Fisheries and Oceans Canada

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Canadian Science Advisory Secretariat
Newfoundland and Labrador Region | **Science Advisory Report 2025/030**

NEWFOUNDLAND AND LABRADOR (DIVISIONS 2HJ3KLNOP4R) SNOW CRAB (*CHIONOECETES OPILIO*) STOCK ASSESSMENT IN 2024

CONTEXT

The Fisheries Resource Management sector of Fisheries and Oceans Canada (DFO) has requested advice on stock status, trends, and harvest levels for Northwest Atlantic Fisheries Organization (NAFO) Divisions 2HJ3KLNOP4R Snow Crab (*Chionoecetes opilio*). This Science Advisory Report is from the February 17-19, 2025, regional peer review of the Stock Assessment of Snow Crab in 2HJ3KLNOP4R. 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

- With status quo removals in 2025, Assessment Divisions (ADs) 3LNO and 3Ps are projected to be in the Healthy Zone of the Newfoundland and Labrador (NL) Snow Crab Precautionary Approach (PA) Framework, while ADs 2HJ and 3K are projected to be in the Cautious Zone. Recent and ongoing data deficiencies result in the exclusion of AD 4R3Pn from the NL Snow Crab PA Framework.

Trends

- The overall exploitable biomass index has increased from historic lows in 2016 to 2018. In 2024, the exploitable biomass index remained near the same level as 2023. There have been declines in the exploitable biomass indices in ADs 3K and 3Ps over the last two years.

- Overall abundance indices of pre-recruit, small male, and mature female crab have declined and are near the lowest levels observed. The overall pre-recruit abundance index indicates poor recruitment prospects in the next 2–4 years.

- Fishery Exploitation Rate Indices (ERIs) decreased in most ADs in recent years. However, status quo removals in 2025 would result in ERIs outside the range permitted in the PA Framework in ADs 3K and 3Ps. The ERI is high in AD 4R3Pn.

Ecosystem and Climate Change Considerations

- The warm phase in ocean climate that started around 2020 continues, with warm bottom temperatures and record high sea surface temperature in 2024. Sustained warm ocean conditions are considered unfavorable for Snow Crab productivity.

- Total ecosystem biomass levels are approaching the post-collapse highs of the 2010s, with increases being driven by groundfish. Fish predation mortality on Snow Crab peaked in the mid-late 2010s and after some decline has been trending upwards since 2020. Current

levels and trends in fish predation mortality could add additional pressure on the stock and hinder future growth.

- Short-term predictions of exploitable biomass based on climate variables indicate resource growth may be limited.

Stock Advice

- As per the NL Snow Crab PA Framework and given that ADs 3LNO and 3Ps are in the Healthy Zone, the exploitation rates should not exceed 42%. As per the NL Snow Crab PA Framework and given that ADs 2HJ and 3K are in the Cautious Zone, the exploitation rates should not exceed 35%.

- While the current overall level of exploitable biomass is generally not a concern, unfavorable ecosystem conditions and low abundances of small Snow Crab indicate that stock productivity is expected to be poor in the near and medium term.

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

2024 (DFO 2025)

Assessment Type

Full Assessment

Most Recent Assessment Date

1. Last Full Assessment: 2024 (DFO 2025)

Stock Assessment Approach

1. Broad category: Index-based

2. Specific category: Index-based (including fishery-dependent and fishery-independent indices)

This assessment is detailed in Pantin et al. in prep[1]. Changes to the established methodology for the current assessment include the establishment of a model-based exploitable biomass index that integrates available trawl and trap data, as well as new model-based abundance indices for pre-recruits, small male Snow Crab, and mature females from trawl surveys. The new integrated exploitable biomass index is calculated as an annual index and does not use a two-year moving average to provide advice. Past assessments have averaged the two-year moving averages of separate trawl and trap exploitable biomass indices for incorporation in the PA Framework, while the annual integrated exploitable biomass index was used in the current assessment.

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[1] Pantin, J., Charmley, K., Mullowney, D., Baker, K., Lefort, K., Munro, H, and Koen-Alonso, M. In prep. An Assessment of Newfoundland and Labrador Snow Crab (*Chionoectes opilio*) in 2024. DFO Can. Sci. Advis. Sec. Res. Doc.

Methods for Ecosystem and Climate Change Considerations

Physical and biological oceanographic conditions were assessed based on information from the Atlantic Zone Monitoring Program (AZMP). Ocean climate conditions and trends were evaluated using physical oceanography indicators such as water temperatures and ice conditions, along with the Newfoundland and Labrador Climate Index (NLCI). Lower trophic levels were characterized using nutrients, chlorophyll, and zooplankton indicators from AZMP surveys and remote sensing information. The status and trends of the fish community, including fish diets, consumption, predation mortality, and risk of ecosystem overfishing, were evaluated using ecological indicators and modeling from the DFO-NL Ecosystem Research Program (ERP). The role of marine mammals was evaluated using data from DFO-NL Marine Mammals Section and DFO-NL ERP.

Stock Structure Assumption

Stock overview information: Pantin et al. in prep[2]

Snow Crab in NL are part of a larger genetic stock unit in Canadian Atlantic waters, ranging from southern Labrador to the Scotian Shelf (Puebla et al. 2008). However, large-scale movements of individuals within the stock are thought to be limited, therefore assessments are conducted at the AD level, where some NAFO Divisions are combined. Accordingly, ADs differ from both NAFO Divisions and the small spatial scale Crab Management Areas (CMAs) used to manage the fishery. Limit Reference Points (LRPs) have been developed for all ADs except AD 4R3Pn, where data deficiencies result in exclusion from the PA Framework.

Reference Points

The NL Snow Crab PA Framework is a multi-indicator decision making PA system consisting of three stock status metrics (predicted Catch Per Unit Effort [CPUE], predicted discards, and proportion of females with full egg clutches) that reflect species biology, industry practices in management processes, fishery management objectives, and data sources and quality (Mullowney and Baker 2023; Mullowney et al. 2018). Each AD is assessed separately within the PA Framework, however the reference points are the same for each AD.

- Limit Reference Point (LRP): predicted CPUE (pCPUE) = 5 kg/trap, predicted discards (pDIS) = 30%, and proportion of females with full egg clutches = 0.6.

- Upper Stock Reference (USR): predicted CPUE (pCPUE) = 9 kg/trap, predicted discards (pDIS) = 20%, and proportion of females with full egg clutches = 0.75.

- Removal Reference (RR): NA

- Target Reference Point (TRP): NA

Harvest Decision Rule

A weighted scoring matrix is used to determine stock status zonation for each AD from the position of each metric relative to the LRP (Table 1).

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[2] Pantin, J., Mullowney, D., Baker, K., Lefort, K., Coffey, W., Munro, H., and Koen-Alonso, M. In prep. An Assessment of Newfoundland and Labrador Snow Crab (*Chionoectes opilio*) in 2023. DFO Can. Sci. Advis. Sec. Res. Doc.

Table 1. Stock health scoring for stock status determination and allowable exploitation rate ranges within each zone.

Zone	Predicted CPUE	Predicted discards	Proportion of females with full egg clutch	Score	Exploitation Rate Index range
Healthy	4	2	1	5.5 to 7	Up to 42%
Cautious	2	1	0.5	2.5 to 5	Up to 35%
Critical	0	0	0	0 to 2	Up to 20%

Data

- DFO-NL multispecies trawl surveys Snow Crab data (1995–2024)

- DFO inshore trap survey data (7 inshore bays 1995–2024)

- DFO-FFAW Collaborative Post-season (CPS) trap survey (2003–24)

- Torngat Joint Fisheries Board (TJFB) post-season trap survey (2013–24)

- At-sea observer program (1999–2024)

- Commercial logbooks (1996–2024)

- Dockside Monitoring Program landings (1979–2024)

- DFO-NL Ecosystem Research Program Indicators (1960–2024)

- Atlantic Zone Monitoring Program Indicators (1950–2024)

- NASA Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua Ocean Color observation (2003–24).
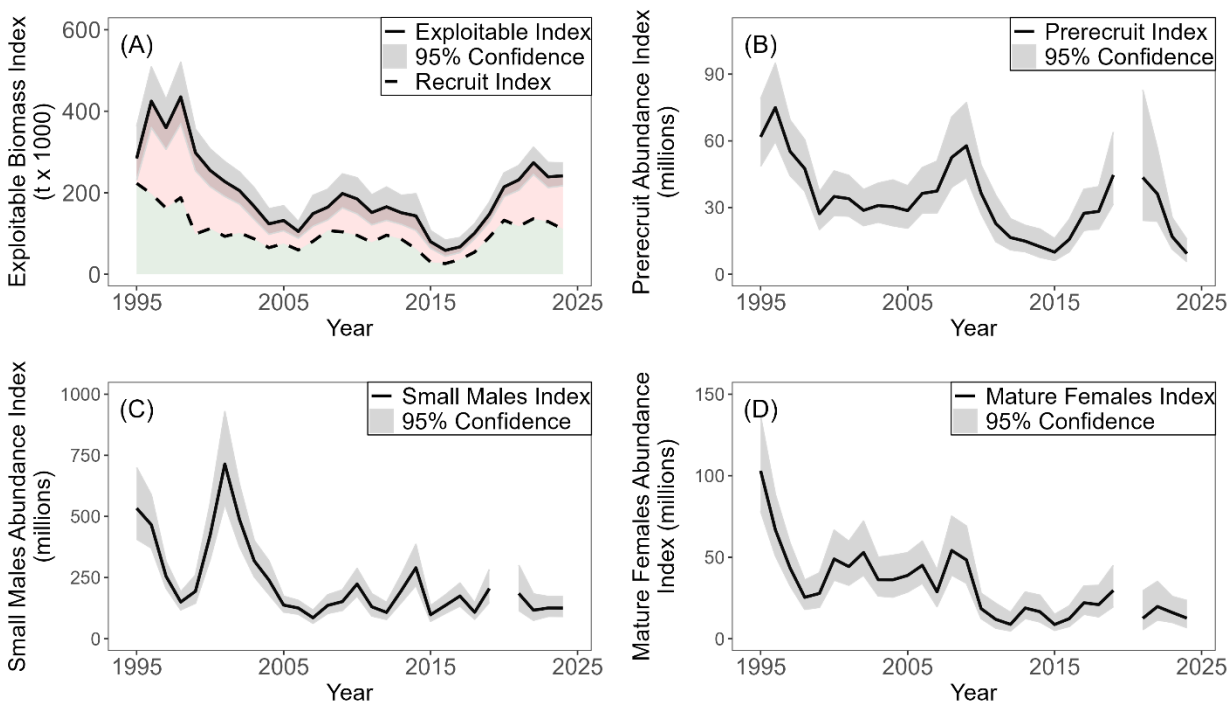
ASSESSMENT

Overall Stock 2HJ3KLNOP4R

Figure 1. (A) Integrated exploitable biomass index (solid line = total exploitable crab, dashed line = recruit crab, shaded area = 95% confidence interval of total estimate), (B) Trawl-based pre-recruitment abundance index (line = annual estimate, shaded area = 95% confidence interval), (C) Trawl-based small males abundance index (line = annual estimate, shaded area = 95% confidence interval), (D) Trawl-based mature females abundance index (line = annual estimate, shaded area = 95% confidence interval). Trawl-based indices (B-D) do not include AD 4R3Pn, due to a lack of trawl surveys in this AD. Due to very poor coverage the 3Ps trawl survey in 2006, trawl-based indices in 2006 do not include this AD.
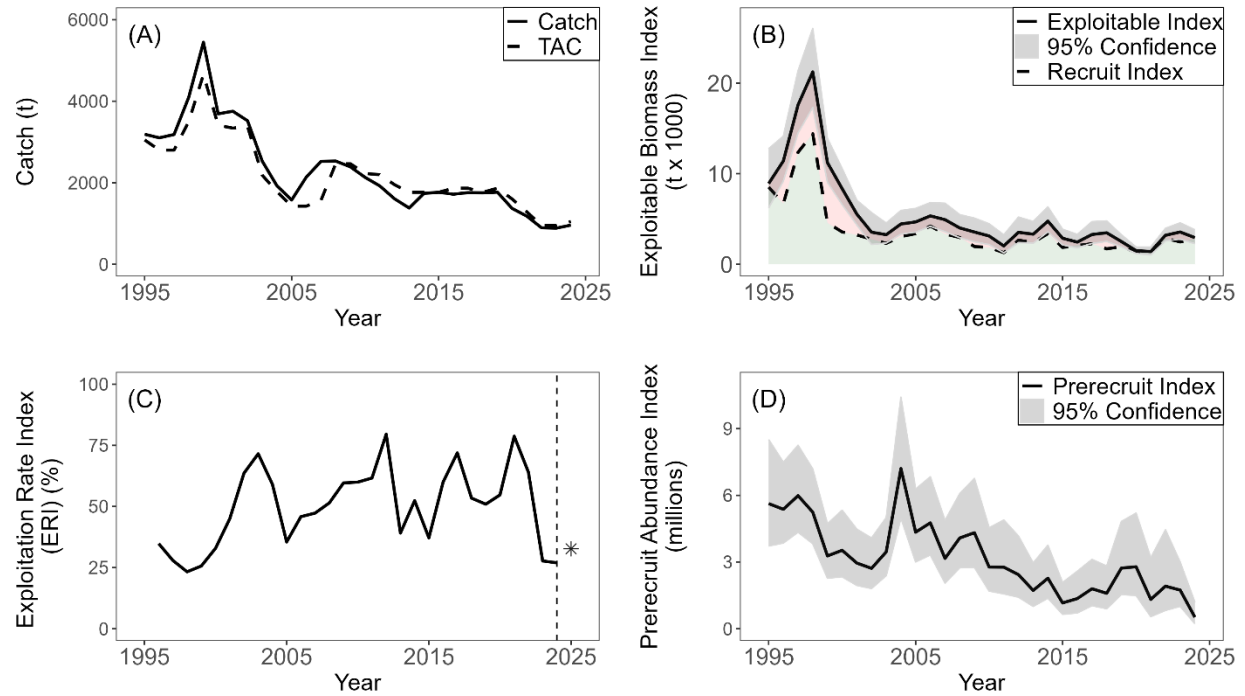
Assessment Division 2HJ

Figure 2. (A) Reported annual landings (solid) and Total Allowable Catch (TAC) (dashed), (B) Integrated exploitable biomass index (solid line = total exploitable crab, dashed line = recruit crab, grey shaded area = 95% confidence interval of total estimate), (C) Exploitation Rate Index (ERI) (line = annual estimate, asterisk = projected ERI with status quo landings in 2025), (D) Trawl-based pre-recruitment abundance index (line = annual estimate, shaded area = 95% confidence interval).
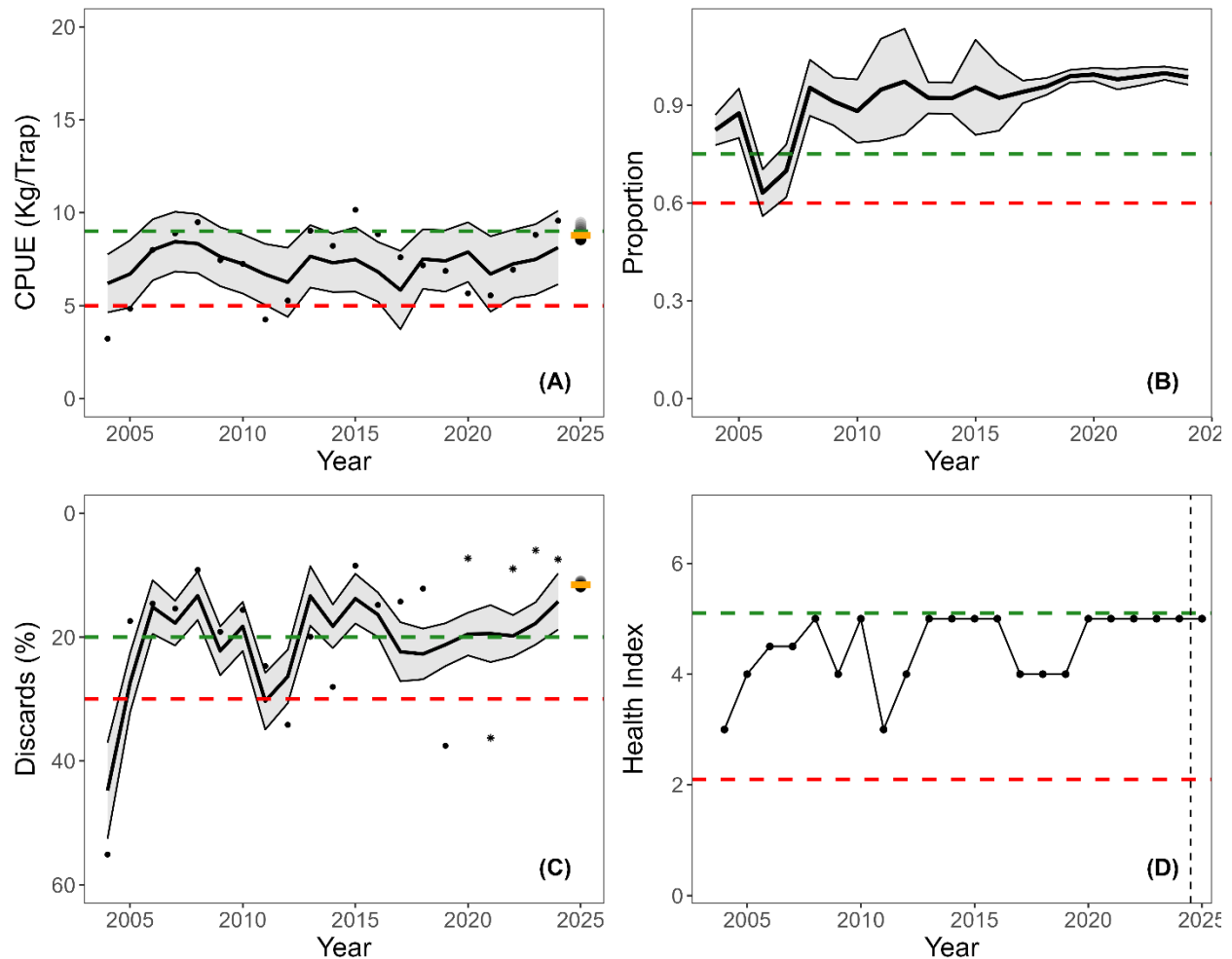
Figure 3. NL Snow Crab PA Framework. Red horizontal line represents the LRP and the green horizontal line represents the USR. (A) Predicted CPUE (solid line = the prediction, points = the annual observed standardized fishery CPUE, shaded area = the prediction interval, 2025 point = predicted value under status quo landings in 2025 with ERI ranging from 5–42% around the point), (B) Proportion of females with full egg clutch (solid line = observed proportion, shaded area = 1 standard deviation), (C) Predicted discards (solid line = the prediction, points = the annual observed standardized fishery CPUE, shaded area = the prediction interval, 2025 point = predicted value under status quo landings in 2025 with ERI ranging from 5–42% around the point), (D) Projected stock status (dashed vertical line = 2024).

Historical and Recent Stock Trajectory and Trends

Fishery

Landings remained near 1,700 t from 2014 to 2019 but have since declined due to TAC reductions. Landings were 959 t in 2024. Standardized CPUE increased to near 10 kg/trap in 2024.

Biomass

The exploitable biomass index has oscillated at a low level for the last decade and remained at a low level in 2024.

Fishing Mortality

The ERI has decreased since 2022 and remained around the same level in 2024 as 2023. Under status quo landings in 2025 the ERI is projected to increase to 33%.

Recruitment and Pre-recruitment

The exploitable biomass is dominated by new-shelled recruits. There has been a decline in the trawl-based pre-recruit crab abundance index over the last two decades, with a time-series low in 2024. This suggests poor recruitment prospects over the next 2–4 years.

Biological Indicators

There has been a downward trend in size-at-terminal molt in males and mature female abundance is low.

Current Status

With status quo landings in 2025, AD 2HJ is projected to remain in the Cautious Zone.
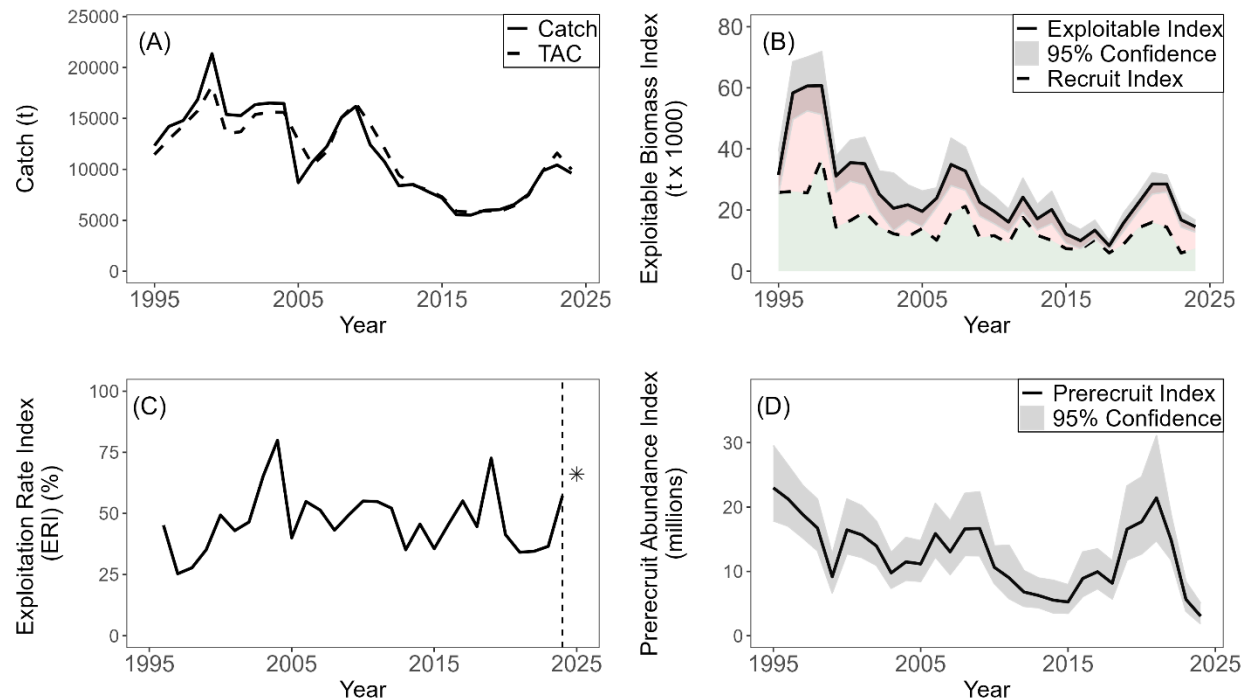
Assessment Division 3K

Figure 4. (A) Reported annual landings (solid) and Total Allowable Catch (TAC) (dashed), (B) Integrated exploitable biomass index (solid line = total exploitable crab, dashed line = recruit crab, grey shaded area = 95% confidence interval of total estimate), (C) Exploitation Rate Index (ERI) (line = annual estimate, asterisk = projected ERI with status quo landings in 2025), (D) Trawl-based pre-recruitment abundance index (line = annual estimate, shaded area = 95% confidence interval).
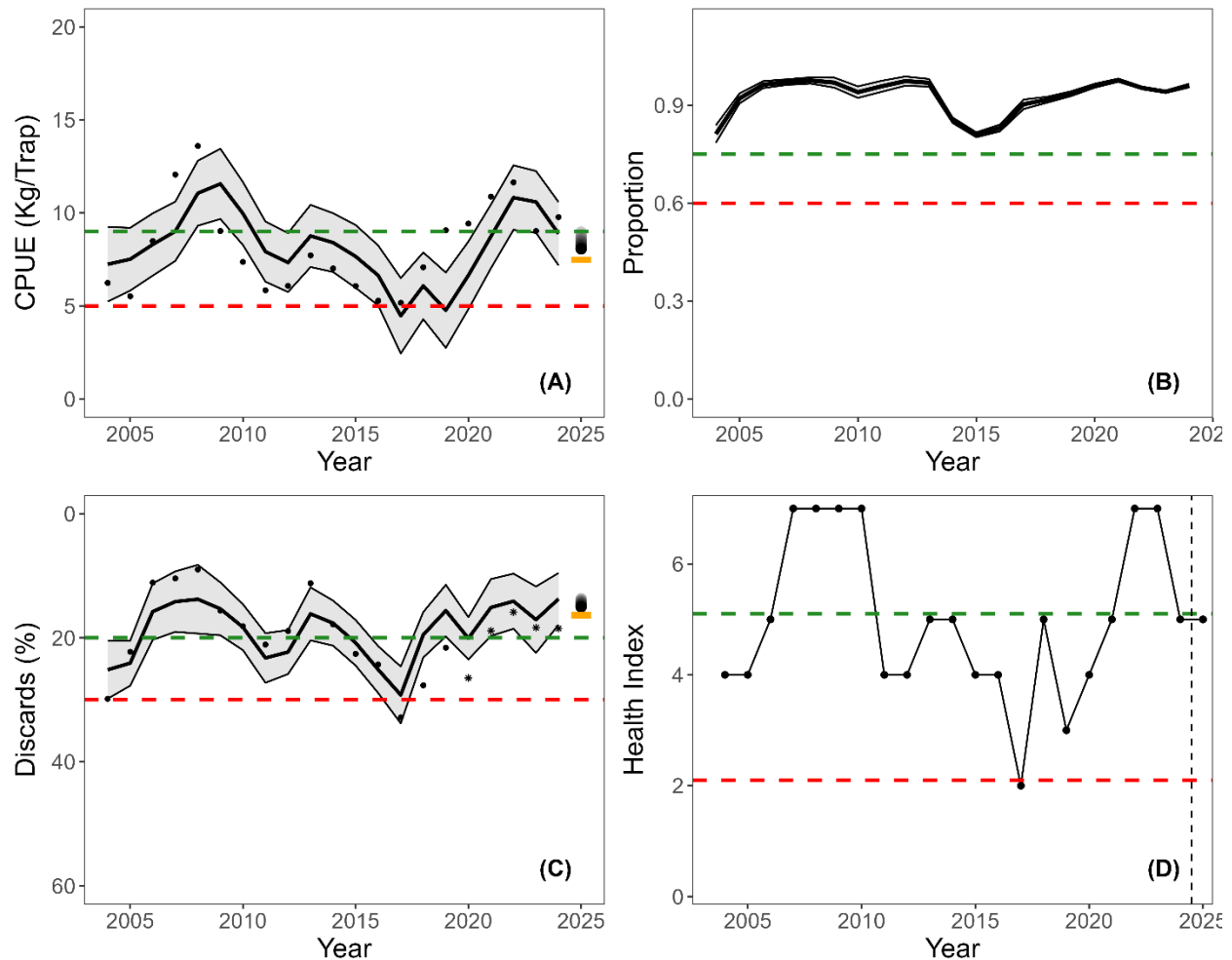
Figure 5. NL Snow Crab PA Framework. Red horizontal line represents the LRP and the green horizontal line represents the USR. (A) Predicted CPUE (solid line = the prediction, points = the annual observed standardized fishery CPUE, shaded area = the prediction interval, 2025 point = predicted value under status quo landings in 2025 with ERI ranging from 5–42% around the point), (B) Proportion of females with full egg clutch (solid line = observed proportion, shaded area = 1 standard deviation), (C) Predicted discards (solid line = the prediction, points = the annual observed standardized fishery CPUE, shaded area = the prediction interval, 2025 point = predicted value under status quo landings in 2025 with ERI ranging from 5–42% around the point), (D) Projected stock status (dashed vertical line = 2024).

Historical and Recent Stock Trajectory and Trends

Fishery

Landings increased from a time-series low of around 5,500 t in 2017 to a decadal high of 10,432 t in 2023. Landings were 9,619 t in 2024. Standardized CPUE decreased from a recent peak in 2022 but remains high for the time series nearing 10 kg/trap in 2024.

Biomass

The exploitable biomass index increased from a time-series low in 2015–18 to peak in 2021 and 2022, and has decreased by almost half in the last two years.

Fishing Mortality

The ERI has decreased since 2019, however it increased to high levels in 2024. Under status quo landings in 2025 the ERI is projected to increase to 66%, which is above the allowable level in the NL Snow Crab PA Framework.

Recruitment and Pre-recruitment

The exploitable biomass consists of a fairly even mix of both new-shelled recruits and old-shelled residual crab. The trawl-based pre-recruit abundance index recently peaked in 2021 and has since declined to a time-series low in 2024. This suggests diminishing recruitment prospects over the next 2–4 years.

Biological Indicators

There are signals of an emergent downward trend in size-at-terminal molt in males and mature female abundance is low.

Current Status

With status quo landings in 2025, AD 3K is projected to be in the Cautious Zone.
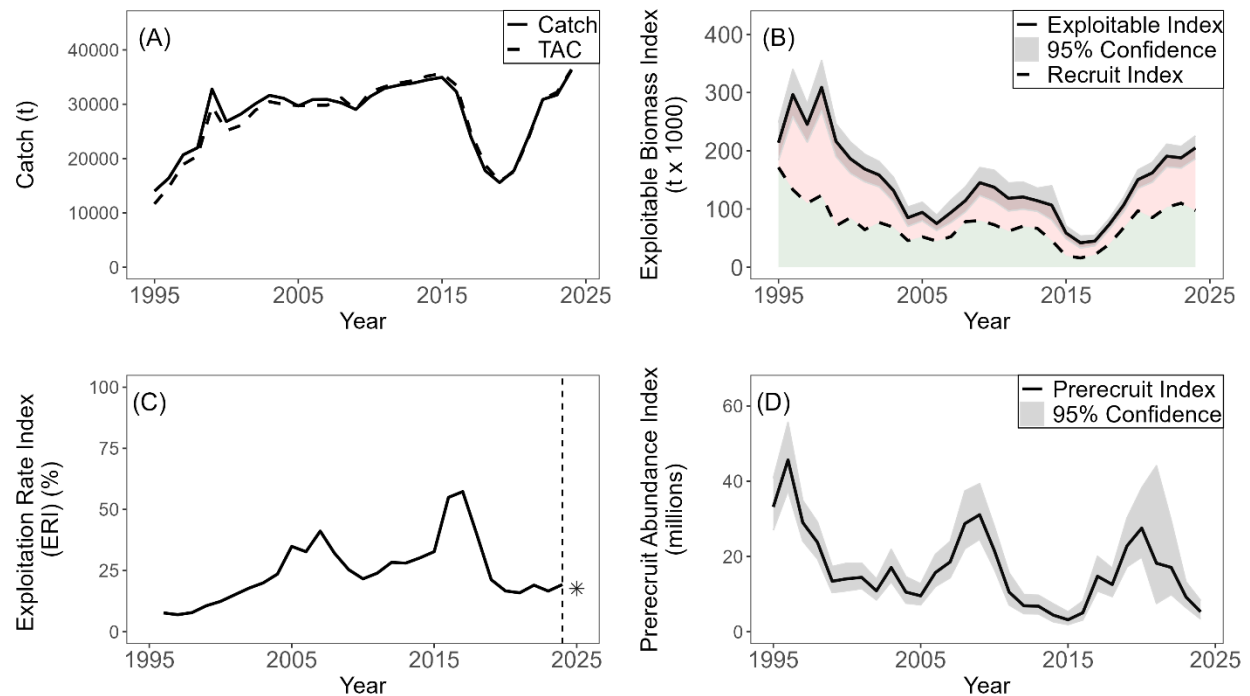
Assessment Division 3LNO

Figure 6. (A) Reported annual landings (solid) and Total Allowable Catch (TAC) (dashed), (B) Integrated exploitable biomass index (solid line = total exploitable crab, dashed line = recruit crab, grey shaded area = 95% confidence interval of total estimate), (C) Exploitation Rate Index (ERI) (line = annual estimate, asterisk = projected ERI with status quo landings in 2025), (D) Trawl-based pre-recruitment abundance index (line = annual estimate, shaded area = 95% confidence interval).
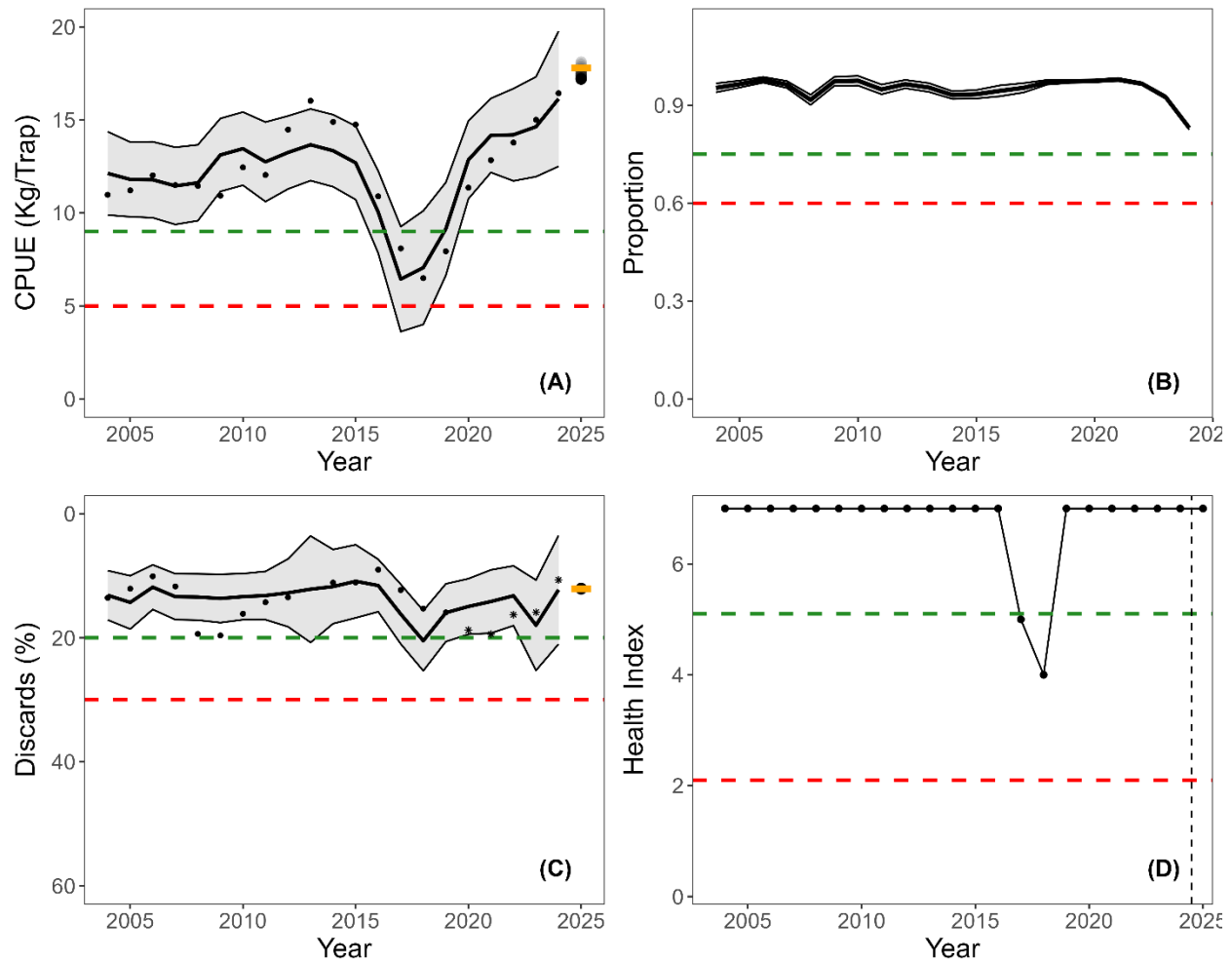
Figure 7. NL Snow Crab PA Framework. Red horizontal line represents the LRP and the green horizontal line represents the USR. (A) Predicted CPUE (solid line = the prediction, points = the annual observed standardized fishery CPUE, shaded area = the prediction interval, 2025 point = predicted value under status quo landings in 2025 with ERI ranging from 5–42% around the point), (B) Proportion of females with full egg clutch (solid line = observed proportion, shaded area = 1 standard deviation), (C) Predicted discards (solid line = the prediction, points = the annual observed standardized fishery CPUE, shaded area = the prediction interval, 2025 point = predicted value under status quo landings in 2025 with ERI ranging from 5–42% around the point), (D) Projected stock status (dashed vertical line = 2024).Historical and Recent Stock Trajectory and Trends

Historical and Recent Stock Trajectory and Trends

Fishery

Landings were at the lowest level in two decades in 2019 (around 15,600 t) but have since increased to 36,266 t in 2024. Standardized CPUE continued to increase from the time-series low in 2018 to nearing a time-series high of 16 kg/trap in 2024.

Biomass

The exploitable biomass index has increased from a time-series low in 2016–17 and has been at some of the highest levels observed in the time series.

Fishing Mortality

The ERI has remained below 20% since 2019 and under status quo landings in 2025 is projected to be 18%.

Recruitment and Pre-recruitment

The exploitable biomass consists of an even mix of both new-shelled recruits and old-shelled residual crab. The trawl-based pre-recruit abundance index recently peaked in 2020 and has since declined to near the time-series low in 2024. This suggests diminishing recruitment prospects over the next 2–4 years.

Biological Indicators

Size-at-terminal molt in males remains high. Mature female abundance is low.

Current Status

With status quo landings in 2025, AD 3LNO is projected to remain in the Healthy Zone.
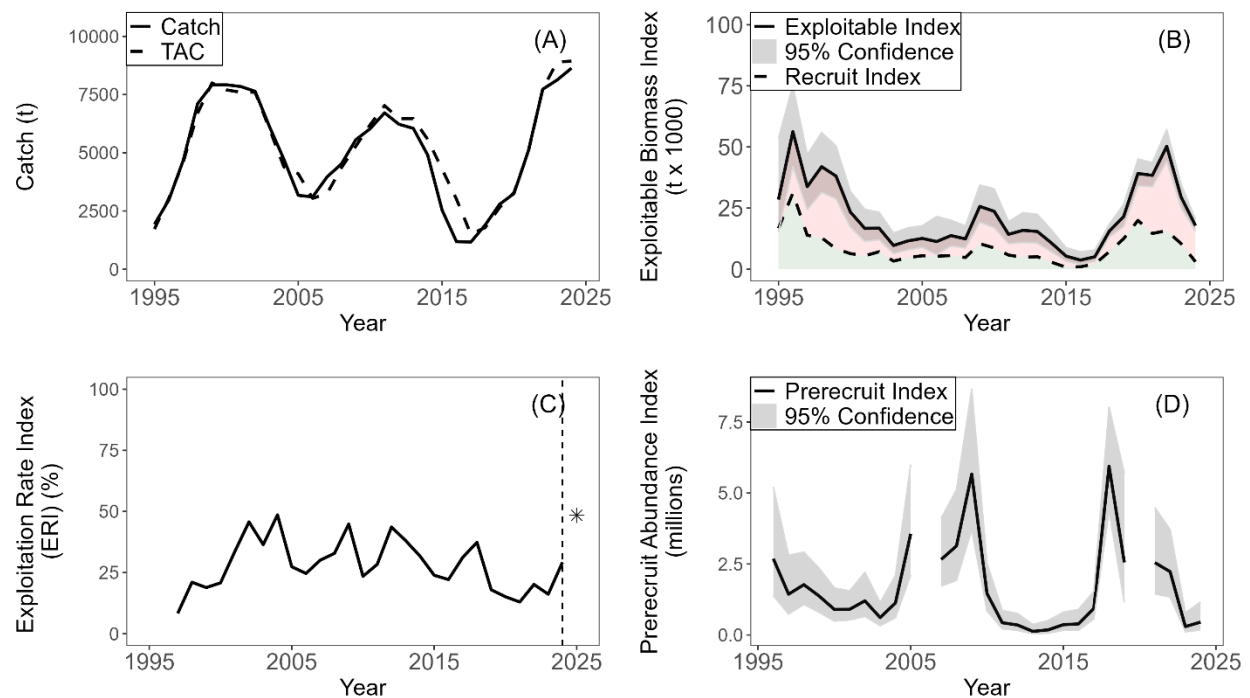
Assessment Division 3Ps

Figure 8. (A) Reported annual landings (solid) and Total Allowable Catch (TAC) (dashed), (B) Integrated exploitable biomass index (solid line = total exploitable crab, dashed line = recruit crab, grey shaded area = 95% confidence interval of total estimate), (C) Exploitation Rate Index (ERI) (line = annual estimate, asterisk = projected ERI with status quo landings in 2025), (D) Trawl-based pre-recruitment abundance index (line = annual estimate, shaded area = 95% confidence interval).
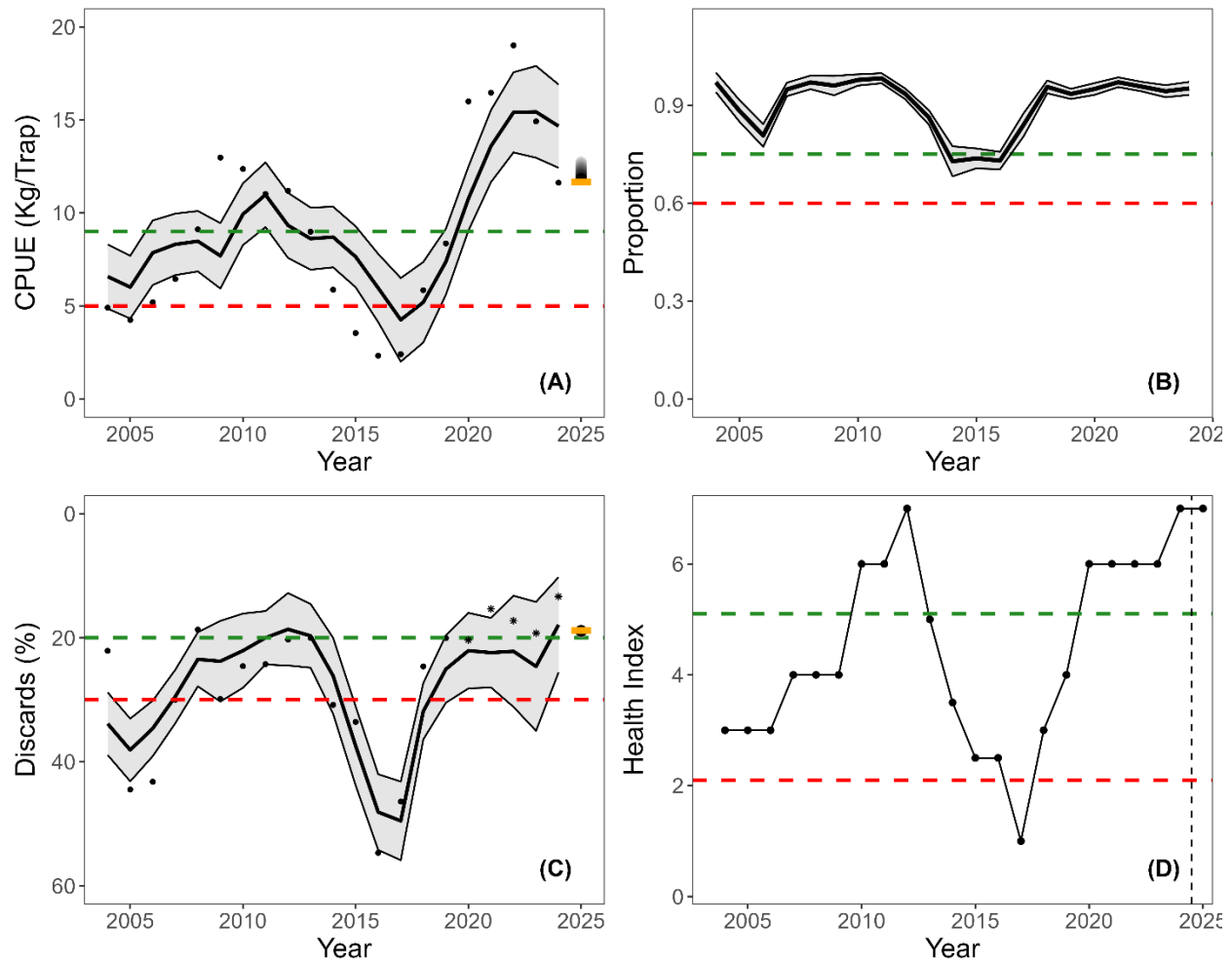
Figure 9. NL Snow Crab PA Framework. Red horizontal line represents the LRP and the green horizontal line represents the USR. (A) Predicted CPUE (solid line = the prediction, points = the annual observed standardized fishery CPUE, shaded area = the prediction interval, 2025 point = predicted value under status quo landings in 2025 with ERI ranging from 5–42% around the point), (B) Proportion of females with full egg clutch (solid line = observed proportion, shaded area = 1 standard deviation), (C) Predicted discards (solid line = the prediction, points = the annual observed standardized fishery CPUE, shaded area = the prediction interval, 2025 point = predicted value under status quo landings in 2025 with ERI ranging from 5–42% around the point), (D) Projected stock status (dashed vertical line = 2024).

Historical and Recent Stock Trajectory and Trends

Fishery

Landings continued to increase from a time-series low of around 1,200 t in 2017 to 8,633 t in 2024. Standardized CPUE was at a time-series high of 19 kg/trap in 2022 but decreased to near 12 kg/trap in 2024.

Biomass

The exploitable biomass index increased from a time-series low in 2015–17 to near a time-series high in 2022. This index has decreased by 65% over the last two years.

Fishing Mortality

The ERI had remained below 25% since 2018, but increased in 2024. Under status quo landings in 2025 the ERI is projected to increase to 48% which is above the allowable level in the NL Snow Crab PA Framework.

Recruitment

The exploitable biomass has consisted of an even mix of both new-shelled recruits and old-shelled residuals throughout most of the time series. However, the exploitable biomass was dominated by residual crab in 2024. The trawl-based pre-recruit abundance index peaked in 2018 and has since declined to near a time-series low in 2024. This suggests diminishing recruitment prospects over the next 2–4 years.

Biological Indicators

Size-at-terminal molt in males remains high. Mature female abundance is low.

Current Status

With status quo landings in 2025, AD 3Ps is projected to remain in the Healthy Zone.
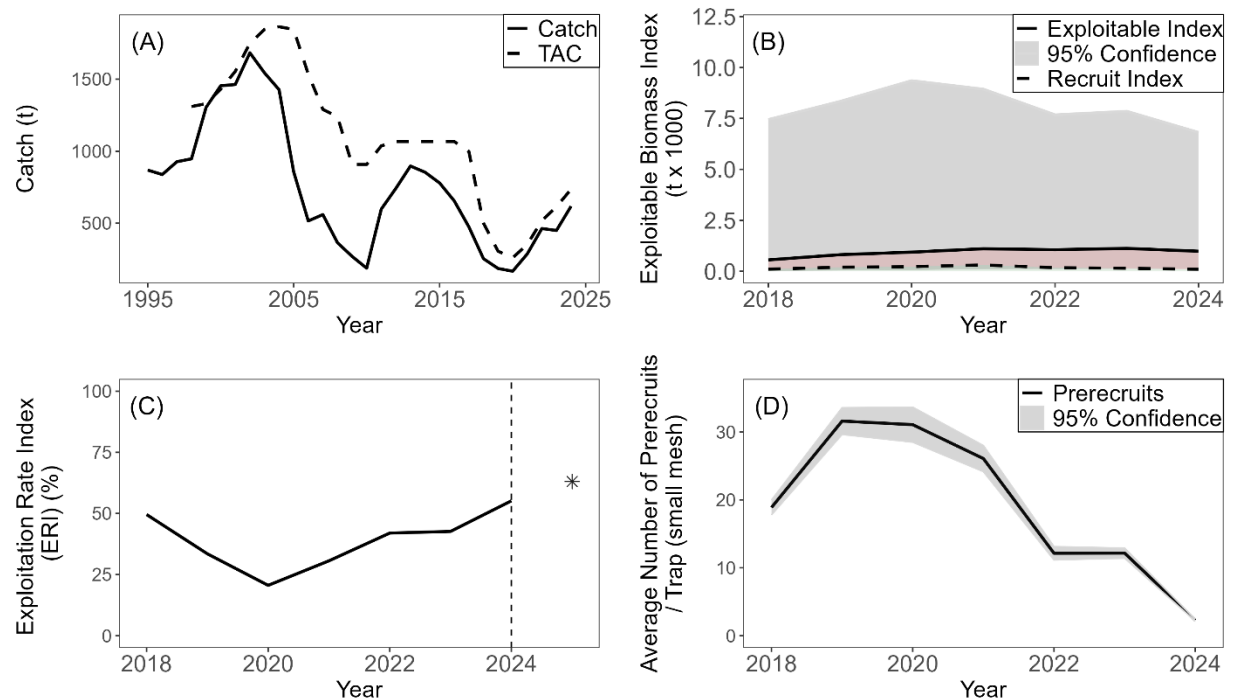
Assessment Division 4R3Pn

Figure 10. (A) Reported annual landings (solid) and Total Allowable Catch (TAC) (dashed), (B) Integrated exploitable biomass index (solid line = total exploitable crab, dashed line = recruit crab, grey shaded area = 95% confidence interval of total estimate), (C) Exploitation Rate Index (ERI) (line = annual estimate, asterisk = projected ERI with status quo landings in 2025), (D) Average number of pre-recruit crab per small-mesh trap in the CPS trap survey (shaded area = 95% confidence interval).

Historical and Recent Stock Trajectory and Trends

Fishery

Landings have increased from a time-series low of around 160 t in 2020 to 618 t in 2024. Standardized CPUE was at a time-series high of 11 kg/trap in 2024.

Biomass

Precision of estimation of the exploitable biomass index is low. The exploitable biomass index remains at a low level in this AD.

Fishing Mortality

Precision of estimation of the ERI is low. The ERI has been at a high level and with status quo removals in 2025 the ERI is projected to increase further.

Recruitment

The exploitable biomass has been dominated by new-shelled recruits throughout most of the time series. However, the exploitable biomass was dominated by residual crab in the last three years. Catch rates of pre-recruit crab in the CPS trap survey indicate a decline in pre-recruit crab in recent years. This suggests poor recruitment prospects over the next 2–4 years.

Current Status

Recent and ongoing data deficiencies result in the exclusion of AD 4R3Pn from the NL Snow Crab PA Framework.

History of Catch and TAC

Table 2. Total Allowable Catch (TAC) and landings for the NL Snow Crab stock from 2015–24.

Year	Total Allowable Catch (TAC) (tonnes)	Landings (tonnes)
2015	50,071	47,214
2016	45,317	41,420
2017	34,950	32,927
2018	28,830	27,663
2019	26,494	26,373
2020	29,156	29,114
2021	37,790	38,066
2022	49,990	49,806
2023	54,279	51,619
2024	57,119	56,095

Projections

Projections or simulations have not been developed for this assessment as it is index-based.

Ecosystem and Climate Change Considerations

The ocean climate in the NL bioregion has shown decadal-scale cold and warm phases. The warm phase that started around 2020 continues, with record high sea surface temperature in 2024. Recent phytoplankton blooms have been early, which favors recruitment of the copepod

Calanus finmarchicus, a key food item for fish. Total zooplankton biomass has been improving since the lows in the early mid-2010s.

Newfoundland and Labrador ecosystems collapsed in the late 1980s and early 1990s associated with extreme cold ocean conditions and ecosystem overfishing. Declines in biomass of groundfish were not compensated by increases in shellfish, with total biomass remaining below pre-collapse levels. Some rebuilding was observed between the mid-2000s and early 2010s, after which declines occurred.

While these ecosystems continue experiencing overall low productivity conditions, likely related to bottom-up processes (e.g., food limitation), improvements in total biomass have been observed since 2020 after the lows in the mid-2010s. These increases are driven by groundfish and not shellfish. Total Snow Crab biomass showed some improvements across ecosystems in the late 2010s and early 2020s, but this pulse appears to be declining.

Fish predation mortality on Snow Crab peaked in the mid-late 2010s and after some decline has been trending upwards since 2020. Values remain generally on the high end of the observations in 2J3K and 3LNO, but on the lower end in 3Ps.

A warm ocean climate does not favor Snow Crab productivity. Environmental conditions and fishing appear to be the dominant drivers of Snow Crab, but current levels and increasing trends in fish predation mortality could add additional pressure on the stock, potentially hindering future growth. At present throughout the stock area, abundances of pre-recruit, small male, and mature female crab are near the lowest levels observed.

SOURCES OF UNCERTAINTY

Snow Crab movements across divisional boundaries affect survey indices, resulting in uncertainties in distributions and the extent to which modes of growth progression can be followed from one year to the next.

The absence of a trawl survey input into the NL Snow Crab assessment in AD 4R3Pn creates a high level of uncertainty in the exploitable biomass index in this AD.

There are concerns regarding the utility of at-sea observer (ASO) data from sampling during the fishery due to low and inconsistent spatiotemporal coverage. There is concern that current coverage introduces bias in interpreting trends in catch rates at broad spatial scales and introduces high uncertainty. Measures should be taken to ensure representative ASO coverage to improve data quality from this program.

Research Recommendations

- Explore availability of Div. 4R trawl data to the model used to derive the exploitable biomass index. More broadly, explore the ability to include additional sources of data and covariates in this model.

- Investigate minimal requirements of ASO coverage for evaluating key metrics, such as discards.

LIST OF MEETING PARTICIPANTS

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Aussi disponible en français :

*MPO. 2025. Évaluation du stock de crabe des neiges (*Chionoecetes opilio*) à Terre-Neuve-et-Labrador (divisions 2HJ3KLNOP4R) en 2024. Secr. can. des avis sci. du MPO. Avis sci. 2025/030.*