upper stock reference over first 10 projection years.	a. Count the number of years the spawning biomass is above the USR over the first 10 years of each projection. b. Sum these counts across the 200 replicates. c. pUSR10 is the sum from (b) divided by 2,000 (the total number of years across the 200 replicates; 10 years multiplied by 200 replicates = 2,000).
MAC10	Fishery Yield	Median of the average annual catch over first 10 projection years (short-term yield, kt).	a. Calculate the average annual catch over the first 10 years of the projection for each of the 200 replicates. b. List the 200 values from lowest to highest. c. MAC10 is the median, or number in the middle of the list.
MAC30	Fishery Yield	Median of the average annual catch over final 10 projection years (2045-2054; long-term yield, kt).	a. Calculate the average annual catch over the final 10 years of the projection for each of the 200 replicates. b. List the 200 values from lowest to highest. c. MAC30 is the median, or number in the middle of the list.
AAV10	Catch Stability	Median average annual variation in catch over first 10 projection years.	a. Calculate the absolute annual percentage change in catch for each of the first 10 projection years in a

Performance Metrics	Objective Category	Definition	How it is Calculated
			replicate (*i.e.,* the percent increase or decrease in catch compared to the previous year). b. Calculate the average of (a). c. List the 200 replicate averages from (b) lowest to highest. d. AAV10 is the median, or number in the middle of the list.
AAV95th	Catch Stability	95th percentile of average annual variation in the first 10 years or 95% of all values are smaller than this. Represents a relatively rare outcome, but indicates the range of possible average annual variations.	a. Calculate the absolute annual percentage change in catch for each of the first 10 projection years in a replicate (*i.e.,* the percent increase or decrease in catch compared to the previous year). b. Calculate the average of (a). c. List the 200 replicate averages from (b) lowest to highest. d. AAV95th is the 95th percentile of the list from (c) (*i.e.,* the 190th value).
C5th	Risk of low Catch	5th percentile of annual catches in first 10 projection years (lower bound of short-term yield, kt).	a. List the annual catch (lowest to highest) for all 200 replicates over first 10 projection years (2,000 values). b. C5th is the 5th percentile of the list from (a) (*i.e.,* the 100th value).

Candidate Management Procedures

Stock Status and Control Points

The assessment framework in December 2024 adopted limit reference points (LRPs) for both the NSAR and SSAR, and upper stock reference points (USR) were also recommended for both regions (DFO 2025). These LRPs and proposed USRs are based on the unfished spawning

biomass (SB) calculated within the stock assessment model (Figure 3A). These biological reference points are specifically used in the Performance Metrics calculations described above (e.g., pLRP and pUSR), and therefore play a role in comparing candidate HDRs. These are also the only reference points used to determine and report on stock status.

Biological reference points (LRPs and USRs) should not be confused with the control points used in candidate HDRs even though they share some similarities. The LRPs and USRs are operating model biological refence points derived from SISCALS estimates of unfished spawning biomass and stock productivity. Because these quantities depend on estimated model states and parameters, they are not directly observable. Control points, by contrast, are specified values of the survey spawning biomass index (SB*; read “SB-star”), where the “*” denotes that these are actual observable indices used operationally within the HDR.

Within the operating model simulations, TACs in each year are determined by the HDR using simulated spawning biomass indices (SB*) relative to predefined operational control points. The resulting catches influence future stock dynamics and subsequent SB* levels, thereby creating the feedback mechanism used to evaluate HDR performance over time. Control points therefore define the SB* thresholds where changes occur in the harvest control rule slope (Figure 3B).

Biomass indices for the fishable (FB*) and spawning (SB*) stocks are derived from the spatio-temporal model of annual survey data (DFO 2025) and are the main inputs to candidate HDRs.

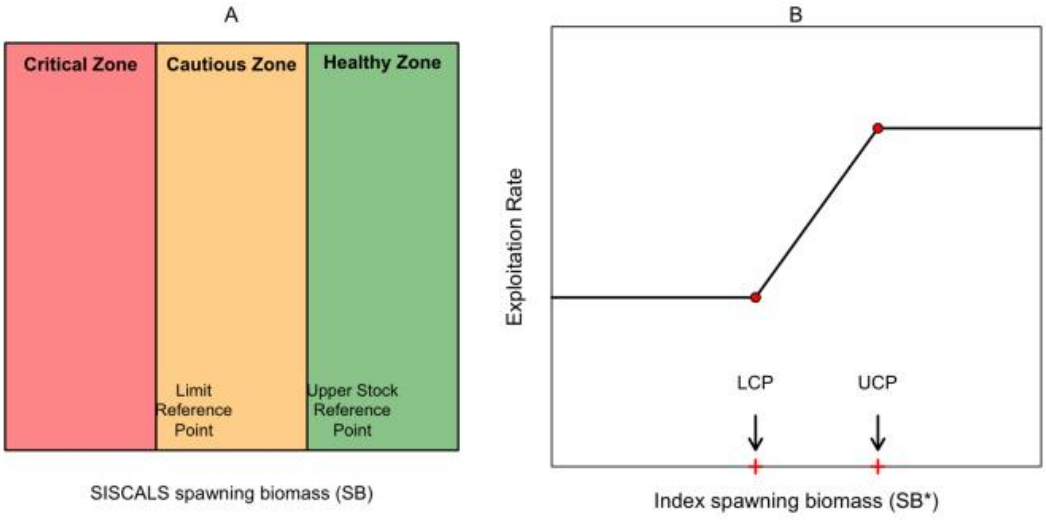

Figure 3. (A) Stock status zones (Critical, Cautious, and Healthy Zones) defined by the Limit Reference Point (LRP) and Upper Stock Reference (USR). These status zones are determined using the spawning biomass (SB) derived by the SISCALS assessment model (referred to as absolute values). (B) An example management procedure (HDR) showing the lower control point (LCP) and upper control point (UCP) which define thresholds where the HDR slope changes. The LCP and UCP are calculated based on the spawning biomass index (SB) derived from survey indices (referred to as relative indices).*

Candidate Management Procedures

Three general forms of HDR were tested based on variations in control points and exploitation rates (Figure 3B). All three forms include two initial stages:

1. The HDR determines the exploitation rate based on SB* (reminder: SB* and FB* are indices derived from the spatio-temporal modeling of survey data) relative to the lower and upper control points; and,

2. The resulting exploitation rate is multiplied by the fishable biomass index derived from survey indices (FB*) to produce an initial catch limit or total allowable catch (TAC).

The “default DFO HDR” (also labelled defHDR in tables and figures) has a constant exploitation rate when above the upper control point. Below the upper control point, the exploitation rate linearly decreases with SB* until reaching the lower control point, at which the exploitation rate is 0%. No exploitation occurs when SB* is below the lower control point (Figure 4: top row).

The “base HDR” (labelled baseHDR in tables and figures) has a constant exploitation rate when above the upper control point. Below the upper control point, the exploitation rate linearly decreases with SB* until reaching the lower control point, at which exploitation rate is 50% of the initial exploitation rate used when above the upper control point. Below the lower control point, the exploitation rate is 50% of the initial exploitation rate (Figure 4: middle row).

The “Half Leaf HDR” (labelled halfLeafLRP in tables and figures), which looks similar to half of a leaf torn in two along its midline, implements the half leaf design below the lower control point (Figure 4: bottom row). This HDR is implemented the same way as the baseHDR when SB* is above the lower control point. When the SB* is below the lower control point, and trending downwards, exploitation rates decline rapidly to zero by following the curve of the leaf. When the SB* is trending upwards exploitation rates increase linearly until the lower control point is reached (Figure 4: bottom row).

Several adjustment mechanisms were layered on top of the baseHDR to control variability in TACs produced by the HDRs. The “2-stage HDR” (2SHDR) mimics the currently adopted HDR used in EAZ, WAZ, and SFAs 4-6. After generating an initial catch limit using the baseHDR the 2SHDR component smooths inter-annual TAC variation based on the direction of the fishable biomass index trend. When fishable biomass is increasing, the TAC is the maximum of (a) the average of the previous TAC and current initial catch limit (50% rule) or (b) the previous year’s initial catch limit (finish rule). When biomass is decreasing, the TAC is the minimum of these values. This provides balance between the TAC responding to short-term survey index trends and stable TACs.

Another adjustment to the HDRs, added to reduce the extent of inter-annual changes to the TACs, applies a flat 25% maximum inter-annual change in the TAC. This constrains year-to-year variation. This “25% maximum change in TAC” was an added option to the 2SHDR procedure.

A third type of adjustment included “phase-in periods” to provide gradual transitions from the current TAC to TACs determined solely by the HDR. Both three-year (3YrPhz) and four-year phase-in (4YrPhz) periods were tested. These are implemented by computing the final TAC as a weighted average of the 2024 TAC and the one derived from the HDR in that year. By the third year (or fourth year) the TAC is solely based on that calculated by the HDR. These phase-ins were added options to the 2SHDR procedure. The following are the weightings used for each phase-in length:

- 3YrPhz
  - Year 1 TAC = 66.7% 2024 TAC + 33.3% HDR TAC calculation
  - Year 2 TAC = 33.3% 2024 TAC + 66.7% HDR TAC calculation
  - Year 3 TAC = 0% 2024 TAC + 100% HDR TAC calculation
- 4YrPhz
  - Year 1 TAC = 75% 2024 TAC + 25% HDR TAC calculation
  - Year 2 TAC = 50% 2024 TAC + 50% HDR TAC calculation

- Year 3 TAC = 25% 2024 TAC + 75% HDR TAC calculation
- Year 4 TAC = 0% 2024 TAC + 100% HDR TAC calculation

All of these HDRs were reviewed and tested within the MS3 simulation package and via an independent MSE Excel spreadsheet to ensure that they were coded correctly, their mathematical formulae aligned with how they were being described, and that they were behaving as expected and described. A review of their particular performance with respect to fishery objectives was not within the terms of reference for this process.

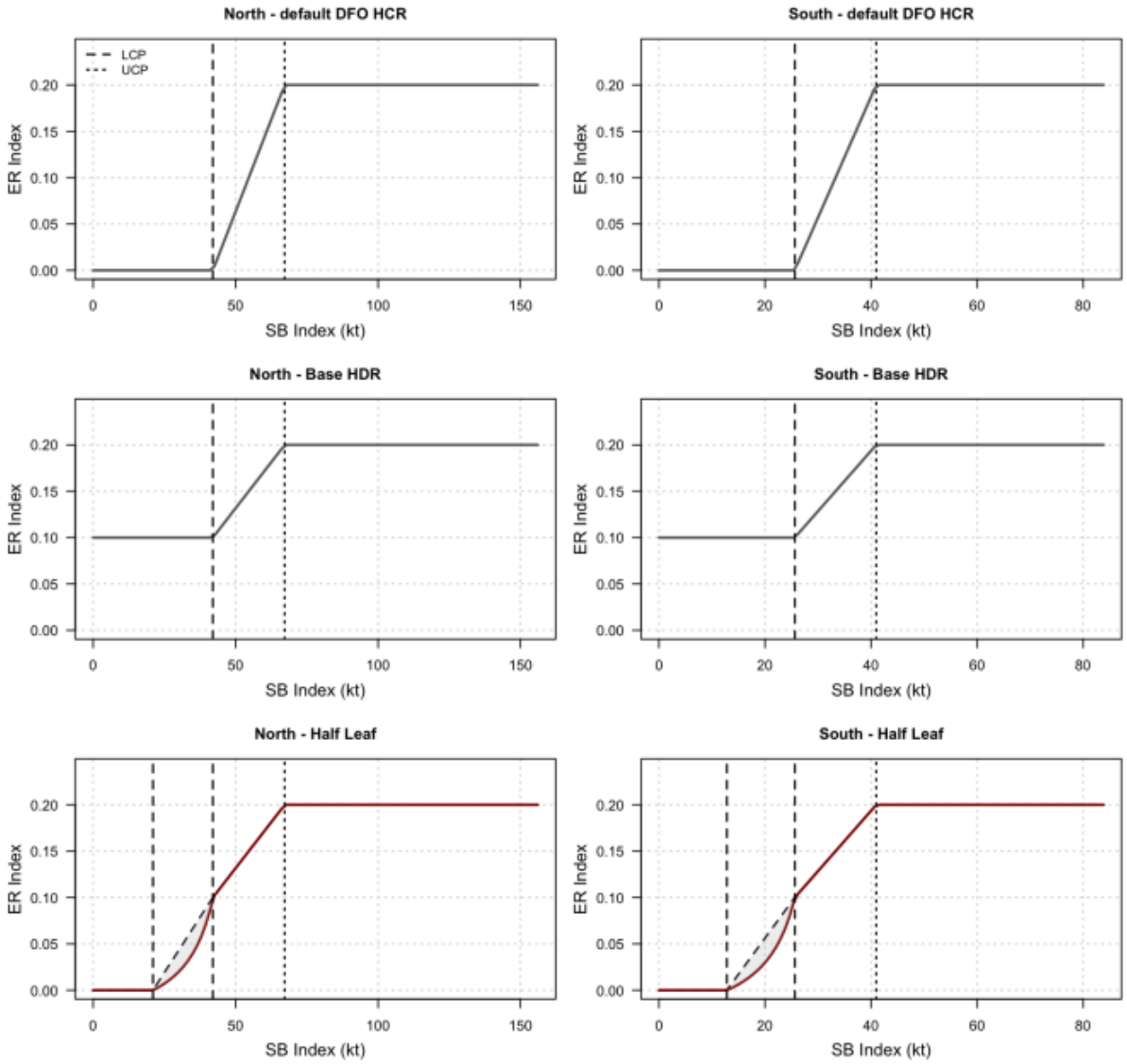

Figure 4. Harvest decision rules (HDRs) for Northern Shrimp management procedures showing the relationship between spawning biomass index (SB, x-axis) and exploitation rates (y-axis; above the upper control point exploitation rates between 10% and 25% were tested; 20% is shown for illustrative purposes only). Columns show North SAR (left) and South SAR (right). Rows show three HDR types: Default DFO HDR (top), Base HDR (middle), and Half-Leaf HDR (bottom). Vertical reference lines indicate control points: dashed line for the lower control point (LCP = 0.5 × $SB^*_{Maximum\ Sustainable\ Yield\ (MSY)}$), dotted line for the upper control point (UCP = 0.8 × SB^*_{MSY}), and lowest dashed line in half-leaf HDR as 0.25 × SB^*_{MSY}.*

TAC Utilization in the Operating Models versus in Reality

The HDR simulations assume that the full TAC calculated by an HDR is removed each fishing season. This is no different from stock assessment projections where a fixed catch scenario is projected into the future, with each year removing the entire fixed value. It is clear from historical catch records that not all the Northern Shrimp management areas have their full TAC removed each year. While the entire TAC is regularly caught and removed each year in some areas, TACs are underutilized in other areas. Under-utilization arises for various reasons including, for example, adverse weather, less favourable catch rates, targeting for quality and/or size, or logistical issues related to trip length and location.

The 5-year average utilization (i.e., proportion of TAC actually caught) rates calculated for each region using reported catch in 2017, 2018, 2019, 2022 and 2023 fishing years (2020 and 2021 were not used due to impacts from COVID-19) were 91% for the NSAR and 95% for the SSAR.

Sources of Uncertainty

Data Inputs in SISCALS

This section outlines key uncertainties associated with the data inputs used in SISCALS, which may in turn affect the operating models (OMs) derived from it. These uncertainties are not directly transferred in MSE outcomes, but may influence some of the inputs used within the MSE framework (e.g., catchability).

- **Survey Length Composition Data:** Survey biomass index data are standardized using spatiotemporal models to account for variability across space and time, but survey length composition data are not. Without standardization, regions not covered by surveys may be underrepresented, which can bias length-based indicators (e.g., size at 50% transition to female, growth estimates). Standardizing survey length composition data could also allow inclusion of pre-2007 observations in the North SAR time series for SISCALS and OM conditioning.
- **Commercial Length Composition Data:** Commercial length data can be biased by differences in fleet behavior, gear type (catchability), and uneven seasonal or spatial coverage, making them less representative of the true population structure. Spatiotemporal standardization of commercial length data would help correct these biases and improve the robustness of length-based indicators used in the stock assessment framework and OMs.
- **Additional Survey Data:**
    - Incorporating other survey data (e.g. European Union survey data covering NAFO Divisions 3LNO outside Canadian waters), which use slightly different protocols and provide limited coverage of the assessment region, could be beneficial. Testing robustness with and without these data would help clarify their potential benefit for improving survey index estimates.
    - The NSAR currently lacks key ecosystem and environmental data, including predation mortality indices, oceanographic information, and pelagic production metrics. These gaps limit the ability to include ecological drivers in assessments and hinder progress toward ecosystem-based fisheries management.

Catchability Parameter for Projections

Uncertainty in survey catchability is taken into account in the HDR projection by sampling from the joint posterior distribution of all estimated parameters from SISCALS. Therefore, although the survey catchability in each region is assumed known and constant for the lower control

point, upper control point, and FB calculations, the operating models simulate a very wide range of alternative values over the 200 simulation replicates. This range of catchability in the posterior samples provides some protection against mis-scaled TACs if true catchability differs from the median estimate. It is possible that survey catchability could vary over time via protocol adjustments or environmental factors but these were not considered in this work. Violation of catchability assumptions primarily affect the absolute scale of operating model biomass and catch projections, which should not affect the relative performance of HDRs against one another – the more important problem would be that performance of all HDRs would be biased with actual risk being more or less than projected depending on the direction of bias. Future MSE iterations could examine catchability in more detail via retrospective analysis and other techniques aimed at evaluating persistent bias in stock assessment model estimates.

Biological and Model Assumptions

Uncertainty also arises from assumptions about biological processes and how they are represented in the model. These include recruitment, growth, sex transition, and natural mortality, all of which are influenced by environmental conditions and biological complexity. Because these factors are difficult to estimate precisely, they introduce variability into HDR projections.

- **Recruitment:**
  - **Trans-boundary Larval Connectivity:** Current assessments do not directly account for larval imports from West Greenland stocks, which may affect recruitment. Expanding the SISCALS framework to include Greenland spawning indices or developing a trans-boundary meta-population model would better reflect potential connectivity via larval dispersal patterns. SISCALS estimates annual deviations from the expected recruitment based on SB, which means that imports from West Greenland stocks could already be accounted for in the recruitment estimates; however, the future role of West Greenland stocks is treated as random around a constant average in projections.
  - **Stock-Recruitment Relationships:** The SISCALS model used to estimate stock dynamics, catchability, recruitment, natural mortality and other parameters assumes constant average recruitment with annual deviations that are independent over years but correlated between NSAR and SSAR shrimp. This assumption helped make the original estimation more tractable as SISCALS was being developed. However, constant average recruitment is inappropriate for projecting stock dynamics for risk assessment. The stock-recruitment models BH-Long and BH-Short were estimated from SISCALS SB and recruitment estimates to better reflect potential future over-fishing risk. While these recruitment scenarios are sufficient for initial MSE screening, a revised SISCALS model should incorporate a Beverton–Holt stock–recruitment relationship within the model structure to better integrate uncertainty in model parameter estimates, recruitment dynamics, and associated biological reference points.
- **Growth and Transition:** Projected spawning biomass dynamics were sensitive to growth and the length at 50% transition (L50), particularly the latter as it directly affects SB. These are modelled independently in SISCALS, so future research could develop biologically plausible scenarios for projections of size-at-transition and growth parameters that would help explore a broader range of uncertainties and strengthen the science advice derived from HDR simulations.
- **Mortality:** Future natural mortality was simulated using a zero-trend random walk, maintaining the recent average and variability without persistent increases or decreases. This approach reflects the absence of reliable information on future ecosystem-driven

mortality shifts, as well as lack of a direct mechanistic link between ecosystem factors and mortality. Future research could develop methods to link mortality to predation, in particular, since there is a relatively high correlation between some predators on Northern Shrimp mortality in the SSAR.

CONCLUSIONS

Operating models

Two operating models were endorsed for use in this initial phase of the Northern Shrimp MSE; one based on the estimated stock recruitment relationship using the whole data-series (1996-2019) and the other using a shorter time period to estimate the stock recruitment relationship (2009-2019). Based on expert opinion the two operating models in the NSAR are equally weighted when calculating performance metrics because the two scenarios imply similar productivity over time. In the SSAR the operating model using the short time-series was given 90% weighting and the operating model using the whole time-series was given 10% weighting, because of the perception that the more recent recruitment levels were more likely to persistent in the near term. Performance metrics calculated for each HDR represent the weighted combination of outputs from these two scenarios.

Performance Metrics

All performance metrics computations were reviewed and determined to be 100% accurate and consistent with their descriptions and intended use. A full list of these performance metrics including clear descriptions of what they represent can be found in Table 1.

Management Procedures

The reviews of the HDRs were conducted to ensure that they had been coded correctly, their mathematical formulae aligned with how they were being described, and that they were behaving as expected and described. They were not reviewed to consider how they performed compared to any MSE objectives for conservation, yield nor variability in catch.

LIST OF MEETING PARTICIPANTS

Name	Organization/Affiliation
Algera, Dirk	Fisheries and Oceans Canada
Baker, Krista	Fisheries and Oceans Canada
Baranova, Liliya	Fisheries and Oceans Canada
Bigney, Kate	Fisheries and Oceans Canada
Butler, Derek	Nunavut Fisheries Association
Carruthers, Erin	Fish, Food and Allied Workers
Chapman, Bruce	Canadian Association of Prawn Producers
Coffey, William	Fisheries and Oceans Canada

Name	Organization/Affiliation
Coombs, Rob	Nunatukavut Community Council
Coombs, Samantha	Government of Newfoundland and Labrador
Cox, Sean	Landmark Fisheries Research
Davis, Ben	Torngat Wildlife, Plants & Fisheries Secretariat
Devine, Brynn	Oceans North
Duprey, Nicholas	Fisheries and Oceans Canada
Dwyer, Karen	Fisheries and Oceans Canada
Fulton, Samantha	Fisheries and Oceans Canada
González Troncoso, Diana	Instituto Español de Oceanografía, Vigo, Spain
Hedges, Kevin	Fisheries and Oceans Canada
Henri, Martin	Fisheries and Oceans Canada
Johnson, Samuel	Landmark Fisheries Research
Le Corre, Nicolas	Fisheries and Oceans Canada
Mullowney, Darrell	Fisheries and Oceans Canada
Munro, Hannah	Fisheries and Oceans Canada
O'Rielly, Alastair	Northern Coalition
Parrill, Erika	Fisheries and Oceans Canada
Rayner, Gemma	Oceans North
Simpson, Mark	Fisheries and Oceans Canada
Thompson, Susan	Fisheries and Oceans Canada
Tuen, Alex	Fisheries and Oceans Canada
Urtizberea Iturco, Agurtzane	AZTI - Centro de Investigación Marina y Alimentaria
Walkusz, Wojciech	Fisheries and Oceans Canada
Zhu, Xinhua	Fisheries and Oceans Canada

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Center for Science Advice (CSA)
National Capital Region
Fisheries and Oceans Canada
200 Kent Street, Ottawa, ON K1A 0E6

E-Mail: DFO.CSAS-SCAS.MPO@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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Appendix 4

To apply the harvest decision rule, control points (Lower Control Point and Upper Control Point) are used as proxies for Limit Reference and Upper Stock Reference points (and therefore the Healthy, Cautious and Critical zones). These control points are needed because the full stock assessment that estimates full stock size and status is only conducted every 3 years. Indices of abundance are updated every year and can be compared to the Lower and Upper Control Points. The harvest decision rule's harvest rate, which is used to calculate the initial harvest limit for the North Stock Assessment Region, is reduced linearly as the abundance indices decline below the Upper Control Point until reaching the Lower Control Point. Added to this are rules that reduce the variability in the calculated harvest limits year-to-year. Reduced variability is achieved through three steps: (1) only applying half of the increase/decrease in the harvest limit resulting from an increase/decrease in the index; (2) imposing a maximum 25% year-to-year change in harvest limit; (3) phasing in the harvest limit calculated by the harvest decision rule during the first 4 years of its implementation.

Table 2. Summary of the Harvest Decision Rule for *P. borealis* in the North Stock Assessment Region

Spawning Stock Biomass index	**Harvest Decision Rule**	
Above the Upper Control Point	• The target harvest rate will be 20% of fishable biomass index.	• Pursue 50% of the change between the initial total allowable catch calculation (i.e. applying the target harvest rate) and the previous year total allowable catch. • In subsequent years, either finish the remainder of the total allowable catch change to the previous year's initial total allowable catch calculation, or pursue 50% of the change to the current year's initial total allowable catch calculation. ▪ Consider whether fishable biomass is increasing (select higher total allowable catch) or decreasing (select lower total allowable catch) to guide management action. • Apply the 25% maximum change in Total Allowable Catch • Apply phase-in when setting the Total Allowable Catch for 2026-27, 2027-28, 2028-29, or 2029-30
Between the Upper Control Point and Lower Control Point	• The target harvest rate will be scaled linearly (slope) from 20% of fishable biomass index at the Upper Control Point, to 10% of fishable biomass index at the Lower Control Point. • The maximum harvest rate will be 1.5x target (slope) harvest rate.	
At or below the Lower Control Point	• The maximum harvest rate will be 10% of fishable biomass index. • Apply the 25% maximum change in total allowable catch • Apply phase-in when setting the total allowable catch for 2026-27,	

Spawning Stock Biomass index	Harvest Decision Rule
	2027-28, 2028-29, or 2029-30

Detailed Explanation of Proposed Harvest Decision Rule for the North Stock Assessment Region

The Harvest Decision Rule adopted by the Northern Shrimp Advisory Committee was a variation of the Harvest Decision Rule previously in place used to calculate the 2025-26 total allowable catches for the Eastern and Western Assessment Zones . This new Harvest Decision Rule adds a 25 per cent maximum change in harvest limit year-to-year and a 4-year phase-in period (2026-27, 2027-28, 2028-29, 2029-30).

Detailed explanation of how the Harvest Decision Rule works:

Part 1: Exploitation rate (ER) is determined using updated Spawning Stock Biomass (SSB) index
- Compare SSB-index to the Lower control point (LCP) and upper control point (UCP)
- If above UCP, then ER = 20%
- If below LCP, then ER = maximum 10%
- If between LCP and UCP, then ER = (((SSB-index – LCP)/(UCP-LCP)) * 10%) + 10%

-- If SSB-index < LCP then proceed to Part 6 otherwise continue to Part 2 --

Part 2: Calculate initial catch limit (ICL)
- The initial catch limit = NSAR Fishable Biomass (FB) index * ER (from part 1)

Part 3: Determine halfway point between ICL and previous year's TAC
- Previous year's TAC = TACy-1
- Halfway point = ((ICL – TACy-1)/2) + TACy-1

Part 4: Select between this year halfway point or last year's ICL
- If the FB-index increased from y-2 to y-1, then select the larger of the two TACs.
- If the FB-index decreased from y-2 to y-1, then select the smaller of the two TACs.

Part 5: check that the selected TAC from Part 4 does not result in a ER over 150% of the ER determined in Part 1.
- Calculate ER of selected TAC from Part 4 = TAC (from Part 4) / FB-index
- If ER is less than 150% of Part 1 ER, move to Part 6
- If ER is more than 150% of Part 1 ER, reduce TAC to 150% of Part 1 ER

Part 6: determine TAC to apply the "max change in TAC" and "phase-in" rules
- If SSB-index < LCP, then TAC = FB-index * 10%
- If SSB-index > LCP, then TAC = TAC determined in Part 5

Part 7: Apply the 25% maximum change in TAC rule
- If TAC in part 6 is great than 125% of TACy-1, then TACy = TACy-1 * 1.25
- If TAC in part 6 is less than 75% of TACy-1, then TACy = TACy-1 * 0.75

Part 8: Apply phase-in when setting the TAC for 2026-27, 2027-28, 2028-29, or 2029-30

- In 2026-27:
  - 75% of 2026-27 TAC based on 2025-26 TAC (41,128 t) = 30,846 t, plus
  - 25% of 2026-27 TAC based on TACy determined in Part 7 = TACy * 0.25
- In 2027-28:
  - 50% of 2027-28 TAC based on 2025-26 TAC (41,128 t) = 20,564 t, plus
  - 50% of 2027-28 TAC based on TACy determined in Part 7 = TACy * 0.50
- In 2028-29:
  - 25% of 2028-29 TAC based on 2025-26 TAC (41,128 t) = 10,282 t, plus
  - 75% of 2028-29 TAC based on TACy determined in Part 7 = TACy * 0.75
- In 2029-30:
  - 0% of 2029-30 TAC based on 2025-26 TAC (41,128 t) = 0 t, plus
  - 100% of 2029-30 TAC based on TACy determined in Part 7 = TACy

Appendix 5

Northern Shrimp Advisory Committee (NSAC)
March 25, 2026.

Welcome and Opening Remarks
Todd Williams, DFO Resource Management (RM), Ottawa, Chair, Northern Shrimp Advisory Committee (NSAC), outlined the Agenda for the meeting.

- Members did not voice any comments or concerns on the Agenda items

Science – Stock Updates
Stock updates were provided for Northern shrimp (*Pandalus borealis*) in the North and South Stock Assessment Regions (NSAR and SSAR) and Striped shrimp (*P. montagui*) in Shrimp Fishing Area (SFA) 4 and the Eastern and Western Assessment Zones (EAZ and WAZ).

Northern shrimp (*P. borealis*)
Nicolas Le Corre, DFO Science, Newfoundland and Labrador Region, presented an overview of the survey coverage, environmental and ecosystem conditions, and survey biomass indices that provided the basis for the March 2026 *P. borealis* stock update.

- The stock status for the NSAR and SSAR is only updated during full assessments; it is not possible to estimate stock status during interim-year updates.
- Fishable Biomass (FB) and Spawning Stock Biomass (SSB) survey indices, estimated using spatiotemporal models, are updated for use in the harvest decision rules that are being tested via Management Strategy Evaluation (MSE).
- Proportional breakdown of each assessment region's FB survey index into management areas is provided.
- The ocean climate in the NL Bioregion has shown decadal-scale cold and warm phases. The warm phase that started around 2020 continued in 2025.
- The biomass of key predatory fishes (Greenland Halibut, Atlantic Cod, and redfish) have increased in both assessment regions in the 2020s and remains high in 2025.
- Clearwater FNC requested the rationale for the warm water observed on the Labrador Shelf (3O), which is noteworthy because there are colder temperatures evident on the Eastern Scotian Shelf.
    - DFO Science suggested that it may be due to increased mixing of warm water from deeper off the ocean shelf.
- Ocean Choice International (OCI) indicated that warmer bottom ocean temperatures are occurring in other nearby areas (3N) and affecting other fisheries (i.e., yellowtail).
- Nunavut Fisheries Association (NFA) raised that comparing pre- (recent past) and post-collapse (current) biomass in the system is not a fair comparison; it is currently a shellfish dominant regime and it doesn't make sense to compare this to a groundfish dominated regime.
- Northern Coalition (NC) asked if the ecosystem is stabilizing at pre-collapse levels and if pre-collapse is referring to the early 1980s timeframe?
    - DFO Science indicated that pre-collapse refers to pre-1990s and there is uncertainty if the system will return to pre-collapse levels because of warming waters, etc.
- OCI noted that a more groundfish dominant ecosystem is returning, yet shrimp SSB and FB is increasing – what could be a rationale for this?
    - DFO Science indicated that it is difficult to decipher the effect of predation – there are multiple aspects at play.
        - Potential predator-prey index is reported and this doesn't mean that predators are present in the same location as the shrimp.
        - There's an abundance of small redfish in the North and it is challenging to determine how much shrimp they are consuming.

        - Depends on fishing pressure.
- The Canadian Association of Prawn Producers (CAPP) noted that the biomass of shrimp in the deeper strata does not appear to be included in the ecosystem survey.
    - DFO Science responded that the survey covers 100m to 750m depth.

NSAR Indices and Trends

- The stock status was not updated in March 2026. The stock was estimated to be in the Healthy Zone when last fully assessed in March 2025.
- The SSB survey index in 2025 (150,000 t) increased from 2024 (142,900 t), and remains above the time-series average.
- The FB survey index in 2025 (231,000 t) increased from 2024 (186,300 t), but remains below the time-series average.
- In the context of the overall trajectory of the stock, these interannual changes in the indices are consistent with the stock biomass remaining near their respective time-series averages.

SSAR Indices and Trends

- The stock status was not updated in March 2026. The stock was estimated to be in the Healthy Zone when last fully assessed in March 2025.
- The SSB survey index in 2025 (73,400 t) increased from 2024 (55,500 t), but remains below the time-series average and is around the lowest level in the survey time series.
- The FB survey index in 2025 (114,500 t) increased from 2024 (90,900 t), but remains below the time-series average and is around the lowest level in the survey time series.
- In the context of the overall trajectory of the stock, these interannual changes in the indices are consistent with the stock biomass remaining near their respective time-series low levels.

FB Spatial Distribution

- The spatial distribution (proportion) of the FB survey index within each stock assessment region was provided to inform the relative distribution of the stock assessment region harvest level into the management areas (i.e., the SFAs).
- CAPP, NFA, and OCI requested clarification on the methodology used to calculate the FB proportions and for DFO to provide calculations (including amounts) of FB in each management area under the old methodology (OGMAP and STRAP) and the new methodology (spatiotemporal modeling) dating back to 2016.
    - DFO Science indicated that the entire survey timeseries data (1996-2025) was input into the spatio-temporal model to calculate the FB and proportions over the entire survey timeseries, but only the most recent years were shown. The FB proportions were requested by DFO RM.
    - DFO RM indicated that tables illustrating these calculations will be provided.

Striped shrimp (*P. montagui*)

Samantha Fulton, DFO Science, Arctic Region, presented and an overview of the survey coverage and survey biomass indices that provided the basis for the March 2026 *P. montagui* stock update.

SFA 4

- Stock status is in the Healthy Zone.
- SSB index increased by 20% (to 30,000 t) from 2024.
- FB index increased by 19% (to 33,900 t) from 2024.

EAZ

- Stock status is in the Critical Zone.
- SSB decreased by 77% (to 3,045 t) from 2024.

- FB decreased by 79% (to 3,298 t) from 2024.

WAZ
- Stock status is in the Healthy Zone.
- SSB decreased by 16% (to 55,465 t) from 2024.
- FB index increased by 14% (to 82,646 t) from 2024.

Discussions on TAC and Management Measures
- NC remarked that the increase in the WAZ biomass is orders of magnitude higher than the biomass in EAZ, and these stock areas are likely not truly discreet; we are likely observing the biomass distribution at the moment it is surveyed, and the combined stock status as a whole may be relatively unchanged.
    - Noted that the relative shifts in stock biomass pose a challenge to developing management measures for these management areas and there was interest expressed in previous years to examine the stock in more holistic way.
    - From a science perspective, how significant should the EAZ stock assessment findings be as we approach management of the resource?
    - DFO Science responded that this year's survey catches of striped shrimp near Resolution Island were much lower relative to adjacent areas. Survey maps show that a concentration of biomass has moved from the EAZ to just over the WAZ management line.
    - Further, the SSB in EAZ is a relatively smaller value, so drops in percentage appear much worse than they actually are in absolute terms (tonnage amounts).
    - A one-year biomass decrease in the EAZ may not be not be of high concern from a science perspective in context of increases in adjacent regions, but is something to keep an eye on.
- NFA noted that there are several decreases in biomass followed by increases evident in the EAZ time series.
- NRL raised that that the dividing line between EAZ and WAZ has been problematic for many years. The changes in stock status are largely driven by migrations in distribution between EAZ and WAZ which yield mathematical effects (artifacts) due to the dividing line.
    - Requested that a Working Group be struck to address this issue.

2026-27 Total Allowable Catches (TACs)
DFO RM presented TAC recommendation options for *P. borealis* and *P. montagui*.

Striped shrimp (*P. montagui*)
TAC recommendations for the Striped shrimp stocks followed application of the 2-step Harvest Decision Rule (HDR) accepted by NSAC in previous years. TAC discussions for the WAZ were reserved for the Indigenous meeting.

SFA 4
- Applying the 2-step = 5,828t (ER of 17.2%).
- Maintaining the 2025 = 4,033t (ER of 11.9%).
- CAPP supported maintaining the TAC at 4,033 t. No objections were raised.

EAZ
- A 10% exploitation rate (ER), as per following the HDRs, results in a TAC of 330t.
- NRL, NC, and CAPP noted that 330 t would pose challenges to the directed *P. borealis* stock in the EAZ and re-iterated their request for a Working Group to examine the EAZ-WAZ management area border.
    - There was general agreement among NSAC members that 330 t is not sufficient for cover *P. montagui* bycatch in the *P. borealis* fishery.

- CAPP proposed applying an adaptation of the 2-step function of the HDR, resulting in a TAC of 1,578t.
    - No objections by industry were raised. The Chair noted the preference for a variation in the application of the HDR for a TAC of 1,578t.
- DFO Science clarified that a 20% maximum ER would not be a major concern for them at this time, however, they could not support removals beyond this level.
    - The Precautionary Approach framework should be used in managing the stocks, and as such, registering the adjustments as an overallocation may be preferable in this regard (as opposed to the overallocation integrated within the TAC).
    -

Northern shrimp (*P. borealis*)
TAC recommendations for Northern shrimp were based on MSE-tested HDRs, applying a 4-year moving average of the FB spatial distribution, and a catch utilization adjustment.

NSAR Harvest Level
- Stock status was in the Healthy Zone when last fully assessed (March 2025).
- Harvest levels for variations of the shortlisted 2-Step HDRs with an ER of 20% and 17% were presented.
- NSAC members (NC, OCI, CAPP) supported retaining NSAC's previous recommendation (from January 20, 2026 meeting) for the HDR with a 20% ER, a maximum harvest level change of 25%, and a 4-year phase-in period (Max25_4-year_20%).
- Max25_4-year_20% results in a NSAR harvest level of 41,760 t.

SSAR Harvest Level
- Stock status was in the Healthy Zone when last fully assessed (March 2025).
- Harvest levels for variations of the shortlisted 2-Step HDRs with an ER of 10%, 12.5%, and 15% were presented.
- NSAC members (FFAW, CAPP) supported retaining NSAC's previous recommendation (from January 20, 2026 meeting) for the HDR with a 15% ER and a maximum harvest level change of 25% (Max25_15%).
- Max25_15% results in a SSAR harvest level of 15,780 t.

Management Area TACs
TACs were presented with the various shortlisted HDRs for the NSAR and SSAR. TACs with the NSAC-recommended HDR for the NSAR and SSAR noted above were as follows:
- WAZ: 4-year average of biomass (19.3%) of the NSAR harvest level = 8,060t.
- EAZ: 4-year average of biomass (23.1%) of the NSAR harvest level = 9,636t.
- SFA 4: 4-year average of biomass (35.3%) of the NSAR harvest level = 14,752t.
- SFA 5-North: 4-year average of biomass (22.3%) of the NSAR harvest level = 9,302t.
- SFA 5-South: 4-year average of biomass (7.2%) of the SSAR harvest level = 1,132t.
- SFA 5 (North and South combined): 10,434t
- SFA 6: 4-year average of biomass (82.3%) of the SSAR harvest level = 12,991t.
- 3L: 4-year average of biomass (10.4%) of the SSAR harvest level = 1,641t; Canadian domestic TAC for SFA 7 = 1,367t .
- 3NO: 4-year average of biomass (0.1%) of the SSAR harvest level = 16t.

Catch Utilization Adjustment
The industry proposal, tabled at the January 20, 2026 NSAC meeting, to add 5% of TAC to each management area in the NSAR was discussed.

- Since the January 20 meeting, views provided to the Department indicated limited benefits of the proposed 5% catch adjustment to Nunavut and Nunavik (NU and NK) entities. Land Claimants submitted a proposal for underutilized quota in the WAZ to benefit NU/NK entities in NU/NK-East and Davis Strait West (DSW), subject to co-management Board decisions.

Discussions on TAC and Management Measures

- NC asked why the new survey data was not integrated into the TAC_1 to TAC_5 projections? When will it be?
    - DFO Science responded that this data was not included in the MSE diagnostic performance statistics because the full MSE will not be run again until it is reviewed (i.e., 2028). However, the survey data was included in updating the biomass indices and determining the NSAR and SSAR harvest levels.
- OCI questioned why additional HDRs were tested after the past NSAC meeting, suggesting that it was not worth expending capital to add this calculation given that the improvements in LRP are minimal yet would have a significant impact on economics.
    - DFO RM responded that RM wanted to see the full profile of options for risk assessment purposes.
- CAPP indicated that the tests with the additional ERs have not changed their recommendation, noting that the 2025-26 ERI would be 17.8% if that TAC was fully caught, and that we're on track to be within the range for ER this year.
- FFAW re-iterated that their previous HDR recommendation with 15% ER still stands. The 0.2% difference in pLRP is an improvement, but has significant implications for inshore fleet amounting to ~$3 million in reduced TAC.
    - Questioned if the HDR numbers for 12.5% ER will be included in the advice to the Minister as an option?
    - DFO Science responded that they recognize the socio-economics implications and that the choice is a management decision, but recommended exploring additional HDRs with lower ERs from a conservation perspective because those lower ERs would be more closely aligned with Umsy values; 15% ERI is almost 2x Umsy numbers. Further, the LRP is much lower than in the past, presenting increased uncertainty with how the stock would respond should it enter the Critical Zone.
- CAPP suggested that with an HDR selected, SFA-specific TAC recommendations are simply arithmetic. Indicated that they are comfortable with the TACs, though their support is conditional on having a method of catching the full harvest level.
    - NC and NFA supported this argument.
- Regarding the catch utilization adjustment, CAPP indicated that it should be included in the TAC (i.e., SFA harvest level + utilization adjustment), rather than an over-allocation which may raise concerns from an MSC perspective.
    - The catch utilization adjustment could be viewed as a way to help the actual removals be more akin to what the model assumes was removed.
    - NFA questioned if this approach would have any impacts to MSE or the model?
    - DFO Science noted that the MSE assumes that 100% of the HDR amount is removed.
- St. Anthony Basin Resources Inc. requested clarification on why the catch utilization adjustment is only for the NSAR and not the SSAR?
    - DFO RM responded that greater utilization is realized in the SSAR, but views regarding a proposal for the SSAR are welcomed.
    - Clearwater FNC noted that SSAR underutilization would likely occur in the future once SFA 7 is re-opened.
- DFO Science indicated concerns that the catch utilization adjustment could result in increased localized fishing pressure and that this adjustment should be recorded separately from the TAC for tracking purposes.

- CAPP re-iterated that the industry proposal continues to be that each SFA in the NSAR receives a 5% increase to the TAC from the MSE HDR output, and that every quota holder within each NSAR SFA receives a 5% increase, which should also apply to Davis Straight West.
    - NFA supported including the 5% adjustment in the TAC, but recognized the need to document how the resulting TACs were determined.
    - DFO RM suggested that TAC can be articulated as inclusive of the HDR output and catch utilization adjustment.

Other Updates

Electronic Video Monitoring (EVM) and Shore-based Reporting

DFO provided an update on the EVM and shore based reporting initiatives.

- EVM in the offshore fleet, which is voluntary, cannot be used while fishing inside the Nunavut and Nunavik Settlement Area waters. Using EVM would be subject to Board decisions to be used in the future.
- Similarly, EVM and the shore-based reporting do not apply for offloading in Greenland.
- The shore-based program will have mandatory and voluntary components:
    - Dockside carton counting (and weighing for industrial shrimp only) by independent service providers will be mandatory.
    - Package inspection to determine the "net frozen weight" of all product types will also be mandatory.
    - Further inspection to determine the net drained (or thawed) weight is optional.
- There will be a 1-year pilot phase for the shore-based program and the fleet will be given a 60-day notice prior to this program coming into effect.
- NRL supported that some aspects of the shore-based component are voluntary.
    - Clarified that industrial shrimp, which is a raw material sold as a raw material and at actual weight, wouldn't require sampling.
    - Noted that it is important that the requirement to provide a complete and accurate hail on a daily basis remains the licence conditions.
- NC expressed concern at the pace that the initiative is being implemented, given and outstanding questions and concerns.
    - Operational considerations as to how this is going to work and additional costs that may be incurred. Will there be incremental effort and time constraints?
    - Next steps are unclear – is further dialog with inspection companies planned?
    - Supports EVM, as long as there's no intent to make it mandatory.
    - Unclear when the specific implementation date will be. Does the term "pilot" extend to EVM? Requested that draft protocols and forms be distributed to NSAC so members can have opportunity to review.
- The Chair indicated that the pilot is for the shore based component, to indicate that there could be changes to the sampling requirements etc., and that "pilot" does not imply mandatory EVM in the future.
    - Further, the Chair committed to:
    - Focus on the implementation questions and ground truthing operational requirements with the service providers.
    - Send protocol documents to NSAC members for their review, and outline next steps in terms of engagement with service providers. Provide 60 days notice to NSAC once operational elements are developed.

Licence Conditions

DFO provided an update on the key changes in the 2026 conditions of licence.

- Added a requirement for licence holders with access to multiple quota types in Davis Straight West to record the allocation type being fished in the Comments section of the logbook.

- Added a requirement to report catches in SFA 5 to SFA 5 North or SFA 5 South in the Comments section of the logbook.
- Added requirement to report tows in SFA 5 that cross the line between SFA 5 North and SFA 5 South in the Comments section of the logbook.
- Added a new Schedule which outlines technical specification and conditions about the functioning and operation of the EVM system, noting that more specific requirements would be in the EVM protocol, which is being finalized and would be distributed.
- Added a new Schedule requiring those using EVM to hail out.

SFA 7

DFO provided an update on the potential re-opening of SFA 7.

- Regarding the 9.4% allocation to Prince Edward Island Atlantic Shrimp Company (PEIASC), the Minister was considering the potential for using that allocation for Section 10 purposes, and had requested PEIASC to provide information with respect to that.
- PEIASC chose not to submit an application, nor provide additional information related to the projects which had been funded through their allocation over the years, which DFO had offered to share with the NSAC memberships.
- The Minister is further contemplating what she would like to do with their allocation.
- The TAC for SFA 7 will be established along with SFAs 4-6, informed by the MSE-tested HDR. However, any decision to re-open SFA 7, and associated TAC, will be announced together with allocation decisions.
- The PEIASC clarified the position of the PEIASC and PEI Government on this matter.
    - While their allocation supported science research, it was never tied to scientific research, there have been all sorts of other projects supported over the years.
    - The PEIASC could mount a credible proposal, but they do believe their access to Northern shrimp in SFA 7 should not be subject to NSAC members support. It should be guaranteed by the Government of Canada, as re-iterated by PEI Minister Bell and Minister Hudson, who personally met with Minister Thompson.
    - PEIASC's and PEI Government's position is that if there is an allocation in SFA 7, PEI should continue to receive their 9.4% allocation.
    - Indicated they would be happy to share the PEIASC letter with the committee.

Section 10 for NSRF in SFA 4

- The Minister decided to allocate 1,500t for 2026-27 from the SFA 4 TAC, and that, from now on, the 1,500t will be distributed proportionately to all allocation holders in SFA 4 according to the sharing key.

Conservation and Protection (C&P)

- C&P provided an update on enforcement activities over the past year.

Safety at Sea

- Transport Canada presented information pertaining to safety at sea.

Participants

Sherry Glynn – Fish Food Allied Workers Union (FFAW)
Julian Ryan – 3K North, FFAW
Catherine Boyd, Dany Jabbour, and Jim Gibbons – Clearwater Seafoods
Bruce Chapman – Canadian Association of Prawn Producers
Carey Bonnell – Ocean Choice International
Michelle Moffat – MV Osprey
Brian McNamara, Brent McNamara, and Mark Quinlan – Newfound Resources Ltd.
Tony Wright – Makivvik Corporation
Alastair O'Reilly – Northern Coalition

Brynne Divine – Oceans North
Patrick Martin and Jerry Ward – Qikiqtaaluk Corporation / Qikiqtaaluk Fisheries Corporation
Derek Butler – Nunavut Fisheries Association
Christopher Mitchelmore – St. Anthony Basin Resources Inc.
Ron Johnson – Torngat Fish Producers Co-operative Society Ltd.
Emma-Rose Murphy – Nunatsiavut Government
Paul Loder and Peter Adams – Baffin Fisheries Cooperative
Ann-Julie Cote – Ministère de l'Agriculture, des Pêcheries et le l'Alimentation du Québec
Shawn Frank – Pikalujak Fisheries
Dave MacEwan – Government of Prince Edward Island
Lewis Creed – Prince Edward Island Atlantic Shrimp Company
Cyril Boudreau – Government of Nova Scotia Department of Fisheries and Aquaculture
Leigh Gustafson – Nunavut Wildlife Management Board (NWMB)
Keith Coady – Arctic Fishery Alliance
Ben Davis – Torngat Wildlife Plants and Fisheries Secretariat

Todd Williams – DFO Resource Management (RM) National Capital Region (NCR), Chair
Leigh Edgar – DFO RM NCR
Liliya Baranova – DFO RM NCR
Dirk Algera – DFO RM NCR
Brian Lester – DFO RM NCR
Nicholas Duprey – DFO Science NCR
Nicolas Rolland – DFO Science NCR
Nicolas Le Corre – DFO Science NL Region
Krista Baker – DFO Science NL Region
William Coffey – DFO Science NL Region
Martin Henri – DFO RM NL Region
Wojciech Walkusz – DFO Science Arctic Region
Samantha Fulton – DFO Science Arctic Region
Matt Martens – DFO FM Arctic Region
Sandra Moore – DFO FM Arctic Region
Danielle Roy – DFO RM Gulf Region
Andrew Humber – DFO Conservation and Protection NL Region
Paul Glavine – Transport Canada

Northern Shrimp Advisory Committee - Indigenous Meeting – March 26, 2026

A virtual meeting of the Northern Shrimp Advisory Committee (NSAC) took place on March 25, 2026. The Department held a virtual post-meeting with Indigenous participants on March 26, 2026, which included representatives from:

- Nunavut Fisheries Association (NFA)
- Torngat Fish Producers Co-Op
- Qikiqtaaluk Corporation (QC) / Qikiqtaaluk Fisheries Corporation (QFC)
- Northern Coalition (NC)
- Canadian Association of Prawn Producers (CAPP)
- NunatuKavut Community Council (NCC)
- Ueushuk Fisheries
- Torngat Joint Fisheries Board
- Nunatsiavut Government (NG)
- Baffin Fisheries Coalition (BFC)
- Makivvik Corporation
- Newfound Resources Ltd (NRL)

The perspectives on science and management of *P. borealis* and *P. montagui* in the EAZ and WAZ in this document encompass views expressed at the Indigenous meeting; views at the broader NSAC meeting on March 25, 2026 are provided in a separate document.

Science – Stock Updates

DFO Science recapped the *P. borealis* and *P. montagui* stock updates presented at the NSAC main table.

- NFA asked if biomass trends for *P. montagui* in WAZ and EAZ could be assessed and reported similarly to SFA 4 *P. montagui (i.e.,* a model-based assessment method)?
- DFO Science indicated that it is not possible to parse out the trends for *P. montagui* in WAZ and EAZ because they are encompassed within SFA 4, which uses the entire region to determine the spawning stock biomass trends.
    - The most effective way to address this would be to emulate what has been done for Northern shrimp – treat it as one biological stock.

2026-27 Total Allowable Catches (TACs)

DFO RM presented TAC recommendation options for *P. borealis* in the EAZ and WAZ, and for *P. montagui* in SFA 4, EAZ, and WAZ.

Striped shrimp (*P. montagui*)

TAC recommendations for the Striped shrimp stocks followed application of the 2-step Harvest Decision Rule (HDR) accepted by NSAC.

<u>EAZ</u>

- Stock status is in the Critical Zone.
- A 10% exploitation rate (ER), as per following the HDRs, results in a TAC of 330t.
- There was recognition of the movement of the stock across the EAZ and WAZ dividing line, which creates uncertainty and potential for fluctuations in the stock dynamics.
- NSAC recommended applying a modified 2-step HDR = 1,578t (ER of 47.8%)instead.
- Indigenous meeting participants supported the NSAC recommendation to apply the modified 2-step HDR, resulting in a TAC of 1,578t.

SFA 4

- Stock status is in the Healthy Zone.
- Applying the 2-step HDR = 5,828t (ER of 17.2%).
- Maintaining the 2025 TAC = 4,033t (ER of 11.9%) (recommended at NSAC).
- No objections were raised against the NSAC recommendation.

WAZ

- Stock status is in the Healthy Zone.
- Applying the 2-step HDR = 15,743t (ER of 19.0%)
- QC/QFC, Makivvik, NFA, BFC, and NC indicated their support for an ER of 20% or higher given the current Healthy status and the stock's past biomass trends that illustrate the stock is able to easily tolerate a 20%+ ER with no conservation risks.
    - Should take advantage of the stock being in the Healthy Zone while the opportunity exists.
- NRL raised that larger, older shrimp are increasingly accounting for more of the catches, which is very desirable from a marketing perspective.
    - It is possible that by setting conservative TACs, we're seeing the sizes of shrimp increase because they are surviving longer.
    - To maximize sustaining catching older, larger shrimp, it would be advantageous to know what the mortality-at-age rates are.
    - NC noted that the science update supports NRL's conclusions: fishable biomass has increased while spawning stock biomass has decreased, suggesting that there's more in the fishable biomass reaching the end of the life cycle.

Northern shrimp (P. borealis)

TAC recommendations for Northern shrimp in the EAZ and WAZ were consistent with the approach presented at NSAC.

EAZ

- Stock status was in the Healthy Zone when last fully assessed (March 2025).
- NSAC recommended applying the MSE-tested HDR selected for the NSAR and the 4-year average of biomass in EAZ = 9,636t .
- No objections were raised against the NSAC recommendation.

WAZ

- Stock status was in the Healthy Zone when last fully assessed (March 2025).
- NSAC recommended applying the MSE-tested HDR for the NSAR and the 4-year average of biomass in WAZ = 8,060t.
- No objections were raised against the NSAC recommendation.

Management Measures

Catch Utilization Adjustment Proposals

- In response to the catch utilization adjustment proposed by CAPP at NSAC on January 20, Nunavut (NU) and Nunavik (NK) entities (Makivvik/NRL and NFA) requested an alternative catch utilization proposal for NU/NK to allow an additional 800t to be fished in EAZ (NU/NK E and DSW). This alternative proposal from NU/NK was discussed.
    - Department suggested that this 800t could be split by adding 200t to NU/NK-E and 600t to NU/NK-DSW, to be shared 50/50 between NU and NK.
- DFO Science requested clarification on when in the season the adjustment would be applied and whether the amount of removals already registered would be considered before the adjustment is

applied.
    - DFO RM indicated that the proposed adjustments would be considered as part of the TAC for each management area, applied at the beginning of the season.
    - NFA raised that the NU/NK proposal would be a one-year trial, with potential adjustments made the following year.
- CAPP expressed support for the flexibilities and the NU/NK proposal in principle, but concern with allowing additional quota to be fished in EAZ without any transfer of the quota out of the WAZ, essentially resulting in overallocation in the EAZ.
- DFO Science asked whether the increased QC/QFC fishing capacity would mean that the TACs in WAZ and EAZ will be become more fully utilized, and what that may mean regarding these catch utilization proposals.
    - NRL noted that even with the increased fishing capacity, the risk of fully utilizing the catch in these areas is very low.
- CAPP raised that the *P. borealis* and *P. montagui* biomass distributions may be shifting between EAZ and WAZ such that the decrease/increase in biomass in one area could be resulting in a corresponding decrease/increase in the other, highlighting the importance of accounting for adjustments between the two areas.
- DFO RM noted for awareness that applying the increases equally within the settlement areas would change the traditionally held 80:20 NU-NK sharing arrangement to 73:27.
    - NRL acknowledged that the minor change to 73:27 sharing was known among NU and NK interests when developing their catch utilization proposal.
- NFA raised that the NU/NK proposal is conceptually similar to the 5% proposal discussed at the NSAC table. The key difference is the amount of quota made available and potentially caught in the EAZ and WAZ.
- CAPP highlighted that allowing quota from one management area to be fished in another (i.e., WAZ quota fished in EAZ) conceptually departs from the 5% proposal and how the management of the fishery has operated to date, and could be considered precedential. Would others be allowed the flexibility to fish quota from one area in another area? Is the NU/NK proposal to be treated as an exception (i.e., one-off)?
    - DFO RM indicated the NU/NK proposal is similar in objective to the CAPP proposal.
    - Striving to provide flexibility without changing allocation keys, sharing arrangements, or opening up new access for entities that didn't have access previously.
- CAPP expressed that ad hoc operationalization and precedent-setting potential of the NU/NK proposal should be avoided. Further, a rationale for the amount in the NU/NK should be developed, so it is not arbitrarily selected. A unifying proposal that meets the flexibility objectives and melds consistency in the 5% and NU/NK proposals regarding rationale and approach should be developed.
    - NFA noted that the 5% proposal is also based on allowing uncaught quota in one area to be fished in another (i.e., Davis Strait East quota to be caught in SFA 4 and SFA 5).
    - NRL noted that the two proposals are the same in concept and complementary in terms of amounts. However, there needs to be consideration regarding the source of the underutilization and adjustments should equally benefit those entities from where it is occurring. To the extent it is sourced from land claims areas, land claimants should benefit accordingly.
- BFC indicated that land claim agreements are a critical component towards evaluating the catch adjustment proposals, and supported NRL's position regarding land claims beneficiaries.
    - The desire for flexibility stems from minimizing environmental (sea ice affecting northern companies to a greater extent) and operational (fleet availability) constraints.
    - Seeking flexibility not to be able to catch more quota necessarily, rather to be able to catch quota in more appropriate areas depending upon the time of year.
- CAPP noted that the 800t adjustment amounts to ~10% of the potential WAZ TAC, which is twice the percentage increase of the 5% proposal, and raises potential equitability and conservation

concerns. Further, the EAZ contains commercial and land claims areas, so adjustment decisions in this area affects all harvesters.
    - Reiterated that limits should be set on adjustment amounts for the NU/NK proposal.
    - BFC indicated that the 5% proposal results in similar tonnage amounts being allocated to industry stakeholders in SFA 4 and 5-North relative to the NU/NK proposal.
- NC raised that the stocks are not biologically divided, this is only for management purposes to retain the existing allocation structures. In situations where there is no risk to the resource, maximum flexibility should be implemented to improve operational efficiencies without prejudice to the risk to people's respective shares.
- DFO Science noted concerns with both the 5% proposal and NU/NK proposal regarding uncertainty with resultant concentration of effort and increased fishing pressure in the NSAR management areas, especially in light of the other proposed flexibilities (e.g. carry forward) that may be operationalized, which will also result in increased pressure.
- The Chair noted the the committee's agreement on the desire to have a catch utilization adjustment included in the TAC. The Department will follow up in the coming days with further information and invite participants to submit views and potential alternative proposals that reconcile the two existing proposals.

Other Updates

Nunavut Fisheries Regulations (NFRs)

DFO provided an update on the NFRs, which are being co-developed with Indigenous partners.

- The Atlantic Fishery Regulations will no longer apply within the Nunavut Settlement Area and Nunavik Marine Region; key provisions will be “ported over” to avoid disruption. No anticipated changes to commercial shrimp fishing or licensing; existing licenses will continue to be valid.
- QC/QCF sought confirmation that NFRS would not affect existing commercial operations outside Nunavut (e.g., Ungava Bay) and whether communal fish plans could be used outside settlement areas.
- DFO clarified that communal plans apply only within settlement areas and that commercial fishing outside of settlement areas remains unchanged.

Electronic Video Monitoring (EVM) and Shore-based Reporting

DFO provided an update on the EVM and shore based reporting initiatives.

- EVM in the offshore fleet, which is voluntary, cannot be used while fishing inside the Nunavut and Nunavik Settlement Area waters. Using EVM would be subject to Board decisions to be used in the future.
- Similarly, EVM and the shore-based reporting do not apply for offloading in Greenland.
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    - Package inspection to determine the “net frozen weight” of all product types will also be mandatory.
    - Further inspection to determine the net drained (or thawed) weight is optional.
- There will be a 1-year pilot phase for the shore-based program and the fleet will be given a 60-day notice prior to this program coming into effect.
- NRL noted that the term service providers need to be expanded beyond what been used in recent years to include offloading companies, independent contractors.

Licence Conditions

DFO provided an update on the key changes in the 2026 conditions of licence.

- Added a requirement for licence holders with access to multiple quota types in Davis Straight West to record the allocation type being fished in the Comments section of the logbook.
- Added a requirement to report catches in SFA 5 to SFA 5 North or SFA 5 South in the Comments section of the logbook.
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- PEIASC chose not to submit an application, nor provide additional information related to the projects which had been funded through their allocation over the years, which DFO had offered to share with the NSAC memberships.
- The Minister is further contemplating what she would like to do with their allocation.
- The TAC decision for SFA 7 will align with SFAs4-6, however, the decision to re-open SFA 7 will align with allocation decisions.

Section 10 for NSRF in SFA 4

- The Minister decided to allocate 1,500t for 2026-27 from the SFA 4 TAC, and that, from now on, the 1,500t will be distributed proportionately to all allocation holders in SFA 4 according to the sharing key.