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Newfoundland and Labrador Region

Canadian Science Advisory Secretariat
Science Advisory Report 2026/030

NAFO DIVISIONS 2J3KL NORTHERN COD (*GADUS MORHUA*) STOCK ASSESSMENT TO 2026

CONTEXT

The Fisheries Management Branch of Fisheries and Oceans Canada (DFO) has requested that the Northwest Atlantic Fisheries Organization (NAFO) Divisions (Div.) 2J3KL Atlantic Cod stock (Integrated Fisheries Management Plan; IFMP) be assessed relative to reference points that are consistent with the DFO Precautionary Approach (DFO 2009), and that harvest advice be provided for this stock.

This Fisheries Science Advisory Report is from the regional peer review meeting of March 24–27, 2026, on the Stock Assessment of Northern Cod in 2J3KL. 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

- The 2026 Spawning Stock Biomass (SSB) is 2.3 (95% Confidence Interval [CI] = 1.4–3.7) times the Limit Reference Point (LRP). The stock is in the Healthy Zone, with a 70% probability of being above the Upper Stock Reference Point (USR).
- The retrospective instability observed in the assessment model in recent years was resolved by excluding the tagging data since 2020.

Trends

- The SSB increased in 2025 after a period of stability from 2016 to 2024. The SSB at the start of 2026 is estimated at 542 Kt (95% CI = 423–696 Kt).
- Estimated numbers of recruits (age 0) has changed little since 2015, corresponding to about 80% of pre-collapse (1954–90) levels.
- Natural mortality (M, ages 5+) has varied between 0.22 and 0.88 since 1995 (mean = 0.47). Estimates have declined since 2020, and M was 0.26 (95% CI = 0.13–0.49) in 2025.
- Fishing mortality (F, ages 5+) has been below 0.05 since 2004 and in 2025 was 0.04 (95% CI = 0.03–0.06).

Ecosystem and Climate Change Considerations

- Ocean climate controls ecosystem-level productivity in the Newfoundland and Labrador (NL) bioregion. The ongoing warm phase that started around 2020, along with recent improvements in zooplankton biomass levels, is favourable for groundfish productivity. The long-term impacts of increasing warming due to climate change remain unknown.

- Ecosystem biomass measured by the research vessel (RV) survey shows increases from the lows in the mid-late 2010s and is currently at or near post-collapse highs, but remains below pre-collapse levels. These increases are being driven by groundfish.
- Northern cod productivity is linked to Capelin availability and ocean climate. Capelin collapsed in 1991 and has yet to recover to its pre-collapse levels. Capelin was at near post-collapse highs in 2024–25, with a positive outlook for 2026. This suggests improved productivity conditions for Northern cod.

Stock Advice

- Three-year projections were completed for catch scenarios of zero to two times total authorized removals for 2025 of 42,867 t.
- The probability of the stock being in the Critical Zone at the start of 2029 increases from 1% with no removals to 8% with removals of 85,734 t, while the probability of being in the Healthy Zone declines from 79% to 53%.
- The probability of stock decline to 2029 increases from 21% with no removals, to 53% with removals of 85,734 t.

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

2023 (DFO 2024)

Assessment Type

Full Assessment

Most Recent Assessment Date

1. Last Full Assessment: 2025 (DFO 2025)
2. Last Interim-Year Update: 2020 (DFO 2021)

Stock Assessment Approach

1. Broad category: Ecosystem-informed stock assessment model
2. Specific category: State-space age-structured assessment model with Capelin-informed mortality rates

The assessment model estimates stock size back to 1954, a stock-recruit relationship, and age- and time-varying rates of fishing mortality (F) and natural mortality (M). The model also accounts for bias introduced by partial reporting of total removals from all sources. Data for Capelin, a key prey species, are used to improve predictions of M and aid forecasts of cod productivity. The model is used to assess the impact of proposed fisheries catches under recent levels of Capelin availability.

Ecosystem and Climate Change Assessment Approach

The physical environment was characterized by examining trends in ocean climate using oceanographic indicators and the Newfoundland and Labrador Climate Index (NLCI). Food web components examined included: lower trophic levels characterized using primary production

and zooplankton indicators; status and trends of the fish community, as well as Capelin; seabird, and marine mammal information. The characterization of ecological and environmental interactions included fish diets and estimations of food consumption. Habitat elements included a summary on Significant Benthic Areas and existing fisheries closures. Aggregated fisheries metrics considered included fishing footprint and the risk of ecosystem overfishing. Explored pathways for climate change impacts included the link between ocean climate and ecosystem productivity.

Stock Structure Assumption

Northern cod is considered to occupy NAFO Div. 2+3KL (Templeman 1962); however, cod in NAFO Div. 2GH are managed separately from the 2J3KL stock complex since 1996 (DFO 1996). Core areas of productivity and discrete components of the Northern cod stock complex are not well defined in 2J3KL. While there is mixing of cod in adjacent areas, levels of mixing are assumed to be negligible within the assessment. Cod in NAFO Div. 2J3KL are managed collectively with one LRP and USR.

Reference Points

- Limit Reference Point (LRP): 40% SSB at maximum sustainable yield (40% B_{MSY}; DFO 2024)
- Upper Stock Reference (USR): 80% SSB at maximum sustainable yield (80% B_{MSY})
- Removal Reference (RR): N/A; not defined
- Target Reference Point (TRP): N/A; not defined

The LRP and USR were defined in accordance with Precautionary Approach (PA) guidelines (DFO 2009). A RR and TRP have yet to be defined for this stock.

Data

- DFO-NL multispecies RV trawl surveys (1983–2003, 2005–20, 2023–25)
- Inshore sentinel survey (1995–2025)
- Acoustic estimates of cod biomass in Smith Sound (1995, 1997–2004, 2006–09)
- Inshore juvenile indices from the Fleming (1959–64, 1992–97, 2001, 2020–21, 2024) and Newman Sound surveys (1996, 1998–2025)
- Fishery landings and catch age composition (1954–2025)
- Telemetry (2007–24)* and Tagging (1954–2019) information
- DFO-NL Capelin spring acoustic survey and forecast (1985–92, 1996, 1999–2005, 2007–15, 2017–19, 2022–26)
- DFO-NL Ecosystem Research Program Indicators (1960–2025)*
- Atlantic Zone Monitoring Program Indicators (1950–2025)*
- Ocean Colour—ESA Climate Change Initiative (1998–2025)*

* data used contextually, but not directly in the assessment model.

Data changes: Contrary to expectations, tag returns have not increased despite higher recent removals. As a result, tagging data imply lower F than suggested by reported removals and survey indices. This conflict contributes to retrospective revisions as new data are added to the assessment model. As an interim measure, tag data from 2020 onwards were excluded from the model to improve the stability of stock size estimates; the cause of the reduced returns requires further investigation.

ASSESSMENT

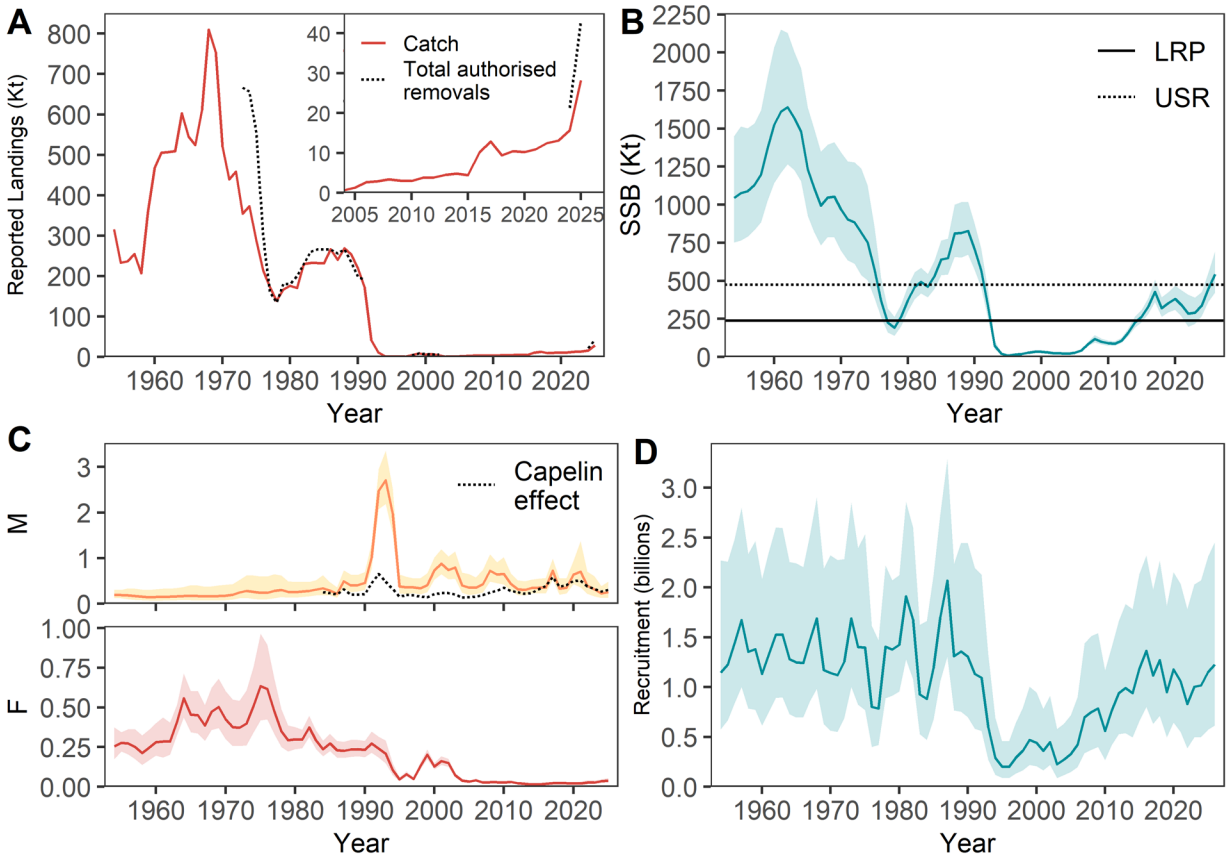

Figure 1. A) Annual reported landings (calendar year; solid red line) and total authorized removals (management year; dashed black line), with inset showing since 2004. B) Estimates of SSB (solid teal line = median estimate; shaded area = 95% CI) relative to the LRP (horizontal solid line) and USR (horizontal dashed line). C) Average Natural mortality (M; solid line; Top) including the effect of Capelin availability (dotted line), and Fishing mortality (F; Bottom) estimates for ages 5+ with 95% CIs (shaded areas). D) Estimated recruitment (median estimate of age-0 abundance [solid teal line], with 95% CI [shaded area]).

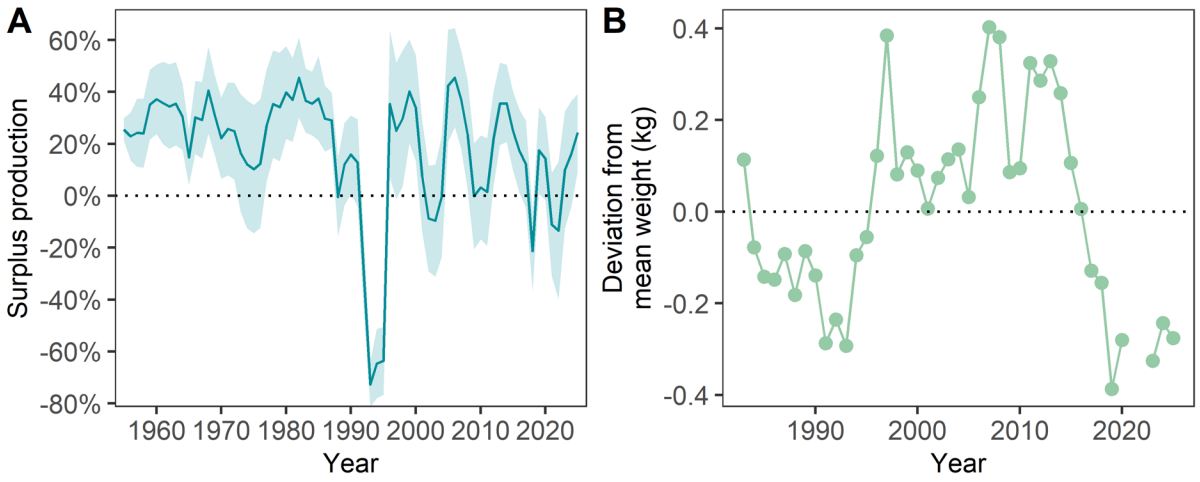

Figure 2. A) Model-estimated annual surplus production—a measure of population growth rate (shaded area = 95% CI). B) Average deviation from mean weight-at-age for ages 3–7 from the fall multispecies RV trawl survey.

Stock Status and Trends

Table 1. Northern cod SSB, recruitment, and mortality rate estimates over the last five years. Lower and upper 95% confidence intervals indicated in parentheses. Dashes (-) indicate estimate is not yet possible for this year.

Year	SSB (Kt)	SSB / LRP	Recruits (age 0; billions)	Average M (ages 5+)	Average F (ages 5+)
2022	284 (198, 410)	1.20 (0.66, 2.17)	0.83 (0.39, 1.78)	0.39 (0.22, 0.71)	0.03 (0.02, 0.04)
2023	291 (217, 389)	1.22 (0.71, 2.11)	1.00 (0.50, 2.03)	0.31 (0.16, 0.61)	0.03 (0.02, 0.04)
2024	338 (268, 426)	1.42 (0.86, 2.35)	1.02 (0.50, 2.07)	0.22 (0.13, 0.39)	0.03 (0.03, 0.05)
2025	449 (363, 554)	1.89 (1.17, 3.06)	1.15 (0.57, 2.31)	0.26 (0.13, 0.49)	0.04 (0.03, 0.06)
2026	542 (423, 696)	2.28 (1.41, 3.71)	1.23 (0.61, 2.45)	-	-

Spawning Stock Biomass

Estimates of SSB increased from the mid-1950s to the early 1960s, after which the stock declined through to the late 1970s. Following a recovery of the stock through the 1980s, SSB rapidly declined in the early 1990s to a time-series low in 1995. The SSB remained low through the 1990s, but subsequently increased, especially from 2010–16. The SSB increased in 2025 after a period of stability from 2016 to 2024. The SSB at the start of 2026 is estimated at 542 Kt (95% CI = 423–696 Kt) (Table 1; Figure 1B).

Recruitment

Recruitment (numbers at age 0) declined to its lowest observed level around 1995, then increased from the mid-2000s to 2015, and has changed little since. The average number of recruits since 2015 correspond to about 80% of the average numbers of recruits observed prior to 1990 (Figure 1D).

Natural Mortality

Population-weighted average M (ages 5+) increased rapidly in the early 1990s from levels below 0.4 to a peak of 2.5 around 1992–94. Average M declined in 1995 and has since varied between 0.22 and 0.88 (mean = 0.47). Estimates have declined since 2020 and M was below

average in 2025 (0.26 [95% CI = 0.13–0.49]). Periods of elevated M correspond to declines in the relative abundance of Capelin, with the effect of Capelin accounting for the majority of the estimated M since 2010 (Figure 1C).

Fishing Mortality

Population-weighted average F (ages 5+) exceeded M through most of the 1950s to the 1980s; however, M has exceeded F since the collapse. Average F declined when the moratorium was imposed in 1992 and again when an inshore fishery was closed in 2003. While directed inshore fisheries for cod have continued through the moratorium, and the commercial fishery reopened in 2024, average F has remained below 0.05 since 2004. In 2025 average F is estimated at 0.04 (95% CI = 0.03–0.06; Figure 1C).

Surplus Production

Prior to the collapse, surplus production – the surplus biomass generated by the stock (through growth and recruitment) beyond what is necessary to keep the overall stock biomass constant – remained positive. Following a large decline in surplus production between 1991–95, associated with the collapse of this stock, variability has increased and several periods of positive surplus production have contributed to stock growth. Surplus production has varied without trend at or near zero between 2017–24 (Figure 2A), reflecting limited productivity and suggesting that conditions had not been favourable for further stock growth; however, surplus production in 2025 is positive.

Biological Indicators

Mean lengths and weights at age, body condition in spring, and age of maturation all declined during the collapse. Following improvements since 2020, body condition is currently near seasonal averages (1977–2025). However, mean lengths and weights-at-age (Figure 2B) have declined across all divisions since 2015, especially for ages 3+. Since cod are smaller at age recently, a higher number of fish are removed from the system by any given removal weight.

Current Status

The 2026 SSB is 2.3 (95% CI = 1.4–3.7) times the LRP. The stock is in the Healthy Zone, with a 70% probability of being above the USR.

History of Landings & TAC

Table 2. Reported catch, including bycatch, of Northern cod by NAFO Div. and calendar year (t). Provisional catches for terminal year.

Division	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2J	216	313	281	444	1,129	1,314	1,836	2,481	2,960	5,437
3K	5,273	6,335	4,436	4,819	3,767	4,387	5,527	5,611	6,297	13,370
3L	4,618	6,232	4,744	5,241	5,364	5,276	5,112	4,990	6,448	9,438
Total	10,107	12,881	9,462	10,503	10,260	10,977	12,475	13,083	15,705	28,245

Northern cod once supported one of the largest fisheries in the world, with catches peaking at 810 Kt in 1968 (Figure 1A). The fishery declined through the 1970s, briefly recovered in the 1980s, and collapsed in the 1990s. A moratorium was established in 1992, during which limited inshore fisheries continued to operate in most years. The moratorium was lifted in 2024 following a stock status change out of the Critical Zone, based on a revised assessment framework and LRP. The commercial fishery reopened in 2024 with total authorized removals of

21,317 t for the 2024–25 management season, which runs from July 1 to June 30. Total authorized removals for this stock include cod removals from all sources, including commercial catch (directed and bycatch by Canadian fleets and NAFO Contracting Parties), the NL recreational groundfish fishery, Sentinel fishery, and Food, Social and Ceremonial fisheries. Total authorized removals for 2025–26 were 42,867 t.

Reported catch, including bycatch, of Northern cod is shown in Table 2 by calendar year. Northern cod is also the primary species targeted in the recreational groundfish fishery in NL. There is no direct measure of landings from the recreational fishery and these removals are not included in reported catch above. Recreational catch of Northern cod was estimated based on mark-recapture tag returns, averaging 1,921 t from 2006–19. Estimates are not provided for 2020 onwards due to unexpected changes in tag reporting.

Ecosystem and Climate Change Considerations

The ocean climate in the NL bioregion shows multi-year to decadal scale cold and warm phases, and controls ecosystem-level productivity. The warm phase that started around 2020 continued in 2025. Recent phytoplankton blooms have been early, which favours recruitment of the copepod *Calanus finmarchicus*, a key food item for many fish. Total zooplankton biomass has been improving since the lows in the early-mid 2010s. These conditions are generally favourable for groundfish production, but long-term impacts of increasing warming due to climate change remain unknown.

Newfoundland and Labrador marine ecosystems collapsed in the late 1980s and early 1990s associated with extreme cold ocean conditions and ecosystem overfishing. Declines in the biomass of groundfish and Capelin were not offset by increases in shellfish at the time. While these ecosystems continue to experience overall lower productivity compared to the pre-collapse period, likely related to bottom-up processes (e.g., food limitation), improvements have been observed since the collapse. Ecosystem biomass measured by the RV survey increased between the 1990s and mid-2000s, and early 2010s, after which declines occurred in the early 2010s. Positive trends have been observed since the lows in the mid-late 2010s, reaching post-collapse highs in 2024–25. These recent increases have been driven by groundfish.

Northern cod productivity and dynamics are linked to Capelin availability and ocean climate. Consumption of cod by fish predators (including cannibalism) appears comparable to pre-collapse levels despite lower groundfish biomass in the ecosystem, suggesting that prey availability still remains comparatively lower. Capelin collapsed in 1991 and has yet to recover to its pre-collapse levels. Capelin was at near post-collapse highs in 2024–25, with a positive outlook for 2026. These improvements have been reflected in the diets of cod and other fish predators, and suggest improved prospects for prey availability and cod productivity.

Projections

Projections assume terminal year selectivity, average mean weight and proportion mature at age over 2023–25 and average levels of Capelin (DFO 2026) over 2024–26. The stock was projected to 2029 under catch scenarios from 0 (no removals), 0.5, 1 (status quo = 42,867 t), 1.5, and 2 times authorized removals for 2025.

Across these removal scenarios, probabilities of being in the Critical, Cautious, and Healthy Zones by 2029 are 1–8%, 20–40%, and 53–79%, respectively. Under status quo removals, SSB relative to the LRP is projected to be 2.48 (95% CI = 0.98–6.25) by 2029 (Figure 3). All catch projections examined show a >75% probability of remaining above the LRP and a >50%

probability of remaining above the USR to 2029. The probability of stock decline to 2029 increases from low (21%) with no removals, to moderately high (53%) with removals of 85,734 t (Table 3).

Table 3. Probability (prob.) of SSB declining from 2026 levels and SSB being in the Critical, Cautious, and Healthy Zones at various catch multipliers over a 3 year projection period.

Catch multiplier	Catch (t)	Prob. decline 2027	Prob. decline 2028	Prob. decline 2029	Prob. Critical 2027	Prob. Critical 2028	Prob. Critical 2029	Prob. Cautious 2027	Prob. Cautious 2028	Prob. Cautious 2029	Prob. Healthy 2027	Prob. Healthy 2028	Prob. Healthy 2029
0	0	11%	17%	21%	0%	0%	1%	21%	19%	20%	79%	81%	79%
0.5	21,434	18%	24%	28%	0%	0%	2%	25%	24%	25%	75%	76%	74%
1	42,867	26%	32%	36%	0%	1%	3%	30%	29%	30%	70%	70%	68%
1.5	64,301	36%	41%	44%	0%	2%	5%	34%	35%	35%	66%	63%	60%
2	85,734	46%	51%	53%	0%	3%	8%	39%	41%	40%	61%	56%	53%

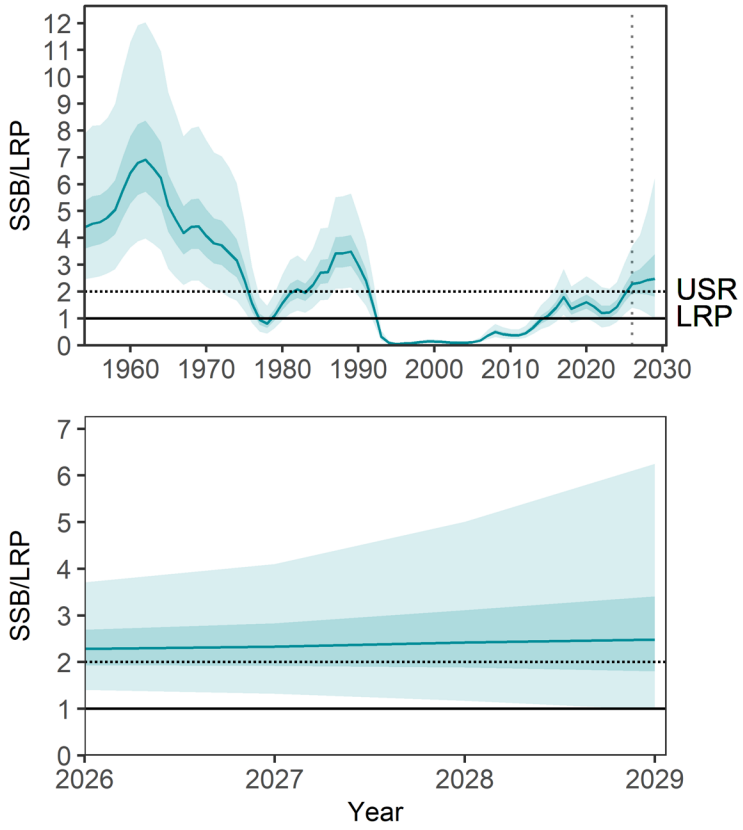

Figure 3. Projected relative SSB (SSB/LRP) assuming status quo levels of Capelin and catch, where LRP (horizontal solid line) and USR (horizontal dashed line) are defined as 40% and 80% of B_{MSY}, respectively. Solid teal line is the model estimate and the light and dark shaded regions are 95% and 50% CIs, respectively. The dotted vertical line in the top panel indicates the beginning of the projection period, which is the focal period of the lower panel.

SOURCES OF UNCERTAINTY

Natural mortality plays an important role in model projections for this stock and the drivers contributing to large changes in M are not fully understood. The inclusion of Capelin in the

model addresses one of the major drivers of M for cod. However, Capelin dynamics are difficult to predict, and projections do not directly account for this uncertainty.

Estimates of B_{MSY} are highly sensitive to changes in M, the stock-recruitment relationship, weights-at-age, maturity-at-age, and fishery selectivity. Systematic changes in some of these metrics have contributed to downward revisions of B_{MSY} and, consequently, the LRP and USR. As a result, perception of stock status has tended to improve with each assessment more than is supported by changes in absolute biomass alone.

Tagging, survey, and catch data imply divergent recent population dynamics, contributing to retrospective revisions in stock size. Potential explanations include changes in the tagging program (e.g., shifting reporting rates, limited coverage in the northern portion of the stock where abundance appears to be increasing) or changes in survey catchability (e.g., overwintering in un-surveyed inshore areas, expansion in NAFO Div. 2H). While the removal of tagging data after 2020 from the assessment model resolved these retrospective patterns, the cause of the reduced tag returns requires further investigation, as do potential changes in survey catchability and how these factors may interact.

The 2025 RV survey was incomplete. While the survey area used for Northern cod was mostly covered, reduced set density and gaps in 3K increase uncertainty in estimated indices which is not accounted for in the assessment model.

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THIS REPORT IS AVAILABLE FROM THE:

Centre for Science Advice (CSA)
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ISSN 1919-5087
ISBN 978-0-662-36986-8 Cat. No. Fs70-6/2026-030E-PDF

Correct citation for this publication:

DFO. 2026. NAFO Divisions 2J3KL Northern Cod (*Gadus morhua*) Stock Assessment to 2026. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2026/030.

Aussi disponible en français :

*MPO. 2026. Évaluation du stock de morue du Nord (*Gadus morhua*) dans les divisions 2J3KL de l'OPANO jusqu'en 2026. Secr. can. des avis sci. du MPO. Avis sci. 2026/030.*