MARITIMES REGION SNOW CRAB STOCK ASSESSMENT FOR 2024

CONTEXT

The Maritimes Region Resource Management sector has requested detailed advice on the status of Snow Crab (*Chionoecetes opilio*, O. Fabricius) stocks on the Scotian Shelf to inform recommendations for management decisions for the 2025 fishing season in North-Eastern Nova Scotia (N-ENS; formerly crab fishing areas [CFA] 20–22), South-Eastern Nova Scotia (S-ENS; CFA23 and CFA24), and Northwest Atlantic Fisheries Organization (NAFO) Division 4X (CFA24W).

This Science Advisory Report is from the February 19–20, 2025 regional peer review on Stock Assessment of Snow Crab in Maritimes Region. 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

- In N-ENS, the modelled biomass (pre-fishery) of Snow Crab in 2024 was 2.7 kt placing the stock in the cautious zone.
- In S-ENS, the 2024 modelled biomass (pre-fishery) of Snow Crab in 2024 was 41.5 kt placing the stock in the healthy zone.
- In 4X (CFA24W), the modelled biomass (pre-fishery) of Snow Crab for the 2024–2025 season was 0.18 kt placing the stock in the critical zone.

Trends

- There is a continued decrease in modelled biomass since 2022 in N-ENS, and since 2020 in S-ENS and 4X.
- The trends in fishing mortality estimates over the past few years show an increase in N-ENS and S-ENS. In 4X, the trend in fishing mortality showed a continued decrease since a peak in 2021 (2024–2025 fishing season ongoing at time of assessment).
- Recruitment for the male component of the population, the contribution to the fishable component, has been declining in N-ENS since 2019, has been relatively steady over the past ten years in S-ENS, and has shown a marked decrease in 4X since 2019.

Environmental and Climate Change Considerations

- Bottom temperatures have reverted to cold-historical conditions in the last two years (2023 and 2024; below 5 degrees) after many years of high and variable conditions.

- Viable habitat for Snow Crab is highest in S-ENS even though temperatures are more stable in N-ENS. Even with ameliorations in temperatures in 2024, overall habitat viability has declined in all areas since 2019. Though 4X showed a marginal improvement in 2024, the overall trend has been downwards since 2010. Previous habitat space seems to have been overtaken by competitors and predators in 4X.

Stock Advice

- Based on the 2024 modelled fishable biomass for each area, the strategies for exploitation rates, presented in the integrated fisheries management plan (DFO 2013), are 0–20% in N-ENS, 10–30% in S-ENS, and consideration of fishery closure for the 4X area.

Other Management Questions

- An evaluation of consequences of various harvest levels in the 2025 fishery on stock abundance and exploitation rate was requested by Resource Management; however, this is not an output that is possible with the current modelling framework for Maritimes Region Snow Crab.

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

2012 - fishery model (Choi and Zisserson 2012)

2018 - index model (Choi 2023)

Assessment Type

Full Assessment

Most Recent Assessment Date

1. Last Full Assessment: February 2024 (DFO 2024)
2. Last Interim Year Update: February 2022 (DFO 2022)

Assessment Approach

1. Broad category: single stock assessment model
2. Specific category: Biomass dynamics, State-Space, Surplus Production

Stock Structure Assumption

Three main crab fishing areas (N-ENS, S-ENS, 4X) are treated independently as environmental variability in each area is sufficiently different and length scale of movement of large male benthic components are small enough (mean and median distance <20 km/year) to ignore immigration/emigration between each area (Choi 2023). For this reason, the areas are treated as separate populations, especially as in the precautionary framework, it is more conservative to treat them as such. The planktonic stages are well mixed throughout the region and include outflow from Southern Gulf of St. Lawrence and Labrador Currents and return flow through the Gulf Stream, and are considered genetically undifferentiated (Puebla *et al*. 2008).

Reference Points

- Limit Reference Point (LRP): 25% of estimated carrying capacity, Choi and Zisserson 2012.
- Upper Stock Reference (USR): 50% of estimated carrying capacity, Choi and Zisserson 2012.
- Removal Reference (RR): F_{MSY}, Choi and Zisserson 2012.

Table 1. Reference points for 2024 for North-Eastern Nova Scotia (N-ENS), South-Eastern Nova Scotia (S-ENS), and 4X.

Management Area	LRP (kt)	USR (kt)	RR
N-ENS	1.4	2.9	0.48
S-ENS	17.2	34.5	0.46
4X	0.46	0.92	0.46

Harvest Control Rules

The harvest control rules (HCR) for Maritimes Snow Crab, as documented in the Eastern Nova Scotia and 4X Snow Crab (*Chionoecetes opillio*) Integrated Fisheries Management Plan (DFO 2013), have operational target exploitation rates that vary as a function of the stock status against the reference points. When the stock is in the healthy zone, above the USR, a target exploitation rate would fall between 10% to 30% of the fishable biomass. In the cautious zone, below the USR and above the LRP, the target exploitation rate would be between 0% to 20% of the fishable biomass. When the stock status falls below the LRP, placing the stock in the critical zone, closure of the fishery is considered. Other biological and ecosystem considerations such as recruitment, spawning stock (female) biomass, size structure, sex ratios and environmental and ecosystem conditions, provide additional guidance and context within each range.

Data

- Survey data: Industry-DFO fishery-independent annual Maritimes Region Snow Crab trawl survey (Zisserson 2015) 1996–2024. All 364 planned survey stations were completed in 2024.
- Data sources for temperature, predator/prey data: Maritimes Region Snow Crab trawl survey, Maritimes Region ecosystem research vessel surveys; Atlantic zonal monitoring program survey, inshore and offshore scallop surveys, inshore lobster trawl survey, Eastern Scotian Shelf shrimp survey.
- Fishery landings data: Maritimes Region fisheries information system 1999–2024. Note the 2024–2025 fishing season in 4X (CFA 24W) was ongoing at the time of the assessment. Data was accessed on January 27, 2025.
- Observer data: 2004–2024 at-sea observer coverage (5% for N-ENS, S-ENS and 10% for 4X) has not been met since 2019. There has been no observer coverage in 4X since 2020 (2.6%).

ASSESSMENT

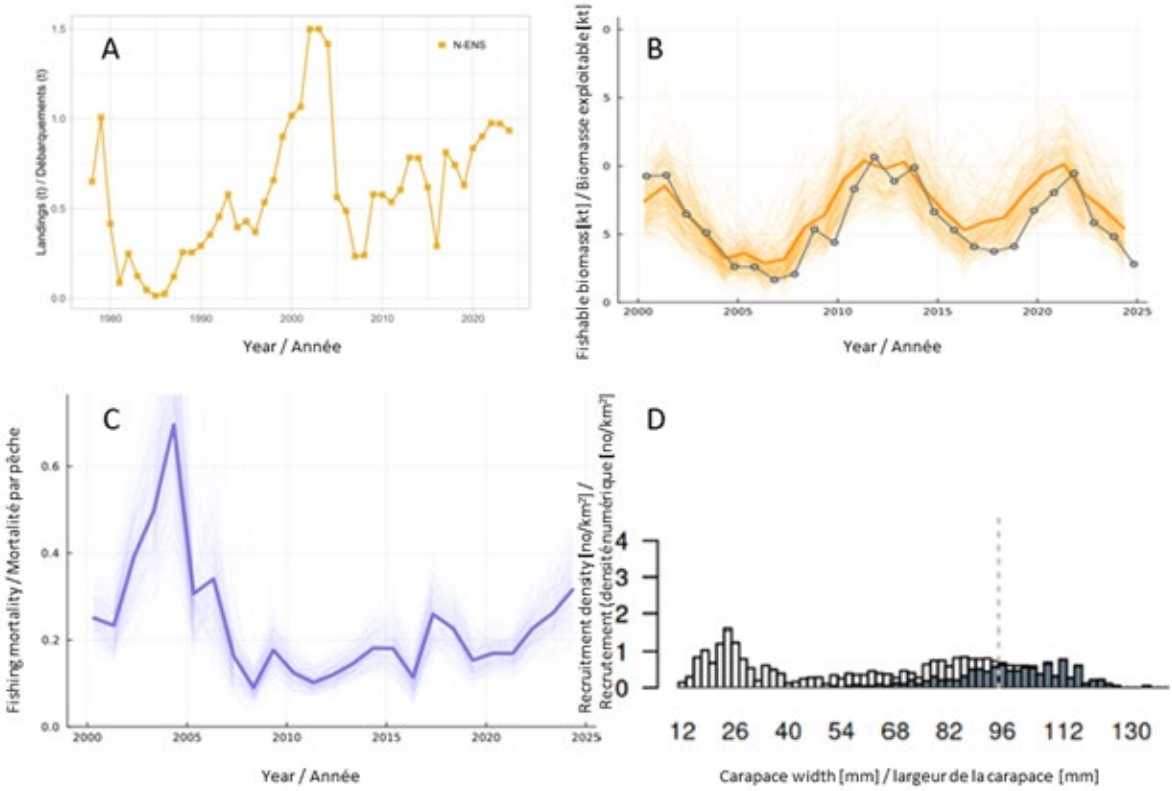

Figure 1. For N-ENS in 2024: (A) Catch (t), (B) Fishable biomass (kt, pre-fishery) with posterior mean (dark) and samples (light) in orange and dots indicating Maritimes Region Snow Crab Trawl Survey index (post-fishery), (C) Fishing mortality (nondimensional) with posterior mean (dark) and samples (light), (D) Recruitment (numerical density (no./km)^2 vs. carapace width (mm)) for immature (light bars) and mature (dark bars) male crab.

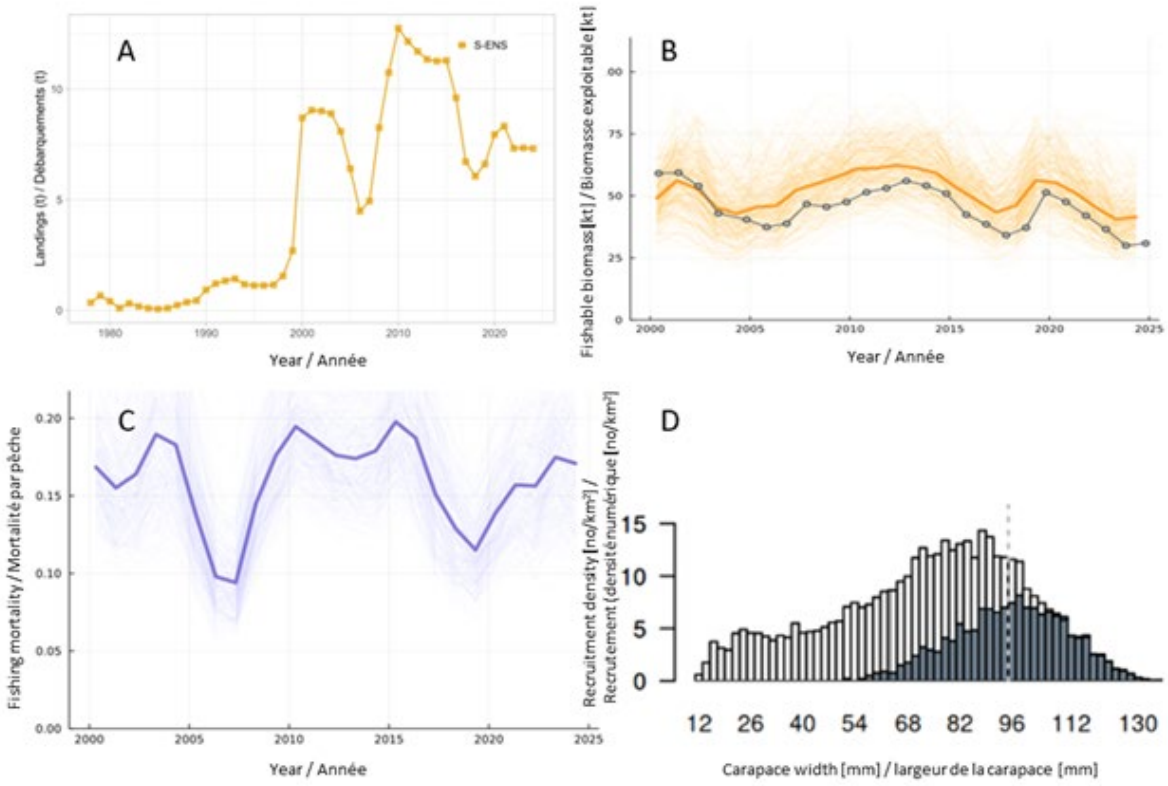

Figure 2. For S-ENS in 2024: (A) Catch (t), (B) Fishable biomass (kt, pre-fishery) with posterior mean (dark) and samples (light) in orange and dots indicating Maritimes Region Snow Crab Trawl Survey index (post-fishery), (C) Fishing mortality (nondimensional) with posterior mean (dark) and samples (light), (D) Recruitment (numerical density (no./km)^2 vs. carapace width (mm)) for immature (light bars) and mature (dark bars) male crab.

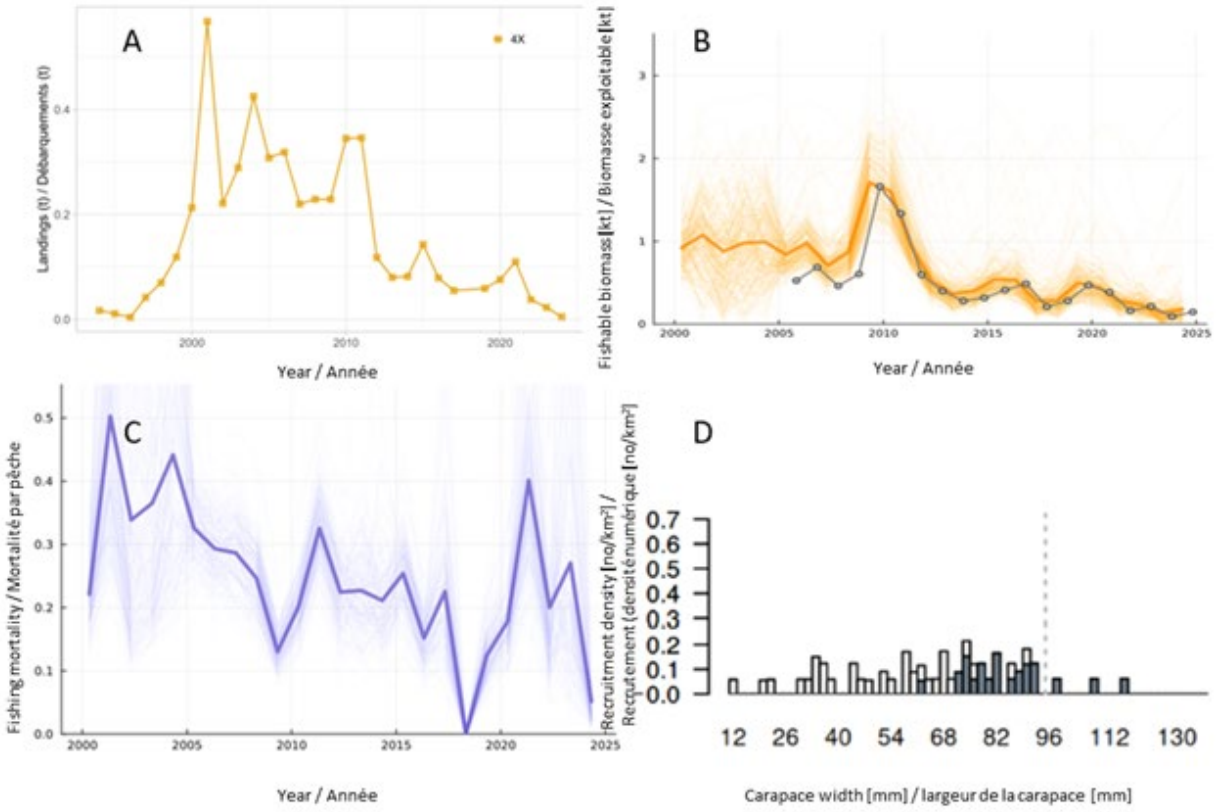

Figure 3. For 4X in 2024: (A) Catch (t), (B) Fishable biomass (kt, pre-fishery) with posterior mean (dark) and samples (light) in orange and dots indicating Maritimes Region Snow Crab Trawl Survey index (post-fishery), (C) Fishing mortality (nondimensional) with posterior mean (dark) and samples (light), (D) Recruitment (numerical density (no./km)^2 vs. carapace width (mm)) for immature (light bars) and mature (dark bars) male crab.

Stock Status and Trends

Modelled Biomass

There is a continuing decrease in modelled biomass (pre-fishery) in N-ENS since 2022 and since 2020 in S-ENS and 4X. In N-ENS, the modelled biomass of Snow Crab in 2024 was 2.7 kt, relative to 3.4 kt in the previous year (Figure 1B). In S-ENS, the 2024 modelled biomass was 41.5 kt, relative to 40.6 kt in the previous year (Figure 2B). In 4X, the modelled biomass for the 2024–2025 season (ongoing) was 0.18 kt, relative to 0.14 kt in the previous season (Figure 3B).

Fishing Mortality

The trend in fishing mortality estimates over the past few years shows a gradual increase in N-ENS and S-ENS. In 4X, while the 2024–2025 season is ongoing at the time of assessment, the trend in fishing mortality shows a continued decrease since a peak in 2021.

In N-ENS, the 2024 fishing mortality is estimated to have been 0.32 (annual exploitation rate of 37%), up from 0.26 in the previous year (annual exploitation rate of 30%; Figure 1C). In S-ENS, the 2024 fishing mortality is estimated to have been 0.17 (annual exploitation rate of 18.6%), while in the previous year it was 0.18 (annual exploitation rate of 19%; Figure 2C). In 4X, the

2024–2025 season (ongoing) fishing mortality is estimated to be 0.052 (annual exploitation rate of 5%), while in the previous season it was 0.27 (annual exploitation rate of 31%; Figure 3C).

Recruitment

The trend in recruitment for the male component of the population, as shown by numerical densities in the juvenile and mature males (Figure 4), has been declining in N-ENS since 2019. In S-ENS the trend in recruitment for the male component has been relatively steady over the past ten years. In 4X the numerical densities in this size range have been variable over time, but have shown a decrease in the numbers moving from juvenile into the mature male component since 2019. Numbers for all sizes were greatly reduced in 2024.

The outlook for recruitment to the fishable component is based on the 2024 size frequency data presented for each area in Figures 1–3. In N-ENS (Figure 1D), recruitment is low; the mode centered on 85 mm carapace width (CW) should begin to recruit into fishable size in 1–3 years. In S-ENS, a stable size structure exists and therefore, continued recruitment is expected for the next 1–3 years (Figure 2D). In 4X, erratic inter-annual patterns of growth stages are evident with minimal to low recruitment; the mode near 68 mm CW can be expected to begin entering the fishable component in 3 years (Figure 3D).

Recruitment of the female component of the population, as shown by numerical densities of both the mature and juvenile females (Figure 5), is an index of contribution to reproduction. In N-ENS and 4X, the trend in female recruitment has shown a decline in numerical densities since 2017. In S-ENS there has been an increase since 2021.

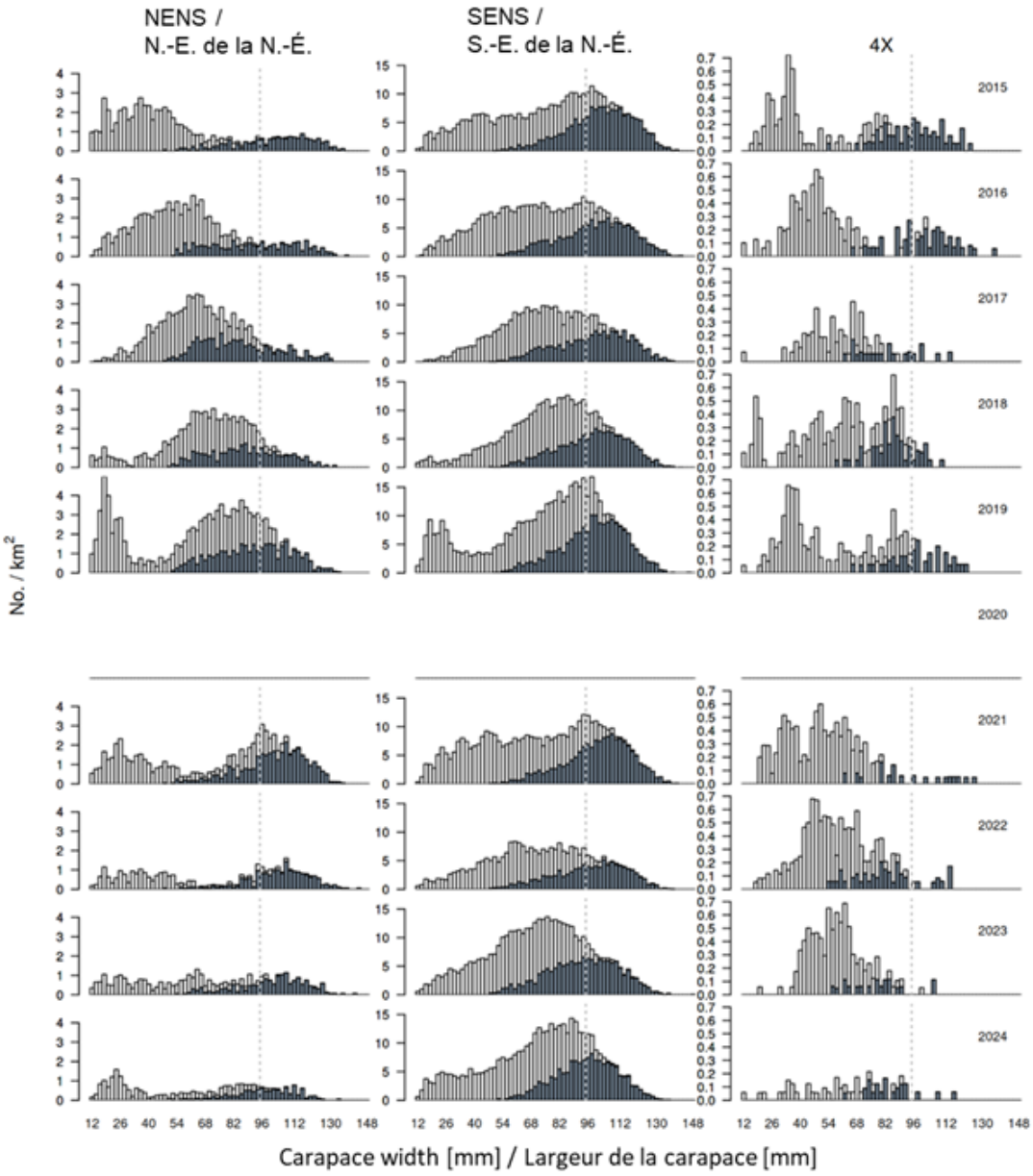

Figure 4. Size-frequency (geometric mean areal density, No./km^2) histograms of carapace width (mm) of male Snow Crab from the snow crab survey by year. The vertical line represents the legal size (95 mm). Immature animals are shown with the lighter bars and mature with darker. The year 2020 is left blank as there was no survey.

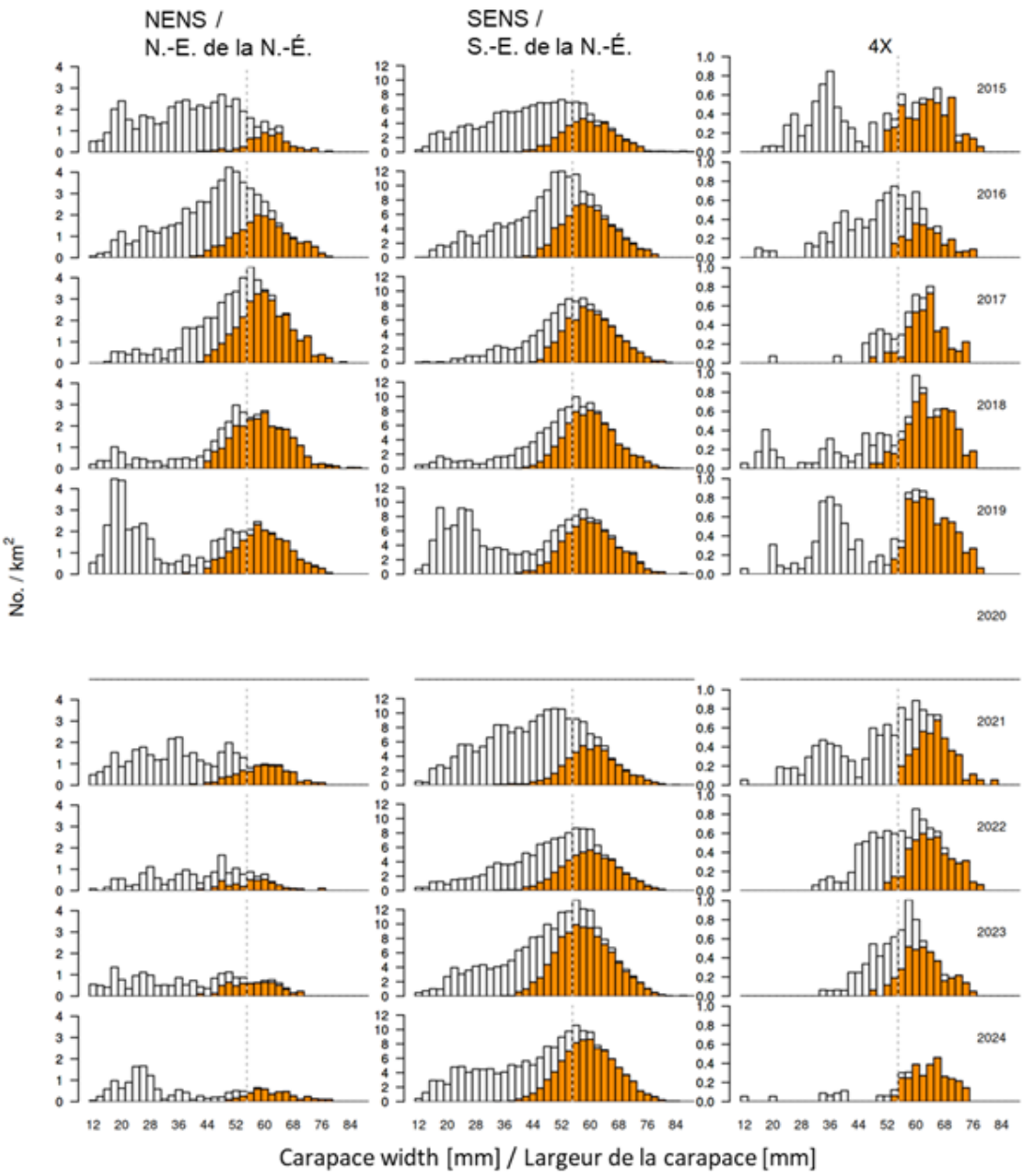

Figure 5. Size-frequency (geometric mean areal density, No./km^2) histograms of carapace width (mm) of female Snow Crab from the snow crab survey by year. Immature animals are shown with the lighter bars and mature with darker. The year 2020 is left blank as there was no survey.

Current Outlook

North-Eastern Nova Scotia

In N-ENS, recruitment continues at low levels, total mortality exceeded recruitment in 2024, and modelled biomass is at 2.7 kt placing the stock in the cautious zone.

South-Eastern Nova Scotia

In S-ENS, recruitment to the fishery continues at a sustainable rate for the upcoming season matching total mortality, and modelled biomass is at 41.5 kt placing the stock in the healthy zone.

Area 4X

In 4X, viable habitat has been minimal for many years. Recruitment has been low and is not expected to change for another three years. Total mortality is now in approximate balance with recruitment, and the modelled biomass is at 0.18 kt placing the stock in the critical zone.

Historical and Recent Landings, Effort, and Catch Per Unit Effort

Fishing effort in 2024 was 11,400, 78,600, and 100 trap hauls in N-ENS, S-ENS, and 4X, respectively. Relative to the previous year, these represent an increase of 20% in N-ENS, 26.6% in S-ENS, and a decline of 90% in 4X. (Tables 2–4). The 2024–2025 4X fishery is ongoing at the time of assessment. Fishing effort was spatially more dispersed in 2024 relative to 2023 in most areas, however, some contraction was seen in 4X.

Landings in 2024 were 934, 7,314, and 5 t in N-ENS, S-ENS, and 4X (season ongoing), respectively. Relative to the previous year, these represent decreases of 3.9% in N-ENS, 0.4% in S-ENS and 78.3% in 4X. (Tables 2–4). TACs for 2024 were 938, 7,345, and 20 t, respectively. As with effort, landings were spatially dispersed in most areas with the exception of 4X.

Non-standardized fishery catch rates in 2024 were 82, 93, and 39 kg/trap haul in N-ENS, S-ENS and 4X (season ongoing), respectively. Relative to the previous year, these represent decreases of 20.4 % in N-ENS and 21.2 % in S-ENS, and an increase of 77.3 % in 4X (season ongoing) relative to the previous year (Tables 2–4). Declines in catch rates were notable in the inshore areas of N-ENS, and in the CFA 24 portion of S-ENS.

Table 2. Fishery performance statistics in North-Eastern Nova Scotia (N-ENS). Units are: total allowable catch (TAC) and landings in tons (t), effort measured by thousands of trap hauls (th), and catch per unit effort (CPUE) in kg/th.

Year	Licenses	TAC (t)	Landings (t)	Effort (1000 th)	CPUE (kg/th)
2014	78	783	781	6.9	114
2015	78	624	619	6.2	100
2016	78	286	290	2.7	109
2017	78	825	813	8.8	93
2018	78	784	742	12.2	61
2019	78	627	629	7.5	84
2020	78	847	836	7.7	108
2021	78	890	901	8.8	102
2022	78	979	975	8.6	113
2023	78	981	972	9.5	103

Year	Licenses	TAC (t)	Landings (t)	Effort (1000 th)	CPUE (kg/th)
2024	78	938	934	11.4	82

Table 3. *Fishery performance statistics in South-Eastern Nova Scotia (S-ENS). Units are: total allowable catch (TAC) and landings in tons (t), effort measured by thousands of trap hauls (th), and catch per unit effort (CPUE) in kg/th.*

Year	Licenses	TAC (t)	Landings (t)	Effort (1000 th)	CPUE (kg/th)
2014	116	11,311	11,265	96.3	117
2015	116	11,311	11,295	103.9	109
2016	115	9,614	9,606	87.3	110
2017	115	6,730	6,718	69.9	96
2018	115	6,057	6,063	51.3	118
2019	115	6,663	6,612	61.7	107
2020	115	8,161	7,951	63.8	125
2021	115	8,161	8,332	80.8	103
2022	115	7,345	7,323	56.5	130
2023	115	7,345	7,342	62.1	118
2024	115	7,345	7,314	78.6	93

Table 4. Fishery performance statistics in 4X. Units are: total allowable catch (TAC) and landings in tons (t), effort measured by thousands of trap hauls (th), and catch per unit effort (CPUE) in kg/th. Dash (—) indicates no data. Data accessed on January 27, 2025.

Year	Licenses	TAC (t)	Landings (t)	Effort (1000 th)	CPUE (kg/th)
2014/15	9	80	82	2.5	33
2015/16	9	150	143	4.4	32
2016/17	9	80	79	2.9	27
2017/18	9	110	55	4.4	13
2018/19	9	0	0	—	—
2019/20	9	55	59	1.1	51
2020/21	9	80	76	1.6	49
2021/22	9	110	110	3.1	36
2022/23	9	125	38	2.3	17
2023/24	9	55	23	1.0	22
2024/25	9	20	5	0.1	39

Environmental and Climate Change Considerations

Being in the southern-most bounds of the distribution of Snow Crab in the northwest Atlantic, climate variability and ecosystem change are concerns. Such factors are incorporated into this assessment, but crudely at best.

Bottom temperatures have reverted to cold-historical conditions in the last two years (2023 and 2024; below 5 degrees) after many years of high and variable conditions. Viable habitat is modelled from depth, substrate, temperature, co-occurring species, etc. (Choi 2023). The index of viable habitat for Snow Crab on the SSE (mean probability of observing fishable Snow Crab in each area; Figure 6) is highest in S-ENS, even though temperatures are more stable and cooler in N-ENS. This is attributed to species composition differences. Area 4X showed a slight improvement, however, the overall trend has been downwards since 2010. As with N-ENS, previous habitat space may have been overtaken by competitors and predators in 4X (Choi et al. 2025).

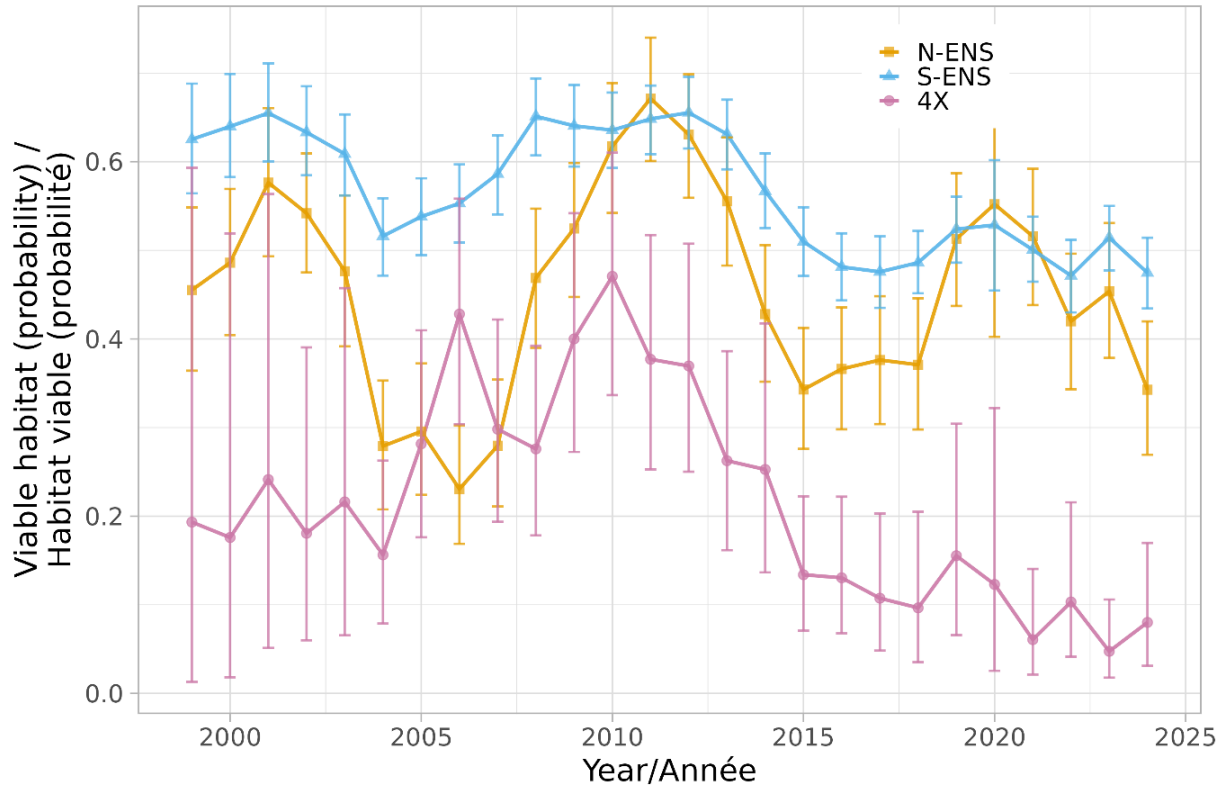

Figure 6. Habitat viability (probability of fishable Snow Crab) in North-Eastern Nova Scotia (N-ENS, yellow), South-Eastern Nova Scotia (S-ENS, blue), and 4X (pink). Means and 95% credible intervals are presented.

Harvest Control Rule Outputs

Based on the stock status of Snow Crab in each of the management areas, the harvest control rules documented in the Eastern Nova Scotia and 4X Snow Crab (*Chionoecetes opillio*) Integrated Fisheries Management Plan (DFO 2013) suggest the following exploitation strategies for the 2025 fishing year for N-ENS and S-ENS, and the 2025–26 fishing year for 4X (see also Figure 7):

- N-ENS: 0-20% of fishable biomass (pre-fishery)
- S-ENS: 10-30% of fishable biomass (pre-fishery)
- 4X: consideration of closure

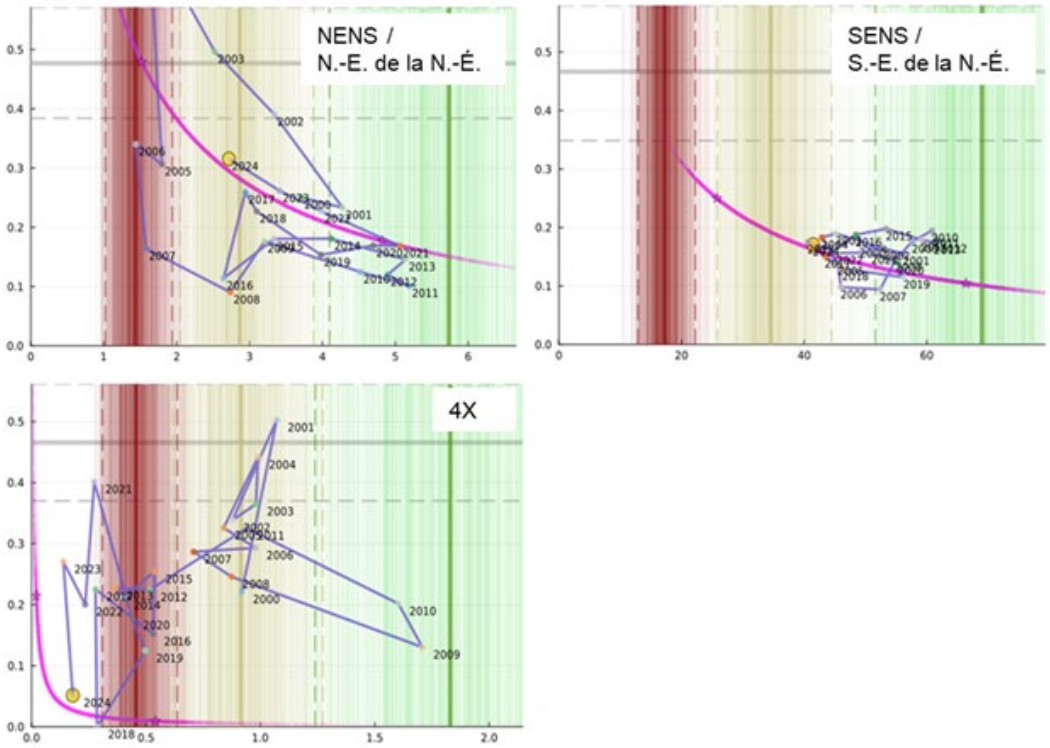

Figure 7. Fishing mortality (F) vs modelled pre-fishery biomass (kt) from 2001–2024 for North-Eastern Nova Scotia (N-ENS), South-Eastern Nova Scotia (S-ENS), and 4X. The 2024 modelled pre-fishery biomass (yellow dot) and associated 95% credible intervals (pink stars) identify current stock status. The variability associated with fishable biomass and fishing mortality estimates are shown as pink lines (with 95% credible intervals shown with stars). The grey solid horizontal line identifies the removal reference (F_{MSY}) estimated for each area and the stippled horizontal lines identify the 95% credible intervals. The red and yellow solid coloured vertical lines identify the estimates of the limit reference point (LRP) and the upper stock reference (USR), respectively. The green solid line represents the carrying capacity (K) for each region. The dashed lines delimit the 95% credible intervals for the correspondingly coloured reference lines. The lighter coloured vertical lines represent the variability associated with each parameter. For fishing area 4X, the year refers to the starting year of the fishing season; the fishery is ongoing.

BYCATCH

The 2024 bycatch estimates are detailed in (Choi et al 2025); however, due to the low level of at-sea observer coverage the individual year estimates are not reliable. Using data from fishing seasons between 2004–2024, the average bycatch estimates in N-ENS and S-ENS are 0.02% and 0.03% of landings, respectively. In CFA 4X, there is no current data (no observer coverage since 2020), but historically, bycatch has averaged 0.87% of landings (average from 2004–2020). Overall, the bycatch levels in this fishery are very low, comprised primarily of other crustaceans, Atlantic Cod (*Gadus morhua*), Halibut (*Hippoglossus hippoglossus*), and sea cucumbers.

OTHER MANAGEMENT QUESTIONS

Resource management had requested an evaluation of consequences of various harvest levels in the 2025 fishery on stock abundance and exploitation rate. In development of the objectives for the terms of reference for the peer review by the steering committee, it was explained by Science that the current modelling framework for Maritimes Region Snow Crab does not track recruitment in the stock assessment model; therefore, projections of this nature are not possible. It was agreed that advice would be provided as it typically has been with a statement of stock status against the established precautionary framework for the three management areas along with contextual statements related to the other important indicators, such as, recruitment. It was noted that an evaluation of methods to address this request may be possible to conduct in a future review of the assessment framework.

SOURCES OF UNCERTAINTY

Marine protected areas (MPAs) continue to be developed (DFO no date). The presence of a refuge from fishing activities is potentially positive for Snow Crab. However, effects upon other organisms (predators or prey) can have counter-balancing indirect effects. The overall long-term effects of MPAs upon Snow Crab are unknown.

Capture of soft-shell Snow Crab is always a concern and leads to uncertainty related to the survival of these Snow Crab when returned to the water. Prompt and careful return of immature (small-clawed, non-terminally molted) crab to the water is an important conservation measure that will enhance the 2–3 year productivity of the fishable component.

Illegal and unreported fishing activities, have the potential to hinder the application of a precautionary approach to the management of this resource and cause potential bias and uncertainty in the estimation of reference points.

Observer coverage targets (5% in N-ENS and S-ENS, 10% in 4X) have not been met since 2019, and absent since 2020 in 4X (CFA24W), This limits the ability to make useful conclusions related to bycatch, discards, soft-shell, size structure

Elevated natural mortality of immature crab in N-ENS and 4X are likely due to environmental stressors and predation.

LIST OF MEETING PARTICIPANTS

Name	Affiliation
Anderson, Bob	Crab Fishing Area 24 representative
Brickman, David	DFO Science - Maritimes Region
Cameron, Brent	DFO Science - Maritimes Region
Cassista-DaRos, Manon	DFO Science - Maritimes Region
Choi, Jae	DFO Science - Maritimes Region
Christmas, Raymond	Membertou First Nation
Clancey, Lewis	Nova Scotia Department Fisheries & Aquaculture
Courtois, Marine	Sipekne'katik First Nation
Couture, John	Oceans North
Denny, Lindros	Eskasoni First Nation
Evans, Rebecca	DFO Science - Newfoundland and Labrador Region
Ganapathiraju, Pramod	DFO Resource Management - Maritimes Region
Glass, Amy	DFO Science - Maritimes Region
Kehoe, Andrew	Crab Fishing Area 24 representative
Langille, Janet	DFO Resource Management - Maritimes Region
MacDonald, Gordon	Crab Fishing Area 23 representative
MacMullin, Neil	Northeastern Nova Scotia Crab Fishermen's Association
McIntyre, Tara	DFO Science - Maritimes Region
McManus, Conor	National Oceanic and Atmospheric Administration Fisheries
Paul, Tyson	Unama'ki Institute of Natural Resources
Pomerleau, Corinne	DFO Science - Maritimes Region
Shackell, Nancy	DFO Science - Maritimes Region
Stockhausen, William	National Oceanic and Atmospheric Administration Fisheries
Townsend, Kathryn	Maritime Aboriginal Peoples Council

SOURCES OF INFORMATION

Choi, J.S. 2023. A framework for the assessment of Snow Crab (*Chionoecetes opilio*) in Maritimes Region (NAFO Div 4VWX). DFO Can. Sci. Advis. Sec. Res. Doc. 2023/077. v + 101 p.

Choi, J.S., Cameron, B.J., and Glass, A.C. 2025. Assessment of Scotian Shelf Ecosystem Snow Crab in 2024. DFO Can. Sci. Advis. Sec. Res. Doc. 2025/036. iv + 45 p.

Choi, J.S., and Zisserson, B.M. 2012. Assessment of Scotian Shelf Snow Crab in 2010. Fisheries and Oceans Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/110.

DFO (no date). The Gully Marine Protected Area (MPA). (Accessed: February 19, 2025).

DFO (no date). St. Anns Bank Marine Protected Area (MPA). (Accessed: February 19, 2025).

DFO. 2013. Eastern Nova Scotia and 4X Snow Crab (*Chionoecetes opillio*)-Effective as of 2013. (Accessed: February 19, 2025).

DFO. 2022. Stock Status Update of Scotian Shelf Snow Crab (*Chionoecetes opilio*, O. Fabricius). DFO Can. Sci. Advis. Sec. Sci. Resp. 2022/036.

DFO. 2024. Assessment of Scotian Shelf Snow Crab from 2022. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2024/032.

Puebla, O., Sévigny, J.M., Sainte-Marie, B., Brêthes, J.C., Burmeister, A., Dawe, E.G., and M.Moriyasu. 2008. Population genetic structure of the snow crab (*Chionoecetes opilio*) at the Northwest Atlantic scale . Can. J. Fish. Aquat. Sci. 65: 425–436.

THIS REPORT IS AVAILABLE FROM THE:

Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive,
PO Box 1006 Dartmouth,
Nova Scotia
B2Y 4A2

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

ISSN 1919-5087
ISBN 978-0-660-77160-1 Cat. No. Fs70-7/2025-022E-PDF

Correct Citation for this Publication:

DFO. 2025. Maritimes Region Snow Crab Stock Assessment for 2024. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2025/022.

Aussi disponible en français :

MPO. 2025. Évaluation du stock de crabes des neiges de la région des Maritimes – 2024. Secr. can. des avis sci. du MPO. Avis sci. 2025/022.