



# STOCK STATUS UPDATE OF WEST COAST OF NEWFOUNDLAND (NAFO DIVISION 4R) HERRING FOR THE 2024 AND 2025 FISHING SEASONS

## Context

The stock assessment of Atlantic herring (*Clupea harengus*) of the west coast of Newfoundland (NAFO Division 4R) is conducted every two years, with the most recent assessment completed in March 2022 (DFO 2022). The next full assessment of this stock, scheduled for March 2024, has been cancelled to allow the review of the assessment framework. The first part of the review took place on April 4-5, 2023, and focused on the data and indices available from a tagging study, the commercial fishery, and acoustic surveys. These inputs will contribute to the renewed assessment framework. The second part of the review, which will take place during 2024-25, will aim at establishing a new assessment model and limit reference points consistent with Fisheries and Oceans Canada's (DFO) precautionary approach (DFO 2009). The next full stock assessment will be conducted in 2025-2026.

DFO's Fisheries Management Branch requested that the Science Branch provides a status update of the west coast of Newfoundland herring stocks and recommend harvest advice for the 2024 and 2025 fishing seasons. The purpose of this Science Response is to update the main status indicators of the 4R herring stocks up to the end of 2022, to estimate the current size at 50% maturity ( $L_{50}$ ), and to provide recommendations on harvest levels for the 2024 and 2025 fishing seasons based on the available data.

This Science Response Report results from the regional peer review of January 11, 2024 on the Stock Status Update of West Coast of Newfoundland (NAFO Division 4R) Herring for the 2024 and 2025 Fishing Seasons.

## Background

The assessment of Division 4R herring stocks is conducted by examining trends in various fishery-dependent and -independent indicators over recent years and comparing annual values to the time series average, as described in Émond et al. 2024. The indicators selected to monitor stock status are commercial fishery landings, age composition of the commercial catch, and results of the acoustic surveys conducted in August and October-November. This Science Response Report is based on the revised data and indices resulting from the assessment framework review meeting conducted in April 2023 (DFO 2024).

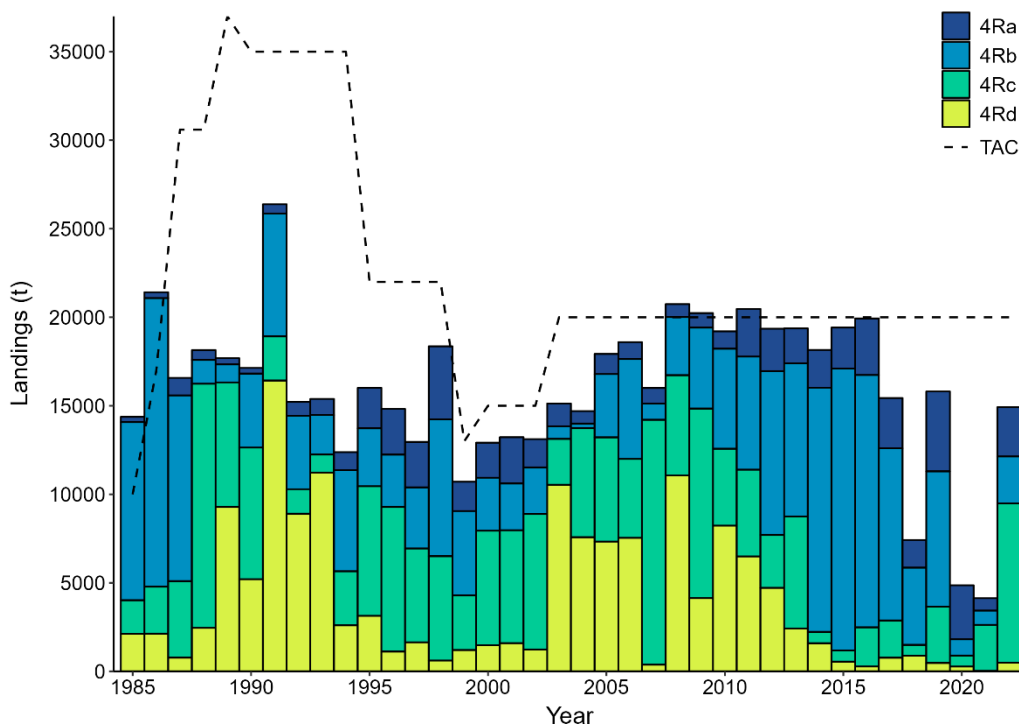
Following the March 2022 assessment, the total allowable catch (TAC) of 20,000 t was maintained for the 2022 and 2023 fishing seasons. Maintaining the TAC was considered appropriate based on the trends and annual values of the different indicators. Exploitation rates, calculated as the ratio of the TAC over the biomass index estimated in the acoustic survey, were lower (< 15%) than reference exploitation rates commonly used for other herring stocks and species with similar life-history characteristics. The high abundance of young fish observed in the commercial catches and the acoustic surveys for both spring and fall spawners was considered a positive sign for the future of these stocks, but prevented harvesters from landing

their quotas since the majority of these fish were below legal catch size. The spring-spawning stock, which had been in a period of low stock status since the mid-2000s, also showed encouraging signs of increase, including a higher proportion of this stock in the commercial catches and the acoustic surveys since 2019.

Due to issues with the high incidence of undersized herring in recent years, a request was made for Science to re-examine the  $L_{50}$ . If a significant decrease in the  $L_{50}$  occurred, the catch size limit could be reduced to reflect this change. At the 2022 assessment, the  $L_{50}$  of the most recent estimable year-class (2017) was estimated at 24.5 cm and 25.4 cm (fork length) for spring and fall spawners, respectively (DFO 2022). These values were slightly higher or near the current minimum size limit of 24.76 cm in the commercial fishery. It was therefore decided not to reduce the catch size limit for the 2022 and 2023 fishing seasons, despite the high incidence of fish below the legal size. The  $L_{50}$  will be updated with the latest data as part of this Science Response process.

**Description of the fishery**

As of November 11, 2023, preliminary landings of herring on the west coast of Newfoundland totalled 14,922 t in 2022, representing approximately 75% of the TAC. As in 2021, more than half of the landings (~60%) in 2022 were reported from subdivision 4Rc (Figure 1). The majority of the herring was landed by the large (8,377 t) and small (2,801 t) mobile gear purse seine fleets (Figure 2). The biomass landed with the tuck seine, which is considered a fixed gear despite its mobility, totalled 3,364 t in 2022, while the other fixed gears (gillnet and trap) landed a total of 380 t.



*Figure 1. Herring cumulative commercial landings (t) per subdivision and total allowable catch (TAC) of the west coast of Newfoundland (NAFO Division 4R), from 1985 to 2022. Landings for the period 2019-2022 are preliminary.*

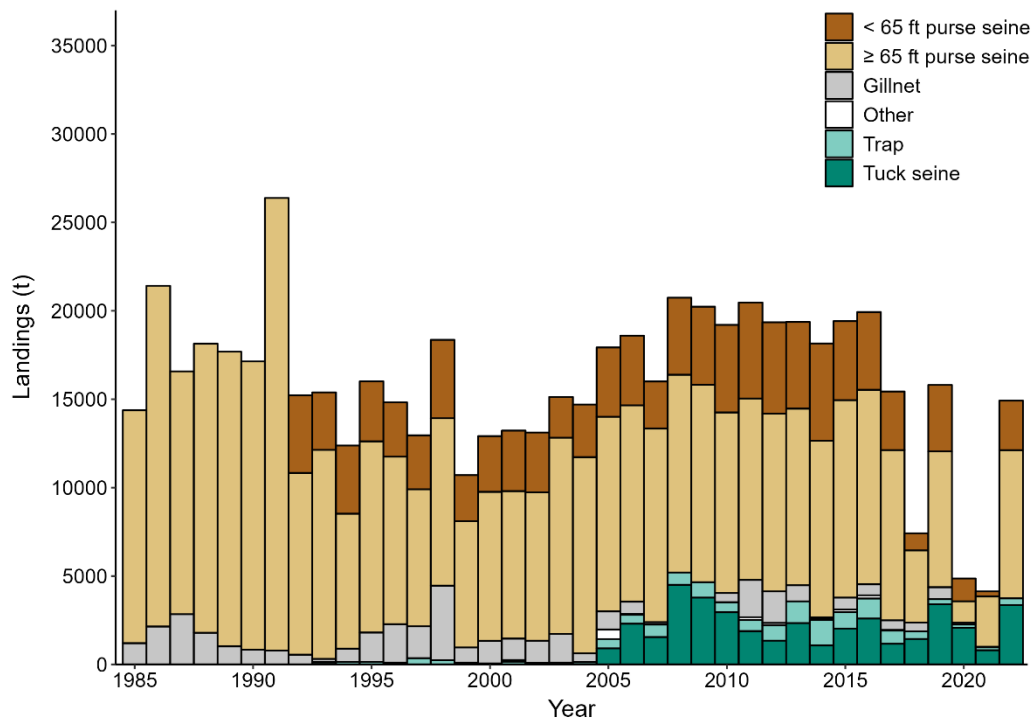


Figure 2. Herring cumulative commercial landings (t) per fishing gear of the west coast of Newfoundland (NAFO Division 4R), from 1985 to 2022. Landings for the period 2019-2022 are preliminary.

## Analysis and Response

### Indicators of the stock status

#### Commercial catch-at-age composition

Over the period 1985-2004, the annual proportion of spring spawners in landings varied between 32.3% and 83.5% (Figure 3). From 2005 onwards, the proportion of spring spawners decreased and reached the lowest value of the time series in 2014 (1.7%). Since then, the proportion of spring spawners in the fishery has been increasing and dominated the fishery in 2021 (87.2%) and 2022 (86.5%; Figure 3).

The age composition of the commercial catch of herring generally allows the dominant cohorts to be tracked from 3–4 years of age onwards (Figures 4 and 5). In the spring spawners, the most recent year-classes are those of 2013 (age 9 in 2022) and 2017 (age 5 in 2022; Figure 4). In the fall spawners, the last abundant year-classes in the fishery were observed in 2008 (age 14 in 2022) and 2016 (age 6 in 2022), although this cohort was less abundant in 2021 (Figure 5).

In 2022, fish of the 2017 year-class dominated the catches of spring-spawning herring (78.7%), whereas fish of the 2013 cohort were almost absent (< 3%; Figure 4). Unlike spring spawners, landings of fall-spawning herring in 2022 were not dominated by a particular cohort, although the 2016 (34.1%) and 2019 (23.1%) year-classes stood out as being relatively abundant that year (Figure 5). This contrasts from the previous assessment (2020-2021), where fall spawner landings were mainly composed of fish aged 9 years and over (DFO 2022). The 2017 spring spawner year-class, as well as the 2016 fall spawner year-class, were also abundant in the summer and fall acoustic surveys of 2022.

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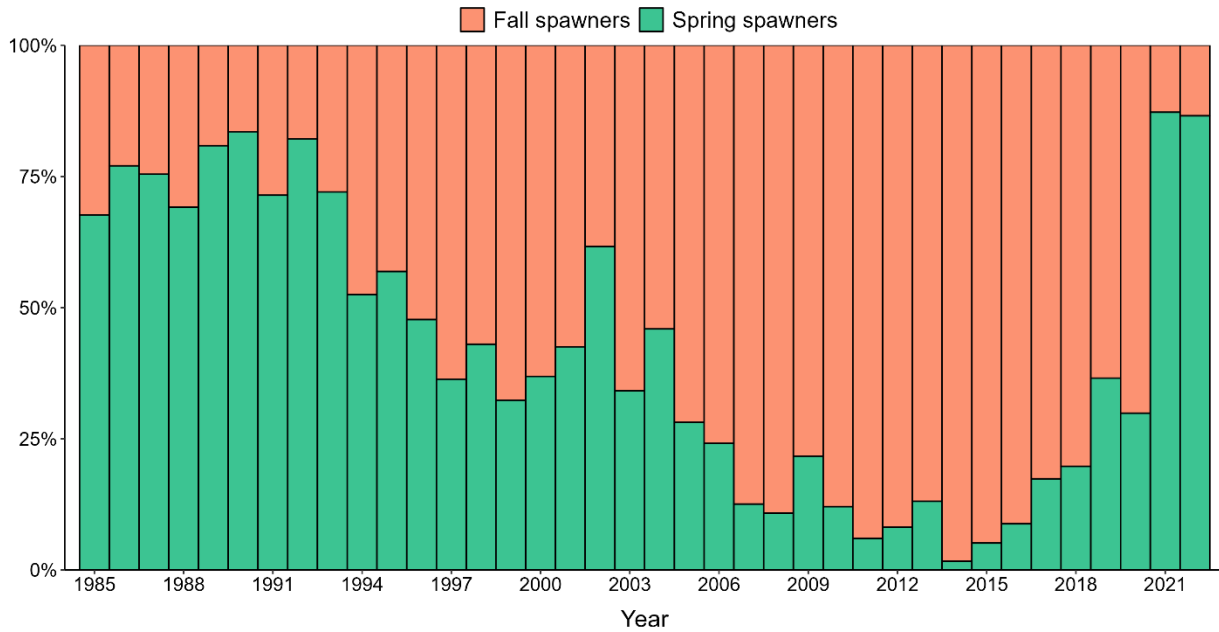


Figure 3. Annual proportion of spring- and fall-spawning herring (number of individuals) in NAFO Division 4R commercial landings from 1985 to 2022.

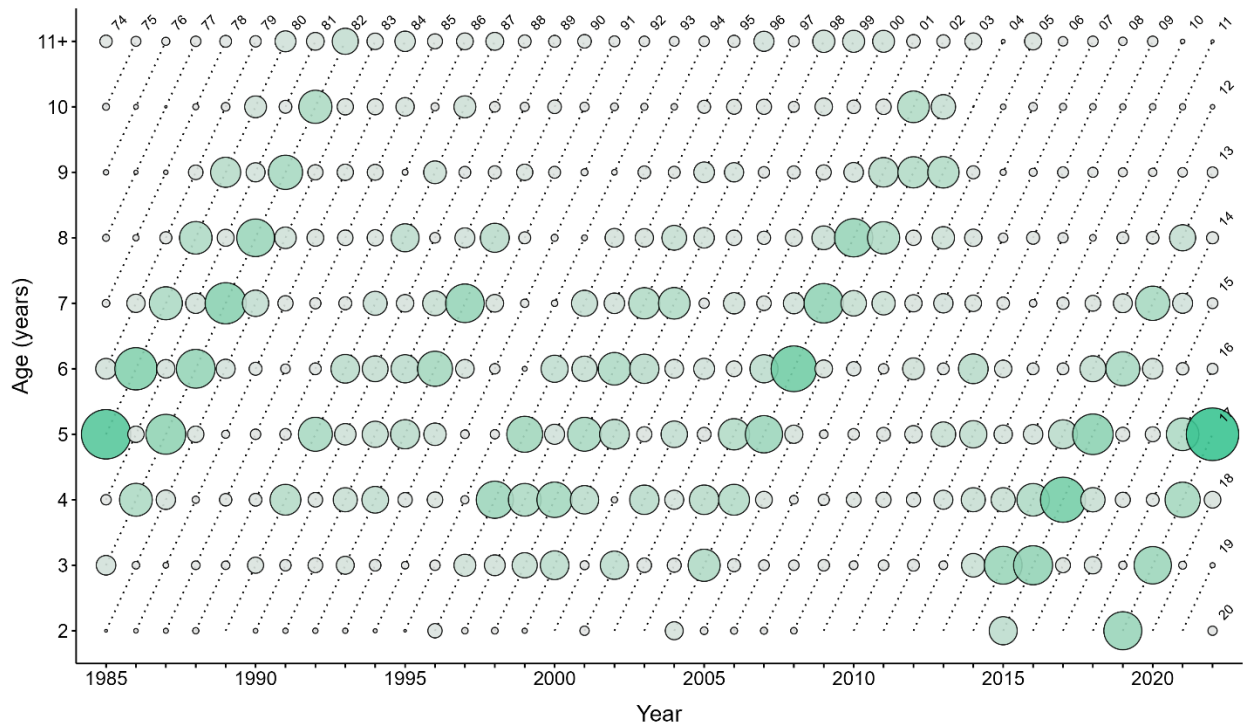


Figure 4. Annual catch-at-age composition (%) of spring-spawning herring in NAFO Division 4R from 1985 to 2022. The circle area is proportional to the proportion of the number of fish at each age. Cohort years' last two digits are indicated above bubbles.

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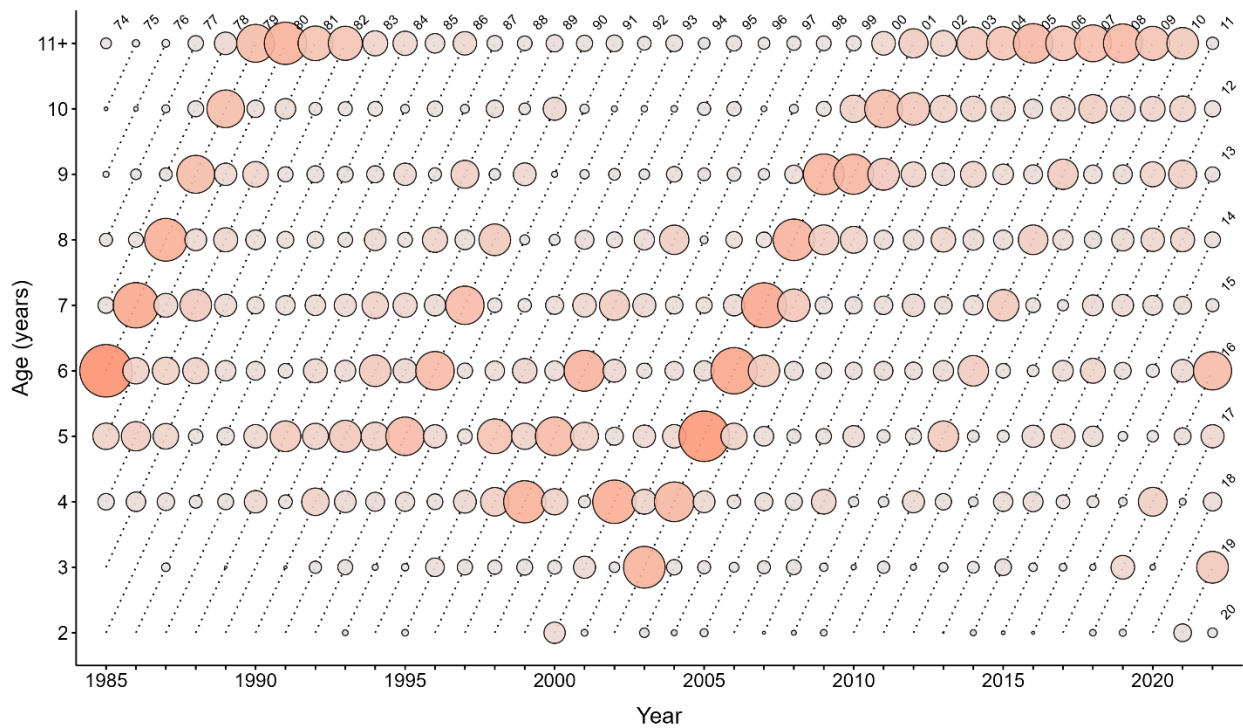


Figure 5. Annual catch-at-age composition (%) of fall-spawning herring in NAFO Division 4R from 1985 to 2022. The circle area is proportional to the proportion of the number of fish at each age. Cohort years' last two digits are indicated above bubbles.

**Acoustic survey**

Acoustic surveys of fall (October-November) concentrations of herring have been carried out in NAFO Division 4R since 1991. In 2019 to 2022, acoustic surveys were also conducted in the summer (August) in addition to the fall survey. Both surveys cover the entire west coast of Newfoundland, from Cape Anguille to the southern portion of the Strait of Belle Isle. In 2019, two new strata were added on the eastern and western sides of the Strait of Belle Isle, which is considered an important summer-fall feeding area for 4R herring (Moore and Winters 1984).

In 2022, the summer and fall acoustic surveys estimated 90,462 t (standard error (SE):  $\pm 12,271$  t) and 22,155 t (SE:  $\pm 4,041$  t) of spring spawners, and 58,547 t (SE:  $\pm 8,118$  t) and 11,130 t (SE:  $\pm 2,251$  t) of fall spawners, respectively. The biomass index for spring spawners from the 2022 summer survey was at the highest level recorded since the beginning of the survey in 1991 (roughly 2.5 times higher than the second-highest value), while fall spawners remained among the highest values (Figure 6). These values are considered to represent minimum estimates of the amount of fish available at the time of the survey. However, it is important to note that the changes in survey coverage and catchability that occurred over the years limit our ability to compare values from year to year and assess long-term trends in biomass.

The proportion of spring spawners in the fall acoustic survey increased substantially in recent years, jumping from an average of 7.3% for the 2009-2017 period to an average of 57.5% for the 2019-2022 period (Figure 7). Percentage of spring spawners in the summer survey was generally less than or equal to that observed in the fall survey (Figure 7). In 2022, spring spawners represented 65.1% and 67.2% of the summer and fall acoustic survey biomass

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estimates, respectively. Increased prevalence of spring spawners is also observed in the commercial fishery catches since 2019 (Figure 3).

In 2022, biomass estimates of spring-spawning herring were strongly dominated by fish of the 2017 year-class (age 5) in both the summer (86.5%) and fall acoustic surveys (86.7%). Fall spawner biomass estimates in the fall survey were mainly comprised of fish of the 2016 year-class (age 6; 48.6%), while 61.1% of the biomass estimate from the summer survey was made up of the 2016 (36.1%) and 2017 (25.0%) year-classes (Figure 9). The 2017 year-class for spring spawners and the 2016 year-class for fall spawners have been dominating the acoustic survey since 2019 (Figures 8 and 9).

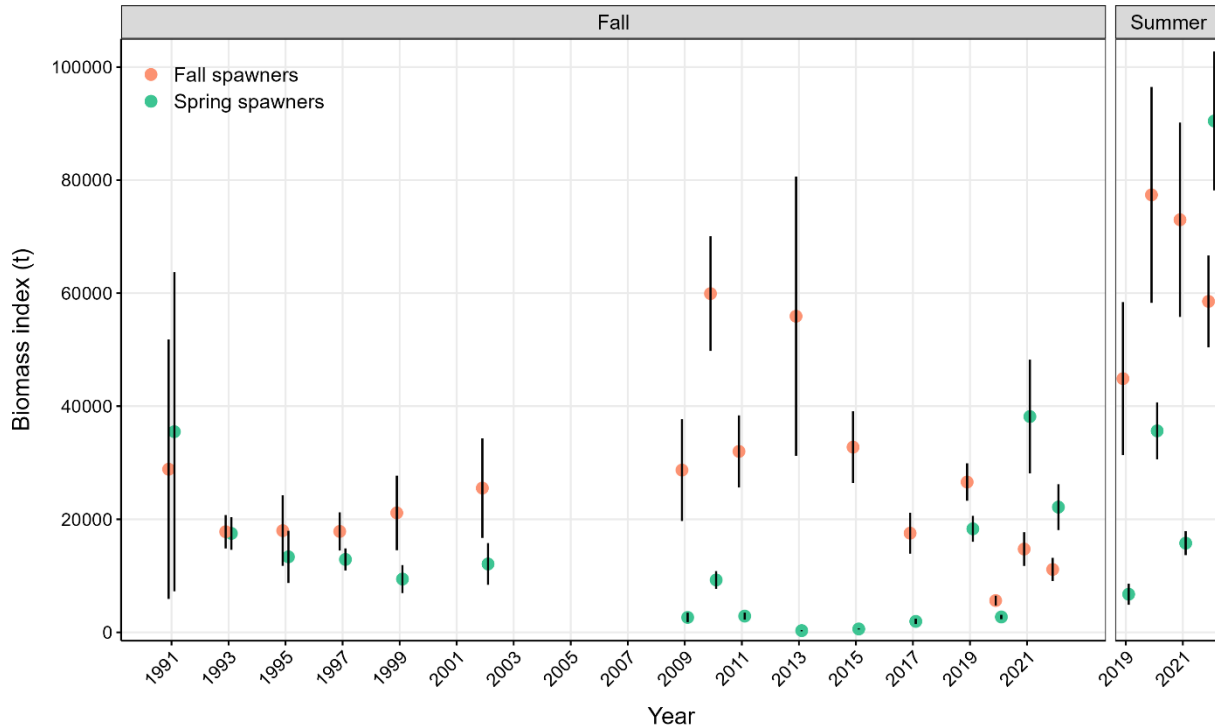


Figure 6. Fall (left panel; 1991-2022) and summer (right panel; 2019-2022) acoustic survey biomass indices for the spring- (in green) and fall-spawning herring (in red) stocks of the west coast of Newfoundland (NAFO Division 4R). Error bars represent standard errors.



Figure 7. Proportion of spring- and fall-spawning herring (number of individuals) estimated from the summer and fall acoustic surveys conducted in NAFO Division 4R from 1991 to 2022.

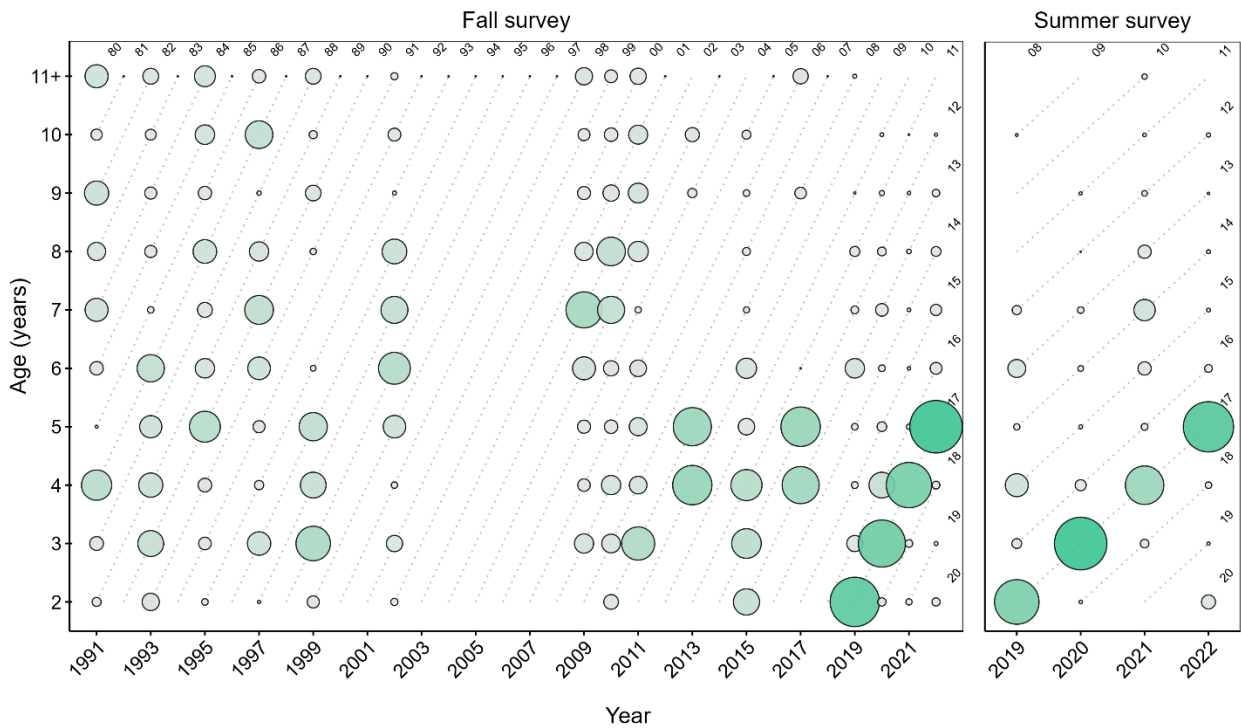


Figure 8. Annual numbers-at-age composition (%) of spring-spawning herring from the summer (August) and fall (October-November) acoustic surveys conducted in NAFO Division 4R between 1991 and 2022. The circle area is proportional to the proportion of the number of fish at each age. Cohort years' last two digits are indicated above bubbles.

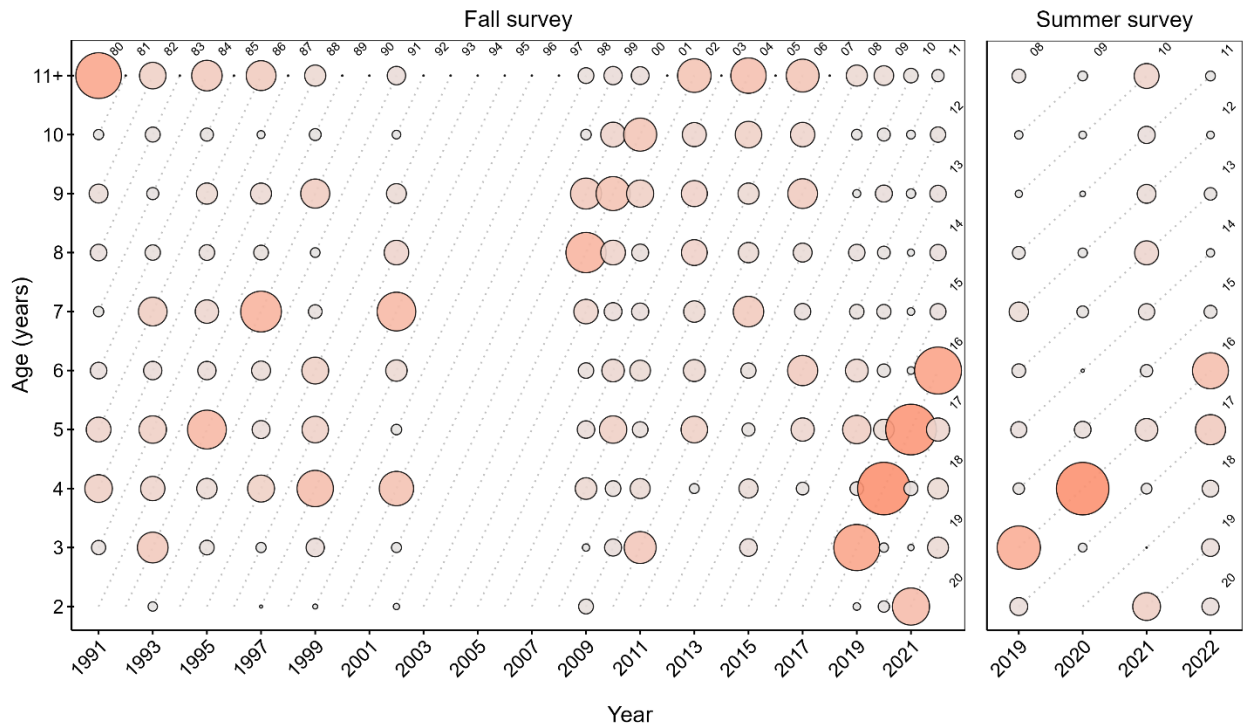


Figure 9. Annual numbers-at-age composition (%) of fall-spawning herring from the summer (August) and fall (October-November) acoustic surveys conducted in NAFO Division 4R between 1991 and 2022. The circle area is proportional to the proportion of the number of fish at each age. Cohort years' last two digits are indicated above bubbles.

### Length at 50% maturity

A request was made for Science to update the length at which 50% of individuals are mature ( $L_{50}$ ). The  $L_{50}$  values were also compared to the commercial size limit. Following a period of relative stability over the 1960 and 1970 year-classes, the  $L_{50}$  of spring spawners declined over the 1980 year-classes and since the 1990 year-classes, varied around or slightly below the long-term average (Figure 10A). The  $L_{50}$  for fall spawners was stable for the 1960 year-classes, declined until the early 1990 year-classes, and then increased towards the time series average until the 1997 year-class (Figure 10B). Since the 2000 year-class, the  $L_{50}$  of fall spawners has been varying without trend around the mean.

The  $L_{50}$  (in fork length) of the most recent estimable year-class (2018) was estimated at 22.11 cm (95% confidence interval (CI): 20.79-22.79 cm) and 24.78 cm (95% CI: 23.57-25.61 cm) for spring and fall spawners, respectively. These values are lower (i.e., spring spawners) or near (i.e., fall spawners) the current minimum size limit of 24.76 cm in the commercial fishery (Figure 10). The  $L_{50}$  of the most recent dominant year-classes for spring (2017 year-class) and fall spawners (2016 year-class) were also re-examined, as these year-classes dominated the fishery in 2022 (Figures 4 and 5). The  $L_{50}$  of the 2017 spring spawner year-class was estimated at 24.24 cm (95% CI: 24.15-24.34 cm), while the  $L_{50}$  of the 2016 fall spawner year-class was estimated at 24.88 cm (95% CI: 24.56-25.01 cm).



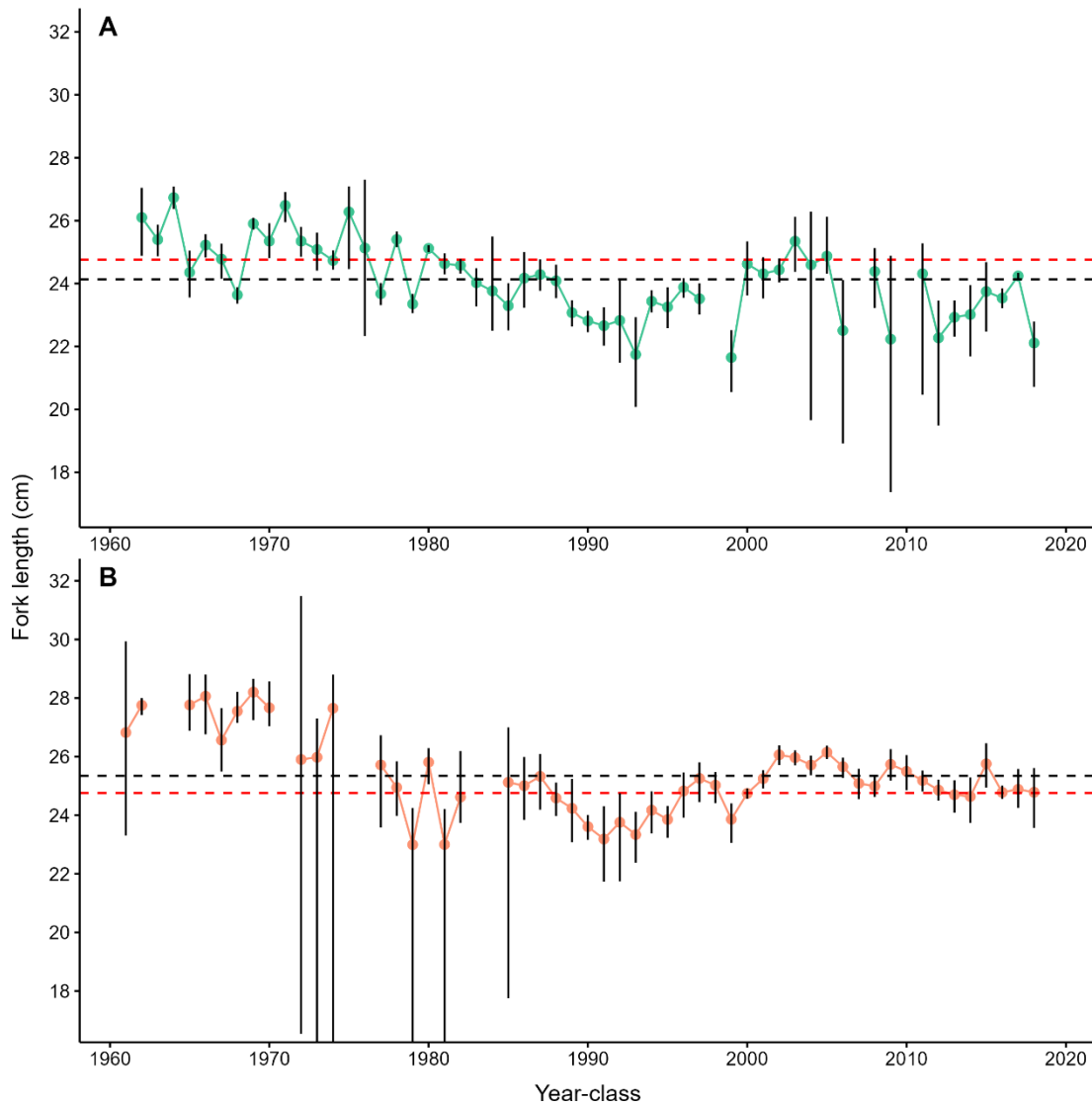


Figure 10. Length at 50% maturity (fork length, cm) by year-class for spring (A) and fall (B) spawners in NAFO Division 4R. Error bars represent bootstrapped 95% confidence intervals. The horizontal dashed black line is the series average and the red dashed line is the legal catch size (24.76 cm).

### Conclusions

The data and knowledge available are insufficient to quantitatively assess the status of the resource. However, the main results of this stock status update indicate that maintaining the TAC of 20,000 t at status quo should not pose a significant risk to the two herring spawning stocks in Division 4R in the short term.

Strong year-classes of recruitment, observed among the spring spawners in 2017 and the fall spawners in 2016, entered the fishery in 2019 and remained dominant up until 2022 in the commercial catches. The 2016 fall spawner year-class and the 2017 spring spawner year-class have also been dominating the summer and fall acoustic surveys since 2019 and represented more than 50% of the biomass estimates in 2022. The  $L_{50}$  of the 2017 spring spawner

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(24.24 cm) and the 2016 fall spawner (24.88 cm) year-classes are very close to the minimum legal size (24.76 cm) in the commercial fishery.

The summer acoustic survey of 2022 estimated the highest biomass of spring spawners since the beginning of the survey in 1991, while fall spawners remained among the highest values. The recent increase in spring spawner biomass is due principally to improved recruitment which produced the strong 2017 year-class. However, since the acoustic survey has uncertainties in relation to its catchability, caution is warranted in interpreting temporal trends and absolute values of abundance. The stable or increasing biomass in the summer acoustic survey, as well as the recruitment of new strong year-classes in 2016 (fall spawners) and 2017 (spring spawners), are encouraging signs for the future of these stocks.

After a period of low stock status in the mid-2000s and 2010s, the spring-spawning herring stock in division 4R is showing signs of improvement since 2019. The proportion of spring spawners has increased significantly since 2019 in the commercial catches and in the acoustic surveys. The 2022 summer acoustic survey also estimated the highest biomass since the beginning of the survey (roughly 2.5 times higher than the second-highest value).

The update of the main indicators for monitoring the stock status of the west coast of Newfoundland herring in 2022 does not present a major change from the previous assessment. Therefore, the conclusion of the most recent Advisory Report (DFO 2022) remains appropriate: “Available evidence up to 2022 (i.e. strong recruitment, stable or increasing biomass) indicates that maintaining the TAC at status quo should not pose a significant short-term risk to the herring stocks in 4R.”

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