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Gulf Region

Canadian Science Advisory Secretariat
Science Advisory Report 2026/028

SOUTHERN GULF OF ST. LAWRENCE (NAFO DIVISION 4TVN) SPRING SPAWNING ATLANTIC HERRING (*CLUPEA HARENGUS*) STOCK ASSESSMENT TO 2025

CONTEXT

The Fisheries and Harbour Management sector of Fisheries and Oceans (DFO) has requested a stock status for the southern Gulf of St. Lawrence (sGSL) (Northwest Atlantic Fisheries Organization (NAFO) 4TVn) Atlantic Herring (*Clupea harengus*) spring spawning component. This stock is prescribed under section 6 of the *Fisheries Act*. The last scientific assessment for this stock was completed in March 2024 to provide advice for the 2024 and 2025 fisheries (DFO 2024). This stock follows a two-year assessment and management cycle.

This Fisheries Science Advisory Report is from the regional peer review meeting of March 18-19, 2026, on the Southern Gulf of St. Lawrence, NAFO Division 4TVn, Atlantic Herring (*Clupea harengus*) Stock Assessment to 2025. 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 Spawning Stock Biomass (SSB) of southern Gulf of St. Lawrence (sGSL) (NAFO division 4TVn) spring spawning Atlantic Herring has been in the Critical Zone of the Precautionary Approach (PA) Framework since 1999.
- As of 2024 and 2025, SSB of spring spawning Atlantic Herring remains in the Critical Zone (> 99.9% probability).

Trends

- Since 1999, the estimated SSB of spring spawning Atlantic Herring has remained consistently low, with little to no sign of increasing biomass.
- Recruitment of spring spawning Atlantic Herring has remained relatively stable at low levels since 1994.
- Starting in 2008, natural mortality estimates for older ages of spring spawning Atlantic Herring sharply increased, then fluctuated around a relatively high average value.
- Fishing mortality (F) was high in the early 2000s before decreasing rapidly to low values starting in 2018. Since the closure of the commercial fishery in 2022, F is almost null.

Ecosystem and Climate Change Considerations

- Recruitment of spring spawning Atlantic Herring is low and not expected to improve; this is associated with long-term environmental trends including water temperature increases and changes in prey dynamics.
- Higher water temperature, poor food availability and high predator abundance likely have negative implications for spring spawning Atlantic Herring size-at-age, fecundity and overall abundance.

Stock Advice

- Under current conditions of high natural mortality, declines in weight-at-age, and low recruitment, the probabilities that SSB of spring spawning Atlantic Herring will have a 5% increase by 2027 ranges from 56.4% at a catch of 0 tonnes (t) to 46.5% at a catch 500 t.
- Even in the absence of fishery removals, it is highly likely (~ 98% probability) that the stock of spring spawning Atlantic Herring will remain in the Critical Zone by 2031.

Other Management Questions

- Since 1990, fishing mortality of spring spawning Atlantic Herring exceeded the provisional harvest decision rule of the Precautionary Approach Framework. Since the closure of the commercial and bait fisheries in 2022, low levels of bycatch in fall fisheries and scientific surveys are the main sources of reported catch.
- Total bait removals and discards-at-sea of spring spawning Atlantic Herring are not explicitly included in this assessment.

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

2026 (Maynard et al. In prep.[1])

Assessment Type

Full Assessment

Most Recent Assessment Date

1. Last Full Assessment: 2024 (DFO 2024; Maynard et al. 2024)
2. Last Interim-Year Update: N/A

Stock Assessment Approach

1. Broad category: Single stock assessment model
2. Specific category: State-Space

[1] Maynard, L.D., Turcotte, F., Burbank, J., and DeJong, R. In preparation. Assessment of the NAFO Division 4TVn Southern Gulf of St. Lawrence Atlantic Spring Spawning Atlantic Herring (*Clupea harengus*) in 2024-2025. DFO Can. Sci. Advis. Sec. Res. Doc.

Ecosystem and Climate Changes Assessment Approach

Use of scientific literature on forage fish predation to provide context in changes in natural mortality of Atlantic Herring in the sGSL over the time-series.

Ecosystem variables are implicitly accounted for in the advice by allowing process errors on natural morality, selectivity, and recruitment.

Stock Structure Assumption

The sGSL spring spawning component of Atlantic Herring (hereafter; spring Herring) is genetically distinct from the fall spawning component (Lamichhaney et al. 2017). Spawning of spring Herring occurs primarily in April-May but extends to June 30 at depths < 10 m. The current spatial distribution of data collected and a lack of sufficient scientific evidence preclude the use of regionally disaggregated models for sGSL spring Herring. Therefore, the model and all advice of catch options are presented at the scale of the entire sGSL (NAFO Division 4TVn)

Reference Points

- Limit Reference Point (LRP): The LRP is 40%$BMSY_{proxy}$, i.e., 40% of the average SSB over a productive period (1981-1984) (Turcotte and McDermid 2024). This LRP estimate is 60,368 t.
- Upper Stock Reference (USR): The candidate USR is 80%$BMSY_{proxy}$, i.e. 80% of the average SSB over a productive period (1981-1984) (Turcotte and McDermid 2024). This candidate USR estimate is 120,737 t.
- Removal Reference (RR): The candidate removal reference is a proxy for F_{MSY} which was defined as the average F in years 1988 to 1992, estimated at 0.14 (Turcotte and McDermid 2024).
- Target Reference Point (TRP): The TRP is $BMSY_{proxy}$, i.e., the average SSB over a productive period (1981-1984) (Turcotte and McDermid 2024). This TRP estimate is 150,921 t.

Data

- Commercial landings extracted from dockside monitoring reports, purchase slips and ZIFF (Zonal Interchange File Format) files to inform catch-at-age and abundance (1978 – 2025)
- Telephone Survey to inform fishing effort calculation of Catch Per Unit Effort (CPUE) (1986 – 2021)
- Dockside Monitoring Program to inform fishing effort calculation of CPUE (1986 – 2021)
- Experimental Net Program to inform catch-at-age (2022 – 2025)
- Scientific Fishery Program to inform abundance (2022 – 2025)
- DFO Port Sampling of commercial and scientific fishery to inform catch-at-age (1978 – 2025)
- Fishery-Independent Acoustic Survey to inform catch-at-age and abundance (1994 – 2025)
- Multispecies Bottom Trawl Research Vessel Survey to inform to abundance (1994 – 2025)

Data changes: Since the closure of the 4T spring Herring fishery in 2022, there were no commercial landings during the spring season and therefore no data is available to calculate the CPUE index for 2022–2025. A small-scale scientific commercial net program was set up in spring 2022 and is being explored as an alternative to address this lack of data (see Maynard et al. In prep.[2] for example). The catches from this program and the experimental nets were sampled by DFO port samplers to continue to inform the catch-at-age.

Catches from the multispecies bottom trawl research vessel survey of spring spawning Atlantic Herring is used to develop a biomass index from 1994 to 2025, which is a new addition to the model relative to the last assessment.

Historically, the sGSL spring Herring assessment model used a knife-edge maturity where all herring were assumed to be immature at age 3 and mature at age 4 across all years. This was not data driven, therefore a maturity-at-age model for sGSL spring Herring was developed to provide data driven maturity ogives. The proportion of mature fish at each age for each year predicted by the maturity-at-age models are now used in stock assessment models to help better inform spawning stock biomass.

[2] Maynard, L.D., Landry, L., and Burbank, J. In preparation. NAFO Division 4TVn Fall Spawning Atlantic Herring Assessment Framework Review: Catch Per Unit Effort Index. DFO Can. Sci. Advis. Sec. Res. Doc.

ASSESSMENT

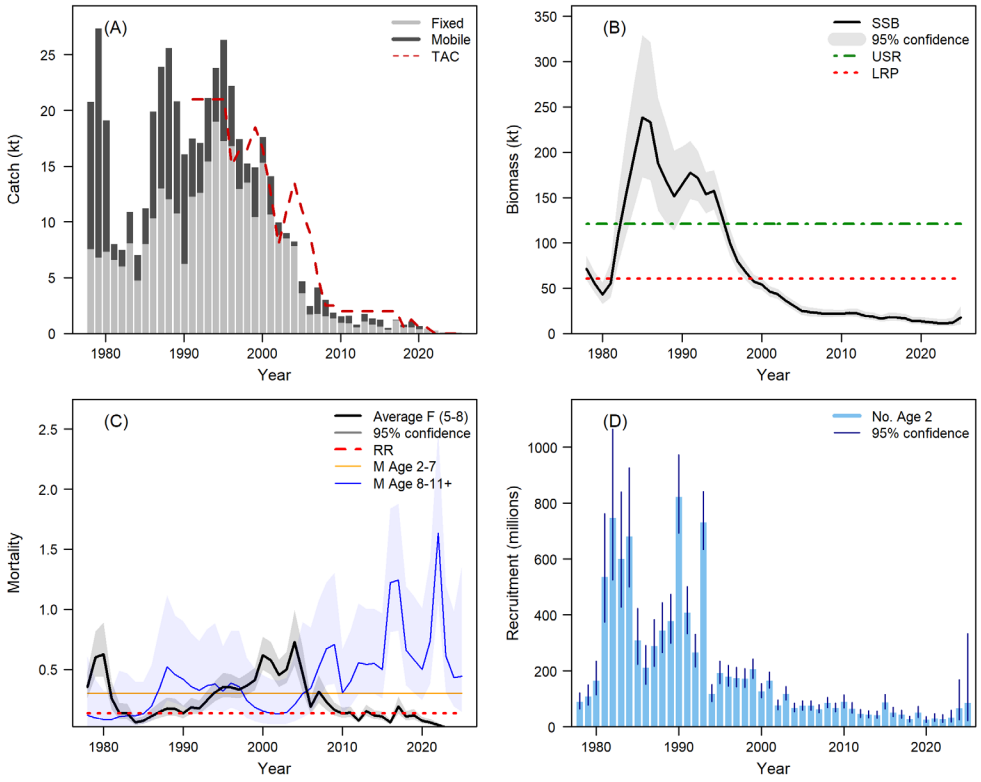

Figure 1. The southern Gulf of St. Lawrence Atlantic Herring spring spawner (A) Catch in kilotonnes by gear (kt; Fixed and Mobile) and Total Allowable Catch (kt; TAC; red), (B) Spawning Stock Biomass (SSB; kt) in relation to the Limit Reference Point (LRP; red) and candidate Upper Stock Reference point (USR; green), (C) Average Fishing Mortality for ages 5-8 (Average F; black) in relation to the provisional Removal Reference (RR, red dashed) and Natural Mortality (M) for ages 2-7 years (yellow) and ages 8-11+ years old (blue), (D) Recruitment (No. Age 2).

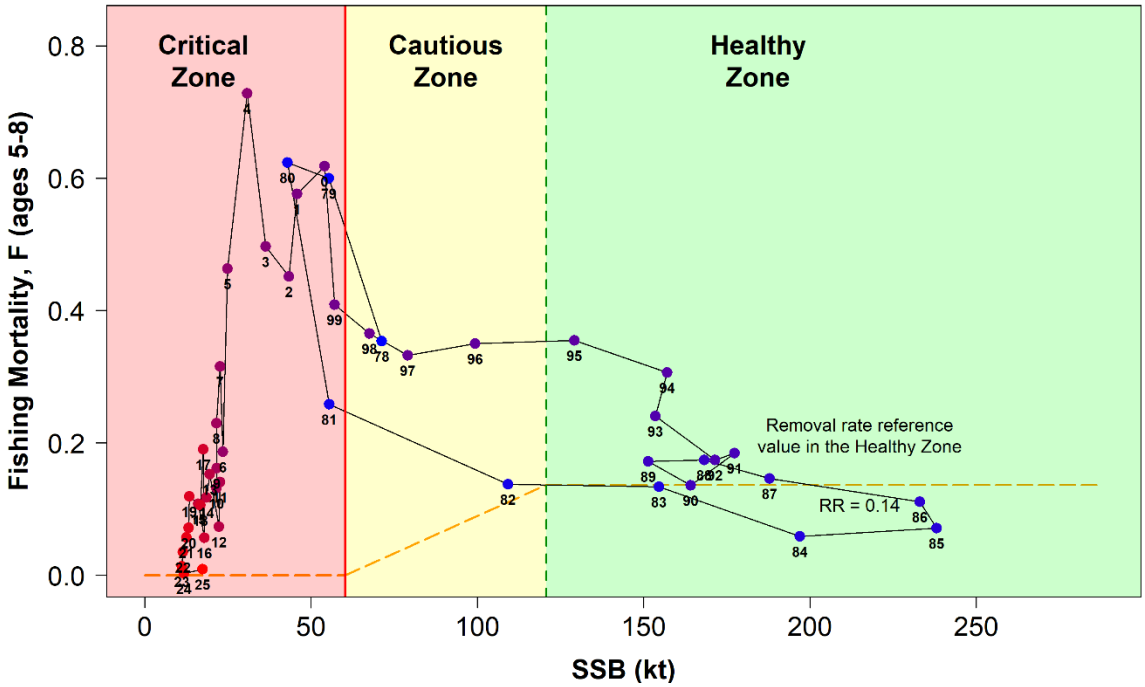

Figure 2. The southern Gulf of St. Lawrence Atlantic Herring spring spawner component of the Spawning Stock Biomass (SSB; kt = kilotonnes) and abundance weighted fishing mortality rates for ages 5 to 8 years. The red vertical line is the Limit Reference Point, the green dashed vertical line is the candidate Upper Stock Reference point. The orange dashed horizontal line is the provisional Removal Rate reference value (RR = 0.14) in the Healthy Zone, and the provisional harvest decision rule of the Precautionary Approach Framework in the Cautious and Critical Zones. Point labels are years (83 = 1983, 0 = 2000, 25 = 2025).

Stock Status and Trends

Biomass

Estimates of SSB are presented at the start of the fishing season (April 1st) to account for three months of natural mortality (Figure 1B). Estimated SSB in 2024 and 2025 were 11,816 t (95% confidence interval (CI): 8,035 t – 17,377 t) and 17,412 t (95% CI: 9,990 – 30,349 t), respectively.

Fishing Mortality

Estimated average fishing mortality for ages 5-8 (Average F) was high from 1979 to 1982 and from 1990 to 2004 (Figure 1C). After 2004, average F rapidly declined and since 2010, it remained at relatively low levels. Average F in the spring season was negligeable in 2024 and 2025 as a result of the fishery closure since 2022.

Natural Mortality

The natural mortality estimate for the younger age group (ages 2-7) is fixed at 0.3 (26% of annual mortality). For the older age group (ages 8-11+), natural mortality gradually increased from 0.12 to 0.71 (between 11% and 51% of annual mortality) between 1978 and 2009, before stabilizing at 0.4 (33% annual mortality) between 2010 and 2016. Starting in 2016, estimates sharply increased to reach 1.24 (71% annual mortality) in 2017 and stayed moderately high around 0.55 (42% annual mortality) from 2018 to 2021. Natural mortality reached an all-time

high of 1.63 (80% annual mortality) in 2022 but came back to 2021 levels in 2023 (Figure 1C). Natural mortality was 0.43 and 0.44 (35% and 36% annual mortality) in 2024 and 2025.

Recruitment

The estimated recruitment (number of age 2 fish) of spring Herring in the sGSL was high from 1978 to 1993 with a high of 821,716,700 individuals in 1990 and a low of 24,584,040 in 2020. Estimated recruitment was generally highest in the early 1980s, in 1990, and 1993. Recruitment has been relatively stable at lower values since 1993 (Figure 1D). Recruitment values for 2024 and 2025 were 65,970,950 (33% of the time series average) and 84,872,640 (43% of the time series average) individuals.

Current status

The stock remains in the Critical Zone of the Precautionary Approach (Figure 1B and 2). The probabilities that SSB were in the Critical Zone were > 99.9% in 2024 and 2025. Fishing mortality was below the RR for 2024 and 2025 (Figure 1C).

History of Commercial Landings and TAC

A Total Allowable Catch (TAC) for the combined harvest of both components (spring and fall spawners) in 4T and 4Vn has been in place from 1972 to 1990. Since 1991, TAC has been allocated by spawning component. The total landings have generally been less than the TAC since 1988 (Figure 1A). The TAC values for spring Herring have been 50 t with 25 t allocated for science and an additional 25 t for bycatch since 2022 due to the fishery closure (Figure 1A).

In the sGSL, Atlantic Herring are harvested by a gillnet fleet (referred to as “fixed” gear fleet) and a purse seine fleet (“mobile” gear fleet). The fixed gear fishery is focused in NAFO Division 4T whereas the mobile gear fishery occurs in Division 4T and occasionally in Division 4Vn. Most of the spring Herring were estimated to have been landed in the fixed-gear fleet over the 1981 to 2021 period, prior to the fishery closure. Local stocks are generally targeted by the fixed gear fishery which takes place on the spawning grounds.

There were approximately 19 and 75 t of total landings (Table 1) of spring Herring during 2024 and 2025 respectively, from the scientific fishery program (18 and 24 t in 2024 and 2025 respectively) and the bycatch from the fall fishery (1 and 51 t in 2024 and 2025 respectively).

Table 1. Landings and Total Allowable Catch (TAC) in tonnes (t) of southern Gulf of St. Lawrence Atlantic Herring spring spawner component by recent year (2021-2025), fishing season (spring and fall) and gear (fixed and mobile). The percentage (%) of catch in the fixed gear fishery is also provided.

Year	TAC (t)	Spring fishery landings (t)			Fall fishery landings (t)			Total landings	Fixed gear (%)
		Fixed	*Mobile*	*Total*	*Fixed*	*Mobile*	*Total*		
2021	500	379	0	379	17	0	17	396	100%
2022	50	0	0	0	236	7	243	243	97.2%
2023	50	6	0	6	81	0	81	87	100%
2024	50	18	0	18	1	0	1	19	100%
2025	50	24	0	24	51	0	51	75	100%

Ecosystem and Climate Change Considerations

Recruitment variability in spring Herring has been linked to environmental conditions, particularly zooplankton dynamics and temperature conditions (Turcotte 2022; Burbank et al.

2023b). Spring Herring have remained in a low recruitment regime since the mid-1990s, coinciding with a shift from a cold water to a warmer water regime and a shift in relative abundance of important zooplankton prey. Given the ongoing trend towards warmer conditions and shifts in the relative abundance and phenology of the zooplankton community in the sGSL (Blais et al. 2025; Galbraith et al. 2025), spring Herring recruitment is not expected to increase in future years. Recruitment in the stock assessment model are estimated using a random walk and projections are based on the recent average recruitment (2020-2024).

Herring are an important forage fish in the sGSL (Benoît and Rail 2016) and experience substantial natural mortality from predation. Consequently, increases in predators in the sGSL have coincided with increases in the natural mortality of older Herring (ages 8-11+) in recent years, which is estimated in the stock assessment model. High natural mortality at older ages, combined with reduced size-at-age, and lower reproductive output limit spawning potential and constrain stock rebuilding (Burbank et al. 2023a; Burbank et al. 2024; Burbank and Darcy 2025; Burbank et al. 2025).

Projections

The population model was projected forward to 2026 and 2027 and six years forward to 2031. Projections were conducted at several levels of annual catch (0, 100, 250, and 500 t) using average recruitment values and average natural mortality from the last five years preceding the last recorded year (2020-2024).

SSB was projected to decrease slightly from 2025 to 2026, and to remain stable from 2026 to 2027 at all annual catch levels from 0 to 500 t. The probability of a 5% increase in SSB between April 1 2025 and April 1 2026 was < 56% at all catch levels (Table 2).

At all catch levels (including no catch) it was very likely (> 99.9%) that SSB would be below the LRP at the start of the 2026 spring fishing season (Table 2). In the short term, there is no chance that the population would reach the USR by 2026.

Six year projections in SSB show stability around 14 kt from 2026 to 2031. By 2031, the probability of the SSB being below the LRP was very likely (> 97.3%) at all catch levels (Table 2), with SSB values ranging between 14,011 t to 14,877 t.

Table 2. Risk analysis table of annual catch options (between 0 and 500 tonnes (t)) for 2026 to 2031, with predicted resulting SSB in tonnes (t) in 2026, 2027 and 2031, resulting probabilities (P%) of SSB being less than the LRP, resulting probabilities (P%) of increases in SSB by 5% from 2025, and resulting abundance weighted fishing mortality rate (F5-8) for the spring spawner component of Atlantic Herring from the southern Gulf of St. Lawrence.

Year		0 t	125 t	250 t	500 t
SSB (t)	2026	14,381	14,371	14,319	14,231
	2027	14,602	14,575	14,410	14,147
	2031	14,877	14,850	14,539	14,011
P (SSB < LRP) (%)	2026	100	100	100	100
	2027	99.9	99.9	99.9	99.9
	2031	97.6	97.5	97.4	97.3
P (Increase in SSB) (%)	2026	56.4	56.3	56.1	55.7
	2027	54.8	54.4	53.8	52.8
	2031	50.1	49.5	48.5	46.8
Average F5-8	2026	0.01	0.01	0.04	0.07
	2027	0.01	0.01	0.03	0.07
	2031	0.01	0.01	0.03	0.07

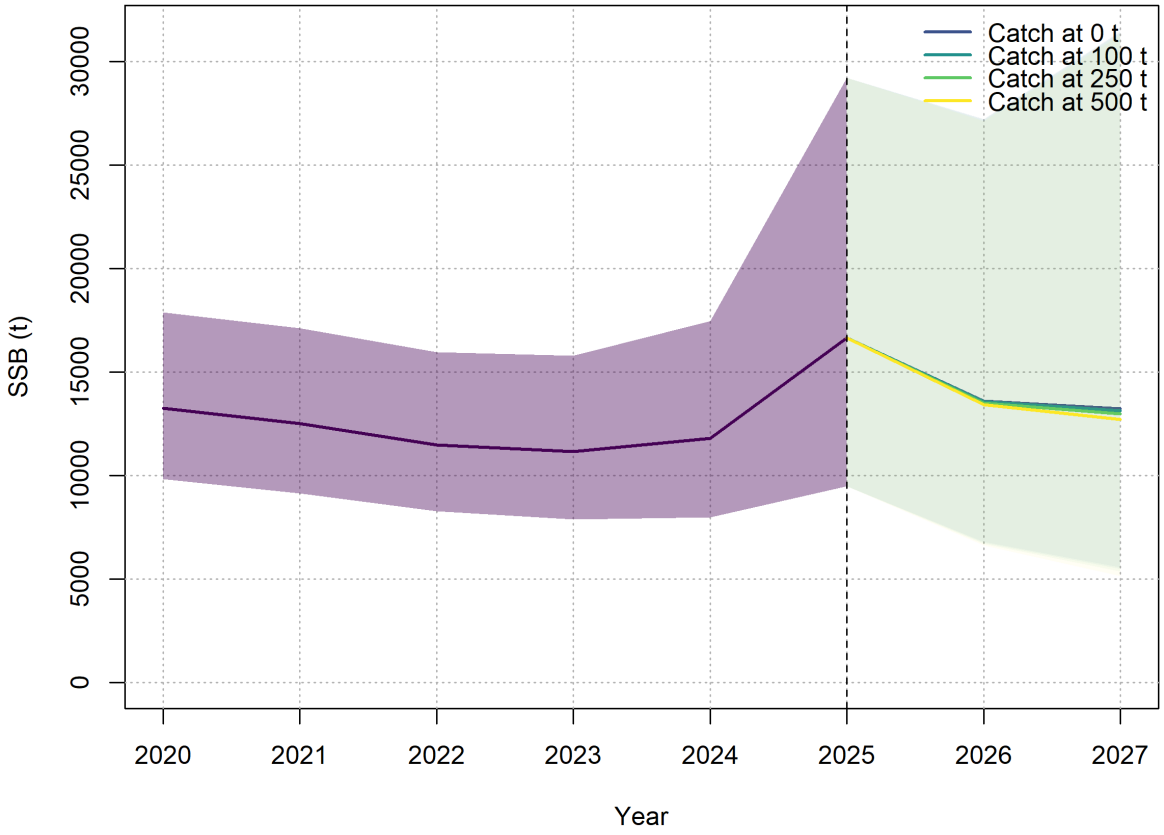

Figure 3. Projections of the Spawning Stock Biomass (SSB) for the southern Gulf of St. Lawrence Atlantic Herring spring spawner with catch options from 0 – 500 tonnes for 2026 and 2027.

BYCATCH

While the fisheries are closed during the spring season, spring Herring may still be caught during active commercial Herring fisheries (fall fixed gear and mobile fisheries). In 2024 and 2025, while the spring Herring fishery was closed, 1 and 51 t of spring Herring were fished, respectively, during the fall fishery (where 100% of catches were with fixed gear in 2024 and 2025; Table 1). Spring Herring can also be caught during the bait fishery when targeting fall spawning Atlantic Herring, however a lack of biological sampling precludes quantification of spring removals in the bait fishery. Lastly, with the reopening of the Redfish fishery, potential bycatch of sGSL Atlantic Herring should be monitored and quantified where possible, especially during the winter months when Atlantic Herring are overwintering along the Laurentian Channel.

SOURCES OF UNCERTAINTY

Uncertainty in SSB estimates has been reduced since the adoption of the previous SCA population models and remains low with the state-space model. In fact, the retrospective patterns for F and SSB were very low. Additionally, the last value of recruitment is always the least informed, therefore some uncertainty is expected. We addressed this issue by averaging recruitment over the years 2020-2024 for projections.

Unreported catches of spring spawning Herring, including in the fall bait fisheries and at-sea discards, are implicitly accounted for in the assessments through natural mortality estimates, but

the proportion of unreported catch, disease, or predation mortality cannot be disentangled. Catches in the bait fisheries are meant to be recorded in harvester logbooks. Recent estimates of catches of Atlantic Herring in the bait fishery were 30% higher than previously thought (Calder et al. 2022) since the inception of mandatory reporting. Given the lack of dockside monitoring and port sampling for the bait fishery, reported numbers are likely underestimated. Overall, these catches are important to document and attempts to improve data quality should be made so they could be incorporated in future assessments.

Given the fishing closure, a CPUE index cannot be derived as was typically done prior to the closure. To address this, a small-scale scientific commercial netting program was undertaken. In this program, harvesters set a small number of commercial nets to facilitate computation of the CPUE index. This new CPUE index will require more years of data and calibration to explore its potential use as a continuation or alternative to the previous CPUE index.

Harvesters continue to report observations on the water of an increase in the abundance of spring Herring and an expansion in spatial distribution, where fish have returned to historical spawning grounds. Monitoring for signs of increases in fish abundance through scientific surveys will continue.

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