Fisheries and Oceans Canada | Pêches et Océans Canada
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Newfoundland and Labrador Region
Arctic Region

Canadian Science Advisory Secretariat
Science Advisory Report 2025/042

NORTHERN SHRIMP (*PANDALUS BOREALIS*) IN NORTH AND SOUTH STOCK ASSESSMENT REGIONS IN 2024

CONTEXT

This Science Advisory Report is from the multi-regional peer review of March 11–14, 2025 on Stock Assessment for Northern Shrimp (*Pandalus borealis*) in the North and South Stock Assessment Regions for the 2025–26 Fishing Season. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SCIENCE ADVICE

Status

- Stock statuses differ from those previously reported at the scale of Shrimp Fishing Areas, resulting from revised stock assessment areas that better reflect the biology of the species and the implementation of a stock assessment model.
- **North stock assessment region (NSAR):** In 2024, the female SSB for Northern Shrimp in the NSAR was above the LRP (greater than 99% probability) and above the proposed USR (greater than 99% probability). If the proposed USR were adopted, this would place the stock in the Healthy Zone of the PA Framework.
- **South stock assessment region (SSAR):** In 2024, the female SSB for Northern Shrimp in the SSAR was above the LRP (greater than 99% probability) and above the proposed USR (greater than 98% probability). If the proposed USR were adopted, this would place the stock in the Healthy Zone of the PA Framework.

Trends

- **NSAR:** SSB derived from the stock assessment model increased by 56% in 2024 relative to the 2023 value, and remained below the time-series mean (1996–2023). The FB spatiotemporal survey index in 2024 declined by 19.7% relative to the 2023 value and remained below the time-series mean (1996–2023).
- **SSAR:** SSB derived from the stock assessment model increased by 2.2% in 2024 relative to the 2023 value which was the lowest in the time series, and remained below the time-series mean (1996–2023). The FB spatiotemporal survey index in 2024 declined by 20.8% relative to the 2023 value and reached a time-series low (1996–2023).

Ecosystem and Climate Change Considerations

- In the northern portion of the NSAR, summer ocean bottom temperatures for 2024 were average to slightly above average. In the southern portion of the NSAR and in the SSAR, the warm phase in ocean climate that started around 2020 continues, with record high sea surface temperature in 2024.

- The potential predator index has increased in both the NSAR and SSAR. The total biomass of the fish and shellfish community in the SSAR is at the highest levels since the 1990s but remains below their pre-ecosystem collapse levels (late 1980s). These increases are driven by groundfish, with the community having returned to a groundfish dominated structure.
- Based on information from cod diets, the current shrimp biomass in the core of the SSAR (2J3KL) is estimated to be around the level of the pre-ecosystem collapse period.

Stock Advice

- In 2025, ERI values were based on the newly adopted two-assessment region framework and FB indices were calculated using spatiotemporal modeling. These values are not directly comparable to previous estimates.
- **NSAR:** The preliminary ERI was 15.7% in 2024/2025. If the entire 2024/2025 aggregated TACs for the SFAs of this region are taken, the ERI will be 21.2%.
- **SSAR:** The preliminary ERI was 6.2% in 2024/2025. If the entire 2024/2025 aggregated TACs for the SFAs of this region are taken, the ERI will be 9.1%.

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

2024 (Johnson et al. in prep[1]).

Assessment Type

Full assessment

Most Recent Assessment Date

1. Last Full Assessment: N/A (first time these stocks are assessed using a new population structure).
2. Last Interim-Year Update: N/A; this stock is assessed annually.

Stock Assessment Approach

1. Broad category: Single stock assessment model.
2. Specific category: Statistical catch-at-length.

The assessment follows the framework established by Johnson et al. in prep[1]. Survey data from the DFO fall multispecies survey and annual Northern Shrimp Research Foundation – DFO (NSRF) summer trawl survey were used to identify Northern Shrimp size compositions and produce model-based biomass indices within the North Stock Assessment Region (NSAR) and the South Stock Assessment Region (SSAR). Trends in fishery performance were inferred from total allowable catch (TAC), commercial catch-to-date, modelled fisheries catch per unit effort (CPUE), fishing patterns, and exploitation rates. A Bayesian size-structured stock assessment

[1] Johnson, S.D.N., Cox, S.P., Baker, K.D., Le Corre, N., Coffey, W., and Enright, D. In prep. A Framework Stock Assessment for Canada's Northern Shrimp (*Pandalus borealis*) Fishery off Newfoundland, Labrador, and Baffin Island. DFO Can. Sci. Advis. Sec. Res. Doc.

model (SISCALS) that incorporated fishery and survey biomass indices from spatiotemporal modeling and size composition data was used to estimate trends in Northern Shrimp biomass, recruitment, natural mortality rates, and stock status for each stock assessment region.

Throughout this document, fishable biomass (FB) values are only reported from the survey spatiotemporal model and are referred to as an index. Spawning stock biomass (SSB) values are only reported from SISCALS. SISCALS biomass estimates and survey spatiotemporal model indices differ due in part to survey catchability and selectivity.

Ecosystem and Climate Change Assessment Approach

Ocean climate conditions and trends were evaluated with indicators including water temperature, ice conditions, and the Newfoundland and Labrador Climate Index (NLCI) (Cyr and Galbraith 2021, Cyr et al. 2022 a,b). Lower trophic levels were characterized using nutrients, chlorophyll, and zooplankton indicators from Atlantic Zone Monitoring Program (AZMP) surveys and remote sensing (Bélanger et al. 2022). Further, fish community status and trends, including fish diets, consumption, predation mortality, potential impacts of fish predation and fishing in relation to shrimp availability, ecosystem overfishing risk, and the role of marine mammals in the ecosystem were evaluated using ecological indicators and modeling (Koen-Alonso et al. 2018, Koen-Alonso et al. 2022).

Stock Structure Assumption

Stock overview information: Johnson et al. (in prep)[1].

A new understanding of Northern Shrimp stock structure in Atlantic and Arctic Canada, based upon their distribution, larval dispersal, gene flow, and life history traits, was adopted in December 2024 (Baker et al. 2025, Johnson et al. in prep[1]). Therefore, in 2025 the spatial scale of assessment for Northern Shrimp has changed from six assessment areas (i.e., Eastern Assessment Zone [EAZ], Western Assessment Zone [WAZ], and Shrimp Fishing Areas [SFAs] 4, 5 , 6, and 7) to two stock assessment regions (i.e., NSAR and SSAR) (Figure 1). NSAR combines the WAZ, EAZ, SFA 4, and the portion of SFA 5 north of the border between Northwest Atlantic Fisheries Organization (NAFO) Divisions 2H and 2J. SSAR combines SFAs 6 and 7, and the portion of SFA 5 south of the border between NAFO Divisions 2H and 2J.

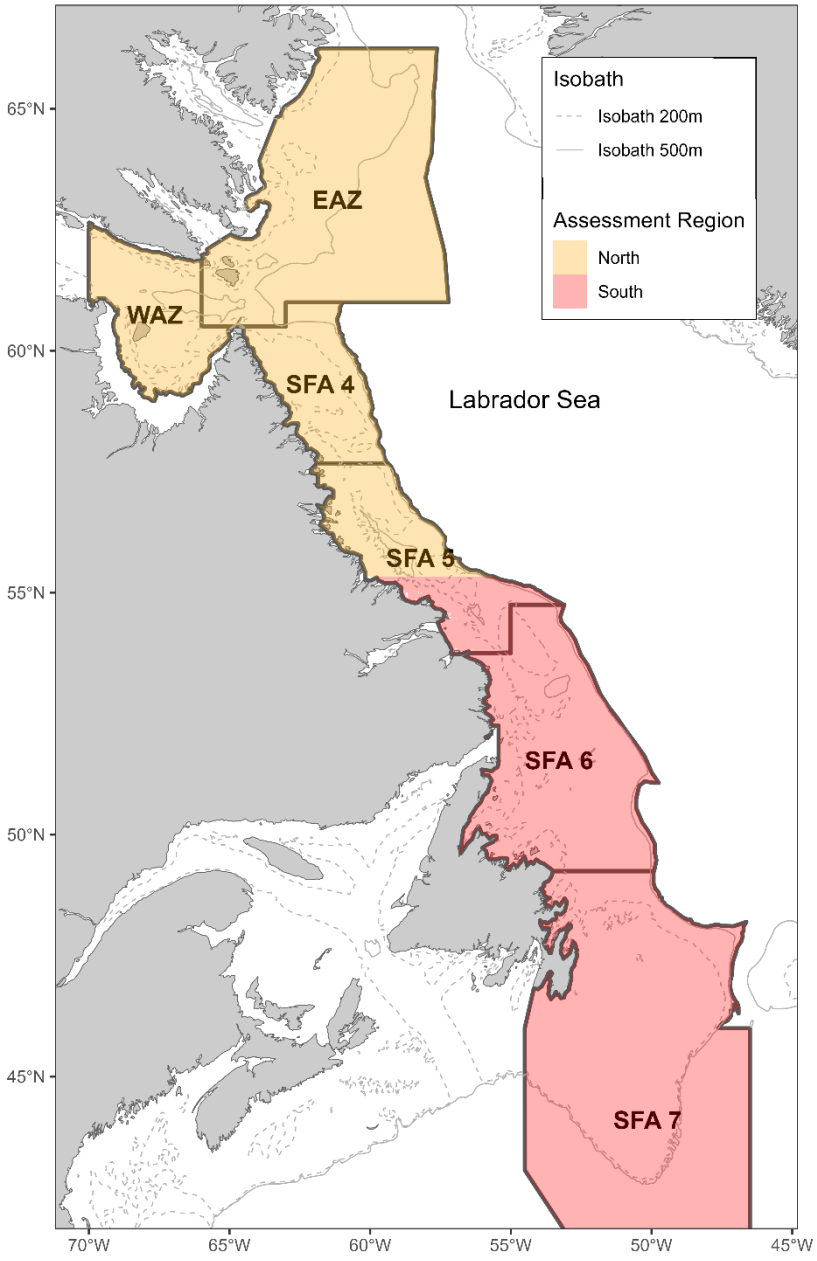

Figure 1. Map showing the six previously used shrimp fishing areas (Eastern Assessment Zone [EAZ], Western Assessment Zone [WAZ], Shrimp Fishing Areas [SFAs] 4–7) and the two new stock assessment regions used in the assessment framework (North and South).

Reference Points

Northern Shrimp reference points in the Precautionary Approach (PA) Framework were developed using SISCALS, and reflect estimated natural mortality and size at sex-transition from the most recent eight years (i.e., approximately one Northern Shrimp generation) (Johnson

et al. in prep[1], Le Corre et al. in prep[2]). The reference points were derived from the B_{MSY}-proxy for each stock assessment region, separately:

- Biomass Maximum Sustainable Yield (B_{MSY})-proxy values were defined for each stock assessment region as 40% of unfished biomass (i.e., B_{MSY}-proxy = 0.40 x B_0).
- The Limit Reference Point (LRP) was defined as 50% of the B_{MSY}-proxy for each stock assessment region.
- The Upper Stock Reference (USR) was proposed at 80% of the B_{MSY}-proxy for each stock assessment region.

Data

- NSRF-DFO collaborative annual trawl survey (2005–24).
- DFO-Newfoundland and Labrador (NL) fall multispecies trawl survey data (1996–2024).
- At-sea-observer data from commercial vessels (1979–2024).
- Commercial catch data from NL logbook databases (SSAR; 1998–2024).
- Commercial catch data from Canadian Atlantic Quota Report (CAQR) and Atlantic Quota Monitoring System (AQMS) (1977–2024).
- DFO-NL Ecosystem Research Program Indicators (1960–2024).
- AZMP Indicators (1950–2024).
- NASA Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua Ocean Color observation (2003–24).

Data changes: Commercial catch data for 2024/2025 are considered preliminary as the season is not officially closed until March 31, 2025. Data were downloaded on January 15, 2025 (Arctic Region) and February 4, 2025 (NL Region).

NSAR biomass and length composition indices from 2000 to 2004 were not included in SISCALS because of poor survey coverage.

[2] Le Corre, N., Baker, K.D., Coffey, W., Enright, D., Walkusz, W., Malayny, C., Atchison, S., and Sullivan, D. In prep. Assessment of Northern Shrimp (*Pandalus borealis*) in North and South Stock Assessment Regions in 2024. DFO Can. Sci. Advis. Sec. Res. Doc.

ASSESSMENT

Historical and Recent Stock Trajectory and Trends – North Stock Assessment Region

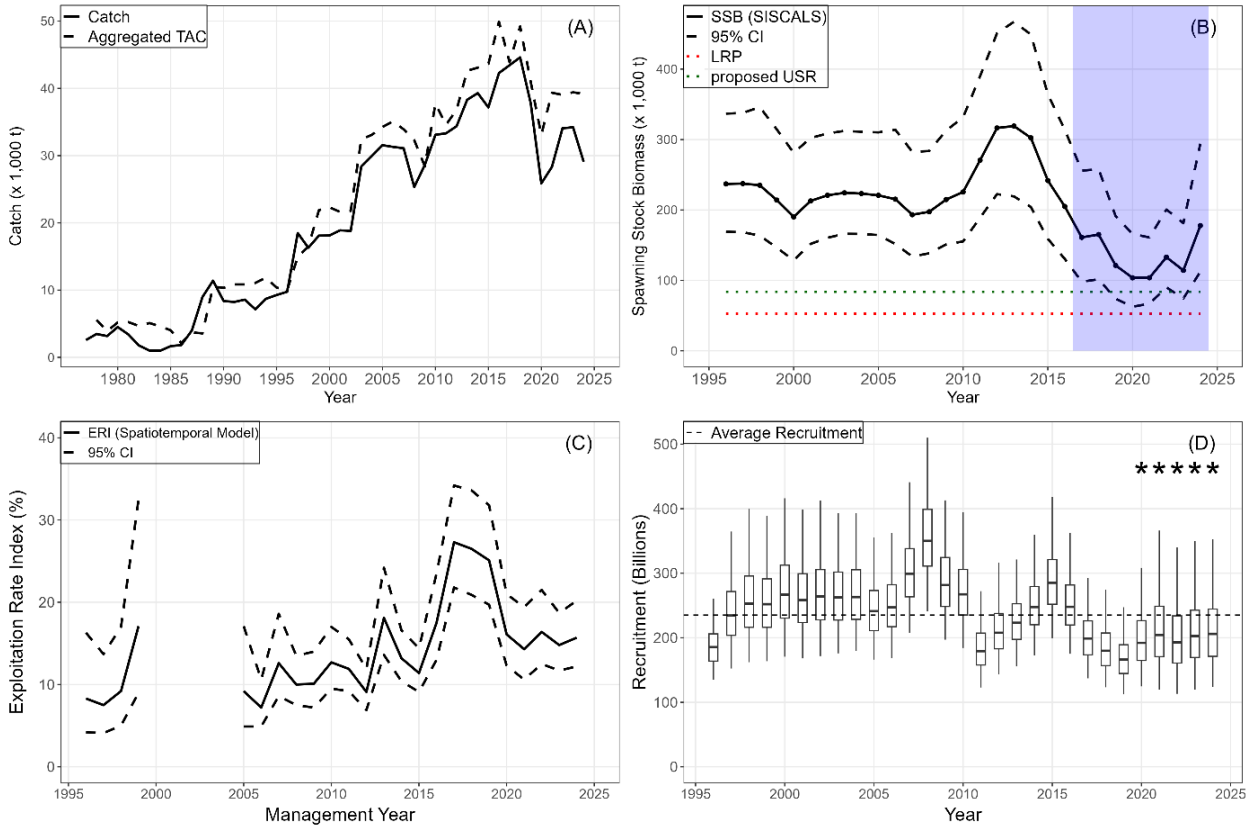

Figure 2. Northern Shrimp in the Northern Stock Assessment Region (NSAR). (A) Catch (x 1,000 t) and aggregated Total Allowable Catch (TAC) (x 1,000 t) (from the Shrimp Fishing Areas [SFAs] in the NSAR) by year (data for 2023/2024–2024/2025 are preliminary), (B) Spawning Stock Biomass (SSB x 1,000 t), from the stock assessment model, by year in relation to the Limit Reference Point (LRP: 0.5 x Biomass at Maximum Sustainable Yield [B_{MSY}]-proxy; median estimate) and proposed Upper Stock Reference (USR: 0.8 x B_{MSY}-proxy; median estimate), blue shading indicates the 8-year window used to represent recent natural mortality and length at transition in SISCALS, (C) Exploitation rate index (ERI; %) based on catch and spatiotemporal Fishable Biomass (FB) index from the same year, (D) Estimated recruitment (5–11 mm carapace length) from SISCALS (box: 25th, 50th, and 75th percentiles; whiskers: 95% confidence interval [CI]), time-series mean (1996–2019; dashed horizontal line), and simulated recruitment over the last five years (*).

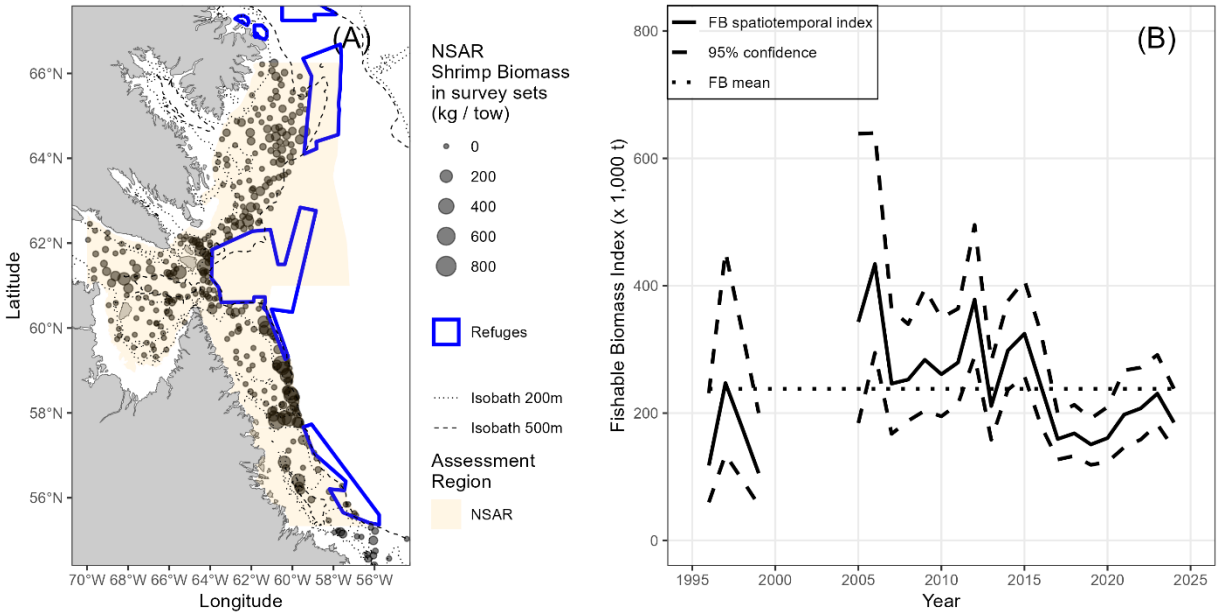

Figure 3. Additional indicators for Northern Shrimp in the North Stock Assessment Region (NSAR). (A) Map of the survey catch of Northern Shrimp in 2024 (kg/tow), (B) Fishable Biomass (FB) spatiotemporal index (x 1,000 t).

Biomass

The spatiotemporal model-based FB index in 2024 (185,200 t; Figure 3b) decreased (-19.7%) relative to the 2023 value (230,600 t) and remained below the long-term arithmetic mean (1996–2023; 238,200 t).

Biological Indicators

Mean female and male carapace length declined steeply in 2024 compared to 2023 to some of the lowest values in the time-series. Similarly, in 2024, the length at 50% female declined to below the previous time-series low. Size at transition is an important component of productivity; smaller females typically have fewer eggs and a long-term change could have negative impacts on stock productivity.

Natural Mortality

Natural mortality has been oscillating without a clear trend over the time series.

Recruitment

NSAR recruitment has been oscillating around the long-term mean but has mostly been below the mean since 2010. It remained below the mean in the last three non-simulated data points (i.e., 2017–2019) (Figure 2d).

Exploitation

The exploitation rate index (ERI) ranged between 7.2% and 27.3% from 1996 to 2024/2025 (Figure 2c). The preliminary ERI for 2024/2025 was 15.7% with 74% of the aggregated TAC taken. Should the entire 2024/2025 aggregated TAC of 39,175 t be taken, the ERI would be 21.2%.

Current Outlook

In 2024, the SSB derived from the stock assessment model was 177,800 t (Figure 2b), representing an increase (+ 56%) relative to 2023 (114,200 t); however, it remains below the long-term mean (1996–2023; 207,900 t).

The 2024 Northern Shrimp SSB is above the LRP with a greater than 99% probability and above the proposed USR with a greater than 99% probability, which, if the proposed USR were adopted, would place the stock in the Healthy Zone of the PA Framework (Figure 2b).

Historical and Recent Stock Trajectory and Trends – South Stock Assessment Region

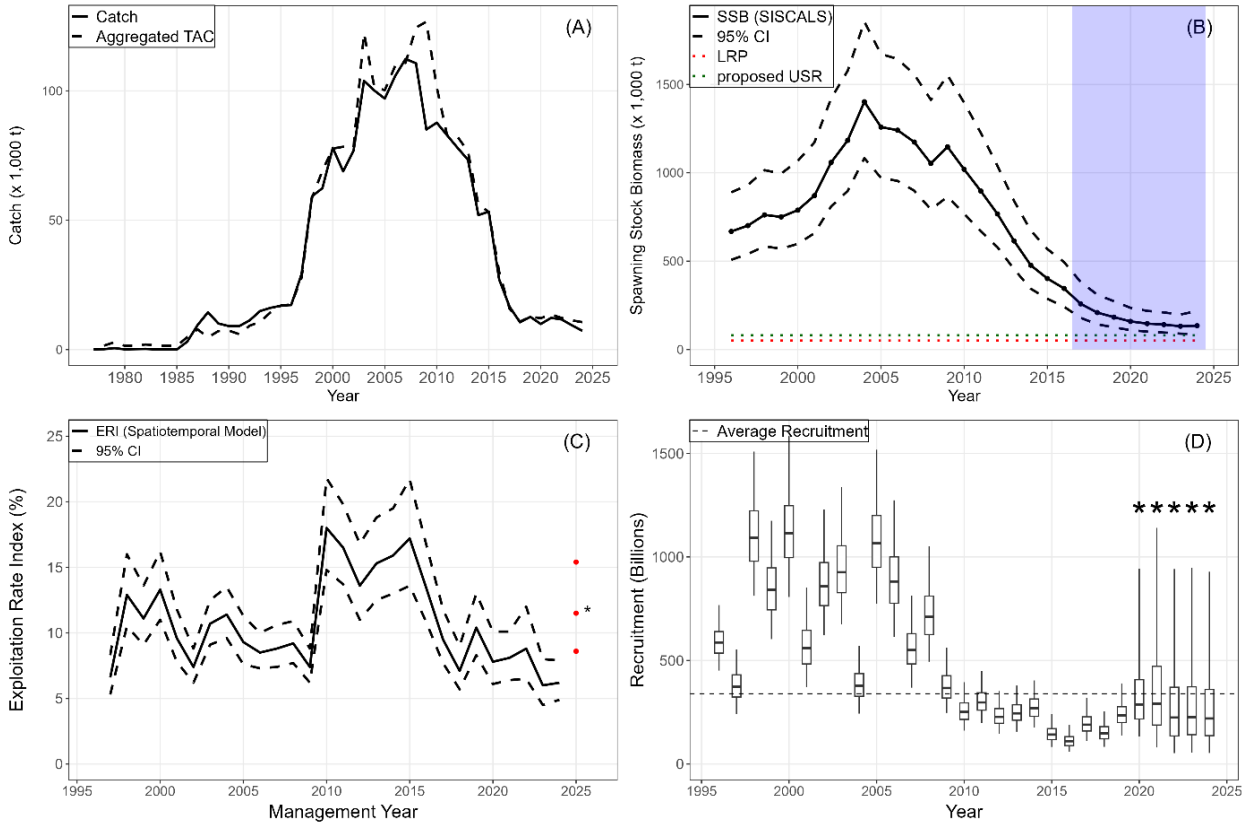

*Figure 4. Northern Shrimp in the South Stock Assessment Region (SSAR). (A) Catch (x 1,000 t) and aggregated Total Allowable Catch (TAC; x 1,000 t) (from the Shrimp Fishing Areas [SFAs] in the SSAR) by year (data for 2023/2024–2024/2025 are preliminary), (B) Spawning Stock Biomass (SSB x 1,000 t), from the stock assessment model, by year in relation to the Limit Reference Point (LRP: 0.5 x Biomass at Maximum Sustainable Yield [B_{MSY}] proxy; median estimate) and proposed Upper Stock Reference (USR: 0.8 x B_{MSY} proxy; median estimate), blue shading indicates the 8-year window used to represent recent natural mortality and length at transition in SISCALS, (C) Exploitation rate index (ERI; %) based on catch and spatiotemporal Fishable Biomass (FB) index from the previous year (*2025/2026 projected ERI and confidence intervals [CI] considering the same aggregated TAC as in 2024/2025; in red), (D) Estimated recruitment (5–11 mm carapace length) from SISCALS (box: 25th, 50th, and 75th percentiles; whiskers: 95% confidence interval, time-series mean (1996–2019; dashed horizontal line), and simulated recruitment over the last five years (*).*

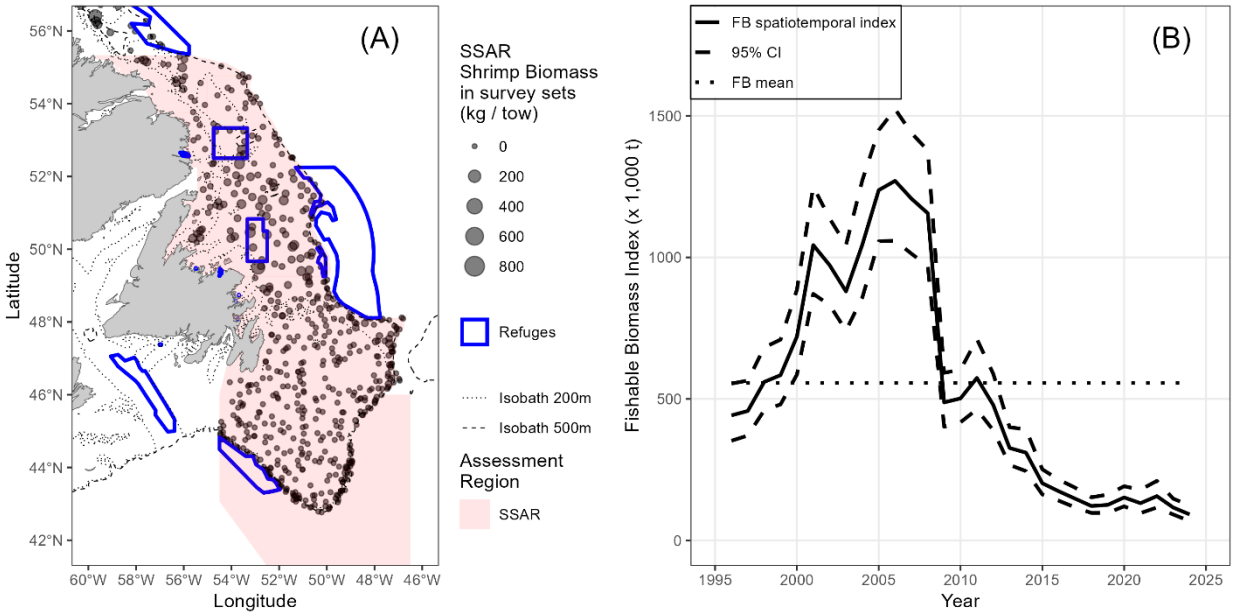

Figure 5. Additional indicators for Northern Shrimp in the South Stock Assessment Region (SSAR). (A) Map of the survey catch of Northern Shrimp in 2024 (kg/tow), (B) Fishable Biomass (FB) spatiotemporal index (x 1,000 t).

Biomass

The spatiotemporal model-based FB index in 2024 (92,300 t; Figure 5b) decreased (-20.8%) relative to the 2023 value (116,600 t) and was the lowest level in the survey time series.

Biological Indicators

Mean female and male carapace length had similar values in 2024 compared to 2023. Likewise, in 2024, the length at 50% female was similar to 2023.

Natural Mortality

Natural mortality has increased over much of the time series but has plateaued since 2015. Changes in natural mortality are consistent with increased predator abundance in the region.

Recruitment

SSAR recruitment was mostly above the long-term average during the first part of the time series (1996–2008) but has been below average since 2009. It reached the lowest level in the time series in the last five non-simulated data points (i.e., 2015–2019) (Figure 4d).

Exploitation

The ERI ranged between 6.0% and 18.0% from 1997 to 2024/2025 and the preliminary ERI was 6.2% in 2024/2025 (Figure 4c). If the entire 2024/2025 aggregated TAC is taken, the ERI would be 9.1%.

Current Outlook

In 2024, the SSB derived from the stock assessment model was 134,700 t (Figure 4b), an increase of 2.2% relative to the 2023 value (131,700 t) which was the lowest in the time series, and remained below the long-term mean (1996–2023; 707,500 t).

The 2024 Northern Shrimp SSB is above the LRP with a greater than 99% probability, and above the proposed USR with a 98% probability, which, if the proposed USR were adopted, would place the stock in the Healthy Zone of the PA Framework (Figure 4b).

History of TAC and Catch

With the change from six SFAs to two stock assessment regions, SFA-specific TACs were summed for each stock assessment region into aggregated TACs for the purpose of understanding catch history (Le Corre et al. in prep[2]). The SFA 5 TAC was divided between the NSAR and SSAR each year based on the proportion of catch in each stock assessment region within that year.

The aggregated TAC within the NSAR decreased from 39,407 t in 2023/2024 to 39,175 t in 2024/2025. Total catch in 2024/2025 was 29,083 t, 74% of the TAC (preliminary AQMS data as of January 15, 2025 and February 4, 2025 for the Arctic and NL regions, respectively) (Figure 2a, Table 1).

The aggregated TAC within the SSAR of 11,280 t in 2023/2024 (83% taken) was reduced for 2024/2025. Total catch in 2024/2025 was 7,237 t, 68% of the 10,604 t TAC (preliminary AQMS data as of February 4, 2025) (Figure 4a, Table 1).

*Table 1. Nominal reported catches and aggregated Total Allowable Catches (TACs) (t) for Northern Shrimp in the North Stock Assessment Region (NSAR) and South Stock Assessment Region (SSAR) over the last 10 years. Catches are based on Atlantic Quota Monitoring System (AQMS) data as of January 15, 2025 and February 4, 2025 for the Arctic and Newfoundland regions, respectively. *Catches for 2023/2024 and 2024/2025 are considered preliminary. ** TAC and Catch in Shrimp Fishing Area (SFA) 5 were based on the values from SFA 5, split between the NSAR and SSAR according to the yearly proportion of catch in each stock assessment region, using observer data (Large Vessel: 2015/2016–2024/2025) and logbook data (Small Vessel: 2015/2016–2024/2025).*

Year	NSAR**		SSAR**	
	Catch (t)	***Aggregated TAC (t)***	***Catch (t)***	***Aggregated TAC (t)***
2015/2016	37,166	43,611	53,304	53,186
2016/2017	42,269	49,891	27,113	30,103
2017/2018	43,433	43,886	16,579	15,807
2018/2019	44,604	49,206	10,557	10,799
2019/2020	37,787	40,968	12,643	12,711
2020/2021	25,867	33,073	9,879	12,141
2021/2022	28,311	39,348	12,248	13,565
2022/2023	34,060	39,022	11,647	12,243
2023/2024*	34,212	39,407	9,379	11,280
2024/2025*	29,083	39,175	7,238	10,604

Projections

Recruitment projections are generated from a Beverton-Holt stock-recruitment relationship post-fitted to SSB and recruitment estimates from 2009–2019 that are smoothed to further reflect recent recruitment conditions.

Based on this recruitment projection method, SSB values under a range of constant catch scenarios (Table 2) in both the NSAR and SSAR would be highly likely to remain within their associated Healthy Zones, if the proposed USRs were adopted.

Table 2. SISCALS Spawning Stock Biomass (SSB) projections for the Northern Stock Assessment Region (NSAR) and South Stock Assessment Region (SSAR) over 2025–2027 under five constant catch scenarios derived from an Exploitation Rate Index (ERI) multiplied by the 2024 Fishable Biomass (FB) spatiotemporal index: (1) ERI based on most recent aggregated Total Allowable Catch (TAC; Current ERI 21.2%); (2) 0% based on zero catch; (3) 10% based on the lower limit of the current harvest decision rule (HDR); (4) 20% based on the upper target of the HDR; and (5) 30% based on the maximum allowable ERI from the HDR. Results are shown for the probabilities (P) of SSB being greater than Biomass at Maximum Sustainable Yield-proxy (B_{MSY}-proxy) - P(SSB > B_{MSY}); SSB greater than Upper Stock Reference Point (USR) – P(SSB > USR); and SSB greater than Limit Reference Point (LRP) – P(SSB > LRP). Expected SSB values (kt) are medians over the posterior distributions.

SISCALS Projections	2024 NSAR FB spatiotemporal index (kt):				185.2	2024 SSAR FB spatiotemporal index (kt):				92.3
Exploitation Rate Index	0%	10%	20%	Current ERI (21.2%)	30%	0%	10%	Current ERI (11.5%)	20%	30%
Aggregated TAC	0	18.5	37.0	39.2	55.6	0	9.2	10.6	18.5	27.7
SSB_{2025}	141.4	138.2	134.9	134.6	131.8	167.5	166.1	165.8	164.5	162.9
$P(SSB_{2025} \geq B_{MSY})$	0.97	0.95	0.93	0.92	0.90	0.96	0.96	0.96	0.96	0.95
$P(SSB_{2025} \geq USR)$	> 0.99	> 0.99	> 0.99	0.99	0.99	> 0.99	0.99	0.99	0.99	0.99
$P(SSB_{2025} \geq LRP)$	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99
SSB_{2026}	150.9	136.2	121.3	119.5	106.6	189.1	181.2	180.1	173.9	166.5
$P(SSB_{2026} \geq B_{MSY})$	0.98	0.91	0.74	0.72	0.52	0.97	0.95	0.95	0.94	0.91
$P(SSB_{2026} \geq USR)$	> 0.99	0.99	0.95	0.94	0.82	0.99	0.99	0.99	0.98	0.97
$P(SSB_{2026} \geq LRP)$	> 0.99	> 0.99	> 0.99	> 0.99	0.99	> 0.99	> 0.99	> 0.99	> 0.99	> 0.99
SSB_{2027}	169.4	142.9	117.1	114.1	92.4	205.1	192.0	190.0	179.0	166.9
$P(SSB_{2027} \geq B_{MSY})$	> 0.99	0.92	0.66	0.62	0.35	0.97	0.94	0.94	0.90	0. 85
$P(SSB_{2027} \geq USR)$	> 0.99	0.99	0.90	0.87	0.61	0.99	0.98	0.98	0.96	0.93
$P(SSB_{2027} \geq LRP)$	> 0.99	> 0.99	> 0.99	0.99	0.93	> 0.99	> 0.99	> 0.99	> 0.99	0.99

Ecosystem and Climate Change Considerations

Ocean climate and predation indices are reported for the NL bioregion, which includes the southern portion of the NSAR (NAFO Divisions 2GH), and the entirety of the SSAR (NAFO Divisions 2J3KLNO). In the remainder of the NSAR, ocean bottom temperatures were closer to average to slightly warmer. Less ecosystem information is available for NSAR.

The NL bioregion shows multi-year to decadal scale cold and warm phases. The current warm phase began in 2020 with record high sea surface temperatures in 2024. In the NL bioregion, recent phytoplankton blooms have been early, which favours the copepod *Calanus finmarchicus*, a key food item for fish. Total zooplankton biomass has been increasing since the lows of the early to mid-2010s.

NL ecosystems collapsed in the late 1980s and early 1990s associated with extreme cold ocean conditions and ecosystem overfishing. Total biomass has remained below pre-collapse levels with increases in shellfish not compensating for declines in groundfish. These ecosystems

continue to experience low overall productivity conditions, likely related to bottom-up processes (e.g., food limitation).

Modest increases in total biomass have been observed since 2020. Both 2H and 2J3KL have returned to a groundfish dominated community structure, after being shellfish dominated since the ecosystem collapsed. Using a model based on cod diets, the current Northern Shrimp biomass in 2J3KL is estimated to be around the level of the pre-collapse period.

Shrimp remains an important forage species, especially in the northern areas; its dominance in diets has decreased in recent years in the NL bioregion. The predation mortality index on shrimp remains at a high level in 2J3KL, but is much lower in 2H. The potential predator biomass index values for both the NSAR and SSAR have increased in recent years. Predators include Greenland Halibut (*Reinhardtius hippoglossoides)*, Atlantic Cod (*Gadus morhua)*, and Redfish (*Sebastes* spp.).

Both fishing and fish predation have been potential drivers of the stock in 2H, while fish predation has been the stronger potential stock driver in 2J3KL.

SOURCES OF UNCERTAINTY

Stock assessments involve several classes of uncertainty. For Northern Shrimp, the most relevant ones include:

- Observation uncertainty or measurement error associated with direct data inputs to the assessment such as catch, survey indices, length composition, and biological characteristics.
- Length composition data from the surveys remain unstandardized, which may cause biased stock assessment estimates (Johnson et al. in prep[1]).
- The variability of Northern Shrimp's vertical distribution across space and time is unclear. Biomass estimates rely on bottom trawl surveys, which may miss shrimp which are higher in the water column, influencing observed fluctuations rather than population size.
- Process uncertainty in variables estimates by SISCALS such as recruitment, natural mortality, growth, and sex-transition.
- Recruitment in the terminal five years of the model and in projection years are uncertain as few young animals are seen in the fishery or the survey and were replaced with estimates. While estimates were based on the recently observed recruitment, these may be over or under estimates. It is unknown if these conditions reflect current and future conditions.
- Model (structural) uncertainty associated with how shrimp dynamics, stock structure, and ecosystem processes (e.g., predation) are represented in the assessment model.
- Environmental data in the NSAR lacks predation mortality indices, comprehensive physical ocean data, and pelagic production data, which are needed to include impacts of environmental conditions and predation in the NSAR and adopt an ecosystem approach to fisheries management.
- Assessment projections assume average conditions from the most recent years, but these conditions can shift over time.
- Implementation uncertainty represented by deviations in how management actions such as TACs translate to actual catch impacts on the population.

- Catch is assumed to be equal to the TAC in all projection years, whereas TAC utilization has been less than 100% in recent years, therefore, all else being equal in this particular assessment, the projected biomass estimates in Table 2 could be underestimated.
- Rollovers and other management actions are difficult to quantify and could also lead to bias in projected biomass estimates.

Research Recommendations

Unlike survey biomass, length composition data input to SISCALS are not standardized in a spatiotemporal model, which means that areas not covered by the survey may not be represented in the length composition information. Uncertainty in length composition is directly related to bias in catchability estimates. To address these concerns, research recommendations include:

- Standardizing survey length composition via the spatiotemporal model to reduce potential for catchability bias.
- Estimating potential catchability bias arising from partial survey coverage.
- Improving the design of biomass and length composition sampling from both fisheries and surveys.
- Investigating relationships between shrimp population dynamics and environmental and ecological factors, including sea ice cover, ocean currents, predation, and larval transport.

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Daniel Enright	DFO – Science, Arctic Region
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Kevin Hedges (co-chair)	DFO – Science, Arctic Region
Wojciech Walkusz	DFO – Science, Arctic Region
Karen Dwyer	DFO – CSAS, National Capital Region
Robert Deering	DFO – CSAS, National Capital Region
Brian Lester	DFO – Resource Management, National Capital Region
Dirk Algera	DFO – Resource Management, National Capital Region
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THIS REPORT IS AVAILABLE FROM THE:

Center for Science Advice (CSA)
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ISSN 1919-5087
ISBN 978-0-660-78353-6 Cat. No. Fs70-6/2025-042E-PDF

Correct Citation for this Publication:

DFO. 2025. Northern Shrimp (*Pandalus borealis*) in North and South Stock Assessment Regions in 2024. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2025/042.

Aussi disponible en français :

*MPO. 2025. Crevette nordique (*Pandalus borealis*) dans les régions d'évaluation du stock du nord et du sud en 2024. Secr. can. des avis sci. du MPO. Avis sci. 2025/042.*