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Supporting Material for Stock Assessment of NAFO Division 4TVn Southern Gulf of St. Lawrence Atlantic Herring (*Clupea harengus*) in 2022-2023

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Atlantic Herring (*Clupea harengus*) in Northwest Atlantic Fisheries Organization (NAFO) Division 4T, referred to as the southern Gulf of St. Lawrence (sGSL), consists of two spawning components, spring spawners and fall spawners. This document presents the most recent information on trends in abundance, distribution, and harvest for the spring and fall spawning Herring components in NAFO Division 4T. This includes catch-at-age and catch-per-unit-effort (CPUE) indices, fisheries-independent acoustic indices, experimental gillnet survey indices, mesh selectivity, fishery-dependent acoustic indices and catches in the multi-species bottom trawl survey of the sGSL. The data and indices are reported for the sGSL for the spring spawners, and regionally-disaggregated (North, Middle, and South regions) for the fall spawners where applicable. This information is the basis of the assessment of spring and fall spawning 4TVn Atlantic Herring. Since the last assessment in 2022, we continued collecting data from our various data sources including commercial landings, telephone survey, port sampling, fishery-independent acoustic survey, industry acoustic survey of spawning grounds, experimental variable mesh size net and multispecies bottom-trawl survey. From these data sources, the calculations of catch-at-age matrices were improved by translating calculations from Statistical Analysis Software and Excel into R language. The translation process facilitates the future reproduction of calculations, and was an opportunity to address issues in the calculation of past biomass estimates. While the trends remained after this process, yearly estimates shifted slightly higher or lower depending on the region and the spawning component. In addition, the process fixed the abnormal retrospective pattern observed in the previous assessment which means a more accurate biomass estimates. The spring and fall populations still face a lot of uncertainties, especially regarding rising sea temperature, which may change spatial distribution of Atlantic Herring and affect other demographic metrics (i.e., recruitment). This document is meant to support the stock assessment of Atlantic Herring in 4TVn by presenting data sources and data changes between the 2022 and 2024 assessment, but does not include details on model methodology.

INTRODUCTION

Atlantic Herring (*Clupea harengus*) in the southern Gulf of St. Lawrence (sGSL) are found in the area extending from the north shore of the Gaspé Peninsula to the northern tip of Cape Breton Island, including the Magdalen Islands. Adults overwinter off the north and east coast of Cape Breton in the Northwest Atlantic Fisheries Organization (NAFO) Divisions 4T and 4Vn (Claytor 2001; Simon and Stobo 1983; Figure 1). Studies in the early 1970s indicated that southern Gulf Herring also overwintered off the south coast of Newfoundland, but an exploratory fishery in 2006 did not detect any concentration (Wheeler et al. 2006). Herring is a pelagic species that schools particularly during feeding, spawning periods, and annual migrations. Eggs are attached to the sea floor and large females can produce up to 360,000 eggs (Messieh 1988). First spawning behaviour typically occurs at four years of age.

Herring in the sGSL are managed across seven Herring Fishing Areas (HFA) (16A-16G; Figure 1a). These HFAs cover the same region as NAFO Division 4T (Figure 1B). The Herring population in the sGSL consists of two spawning components: spring spawners and fall spawners. Spring spawning occurs primarily in April-May but extends to June 30 at depths < 10 m. Fall spawning occurs from mid-August to mid-October at depths of 5 to 20 m, but can occur as early as July 1. Both spawning behaviours are explained by the genetic differentiation between these stocks (Lamichhaney et al. 2017). Spring and fall Herring spawners within 4T are therefore considered distinct stocks and are assessed separately. Herring also show high spawning site fidelity (Winters and Wheeler 1985; McQuinn 1997; Brophy et al. 2006) and local stocks are targeted by the gillnet fishery which takes place on the spawning grounds. Fall spawning Herring in the sGSL are therefore assessed using regionally-disaggregated assessment models (North, Middle, South regions; Figure 1B).

The sGSL Herring are harvested by a gillnet fleet (referred to as “fixed” gear fleet) and a purse seine fleet (“mobile” gear fleet). The mobile gear fleet mainly consists of large vessels (> 19.8 m), but some small seiners (< 19.8 m) can also participate in the inshore fishery as part of the gillnet fleet. The fixed gear fishery is focused in NAFO Division 4T, whereas the mobile gear fishery occurs in 4T and historically, occasionally in 4Vn (Figure 1B). During the spring and fall fishing seasons, the mobile fleet is prohibited from fishing in areas set aside exclusively for the fixed-gear fleet (Claytor et al. 1998). In the spring fishing season, mobile gear fleets fish along the northern boundary of NAFO region 4Tf, which is referred to as the “Edge” fishery. In the fall fishing season, mobile gear fleets fish in the Chaleur Bay area. Both spring and fall spawning Herring are harvested in the spring and fall fishing seasons and must therefore be separated into the appropriate groups for assessment purposes.

Prior to 1967, sGSL Herring was mainly exploited by fixed gear and average landings from 1935 to 1966 were 34,000 tonnes (t). In the mid-1960s, a mobile gear fishery was introduced and average landings by both fleets were 166,000 t from 1967 to 1972. Since 1981, fishing effort was reduced in the mobile gear fleets and the fixed gear fleet has accounted for most of the catch of spring and fall spawners (Figures 2 and 3; McDermid et al. 2018).

A global allocation or Total Allowable Catch (TAC) was introduced in 1972 at 166,000 t, and reduced to 40,000 t in 1973. Separate TAC for the spring and fall spawners components began in 1985 (Table 1; Figure 3). The TAC was first allotted by fishing season (spring and fall) and later attributed to spring or fall spawners landings based on biological samples taken during the fishery. The percentage of spring and fall spawners in the catch varies according to season and gear type (Figure 3). As a result, landings during the spring and fall fishing seasons must be separated into the appropriate spring and fall spawners groups to determine if the TAC for these groups has been attained.

This document is meant to support the stock assessment of Atlantic Herring in 4TVn and only presents data sources and data changes between the 2022 and 2024 assessment. For details on the model, please refer to Turcotte et al. 2021 and Rolland et al. 2022.

DATA SOURCES

For the spring spawning Herring assessment, data collected in NAFO Div. 4T is used to model the population at the scale of the sGSL. The spatial distribution of the data collected during the spring fishery does not permit, for now, use of a regionally-disaggregated model as for the fall spawning stock.

For the fall spawning Herring assessment, a regionally-disaggregated model is used to evaluate the population in three regions (North, Middle, and South) that encompass the entire NAFO Div. 4T. The regions are defined on the basis of traditional Herring spawning beds and fishing areas (Figure 1):

- North (Gaspé and Miscou; 4Tmnpq),
- Middle (Escuminac-Richibucto and west Prince Edward Island; 4Tkl), and
- South (east Prince Edward Island and Pictou; 4Tfghj).

The choice of three regions was dictated by geographic proximity of spawning beds and is the finest level of disaggregation that can presently be supported by the available data. The regionally-disaggregated models include inputs that are region-specific (e.g., catch-at-age, catch-per-unit-effort, experimental nets proportions-at-age (PAA), selectivity-at-age, biomass indices from hydroacoustic surveys on spawning grounds) and inputs that are common to the entire area (e.g., acoustic survey index, RV survey index).

LANDINGS

Catch data were extracted from the Dockside Monitoring Program (DMP), logbooks, purchase slips and ZIFF (Zonal Interchange File Format) files collected by the Statistics Branch of Fisheries and Oceans Canada (DFO). Catch data to 1985 are available for each fishery (fixed and mobile) and fishing area. Beginning in 1986, the catch data are further reported by vessel and trip. The ZIFF files are based on information collected by the Dockside Monitoring Program (DMP). This program provides accurate, timely, and independent third-party verification of fish landings. Contracted companies are hired by the fishing industry to observe the offloading of fish and to record and report the landings information to DFO.

The fishery TACs within NAFO Div. 4T are set for the sGSL spring spawners and fall spawners components separately. In 2022 and 2023, the spring fishery was closed and the TAC for the fall fishery was 10,000 t (Table 1; Figure 2) for both years. Bait removals were not counted against the TAC.

The estimated spring landings fall bycatch of spring spawning Herring were 243 t in 2022 and 88 t in 2023. (Table 1; Figure 3). From a total of 331 t for both years, 6 t came from scientific work with fixed gear during the spring fishery in 2023 and 318 t from the fall fishery season with fixed gear (236 t in 2022 and 82 t in 2023; Table 1). The mobile fleet landed the remaining 7 t in 2022 and did not fish in 2023 (Table 2). Over the 1981 to 2023 period, most of the spring spawning Herring were estimated to have been landed in the fixed-gear fleet (Figure 2). In 2022 and 2023, the fixed-gear fleet was estimated to have landed 96% and 100%, respectively, of the total harvests of spring spawning Herring (Table 1; Figure 3A). For 2022 and 2023, only 2% of the spring spawning Herring was landed by the fixed gear fleet during the spring scientific fishing work, and 100% of the spring spawning Herring landed by the mobile fleet was landed in

the fall season (Table 1). This observation is due to the spring fishery closure, which only allowed spring spawners to be caught during the fall season (Figure 3BC).

The estimated landings of fall spawners in 2022 and 2023 were 9,380 t and 5,484 t, respectively (Table 1; Figure 3D). Over the 1978 to 2023 period, most of the fall spawning Herring have been landed in the fixed-gear fleet. In 2022 and 2023, the fixed-gear fleet was estimated to have landed 99% and 100% of the total harvests of fall spawning Herring, respectively (Figure 3). In 2022 and 2023, all of the fall spawning Herring captured in the fixed-gear fishery were landed during the fall fishing season (Figure 3E). In 2022, 100% of the fall spawners landed by the mobile fleet were landed in the fall fishing (Figure 3F).

The recent 2019 to 2023 mean proportion of the total catch caught by fixed gear was 51% (CI: [24; 77]) of the spring spawners and 96% [94;98] of the fall spawners (Table 1) with 100% of the fixed gear that had a mesh size of 2 5/8 (Figure 4). About 44% of the 2022-2023 fall fishery fixed gear catches occurred in Herring area 4Tmn (North; Figure 1; Table 2). The mobile gear (Edge) spring fishery was not active in both 2022 and 2023. The fall fishery 2022 mobile gear catches were 22.2 t and from 4Tmn (North; Figure 1; Table 2).

In 2022, 95% of the fall spawners' TAC was attained compared to 56% in 2023 (Table 1). Herring fishing area landings information can be found in Table 2.

SPAWNING STOCK ASSIGNMENT

Gulf Region Science uses three methods to assign Herring samples to either spring or fall spawners based on gonad maturity stages (Cleary et al. 1982):

1. For immature Herring of maturity stages 1 and 2 (juveniles), the season of hatching is based on the size at capture and visual examination of otolith characteristics (Messieh 1972). The spawning component assignment for juvenile Herring is its hatching season (Cleary et al. 1982). Juveniles represent a small percentage of commercial catch, but are typically captured in higher proportions in the research survey samples.
2. Adult Herring with ripe or spent gonads are assigned their maturity stage by macroscopic laboratory examination of the gonads. The fish are assumed to belong to the spawning component of the season in which they were caught.
3. Adult Herring with unripe gonads are assigned their maturity stage by using a gonadosomatic index (GSI) based on a discriminant function model. The GSI is based on the length of the fish and its gonad weight. Once the maturity stage is determined by GSI, the spawning component is assigned by using a maturity schedule decision rule (a table cross-referencing maturity stage assigned by GSI and the date of capture to assign a spawning component; McQuinn 1989).

TELEPHONE SURVEY

A telephone survey has been conducted annually since 1986 to collect information on the fixed-gear fishery and opinions on abundance trends (details in LeBlanc and Leblanc 1996). The sGSL was divided into eight telephone survey areas corresponding to the areas where the major fisheries occur (Table 3; Figure 1C). Active commercial license holders were asked a series of questions concerning the number, dimensions, and mesh size of nets used, the frequency of fishing and how the abundance in the current year compared to the previous year and the medium-term trend. A 2008 review of the consistency of the abundance relationship among years concluded that this index should not be used as a biomass index in the population model. The telephone survey responses inform the fishing effort calculation for the CPUE in the

gillnet fishery. Because of the spring fishery closure, this survey was only conducted for fall fishery in 2022 and 2023 (Table 3).

The 2022 fixed gear telephone survey contacted 202 fishermen randomly selected out of active commercial licence holders in the fall season. A total of 143 fishermen responded to the fall fishing season survey. The 2023 fixed gear telephone survey contacted 158 fishermen randomly selected out of active commercial licence holders. A total of 117 fishermen responded to the fall fishery survey. The distribution of respondents across the 8 telephone survey areas, mean net hauls, net lengths, and trend in the abundance from the previous year are shown in Table 3. Overall, fishermen felt that abundances in the 2022 and 2023 fall fishery were more similar than abundance in the previous years, except for the North region. In the Acadian peninsula (North) there was a sense that the 2023 abundance was significantly lower than previous years (Table 3). For abundances for the Middle and South region, respondents indicated a status quo (Table 3).

In the fall fishery, 2⁵/₈" mesh is the most common. However, many fishers started using bigger mesh sizes (2³/₄") in 1992. By 2002, the proportion of 2⁵/₈" mesh reverted to pre-1992 numbers. The proportion of 2⁵/₈" mesh in 2022 and 2023 was 100% (Table 3).

FISHERY SAMPLING

Commercial fishery catches are sampled dockside by DFO scientific personnel for the fixed and mobile fisheries, and at sea by fisheries observers in the mobile fishery. Sampling procedures are designed to obtain samples that are spatially and temporally representative of landings. The landings and samples by area used to calculate catch-at-age are shown in Table 2. The samples are used to determine the size, age, and spawning components (spring spawners or fall spawners) composition of the catch. Catch-at-age and weight-at-age matrices by spawning component (spring; fall) and type of gear (fixed and mobile) are presented in Tables 4-11 and Figures 5-8. Catch-per-unit-effort by age and spawning component (spring; fall) is presented in Tables 12-14 and Figures 9-14. Catchability is presented in Figures 15-18.

FISHERY-INDEPENDENT ACOUSTIC SURVEY

Since 1991, an annual fishery-independent acoustic survey of early fall (September-October) concentrations of Herring has been conducted in the sGSL. The standard annual survey area occurs in the 4Tmno areas where both NAFO Div. 4T Herring spawning components aggregate in the fall. The survey uses a random stratified design of parallel transects within predefined strata. The survey is conducted at night and uses two vessels: an acoustic vessel to quantify the fish schools biomass using a hull-mounted 120 kHz split-beam transducer, and a fishing vessel to sample aggregates of fish with a pelagic (details in LeBlanc et al. 2015; see also LeBlanc and Dale 1996) or bottom trawl.

The acoustic survey covered 87.5% and 94.0% of the transects in 2022 and 2023, respectively (Appendix A Figure A1). All strata were covered in 2022 and 2023. The trawl samples are used to separate the estimated biomass by spawning component and age, determine species composition, and size distribution for the estimation of the target strength (LeBlanc and Dale 1996; LeBlanc et al. 2015). Catch-at-age matrix for the fishery-independent acoustic survey is presented in Table 15 and Figure 19.

SPAWNING GROUND ACOUSTIC SURVEY

In 2015, a spawning ground acoustic survey that follows the design of the fishery-independent acoustic survey described above was initiated. This survey is the result of a partnership between DFO and fishery associations. The survey design uses random parallel transects

within predefined strata that cover the same spawning grounds as the experimental nets (Appendix B). Surveys are conducted by fishermen in the fall fishing season according to protocols developed by DFO. The survey is conducted at night, during the weekend fishery closures except in Herring fishing area 16C and 16E in 2015 to 2017 (Middle; Figure 1A), where this region didn't have weekend closures. The spawning ground acoustic survey is meant to provide a nightly estimate of spawning biomass among regions. It is analyzed in the same manner as the fishery-independent acoustic survey. The catches from the experimental nets are used to calibrate the spawning group specific target strength in order to obtain the nightly estimates of spawning biomass. FSCP index is presented in Figures 20-21 and the detailed results of the 2022-2023 surveys are available in Appendix B.

EXPERIMENTAL NETS

As part of an industry partnership project between DFO and fishery associations, experimental gillnets consisting of multiple panels of varying mesh size were deployed weekly by fishermen during the fall fishing season. These modified gillnets catch a wider range of fish sizes and provide information on the relative selectivity of various mesh sizes. Each experimental gillnet had five panels, each with a different mesh size, from a set of seven possible mesh sizes, ranging from 2" to 2¾". Since 2015, all gillnets had panels with mesh sizes of 2", 2¼", 2½", 2⅝", and 2¾" in the fall. Harvesters in the fall fishing season participated in the study on the following spawning grounds (Figure 1A): Miscou Bank (North region; 16B), Gaspé (North; 16B), Escuminac (Middle; 16C), West PEI (Middle; 16E), Fisherman's Bank (South; 16G), and Pictou (South; 16F). The target fishing procedure was a one-hour soak and nets were set on the fishing grounds during the commercial fishery. Data from Pictou prior to 2015 were corrected for gillnet depth as nets in this region were 5 m (17 ft) deep compared with the standard 2.4 m (8 ft) used on other spawning grounds. A correction factor of 8/17 (in ft) was applied to the Pictou nets to address the difference in net depth size. Catches from the experimental nets were used to estimate the relative size-selectivity of gillnets of different mesh sizes (details in Surette et al. 2016) and to produce proportion-at-age, both of which are inputs to the fall spawners assessment model.

In spring, gillnets had panels with mesh size of 1¾", 2", 2¼", 2½", 2⅝". The use of experimental gillnets standardized across regions in spring only started in 2022 and a selectivity index is not yet in place for the spring spawner population model. Data from the spring experimental nets are still used in the catch-at-age matrices for years of fishery closure (2022-2023). Selectivity-at-age matrices from the fall experimental nets are presented in Table 16 and Figures 22-24.

MULTISPECIES BOTTOM-TRAWL SURVEY

The annual multi-species bottom trawl survey, conducted each September since 1971, provides information on the abundance and distribution of NAFO Div. 4T Herring throughout the sGSL in September (Savoie 2014). Total catch weights and numbers, representative length frequency and individual length-weight data has been recorded for each fish species in each survey set since 1971. Since 1994, additional sampling of Herring catches has been undertaken to disaggregate catches by spawning group and age (additional details in Hurlbut and Clay 1990). Herring were primarily caught near shore in waters < 30 fathoms, mostly off northeast P.E.I., west of Cape Breton, as well as in the Northumberland Strait, and Chaleur Bay (Appendix C, Figure C1). Catch-at-age matrix for the multispecies bottom-trawl survey is presented in Table 17 and Figure 25 and calculated biomass index is presented in Figures 26 and 27.

ECOSYSTEM INFORMATION

Sea temperature in the sGSL was abnormally high in summer and fall 2023, especially in the North region in the Chaleur Bay (Galbraith et al. 2024). High water temperature may affect spatial distribution of Atlantic Herring, which tends to avoid areas with higher sea surface temperatures (Maravelias 1997; Maravelias et al. 2000; Nøttestad et al. 2007). It is likely that warmer waters are associated to the low presence of Atlantic Herring in the North region in fall 2023. Warmer water temperatures increase energetic demands which can limit growth, resulting in smaller size-at-age Atlantic Herring with lower egg production (Burbank et al. 2023). Low presence of Atlantic Herring in historical spawning sites may be expected as sea temperatures increase with climate changes (Garcia-Soto et al. 2021), especially in the fall season which is subject to high water temperatures after the summer.

MODEL AND DATA PRESENTED

We used a Statistical Catch-at-Age model with time-varying catchability and time-varying mortality for age groups 2-6 years old and 7-11+ years old. The model is regionally-disaggregated for fall spawners (North, Middle, South), but not for the spring spawners due to limited data in some regions. For details on the model, please refer to Turcotte et al. 2021 and Rolland et al. 2022. This document is to support the Fisheries Science Advisory Report (FSAR) and thus, presents the results through figures and tables.

For spring spawner component, we present biomass estimates and abundances for start of the year (January 1st 2023) and start of the fishery season (April 1st 2023) in Tables 18-19 and Figure 28. Recruitment abundance and rate are presented in Figures 29-31. Natural mortality rate is presented in Figure 32 while fishing mortality rates are presented in Table 20 and Figure 33. Retrospective patterns are presented in Figure 34. Projections and risk analyses for different catch options are presented in Table 21 and Figures 35-38.

For the fall spawner component, we present biomass estimates and abundances for start of the year (January 1st 2023) and start of the fishery season (August 1st 2023) for North, Middle and South in Tables 22-29 and Figure 39. Recruitment abundance and rates are presented in Figures 40-42. Natural mortality rate is presented in Figure 44 while fishing mortality rates are presented for each region in Tables 30-33 and Figure 44. Retrospective patterns are presented in Figure 45. Projections and risk analyses for different catch options are presented in Table 34 and Figures 46-49.

DATA CHANGES

CATCH-AT-AGE MATRICES

Since 2020, the spawning biomass of Atlantic Herring in the sGSL (4TVn) has been assessed using a statistical Catch-at-age (SCA) model (Turcotte et al. 2021).

Prior to 2022, catch-at-age (CAA; see Tables 4;6;8 and 10 for examples), length-at-age and weight-at-age (WAA; see Tables 5;7;9 and 11 for examples) were estimated from automated code written in SAS (Statistical Analysis Software). In order to facilitate calculation and revise the methodology of the catch-at-age calculation, SAS code was translated in R language (R Core Team 2023). This improvement resulted in less than 2% change in value for length-at-age and less than 8% for weight-at-age. However, this revised methodology reassigned some samples in the proper fishing regions and spawning component, which slightly affected SSB estimates.

To run the model, catch-at age data is converted into proportion-at-age (i.e., proportion of fish that are of a certain age relative to total abundance) and number of fish-at-age by region and spawning component, which implies multiple adjustments depending on location and gear type (e.g., fixed gear vs mobile gear). Using the new CAA output from the R code, we automated this process by reproducing calculations that were previously conducted in pivot tables in Microsoft Excel. This automation identified calculations mismatches in proportion-at-age, which affected the SSB. After addressing the mismatches, population trends were left unchanged across spawning component and regions, but mean values shifted. For fall fishery, SSB from the automated code were ~30% higher in the North, ~20% lower in the Middle and ~7% lower in the South across the time series (Appendix D). For the Spring, SSB were ~14% higher across the time series (Appendix D). Some of these variations are due to the CAA translation from SAS to R, but most of them are associated to the calculations automatization and translation from Excel to R. Overall, the improvements on the code translate into more accurate biomass estimates and a diminution of retrospective patterns (-0.01 to -0.24; Figure 34), which were previously abnormal (< -0.22; Hurtado-Ferro et al. 2014).

CATCH-PER-UNIT-EFFORT FOR SPRING SPAWNING COMPONENT

Since the closure of the 4T spring Atlantic Herring fishery in 2022, there are no commercial landings data available for 2022 and 2023 to calculate catch-per-unit-effort (CPUE) and catch-at-age matrices (CAA). To address this lack of data, a small-scale experimental commercial net program was set up in spring 2023 and will continue in 2024. The catches were also sampled by DFO port samplers to inform the catch-at-age index.

This small-scale fishery is different than a commercial fishery, as parameters are standardized across fishermen and regions. The CPUE index from commercial fishery is generally evaluated from the phone survey and logbooks, the latest often missing a lot of information. A CPUE index derived from the small-scale scientific fishery would be much more accurate as we determined effort *a priori*. Therefore, it is unclear if both CPUE indices (commercial fishery and scientific fishery) is truly comparable to each other. While both may be used in the biomass estimates, it is unclear if they should be used together or as separate indexes. Given this uncertainty, we decided to exclude the scientific CPUE index in the spring component model for now. A few years of the scientific fishery will be needed to understand the differences and relationship between the commercial index and the scientific index, which can be expected to inform the next stock assessment.

We tested whether the unavailability of values from the CPUE index for 2022 and 2023 likely impacted our biomass estimates for those years. To do so, the 2021 model (model with the latest value available) was rerun without the CPUE index (put as null from 1990 to 2021). The resulting difference in SSB was 2.82 kilotonnes (kt) on average [2.47;3.17] (~10% of 2023 biomass estimate), with a generally higher SSB observed for the model with the CPUE index (Figure 50). The confidence interval on the SSB estimates was generally wider for the model including the CPUE index (average difference : 22.72 kt [19.25;26.21]). Overall, the differences regarding the estimation of the SSB and the results suggest that SSB estimates computed without a CPUE index are still reliable.

PROJECTIONS FOR FALL SPAWNING COMPONENT

Projections for the fall spawning component show a large confidence interval and a steep increase (Figures 47 and 49) reaching the USR without exceeding it for all catch options. The risk analysis predicts a probability of exceeding the USR of 46-52% in 2025 and 28-34% in 2026. While these projections appear optimistic, they are unrealistic and unsupported by current

recruitment and biomass estimates. Therefore stock advice would be better informed from 2023 SSB estimates than from the projections.

In our SCA model, projections are largely driven by recruitment i.e., number of fish at age 2 (Figure 40). Number of fish at age 2 is mostly estimated by the fishery-independent acoustic survey in the model. Since 2006, there have been close to no landings of age 2 fish in the Middle and the South region and very low in the North since 2011. Given the limited landings of age 2 fish in the recent years, our estimates of recruitment are very limited, especially in the Middle and South regions, and are optimized by the model. When looking at recent recruitments (Figures 40-42) or number of age 2 fish from the acoustic survey (Figure 19), numbers are not especially high, except for a slightly higher number of recruits in 2022, which represent only one stronger cohort. Additionally, age 3 fish seem to be slightly heavier in 2022 and 2023 than in previous years, which translates into higher biomass estimates in the projections.

Yet, SCA models are very sensitive to sudden increases in fish abundance, which paired with low estimates of mortality-at-ages 2-6 (Figure 43) can result in overoptimistic projections (Figures 47 and 49). In 2024-2029 projections, the optimistic increase is only responding to a stronger estimate of age 2 mostly based on the 2022 estimates, and not necessarily representative of the overall small abundance of recruits observed in the recent years. Additionally, confidence intervals are wide which reflect the relatively high uncertainty around these projections.

Indices of abundance and current biomass estimates do not show indication or support for the high one-year spike observed in the projections for 2024. Indeed, in 2022 and 2023, we observed low catches, low biomass in experimental net and multi-species survey, poor environmental conditions detrimental to larvae survival and adult reproductive output, which do not suggest any future increase in biomass. In summary, the model shows a high sensitivity to small increases in abundance and projections are likely overoptimistic.

Even if these projections were probable and SSB was meant to increase substantially as early as 2024, this stronger cohort would be at age 4 in 2024, meaning only one year into reproductive maturity. Younger, smaller fish are known to produce fewer eggs (Hixon et al. 2014), and extensively fishing (> the catch option presented) this cohort may not enable the population to sustain a higher SSB in the long-term as they would not be given multiple chances to reproduce as they grow. Looking back at the population trends, the only rapid increase that may resemble our projections are in 2008-2010 (Figure 39). Yet, that increase spanned over a least 2 years and was followed several years of high recruitment (Figure 40). Additionally, this sudden boom was followed by a rapid decline and was not sustained for more than a season (Figure 39).

Many avenues may improve our projections, and would follow a conservative approach. As a next step, sensitivity analyses will be performed to quantify the role of Age 2 estimates in these projections and focus our array of solutions to increase the precision of the projection calculations. Including environmental variables to estimate recruitment or considering other methods of modelling projections would likely help reduce this uncertainty.

In light of recent stock trends and unfavourable environmental conditions, caution should be taken when interpreting projections, as they are based on unrealistic estimates of natural mortality and recruitment, which result in an overoptimistic trend. Given these considerations, and the aforementioned historical trends in stock biomass estimates (i.e., 2010), stock advice would be better informed from 2023 SSB estimates than from the projections.

CONCLUSION

Since the last assessment, we continued to collect data from our various data sources to inform our population models. We improved the calculations of catch-at-age matrices with translating previous SAS code and Excel sheets in the more versatile R language. These changes improved the accuracy of our estimates and our ability to reproduce the data in the long-term. These changes also decreased the magnitude of retrospective patterns, previously abnormal, which increase our confidence in our SSB estimates. Nevertheless, there are still uncertainties regarding the spring and fall populations, especially regarding rising sea temperature, which may change spatial distribution of Atlantic Herring and affect other demographic metrics (i.e., recruitment).

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TABLES

Table 1. Landings (in tonnes) of 4TVn Herring in the spring and fall fisheries by gear (fixed and mobile) and spawning group (SS=spring spawners and FS=fall spawners). TAC allocations and target catches are also provided, as TAC is higher than the targeted catch decision due to historical shares between regions.

Year	Spawning group	4T catch				Annual 4T catch	Annual 4Vn catch	Total catch 4TVn	TAC 4TVn	Target catch
		Spring fishery		Fall fishery						
		Fixed	Mobile	Fixed	Mobile					
1981	SS	6,288	20	293	1,411	8,012	822	-	-	-
	FS	1,212	1	10,932	5,192	17,336	2,594	-	-	-
	Total	7,500	21	11,225	6,603	25,349	3,416	28,765	19,000	-
1982	SS	5,692	57	292	1,409	7,449	834	-	-	-
	FS	230	5	12,690	4,678	17,604	2,674	-	-	-
	Total	5,923	62	12,982	6,087	25,054	3,508	28,562	18,000	-
1983	SS	7,655	17	423	2,773	10,868	1,307	-	-	-
	FS	865	2	13,417	4,694	18,978	2,672	-	-	-
	Total	8,520	19	13,840	7,467	29,846	3,979	33,825	25,000	-
1984	SS	4,434	3	303	2,270	7,011	1,376	-	-	-
	FS	847	1	15,671	3,933	20,451	2,549	-	-	-
	Total	5,281	4	15,974	6,203	27,462	3,925	31,387	22,500	-
1985	SS	6,719	0	1,287	3,187	11,193	1,082	-	-	-
	FS	498	0	22,420	7,255	30,173	2,388	-	-	-
	Total	7,217	0	23,707	10,442	41,366	3,470	44,836	36,000	-
1986	SS	7,153	0	3,181	9,553	19,887	2,782	-	-	-
	FS	1,397	0	36,710	5,711	43,818	1,568	-	-	-
	Total	8,550	0	39,891	15,264	63,705	4,350	68,055	47,600	-
1987	SS	10,419	0	2,538	10,907	23,865	1,446	-	-	-
	FS	1,340	0	49,590	5,190	56,120	917	-	-	-
	Total	11,759	0	52,128	16,098	79,985	2,363	82,348	77,000	-
1988	SS	9,165	0	2,843	13,579	25,587	1,766	-	-	-
	FS	3,720	0	38,368	6,296	48,383	806	-	-	-
	Total	12,885	0	41,211	19,875	73,970	2,572	76,542	83,100	-
1989	SS	9,061	0	1,691	10,047	20,799	1,302	-	-	-
	FS	2,032	0	32,158	6,306	40,496	815	-	-	-
	Total	11,093	0	33,850	16,352	61,295	2,117	63,412	91,100	-
1990	SS	4,330	1	1,898	9,841	16,070	3,088	-	-	-
	FS	4,730	0	55,223	5,175	65,129	1,623	-	-	-
	Total	9,060	1	57,121	15,016	81,198	4,711	85,909	91,100	-
1991	SS	12,075	5	178	5,217	17,475	1,902	19,377	21,000	-
	FS	817	13	26,966	7,628	35,424	2,888	38,312	70,100	-
	Total	12,892	18	27,144	12,845	52,899	4,790	57,689	91,100	-

Year	Spawning group	4T catch				Annual 4T catch	Annual 4Vn catch	Total catch 4TVn	TAC 4TVn	Target catch
		Spring fishery		Fall fishery						
		Fixed	Mobile	Fixed	Mobile					
1992	SS	12,289	640	322	3,820	17,071	493	17,564	21,000	-
	FS	186	478	32,757	7,523	40,944	3,735	44,679	70,100	-
	Total	12,475	1,119	33,079	11,343	58,016	4,228	62,244	91,100	-
1993	SS	14,644	1,526	780	4,171	21,120	434	21,554	21,000	-
	FS	538	1,190	22,318	6,005	30,051	3,517	33,568	85,000	-
	Total	15,182	2,716	23,098	10,176	51,171	3,951	55,122	106,000	-
1994	SS	18,497	887	481	3,922	23,786	568	24,354	21,000	-
	FS	517	3,051	53,331	6,282	63,182	2,681	65,863	85,000	-
	Total	19,014	3,938	53,812	10,204	86,968	3,249	90,217	106,000	-
1995	SS	15,137	950	2,102	8,140	26,329	470	26,799	21,000	-
	FS	836	875	54,163	11,268	67,142	3,674	70,816	85,000	-
	Total	15,973	1,825	56,265	19,408	93,471	4,144	97,615	106,000	-
1996	SS	15,407	441	1,365	5,010	22,224	1,033	23,257	15,114	-
	FS	668	1,466	44,407	7,278	53,817	3,234	57,051	58,749	-
	Total	16,075	1,907	45,772	12,288	76,041	4,267	80,308	73,863	-
1997	SS	12,844	614	98	3,854	17,410	231	17,641	16,500	-
	FS	380	888	34,973	5,474	41,717	3,299	45,016	50,000	-
	Total	13,225	1,502	35,071	9,328	59,126	3,530	62,656	66,500	-
1998	SS	13,381	297	121	1,420	15,219	2	15,221	16,500	-
	FS	528	707	39,008	3,207	43,450	50	43,500	57,568	-
	Total	13,909	1,004	39,129	4,628	58,670	52	58,722	74,068	-
1999	SS	10,255	688	176	3,754	14,872	0	14,872	18,500	-
	FS	1,625	4,130	44,616	5,332	55,703	0	55,703	60,500	-
	Total	11,880	4,817	44,792	9,086	70,575	0	70,575	79,000	-
2000	SS	14,586	10	706	2,304	17,606	0	17,606	16,500	-
	FS	1,596	538	49,681	6,373	58,188	0	58,188	71,000	-
	Total	16,181	549	50,388	8,677	75,795	0	75,795	87,500	-
2001	SS	9,938	459	736	2,952	14,085	0	14,085	12,500	-
	FS	659	638	44,785	7,281	53,363	0	53,363	60,500	-
	Total	10,597	1,097	45,521	10,233	67,448	0	67,448	73,000	-
2002	SS	8,137	420	673	700	9,930	0	9,930	8,000	-
	FS	973	464	41,286	10,897	53,620	0	53,620	51,500	-
	Total	9,109	884	41,959	11,597	63,550	0	63,550	59,500	-
2003	SS	8,458	41	37	447	8,983	0	8,983	11,000	-
	FS	608	60	47,769	12,780	61,217	0	61,217	62,000	-
	Total	9,065	101	47,806	13,227	70,200	0	70,200	73,000	-
2004	SS	7,671	21	122	403	8,217	0	8,217	13,500	-
	FS	374	31	35,905	7,089	43,398	0	43,398	73,000	-
	Total	8,045	52	36,026	7,492	51,615	0	51,615	86,500	-

Year	Spawning group	4T catch				Annual 4T catch	Annual 4Vn catch	Total catch 4TVn	TAC 4TVn	Target catch
		Spring fishery		Fall fishery						
		Fixed	Mobile	Fixed	Mobile					
2005	SS	3,571	0	14	1,055	4,641	0	4,641	11,000	-
	FS	925	0	51,715	7,756	60,396	0	60,396	70,000	-
	Total	4,496	0	51,729	8,811	65,036	0	65,036	81,000	-
2006	SS	1,409	0	293	741	2,444	0	2,444	9,000	-
	FS	1,256	0	47,630	4,410	53,296	0	53,296	68,800	-
	Total	2,666	0	47,923	5,151	55,740	0	55,740	77,800	-
2007	SS	1,734	0	10	2,383	4,127	0	4,127	5,000	-
	FS	496	0	43,159	4,427	48,082	0	48,082	68,800	-
	Total	2,230	0	43,170	6,809	52,209	0	52,209	73,800	-
2008	SS	1,503	0	35	1,453	2,991	0	2,991	2,500	-
	FS	187	0	38,827	2,738	41,752	0	41,752	68,800	-
	Total	1,690	0	38,863	4,190	44,743	0	44,743	71,300	-
2009	SS	1,256	0	70	518	1,844	0	1,844	2,500	-
	FS	94	0	44,783	1,939	46,815	0	46,815	65,000	-
	Total	1,349	0	44,853	2,457	48,659	0	48,659	67,500	-
2010	SS	935	5	2	595	1,536	0	1,536	2,000	-
	FS	220	297	42,460	4,153	47,131	0	47,131	65,000	-
	Total	1,155	302	42,462	4,748	48,667	0	48,667	67,000	-
2011	SS	880	0	18	663	1,561	0	1,561	2,000	-
	FS	163	0	36,882	1,372	38,417	0	38,417	65,000	-
	Total	1,043	0	36,900	2,035	39,978	0	39,978	67,000	-
2012	SS	442	5	68	259	774	0	774	2,000	-
	FS	229	223	31,895	377	32,724	0	32,724	43,500	-
	Total	671	228	31,963	636	33,498	0	33,498	45,500	-
2013	SS	1,037	155	1	547	1,740	0	1,740	2,000	-
	FS	58	3,049	30,004	1,505	34,616	0	34,616	43,500	-
	Total	1,095	3,204	30,005	2,053	36,356	0	36,356	45,500	-
2014	SS	632	46	145	494	1,317	0	1,317	2,000	-
	FS	73	1,895	25,771	1,406	29,146	0	29,146	35,000	-
	Total	705	1,941	25,916	1,901	30,463	0	30,463	37,000	-
2015	SS	579	43	3	565	1,190	0	1,190	2,000	-
	FS	7	1,390	25,965	777	28,140	0	28,140	40,000	-
	Total	586	1,433	25,969	1,343	29,330	0	29,330	42,000	-
2016	SS	274	29	45	146	495	0	494.85694	2,000	-
	FS	17	776	23,192	625	24,609	0	24,609	35,000	-
	Total	291	805	23,237	771	25,103	0	25,103	37,000	-
2017	SS	928	4	215	42	1,189	0	1,189	2,000	-
	FS	18	86	20,614	39	20,756	0	20,756	35,000	-
	Total	946	90	20,828	81	21,945	0	21,945	37,000	-

Year	Spawning group	4T catch				Annual 4T catch	Annual 4Vn catch	Total catch 4TVn	TAC 4TVn	Target catch
		Spring fishery		Fall fishery						
		Fixed	Mobile	Fixed	Mobile					
2018	SS	438	58	99	203	798	0	798	500	500
	FS	39	1,188	15,185	330	16,741	0	16,741	25,200	16
	Total	477	1,246	15,283	533	17,539	0	17,539	25,200	16,5
2019	SS	484	0	44	518	1,046	0	1,046	1,250	500
	FS	56	0	14,844	644	15,545	0	15,545	22,250	16
	Total	541	0	14,888	1,163	16,592	0	16,592	23,500	16,5
2020	SS	343	0	18	286	647	0	647	500	-
	FS	76	0	9,656	360	10,092	0	10,092	12,000	-
	Total	419	0	9,674	646	10,739	0	10,739	12,500	-
2021	SS	379	0	17	0	396	0	396	500	-
	FS	25	0	10,801	9	10,835	0	10,835	12,000	-
	Total	403	0	10,819	9	11,231	0	11,231	12,500	-
2022	SS	0	0	236	7	243	0	243	0	-
	FS	0	0	9,312	15	9,328	0	9,328	10,000	-
	Total	0	0	9,548	22	9,571	0	9,571	10,000	-
2023	SS	6	0	82	0	88	0	88	0	-
	FS	0	0	5,518	0	5,519	0	5,519	10,000	-
	Total	6	0	5,600	0	5,606	0	5,606	10,000	-

Table 2. Commercial fishery samples collected, number of fish processed (N), landings, and % TAC landed by zone in the spring (April 1-June 30) and fall (July 1-December 31). These data are used to derive the 2022 and 2023 catch and weight-at-age matrices for 4T Herring.

Gear/ Region	Fishery	Zone	Samples	N	Landings (t)	% TAC landed
a) 2022						
Fixed Gear - Gillnets						
Spring						
	Gaspé (16A) May-June	4Topq	0	0	0.02	0.4
	Chaleur (16B) April-May-June	4Tmn	6	75	0.04	0.1
	East P.E.I. April-May-June	4Tgj	0	0	0.00	0.0
	Northumberland Strait (16E) April-May-June	4Th	4	56	0.00	0.0
	West P.E.I. (16E) April-May	4TI	2	65	0.00	0.0
	I. de la Madeleine (16D) April-May	4Tf	0	0	0.00	0.0
Fall						
North	Gaspé (16A) July	4Topq	0	0	5.0	41.8
North	Chaleur (16B) July-August	4Tmn	6	135	2665.5	66.0
North	Chaleur (16B) September - October	4Tmn	14	338	2387.1	
Middle	Escuminac-W P.E.I. (16CE) September	4TI	4	98	351.1	15.6
Middle	Escuminac-W P.E.I. (16CE) October	4TI	2	48	77.2	
South	I. de la Madeleine (16D)	4Tf	0	0	0	0.0
South	Pictou (16F) July - September-October	4Th	6	136	3242.9	213.5
South	East P.E.I. (16G) August - October	4Tgj	0	0	819.6	81.1
	Total Fixed gear	4T	44	951	9548.6	95.5
Mobile Gear						
North	East of Grande-Anse (16B) September-November	4Tmn	2	59	22.2	3.1
	Total Mobile Gear	4T	2	59	22.2	0.1
b) 2023						
Fixed Gear - Gillnets						
Spring						
	Gaspé (16A) April-May	4Topq	0	0	0.0	0
	Chaleur (16B) April-May	4Tmn	9	118	0.2	0.1
	East P.E.I. April-May	4Tgj	4	58	1.1	0.4
	Northumberland Strait (16E) April-May	4Th	3	44	1.4	0.5
	West P.E.I. (16E) April-May-June	4TI	17	345	4.2	1.4
	I. de la Madeleine (16D) April-May	4Tf	0	0	0.0	0

Gear/ Region	Fishery	Zone	Samples	N	Landings (t)	% TAC landed
Fall						
North	Gaspé (16A) July - Sept	4Topq	0	0	0.2	1.2
North	Chaleur (16B) July-August	4Tmn	4	108	759.3	30.3
North	Chaleur (16B) September - October	4Tmn	12	364	835.0	67.7
North	Escuminac-W P.E.I. (16CE) July - August - September	4TI	6	172	1113.9	67.7
Middle	Escuminac-W P.E.I. (16CE) October	4TI	2	55	386.6	67.7
South	I. de la Madeleine (16D) September-October	4Tf	0	0	0.0	0.0
South	Pictou (16F) July - September - October	4Th	4	93	1846.0	152.3
South	East P.E.I. (16G) September - October	4Tgj	4	116	590.0	194.7
Total fixed gear		4T	65	1473	5537.9	55.4
Mobile Gear						
North	East of Grande-Anse (16B) November	4Tmn	0	0	0.0	0.0
Total Mobile Gear		4T	0	0	0.0	0.0

Table 3. Comparison of 2022 and 2023 DMP and telephone survey results including number of respondents, mean net length (fathoms), numbers of nets set, percentage of nets of mesh size 2⁵/₈" in the fall fishery, and a comparative index abundance from 2022 and 2023, respectively [scale 1 (poor) to 10 (excellent)].

Region	Telephone survey area	Source	Number of responses	Net length (fathom)	Number of nets set	% of 2 ⁵ / ₈ " mesh size	Comparison to previous year
2022							
Fall fishery							
		DMP	2	14.0	-	-	-
South	1 - Magdalen Islands	Phone	-	-	-	-	-
		DMP	37	14.0	-	-	-
North	2- Quebec	Phone	34	14.4	7.7	100	5.1
		DMP	65	14.5	8.2	100	-
North	3- Acadian Peninsula	Phone	56	13.9	7.6	100	5.1
		DMP	4	14.5	6.8	100	-
Middle	4- Escuminac	Phone	11	14.1	8.9	100	5.6
		DMP	1	14.0	7.2	100	-
Middle	5- Southeast NB	Phone	2	13.8	8.8	100	6.0
		DMP	75	16.1	6.2	100	-
South	6- Nova Scotia	Phone	46	14.8	6.1	100	5.3
		DMP	26	14.0	6.3	100	-
South	7- East P.E.I.	Phone	11	13.2	7.4	100	5.3
		DMP	17	14.2	6.6	100	-
Middle	8- West P.E.I.	Phone	13	14.0	8.9	100	5.9
2023							
Fall fishery							
		DMP	2	14.0	-	-	-
South	1 - Magdalen Islands	Phone	-	-	-	-	-
		DMP	17	14.0	-	-	-
North	2- Quebec	Phone	-	-	-	-	-
		DMP	83	14.9	8.1	100	-
North	3- Acadian Peninsula	Phone	50	13.9	7.6	100	0.5
		DMP	5	14.2	8.2	100	-
Middle	4- Escuminac	Phone	2	12.5	8.9	100	5.0
		DMP	1	14.0	9.0	100	-
Middle	5- Southeast NB	Phone	-	-	-	-	-
		DMP	81	17.8	4.8	100	-
South	6- Nova Scotia	Phone	39	15.0	6.4	100	4.0
		DMP	24	14.2	6.7	100	-
South	7- East P.E.I.	Phone	2	13.0	7.2	100	5.0
		DMP	24	12.9	8.1	100	-
Middle	8- West P.E.I.	Phone	10	14.0	9.9	100	5.1

Table 4. Spring spawner catch-at-age (thousands) for fixed gear in the 4T Herring fishery.

Year	2	3	4	5	6	7	8	9	10	11+	Total
1978	44	6026	25253	1042	2123	660	243	370	1561	752	38072
1979	112	7352	2544	17559	540	842	127	127	327	1421	31050
1980	217	9420	6744	2378	9068	1424	807	612	442	720	31831
1981	438	11843	7099	1941	1399	3051	415	422	171	882	27664
1982	216	23577	4191	988	421	299	315	143	88	618	30868
1983	155	13547	26209	2142	472	76	0	0	8	0	42608
1984	39	3377	12082	7529	409	59	14	7	4	0	23538
1985	39	4921	12686	13742	4629	614	100	32	71	0	36833
1986	11	2712	13905	12357	10348	2783	391	20	233	349	43109
1987	10	1232	6164	20071	11410	9674	4080	947	512	258	54357
1988	549	3536	6298	9353	14600	6944	5246	935	68	269	47859
1989	0	3941	15672	4836	4912	6957	4326	2598	1025	279	44546
1990	128	1925	7387	4109	2178	2532	3928	1827	733	306	25054
1991	0	6070	11715	14139	9142	3166	2897	4448	1640	1097	54314
1992	0	2160	30046	11543	7579	3460	1593	1956	1423	2263	62024
1993	8	231	5487	40373	18381	4900	2409	1375	708	2724	76596
1994	0	2061	5847	24642	48553	9048	3595	1221	438	1032	96438
1995	0	200	13344	10781	17781	28929	6408	1788	1156	2271	82660
1996	0	416	1682	48104	9122	14153	9414	3102	590	1087	87671
1997	2	107	5440	4068	37818	6961	4149	3938	1015	179	63678
1998	0	785	7743	15785	2264	29871	3421	2449	1966	875	65158
1999	89	1724	6599	9410	10297	2255	16045	2583	1342	1155	51499
2000	12	2141	11978	15975	15248	7568	4457	11675	2912	1756	73722
2001	0	910	11316	13082	9859	4920	3360	1387	6593	1735	53164
2002	1	2507	7039	18341	7620	3604	2072	1150	1051	1213	44600
2003	0	285	10767	11071	12831	3925	2483	998	686	759	43803
2004	21	1608	2606	15101	5400	8500	3223	1164	413	1005	39040

Year	2	3	4	5	6	7	8	9	10	11+	Total
2005	0	72	3639	3209	5784	2561	2023	566	125	174	18153
2006	1	719	1299	4653	1652	528	285	387	28	73	9626
2007	1	864	2037	1563	2323	1738	803	196	149	110	9784
2008	71	177	2812	3111	1139	1261	269	52	23	12	8928
2009	23	411	1060	2445	3033	344	349	91	6	14	7775
2010	0	144	1107	860	1559	766	366	358	4	13	5177
2011	0	25	116	885	812	1102	512	782	287	5	4526
2012	0	153	400	400	609	671	340	225	186	84	3068
2013	0	16	303	963	1157	1492	1141	814	50	39	5973
2014	0	1	99	453	772	866	1076	558	221	67	4111
2015	0	0	103	157	783	1195	535	396	76	41	3287
2016	0	24	13	147	414	601	426	151	17	3	1797
2017	6	88	703	746	1977	1617	1207	276	49	3	6673
2018	0	10	57	832	648	940	346	107	4	0	2944
2019	0	13	261	604	1338	428	539	107	16	0	3306
2020	0	43	244	496	447	491	367	43	38	12	2183
2021	0	0	57	292	392	748	657	108	26	9	2290
2022	0	0	0	0	197	60	467	90	0	381	1195
2023	0	0	8	82	228	31	79	3	1	0	432

Table 5. Spring spawner weight-at-age (kg) for fixed gear in the 4T Herring fishery.

Year	2	3	4	5	6	7	8	9	10	11+
1978	0.154	0.148	0.187	0.215	0.251	0.283	0.318	0.308	0.337	0.364
1979	0.161	0.163	0.198	0.226	0.243	0.313	0.335	0.352	0.326	0.360
1980	0.184	0.167	0.189	0.231	0.278	0.304	0.334	0.359	0.369	0.379
1981	0.156	0.178	0.232	0.267	0.318	0.343	0.350	0.374	0.411	0.419
1982	0.186	0.173	0.207	0.261	0.311	0.370	0.385	0.396	0.416	0.449
1983	0.170	0.148	0.206	0.236	0.258	0.343	-	-	0.361	-

Year	2	3	4	5	6	7	8	9	10	11+
1984	0.104	0.174	0.196	0.217	0.289	0.340	0.404	0.490	0.369	-
1985	0.213	0.169	0.198	0.229	0.266	0.315	0.315	0.329	0.432	-
1986	0.111	0.183	0.210	0.242	0.261	0.307	0.348	0.336	0.364	0.392
1987	0.091	0.192	0.196	0.218	0.249	0.267	0.280	0.317	0.310	0.377
1988	0.080	0.160	0.197	0.237	0.265	0.290	0.307	0.335	0.369	0.359
1989	-	0.165	0.202	0.229	0.257	0.291	0.301	0.314	0.328	0.300
1990	0.153	0.169	0.203	0.241	0.273	0.297	0.290	0.311	0.322	0.339
1991	-	0.146	0.182	0.219	0.246	0.260	0.292	0.303	0.320	0.319
1992	-	0.145	0.172	0.201	0.232	0.255	0.274	0.291	0.299	0.332
1993	0.135	0.127	0.164	0.186	0.207	0.244	0.252	0.268	0.294	0.292
1994	-	0.141	0.156	0.177	0.200	0.218	0.249	0.314	0.272	0.304
1995	0.116	0.182	0.160	0.179	0.202	0.222	0.245	0.271	0.301	0.322
1996	-	0.157	0.182	0.173	0.193	0.209	0.233	0.230	0.275	0.277
1997	0.133	0.131	0.162	0.183	0.200	0.213	0.233	0.246	0.246	0.303
1998	-	0.137	0.161	0.185	0.206	0.221	0.240	0.246	0.257	0.278
1999	0.121	0.120	0.149	0.176	0.204	0.220	0.230	0.244	0.254	0.269
2000	0.114	0.131	0.158	0.184	0.207	0.225	0.250	0.253	0.262	0.273
2001	-	0.135	0.158	0.182	0.198	0.223	0.236	0.257	0.260	0.270
2002	0.098	0.141	0.165	0.188	0.205	0.227	0.251	0.270	0.279	0.289
2003	-	0.143	0.160	0.184	0.202	0.223	0.233	0.253	0.260	0.280
2004	0.130	0.134	0.149	0.178	0.203	0.229	0.238	0.254	0.262	0.288
2005	0.075	0.134	0.152	0.172	0.201	0.221	0.252	0.253	0.269	0.308
2006	0.12	0.132	0.147	0.169	0.196	0.221	0.246	0.248	0.293	0.242
2007	0.108	0.139	0.152	0.169	0.185	0.194	0.212	0.253	0.246	0.234
2008	0.137	0.144	0.158	0.164	0.181	0.203	0.237	0.240	0.268	0.297
2009	0.118	0.144	0.155	0.165	0.173	0.205	0.209	0.253	0.223	0.206
2010	-	0.121	0.148	0.157	0.189	0.202	0.225	0.234	0.248	0.268

Year	2	3	4	5	6	7	8	9	10	11+
2011	-	0.112	0.144	0.170	0.179	0.199	0.217	0.229	0.250	0.233
2012	-	0.154	0.140	0.143	0.155	0.169	0.186	0.190	0.222	0.220
2013	-	0.119	0.134	0.147	0.160	0.181	0.187	0.203	0.217	0.224
2014	-	0.114	0.153	0.160	0.170	0.190	0.197	0.208	0.226	0.226
2015	-	0.095	0.133	0.144	0.163	0.176	0.188	0.208	0.188	0.231
2016	-	0.126	0.127	0.147	0.176	0.176	0.187	0.200	0.213	0.203
2017	0.125	0.148	0.138	0.150	0.176	0.177	0.186	0.185	0.197	0.212
2018	-	0.138	0.143	0.168	0.178	0.191	0.200	0.201	0.216	0.225
2019	-	0.114	0.136	0.140	0.158	0.167	0.187	0.186	0.218	-
2020	-	0.114	0.113	0.148	0.166	0.179	0.199	0.184	0.258	0.209
2021	-	0.126	0.142	0.153	0.160	0.179	0.182	0.187	0.193	0.209
2022	-	0.120	0.125	0.152	0.189	0.250	0.202	0.237	-	0.178
2023	-	0.126	0.149	0.160	0.220	0.180	0.210	0.189	0.215	0.215

Table 6. Fall spawner catch-at-age (thousands) for fixed gear in the 4T Herring fishery, by region: a) North, b) Middle, c) South.

Year	2	3	4	5	6	7	8	9	10	11+	Total
a) NORTH											
1978	0	216	3,414	2,450	510	432	2,709	50	81	1,189	11,050
1979	0	168	3,271	1,465	1,260	256	644	531	252	267	8,113
1980	26	3,056	1,471	1,648	233	1,154	129	110	147	0	7,974
1981	23	3,963	12,839	2,839	593	240	278	53	99	60	20,988
1982	0	1,726	5,625	11,797	1,746	331	202	64	40	62	21,593
1983	0	98	9,238	3,748	9,002	1,018	413	96	16	102	23,731
1984	0	453	7,434	6,808	3,462	3,133	556	113	108	71	22,140
1985	0	99	2,878	13,139	8,176	4,901	4,915	1,832	372	6	36,318
1986	0	617	9,919	9,734	21,934	15,361	7,286	3,326	447	770	69,393
1987	16	7,260	24,248	14,636	13,277	19,804	9,068	5,494	2,412	759	96,973
1988	0	152	14,470	24,858	9,543	8,464	7,752	4,121	1,998	1,953	73,312

Year	2	3	4	5	6	7	8	9	10	11+	Total
1989	0	283	12,133	19,801	21,160	10,289	4,716	5,928	2,655	2,118	79,082
1990	14	2,351	13,755	12,558	19,492	20,685	7,816	5,478	5,759	4,141	92,049
1991	0	131	28,732	7,306	5,390	7,996	7,653	2,463	1,539	2,511	63,722
1992	0	11	6,153	37,343	10,677	6,225	6,775	5,961	2,872	5,423	81,439
1993	0	82	2,051	21,080	24,447	3,430	1,918	1,975	559	712	56,254
1994	0	0	6,553	10,533	31,557	47,626	9,076	7,049	3,228	5,404	121,028
1995	0	23	3,298	23,949	11,096	26,765	28,407	4,969	3,188	3,483	105,177
1996	0	0	12,767	15,443	20,775	4,565	8,681	9,465	1,341	1,561	74,598
1997	0	367	8,897	30,662	9,453	8,423	1,621	2,817	2,524	732	65,496
1998	0	37	8,752	23,986	22,898	5,734	5,461	787	1,272	2,305	71,232
1999	0	175	19,794	23,825	29,631	10,527	2,083	1,327	362	517	88,242
2000	0	266	17,184	56,056	14,915	6,279	3,445	668	493	224	99,531
2001	0	516	22,863	28,903	29,781	4,552	2,051	561	175	228	89,628
2002	1	212	21,279	23,278	16,324	8,777	2,292	682	471	187	73,503
2003	0	235	11,578	24,362	16,356	11,533	13,769	3,447	1,512	948	83,741
2004	0	1	23,784	17,748	8,619	5,219	4,049	2,776	638	433	63,268
2005	0	1	5,034	56,213	22,400	8,627	4,759	2,861	2,025	184	102,103
2006	0	5	6,092	37,842	36,714	5,458	1,549	2,922	1,127	602	92,313
2007	0	32	5,160	15,268	34,716	23,879	5,096	951	887	561	86,550
2008	0	403	18,423	11,717	18,718	15,180	14,670	1,778	598	865	82,352
2009	0	532	22,607	38,575	10,619	10,493	6,117	1,701	302	253	91,200
2010	0	0	3,121	26,685	23,029	7,969	5,320	4,186	1,708	199	72,217
2011	0	0	1,657	6,387	26,763	24,243	2,750	3,140	2,850	773	68,564
2012	0	8	156	8,609	17,648	26,305	11,746	2,365	2,749	954	70,539
2013	0	0	1,053	9,007	29,030	20,828	10,692	2,295	183	102	73,191
2014	0	0	91	4,454	9,817	24,496	11,276	7,629	100	60	57,924
2015	0	0	91	2,684	19,072	14,182	17,093	5,314	844	225	59,506

Year	2	3	4	5	6	7	8	9	10	11+	Total
2016	0	23	1,288	5,314	14,491	17,913	12,473	3,986	1,870	318	57,678
2017	0	0	553	5,261	7,935	14,281	16,572	5,793	2,069	364	52,829
2018	0	0	0	849	10,205	12,361	9,637	4,674	1,679	201	39,606
2019	0	0	38	503	8,527	15,957	5,548	3,849	1,235	404	36,061
2020	0	0	153	579	2,079	10,049	8,069	5,047	1,298	192	27,466
2021	0	0	162	2,498	2,571	3,424	8,110	4,140	1,508	261	22,674
2022	0	2	137	664	4,538	3,795	3,731	5,327	3,760	972	22,927
2023	0	54	286	1,224	1,046	2,649	930	859	649	273	7,970
b) MIDDLE											
1978	0	38	601	749	220	442	2,005	9	59	1,139	5,262
1979	0	144	3,673	2,048	831	205	100	209	18	161	7,389
1980	0	424	964	2,283	579	271	225	282	107	96	5,232
1981	0	974	6,224	1,910	1,150	460	629	31	83	238	11,699
1982	0	29	1,653	1,559	210	139	116	0	0	31	3,737
1983	0	255	3,998	1,482	1,578	351	130	0	0	0	7,794
1984	0	41	1,908	2,723	937	1,001	315	77	11	6	7,019
1985	0	11	235	1,370	1,010	562	536	200	41	1	3,964
1986	0	47	1,600	1,328	2,455	1,120	435	200	27	46	7,257
1987	0	298	934	1,761	1,532	3,059	289	267	298	19	8,457
1988	0	817	3,091	2,817	2,473	1,135	1,189	886	15	0	12,424
1989	0	16	772	1,431	1,274	694	428	378	171	139	5,303
1990	0	219	1,923	1,390	1,508	2,655	548	382	298	64	8,987
1991	0	17	5,973	1,617	1,332	1,749	2,066	1,271	585	1,335	15,945
1992	0	12	3,880	9,415	1,284	534	304	220	106	249	16,004
1993	0	0	350	6,612	8,298	1,417	597	415	470	716	18,875
1994	0	0	850	1,373	6,908	9,293	1,134	359	439	741	21,099
1995	0	0	214	10,010	3,408	12,249	10,646	1,363	243	4,272	42,404

Year	2	3	4	5	6	7	8	9	10	11+	Total
1996	0	0	3,414	2,107	12,096	1,046	3,144	3,605	833	869	27,113
1997	0	285	4,835	10,979	1,980	4,125	782	938	1,026	639	25,588
1998	0	23	5,113	4,301	8,730	1,761	3,286	596	1,293	2,229	27,332
1999	0	0	9,709	12,903	5,104	3,222	1,303	2,854	278	1,330	36,703
2000	0	13	11,054	21,136	7,789	2,516	1,394	414	369	165	44,850
2001	0	383	5,519	13,581	9,633	2,919	630	208	0	293	33,166
2002	0	275	9,081	8,110	7,171	6,936	1,245	171	145	216	33,352
2003	0	123	5,648	11,842	5,541	3,737	3,739	839	110	156	31,736
2004	0	15	5,579	10,122	7,144	5,096	4,523	2,652	920	175	36,226
2005	0	0	2,355	14,518	11,757	3,536	3,046	2,099	895	66	38,272
2006	0	0	1,697	7,740	13,789	5,094	2,598	1,949	1,544	523	34,934
2007	0	193	1,197	3,429	9,509	9,811	3,736	1,509	733	454	30,571
2008	0	1,426	12,175	2,575	4,491	5,326	8,514	1,536	1,451	332	37,825
2009	0	101	8,185	14,543	3,368	7,438	3,578	1,245	530	245	39,232
2010	0	8	1,529	11,467	17,000	4,954	4,333	2,473	1,154	644	43,562
2011	0	0	405	2,089	12,157	15,610	2,973	2,237	2,101	631	38,202
2012	0	7	147	1,935	8,679	11,646	8,142	925	526	443	32,450
2013	0	7	590	1,125	7,042	10,527	6,451	2,488	201	43	28,474
2014	0	0	41	4,663	1,923	8,176	6,541	1,529	487	0	23,362
2015	0	0	165	1,052	10,058	4,474	7,592	2,986	1,060	0	27,388
2016	0	18	279	1,227	7,869	6,459	3,603	1,610	570	0	21,634
2017	0	25	128	1,032	3,573	6,650	8,169	4,645	638	23	24,883
2018	0	0	76	712	2,951	7,465	5,674	557	302	0	17,737
2019	0	0	103	187	1,689	5,691	2,695	3,532	1,081	216	15,194
2020	0	0	29	265	460	2,674	3,059	1,900	1,185	685	10,256
2021	0	6	80	758	917	1,175	3,145	1,736	437	205	8,460
2022	0	2	24	56	270	231	403	545	288	89	1,909

Year	2	3	4	5	6	7	8	9	10	11+	Total
2023	0	37	271	1,040	1,450	1,525	1,145	870	559	225	7,123
c) SOUTH											
1978	41	1,988	1,390	632	154	75	119	22	0	13	4,434
1979	16	267	4,634	2,198	773	263	292	175	52	205	9,785
1980	38	4,404	1,939	2,352	294	923	129	164	154	77	10,474
1981	42	1,158	5,336	2,185	1,049	531	310	88	99	24	10,822
1982	0	353	7,029	3,634	3,226	2,345	819	332	81	37	17,857
1983	0	467	7,485	5,047	3,237	1,011	1,266	477	47	161	19,198
1984	0	397	15,010	5,562	4,586	2,288	703	381	110	23	29,060
1985	0	89	3,442	15,465	6,385	3,221	2,234	509	333	29	31,706
1986	383	871	20,436	5,746	12,066	3,350	1,635	487	106	164	45,245
1987	0	1,083	11,141	12,821	6,139	14,100	6,213	4,292	1,851	1,323	58,964
1988	0	377	4,361	16,703	9,665	4,750	6,641	3,036	985	665	47,183
1989	0	33	1,355	2,076	8,332	4,204	1,803	2,446	622	300	21,171
1990	0	875	6,772	6,732	7,712	36,015	9,853	4,322	4,591	2,472	79,345
1991	0	11	4,956	1,670	1,339	1,201	3,899	1,365	840	1,190	16,471
1992	0	0	1,335	7,461	1,081	631	1,510	3,338	1,241	1,316	17,913
1993	0	0	302	3,227	3,902	982	405	586	485	1,123	11,013
1994	0	0	1,463	310	10,000	13,800	1,873	2,460	5,256	8,730	43,892
1995	0	1	341	7,908	2,733	12,171	10,382	2,759	3,036	7,345	46,676
1996	0	4	3,477	2,082	13,644	4,899	11,411	10,891	2,781	8,448	57,638
1997	0	454	3,780	22,567	2,027	8,585	1,488	3,105	2,920	2,597	47,522
1998	0	0	9,390	4,415	15,711	3,964	8,891	1,751	3,429	4,223	51,773
1999	0	89	8,880	32,161	4,365	9,706	1,899	3,102	1,152	1,593	62,949
2000	0	77	8,101	31,645	18,887	3,076	3,685	715	1,148	717	68,049
2001	0	56	1,816	22,486	21,033	13,536	1,991	1,593	433	824	63,768
2002	0	0	18,025	7,625	17,279	14,378	4,329	1,101	928	552	64,218

Year	2	3	4	5	6	7	8	9	10	11+	Total
2003	0	61	5,076	41,894	6,513	13,669	8,690	1,700	262	381	78,245
2004	0	0	4,823	11,134	24,501	4,842	4,452	2,175	600	312	52,839
2005	0	3	424	12,345	20,406	31,839	6,051	6,169	1,732	385	79,354
2006	0	51	2,825	7,738	20,291	20,875	15,511	5,119	2,721	760	75,890
2007	0	492	206	9,238	13,512	24,751	15,373	4,948	2,939	938	72,397
2008	0	292	4,858	1,774	6,585	12,063	15,009	6,873	3,646	2,818	53,919
2009	0	411	2,398	20,655	10,345	20,618	6,815	3,615	5,240	2,610	72,706
2010	0	0	2,080	8,755	32,103	8,352	10,398	6,809	3,819	2,439	74,755
2011	0	1	312	7,530	7,478	25,275	8,102	4,030	2,350	4,185	59,262
2012	0	0	24	1,139	12,787	14,800	15,466	1,741	498	1,641	48,097
2013	0	15	341	1,024	9,165	19,571	7,271	3,448	110	108	41,053
2014	0	0	173	2,842	2,276	8,974	15,939	3,502	1,700	57	35,464
2015	0	0	0	1,224	8,409	4,406	12,483	3,358	1,923	208	32,011
2016	0	10	305	3,417	10,631	5,817	4,280	1,938	548	38	26,985
2017	0	0	368	337	3,865	7,831	2,963	1,216	208	18	16,807
2018	0	0	25	875	4,046	3,837	4,573	856	326	77	14,615
2019	0	0	54	80	3,369	8,388	3,536	2,599	826	352	19,204
2020	0	0	0	199	612	1,759	1,980	979	585	21	6,135
2021	0	0	39	477	3,374	2,678	6,285	2,678	341	446	16,319
2022	0	0	56	746	4,290	4,820	1,661	3,279	1,714	1,396	17,962
2023	0	156	712	1,326	879	3,027	2,582	1,652	1,208	218	11,761

Table 7. Fall spawner weight-at-age (kg) for fixed gear in the 4T Herring fishery, by region: a) North, b) Middle, c) South.

Year	2	3	4	5	6	7	8	9	10	11+
a) NORTH										
1978	-	0.200	0.259	0.296	0.339	0.347	0.379	0.416	0.396	0.447
1979	-	0.215	0.266	0.307	0.332	0.384	0.401	0.417	0.434	0.452
1980	0.212	0.205	0.239	0.296	0.308	0.289	0.319	0.362	0.376	-
1981	0.208	0.220	0.255	0.307	0.349	0.404	0.419	0.452	0.466	0.487
1982	-	0.226	0.271	0.304	0.344	0.384	0.425	0.425	0.439	0.447
1983	-	0.198	0.250	0.291	0.325	0.364	0.404	0.391	0.505	0.460
1984	-	0.232	0.255	0.295	0.340	0.356	0.398	0.434	0.391	0.507
1985	-	0.224	0.230	0.297	0.343	0.373	0.391	0.414	0.454	0.563
1986	-	0.216	0.265	0.303	0.333	0.376	0.396	0.407	0.446	0.452
1987	0.174	0.237	0.252	0.289	0.323	0.355	0.380	0.400	0.415	0.437
1988	-	0.212	0.260	0.285	0.311	0.341	0.367	0.393	0.389	0.421
1989	-	0.223	0.256	0.295	0.327	0.352	0.377	0.391	0.420	0.427
1990	0.148	0.198	0.248	0.287	0.325	0.350	0.368	0.388	0.408	0.435
1991	-	0.196	0.230	0.263	0.299	0.330	0.350	0.364	0.362	0.398
1992	-	0.200	0.229	0.258	0.283	0.312	0.345	0.355	0.363	0.409
1993	-	0.172	0.219	0.239	0.265	0.291	0.330	0.347	0.326	0.360
1994	-	-	0.209	0.237	0.257	0.288	0.315	0.348	0.353	0.400
1995	-	0.187	0.205	0.227	0.247	0.282	0.302	0.333	0.361	0.386
1996	-	-	0.221	0.244	0.258	0.281	0.306	0.329	0.376	0.426
1997	-	0.191	0.206	0.236	0.260	0.275	0.308	0.337	0.351	0.403
1998	-	0.149	0.209	0.232	0.258	0.286	0.293	0.330	0.355	0.362
1999	-	0.166	0.212	0.237	0.250	0.279	0.301	0.327	0.370	0.362
2000	-	0.177	0.214	0.235	0.260	0.275	0.304	0.317	0.334	0.387
2001	-	0.172	0.211	0.237	0.255	0.282	0.305	0.330	0.347	0.371
2002	0.030	0.181	0.220	0.240	0.264	0.282	0.296	0.327	0.332	0.362

Year	2	3	4	5	6	7	8	9	10	11+
2003	-	0.158	0.209	0.238	0.255	0.278	0.296	0.313	0.333	0.351
2004	-	0.149	0.200	0.218	0.252	0.263	0.285	0.308	0.329	0.349
2005	-	0.188	0.196	0.225	0.240	0.260	0.285	0.296	0.296	0.313
2006	-	0.158	0.202	0.220	0.241	0.258	0.285	0.300	0.303	0.323
2007	-	0.156	0.197	0.204	0.225	0.242	0.254	0.290	0.292	0.317
2008	-	0.159	0.190	0.214	0.228	0.244	0.259	0.264	0.294	0.319
2009	-	0.156	0.190	0.202	0.233	0.251	0.261	0.258	0.282	0.279
2010	-	-	0.179	0.206	0.217	0.238	0.250	0.261	0.279	0.295
2011	-	-	0.184	0.197	0.216	0.222	0.258	0.263	0.265	0.298
2012	-	0.126	0.158	0.183	0.204	0.214	0.225	0.251	0.250	0.290
2013	-	-	0.171	0.195	0.205	0.215	0.231	0.242	0.286	0.285
2014	-	0.115	0.202	0.213	0.220	0.230	0.241	0.243	0.292	0.301
2015	-	0.105	0.173	0.200	0.212	0.227	0.229	0.241	0.225	0.268
2016	-	0.158	0.176	0.198	0.212	0.215	0.223	0.236	0.239	0.241
2017	-	-	0.182	0.190	0.205	0.221	0.227	0.238	0.254	0.270
2018	-	-	0.111	0.201	0.203	0.210	0.226	0.232	0.247	0.271
2019	-	-	0.168	0.198	0.203	0.215	0.222	0.229	0.239	0.258
2020	-	-	0.165	0.183	0.206	0.215	0.225	0.229	0.244	0.267
2021	-	-	0.196	0.207	0.221	0.229	0.240	0.248	0.250	0.293
2022	-	0.154	0.178	0.193	0.205	0.207	0.220	0.231	0.235	0.246
2023	-	0.134	0.164	0.181	0.194	0.211	0.212	0.225	0.232	0.229
b) MIDDLE										
1978	-	0.200	0.259	0.261	0.305	0.279	0.363	0.416	0.313	0.410
1979	-	0.183	0.224	0.269	0.278	0.315	0.369	0.420	0.419	0.458
1980	-	0.244	0.249	0.353	0.384	0.354	0.390	0.546	0.504	0.510
1981	-	0.220	0.255	0.294	0.344	0.360	0.393	0.501	0.473	0.439
1982	-	0.247	0.270	0.305	0.330	0.424	0.449	-	-	0.499

Year	2	3	4	5	6	7	8	9	10	11+
1983	-	0.183	0.217	0.263	0.302	0.340	0.430	-	-	-
1984	-	0.224	0.227	0.253	0.301	0.344	0.397	0.433	0.484	0.54
1985	-	0.224	0.259	0.302	0.331	0.369	0.391	0.414	0.454	0.563
1986	-	0.194	0.209	0.244	0.276	0.347	0.397	0.407	0.446	0.453
1987	-	0.249	0.230	0.261	0.229	0.326	0.296	0.361	0.249	0.402
1988	-	0.234	0.282	0.305	0.357	0.362	0.413	0.439	0.366	0.420
1989	-	0.224	0.249	0.278	0.324	0.336	0.336	0.384	0.410	0.419
1990	-	0.194	0.236	0.284	0.324	0.342	0.355	0.365	0.404	0.431
1991	-	0.185	0.233	0.262	0.272	0.348	0.348	0.364	0.395	0.406
1992	-	0.199	0.219	0.241	0.269	0.285	0.328	0.348	0.358	0.412
1993	-	-	0.218	0.242	0.263	0.263	0.321	0.341	0.354	0.387
1994	-	-	0.213	0.243	0.270	0.294	0.309	0.328	0.399	0.427
1995	-	-	0.222	0.244	0.255	0.280	0.286	0.341	0.358	0.385
1996	-	-	0.226	0.250	0.261	0.304	0.310	0.318	0.393	0.432
1997	-	0.174	0.206	0.235	0.247	0.256	0.295	0.320	0.314	0.387
1998	-	0.176	0.219	0.234	0.265	0.286	0.279	0.336	0.343	0.388
1999	-	-	0.210	0.237	0.245	0.275	0.296	0.283	0.351	0.362
2000	-	0.111	0.214	0.234	0.260	0.273	0.300	0.318	0.311	0.366
2001	-	0.168	0.205	0.233	0.254	0.277	0.290	0.303	-	0.308
2002	-	0.191	0.219	0.244	0.257	0.288	0.293	0.330	0.330	0.314
2003	-	0.170	0.209	0.234	0.260	0.275	0.301	0.312	0.359	0.390
2004	-	0.146	0.208	0.229	0.248	0.268	0.286	0.310	0.305	0.362
2005	-	-	0.200	0.227	0.240	0.266	0.285	0.303	0.309	0.430
2006	-	-	0.197	0.224	0.245	0.260	0.279	0.297	0.310	0.317
2007	-	0.155	0.196	0.211	0.228	0.244	0.257	0.275	0.281	0.310
2008	-	0.120	0.169	0.206	0.220	0.236	0.242	0.252	0.272	0.300
2009	-	0.156	0.180	0.201	0.234	0.239	0.260	0.270	0.268	0.287

Year	2	3	4	5	6	7	8	9	10	11+
2010	-	0.139	0.176	0.201	0.213	0.228	0.246	0.255	0.274	0.269
2011	-	0.104	0.175	0.197	0.215	0.226	0.231	0.264	0.266	0.283
2012	-	0.115	0.153	0.181	0.199	0.212	0.218	0.241	0.262	0.280
2013	-	0.131	0.156	0.194	0.197	0.213	0.227	0.232	0.251	0.284
2014	-	-	0.168	0.196	0.207	0.215	0.229	0.237	0.242	0.254
2015	-	-	0.195	0.216	0.211	0.227	0.229	0.245	0.247	-
2016	-	0.129	0.182	0.220	0.226	0.232	0.240	0.247	0.259	-
2017	-	0.134	0.174	0.200	0.212	0.213	0.225	0.234	0.251	0.289
2018	-	-	0.178	0.190	0.209	0.222	0.227	0.226	0.232	-
2019	-	-	0.172	0.179	0.201	0.209	0.222	0.225	0.238	0.248
2020	-	-	0.159	0.192	0.202	0.215	0.227	0.237	0.248	0.258
2021	-	0.159	0.166	0.199	0.210	0.219	0.229	0.234	0.251	0.261
2022	-	0.155	0.168	0.187	0.207	0.207	0.219	0.227	0.235	0.251
2023	-	0.152	0.169	0.182	0.203	0.213	0.220	0.230	0.232	0.238

c) SOUTH

1978	0.077	0.133	0.192	0.228	0.236	0.295	0.318	0.331	-	0.338
1979	0.132	0.186	0.243	0.277	0.314	0.357	0.387	0.417	0.430	0.358
1980	0.212	0.205	0.245	0.297	0.315	0.324	0.340	0.358	0.397	0.351
1981	0.156	0.220	0.271	0.329	0.381	0.416	0.422	0.448	0.469	0.488
1982	-	0.210	0.263	0.297	0.330	0.371	0.360	0.391	0.357	0.404
1983	-	0.195	0.245	0.278	0.299	0.333	0.359	0.368	0.398	0.418
1984	-	0.212	0.242	0.282	0.304	0.339	0.400	0.405	0.406	0.496
1985	-	0.197	0.248	0.281	0.314	0.346	0.368	0.404	0.417	0.445
1986	0.175	0.189	0.240	0.277	0.311	0.343	0.361	0.385	0.427	0.348
1987	-	0.230	0.241	0.276	0.312	0.333	0.361	0.378	0.385	0.429
1988	-	0.226	0.246	0.287	0.322	0.352	0.381	0.403	0.416	0.446
1989	-	0.171	0.234	0.262	0.312	0.331	0.373	0.390	0.391	0.440

Year	2	3	4	5	6	7	8	9	10	11+
1990	-	0.192	0.240	0.277	0.325	0.347	0.372	0.398	0.410	0.428
1991	-	0.176	0.235	0.262	0.292	0.335	0.356	0.369	0.392	0.420
1992	-	-	0.215	0.252	0.280	0.287	0.338	0.344	0.368	0.388
1993	-	-	0.224	0.245	0.262	0.268	0.323	0.357	0.366	0.411
1994	-	-	0.212	0.222	0.258	0.284	0.322	0.331	0.360	0.376
1995	0.103	0.135	0.215	0.227	0.258	0.275	0.298	0.335	0.356	0.383
1996	-	0.172	0.217	0.244	0.254	0.278	0.306	0.322	0.347	0.386
1997	-	0.165	0.203	0.232	0.271	0.279	0.320	0.323	0.342	0.399
1998	-	-	0.211	0.237	0.257	0.283	0.296	0.319	0.331	0.369
1999	-	0.161	0.209	0.236	0.253	0.269	0.300	0.306	0.344	0.346
2000	-	0.150	0.203	0.227	0.256	0.281	0.300	0.326	0.329	0.360
2001	-	0.160	0.209	0.230	0.248	0.270	0.291	0.306	0.336	0.301
2002	-	-	0.212	0.229	0.245	0.266	0.282	0.297	0.308	0.333
2003	-	0.169	0.203	0.227	0.247	0.259	0.278	0.302	0.306	0.327
2004	-	-	0.206	0.224	0.237	0.254	0.282	0.282	0.303	0.308
2005	-	0.188	0.194	0.219	0.234	0.245	0.257	0.272	0.286	0.307
2006	-	0.169	0.190	0.215	0.231	0.249	0.257	0.276	0.279	0.299
2007	-	0.146	0.163	0.200	0.218	0.234	0.242	0.250	0.258	0.265
2008	0.093	0.138	0.160	0.206	0.214	0.227	0.237	0.248	0.257	0.271
2009	-	0.143	0.186	0.201	0.228	0.246	0.260	0.274	0.268	0.267
2010	-	0.107	0.161	0.205	0.214	0.241	0.257	0.264	0.281	0.296
2011	-	0.111	0.146	0.176	0.204	0.217	0.249	0.257	0.258	0.269
2012	-	-	0.150	0.170	0.193	0.216	0.221	0.239	0.272	0.265
2013	-	0.137	0.146	0.179	0.194	0.210	0.220	0.226	0.254	0.259
2014	-	-	0.157	0.175	0.200	0.201	0.213	0.237	0.231	0.276
2015	-	0.151	0.165	0.170	0.195	0.194	0.210	0.232	0.218	0.256
2016	-	0.120	0.161	0.208	0.206	0.214	0.220	0.237	0.236	0.261

Year	2	3	4	5	6	7	8	9	10	11+
2017	-	0.126	0.168	0.171	0.201	0.208	0.214	0.222	0.248	0.240
2018	-	-	0.129	0.156	0.171	0.189	0.199	0.216	0.229	0.246
2019	-	-	0.164	0.171	0.189	0.196	0.205	0.210	0.220	0.225
2020	-	-	-	0.191	0.192	0.210	0.218	0.232	0.240	0.250
2021	-	-	0.160	0.188	0.207	0.215	0.222	0.235	0.250	0.244
2022	-	-	0.174	0.195	0.200	0.216	0.215	0.227	0.228	0.221
2023	-	0.132	0.154	0.164	0.184	0.209	0.215	0.220	0.227	0.222

Table 8. Spring spawner catch-at-age (thousands) for mobile gear in the 4T Herring fishery.

Year	2	3	4	5	6	7	8	9	10	11+	Total
1978	14,933	3,664	24,366	3,053	4,619	1,293	734	565	2,877	599	58,094
1979	14,535	4,553	4,800	25,926	4,014	6,971	2,139	1,638	1,501	12,300	90,020
1980	11,101	10,404	1,790	1,878	11,154	8,852	4,207	2,229	751	286	53,389
1981	362	1,105	939	9	881	347	699	264	417	7	5,031
1982	2,343	3,816	400	53	10	89	165	210	2	19	7,109
1983	1,349	8,017	3,838	449	1	65	71	89	0	0	13,878
1984	619	1,831	4,190	2,901	291	0	71	41	0	0	9,943
1985	1,132	4,581	2,451	3,085	1,153	77	0	0	0	294	13,372
1986	4,194	3,982	9,552	7,647	7,410	3,070	212	514	0	60	36,641
1987	1,476	1,977	2,944	10,494	7,260	7,060	3,696	0	0	93	35,001
1988	6,285	2,123	1,545	2,729	11,772	9,514	5,400	2,434	0	2,156	46,666
1989	425	2,982	4,949	1,644	4,682	10,289	4,223	2,285	430	118	32,401
1990	5,182	6,250	7,301	4,236	2,645	1,504	5,841	2,964	737	318	37,024
1991	1,825	9,393	3,064	2,640	1,271	654	1,000	890	653	1,307	22,730
1992	860	2,808	7,350	3,461	2,489	707	448	790	527	453	19,896
1993	3,094	2,374	6,698	5,404	2,662	1,577	974	1,309	902	2,288	27,316
1994	52	4,057	2,255	3,477	5,930	2,435	1,349	647	166	1,251	21,620
1995	1,418	1,588	17,082	5,809	4,899	7,749	1,675	1,024	280	1,708	43,231

Year	2	3	4	5	6	7	8	9	10	11+	Total
1996	385	2,942	919	11,291	3,589	2,107	1,965	370	388	138	24,101
1997	419	1,405	3,457	1,246	7,719	911	1,610	1,444	146	466	18,906
1998	298	796	1,930	1,524	213	1,767	461	337	373	254	7,959
1999	1,769	2,840	4,853	3,057	1,516	934	2,951	988	480	580	20,234
2000	1,314	3,254	3,739	1,485	891	354	305	491	70	92	12,290
2001	4,258	3,721	4,853	2,521	1,130	1,157	448	195	288	148	19,276
2002	744	3,135	1,060	729	195	554	109	42	7	42	6,671
2003	209	654	869	327	279	270	9	5	40	22	2,709
2004	487	825	433	360	135	234	17	10	1	17	2,621
2005	1,816	1,864	2,571	259	336	52	0	71	0	0	7,340
2006	236	898	521	1,824	620	138	24	6	5	0	4,333
2007	3,651	3,605	2,396	1,786	2,368	700	256	15	0	113	15,414
2008	3,474	1,887	765	1,209	587	775	137	93	16	28	9,239
2009	441	1,670	227	171	172	441	17	0	173	38	3,358
2010	116	406	941	506	713	634	74	8	0	1	3,398
2011	629	814	669	682	577	576	73	106	356	23	4,524
2012	17	404	454	279	237	169	9	33	0	21	1,624
2013	124	271	891	1,136	697	623	282	41	0	18	4,085
2014	460	199	537	391	896	489	260	16	36	47	3,328
2015	564	560	206	270	554	864	457	190	22	17	3,704
2016	271	495	138	91	41	114	38	86	0	0	1,274
2017	102	102	140	18	2	5	1	0	0	0	427
2018	0	58	325	660	128	176	268	101	0	0	1,715
2019	0	43	687	542	1,469	258	100	49	0	0	3,147
2020	11	363	422	302	263	389	52	6	5	4	1,823
2021	0	0	0	0	0	0	0	0	0	0	0
2022	0	3	10	7	8	6	4	2	0	0	41

Table 9. Spring spawner weight-at-age (kg) for mobile gear in the 4T Herring fishery.

Year	2	3	4	5	6	7	8	9	10	11+
1978	0.131	0.182	0.262	0.248	0.281	0.301	0.308	0.352	0.381	0.389
1979	0.173	0.193	0.212	0.261	0.259	0.303	0.305	0.340	0.342	0.364
1980	0.158	0.165	0.217	0.262	0.273	0.258	0.264	0.275	0.364	0.341
1981	0.158	0.203	0.274	0.272	0.425	0.306	0.284	0.290	0.316	0.417
1982	0.133	0.225	0.266	0.253	0.315	0.463	0.308	0.339	0.436	0.450
1983	0.145	0.188	0.231	0.278	0.270	0.315	0.243	0.411	0.000	0.000
1984	0.121	0.192	0.229	0.262	0.291	0.299	0.380	0.351	0.375	0.000
1985	0.137	0.221	0.244	0.297	0.313	0.384	0.000	0.000	0.000	0.384
1986	0.144	0.196	0.249	0.283	0.315	0.339	0.349	0.315	0.000	0.392
1987	0.156	0.189	0.251	0.304	0.332	0.359	0.375	0.000	0.000	0.527
1988	0.115	0.176	0.251	0.301	0.337	0.339	0.393	0.412	0.000	0.442
1989	0.141	0.212	0.258	0.270	0.312	0.343	0.363	0.385	0.411	0.466
1990	0.173	0.197	0.246	0.280	0.294	0.333	0.342	0.352	0.409	0.363
1991	0.143	0.181	0.215	0.248	0.264	0.322	0.334	0.357	0.349	0.401
1992	0.117	0.148	0.200	0.241	0.272	0.292	0.323	0.327	0.338	0.385
1993	0.109	0.152	0.179	0.195	0.235	0.252	0.290	0.281	0.311	0.347
1994	0.145	0.156	0.188	0.207	0.234	0.258	0.269	0.274	0.316	0.330
1995	0.105	0.146	0.182	0.202	0.226	0.247	0.278	0.303	0.314	0.315
1996	0.116	0.169	0.205	0.224	0.233	0.246	0.276	0.324	0.300	0.378
1997	0.124	0.155	0.192	0.209	0.249	0.271	0.287	0.308	0.329	0.326
1998	0.109	0.145	0.171	0.217	0.203	0.248	0.263	0.279	0.296	0.402
1999	0.118	0.156	0.187	0.232	0.265	0.277	0.294	0.309	0.317	0.319
2000	0.131	0.159	0.186	0.219	0.247	0.277	0.292	0.294	0.284	0.332
2001	0.118	0.149	0.190	0.209	0.242	0.256	0.296	0.327	0.330	0.323
2002	0.106	0.149	0.176	0.206	0.213	0.251	0.281	0.288	0.287	0.329
2003	0.099	0.141	0.177	0.199	0.238	0.251	0.282	0.291	0.295	0.330
2004	0.110	0.146	0.162	0.209	0.231	0.251	0.300	0.314	0.290	0.367

Year	2	3	4	5	6	7	8	9	10	11+
2005	0.120	0.145	0.163	0.188	0.210	0.197	0.000	0.261	0.000	0.000
2006	0.110	0.145	0.171	0.179	0.203	0.234	0.300	0.350	0.286	0.000
2007	0.118	0.145	0.177	0.181	0.197	0.191	0.213	0.300	0.000	0.198
2008	0.128	0.141	0.182	0.199	0.207	0.222	0.245	0.230	0.349	0.253
2009	0.116	0.139	0.191	0.195	0.210	0.172	0.236	0.000	0.201	0.212
2010	0.109	0.134	0.162	0.167	0.200	0.211	0.241	0.255	0.000	0.269
2011	0.083	0.122	0.124	0.174	0.169	0.199	0.210	0.191	0.164	0.192
2012	0.083	0.123	0.151	0.177	0.184	0.219	0.242	0.215	0.000	0.236
2013	0.100	0.128	0.149	0.171	0.182	0.202	0.218	0.227	0.000	0.286
2014	0.097	0.124	0.149	0.171	0.181	0.180	0.206	0.248	0.210	0.207
2015	0.105	0.116	0.140	0.158	0.183	0.194	0.188	0.249	0.268	0.281
2016	0.104	0.123	0.142	0.156	0.160	0.185	0.211	0.195	0.000	0.000
2017	0.108	0.126	0.130	0.137	0.178	0.151	0.194	0.240	0.000	0.000
2018	0.000	0.125	0.128	0.153	0.154	0.176	0.167	0.170	0.000	0.000
2019	0.000	0.135	0.140	0.154	0.174	0.183	0.197	0.230	0.306	0.000
2020	0.104	0.130	0.133	0.157	0.176	0.190	0.191	0.224	0.252	0.238
2021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2022	0.000	0.150	0.158	0.164	0.170	0.167	0.192	0.204	0.000	0.000

Table 10. Fall spawner catch-at-age (thousands) for mobile gear in the 4T Herring fishery, by region: a) North, b) Middle, c) South.

Year	2	3	4	5	6	7	8	9	10	11+	Total
a) NORTH											
1978	0	216	3,414	2,450	510	432	2,709	50	81	1,189	11,050
1979	0	168	3,271	1,465	1,260	256	644	531	252	267	8,113
1980	26	3,056	1,471	1,648	233	1,154	129	110	147	0	7,974
1981	23	3,963	12,839	2,839	593	240	278	53	99	60	20,988
1982	0	1,726	5,625	11,797	1,746	331	202	64	40	62	21,593
1983	0	98	9,238	3,748	9,002	1,018	413	96	16	102	23,731

Year	2	3	4	5	6	7	8	9	10	11+	Total
1984	0	453	7,434	6,808	3,462	3,133	556	113	108	71	22,140
1985	0	99	2,878	13,139	8,176	4,901	4,915	1,832	372	6	36,318
1986	0	617	9,919	9,734	21,934	15,361	7,286	3,326	447	770	69,393
1987	16	7,260	24,248	14,636	13,277	19,804	9,068	5,494	2,412	759	96,973
1988	0	152	14,470	24,858	9,543	8,464	7,752	4,121	1,998	1,953	73,312
1989	0	283	12,133	19,801	21,160	10,289	4,716	5,928	2,655	2,118	79,082
1990	14	2,351	13,755	12,558	19,492	20,685	7,816	5,478	5,759	4,141	92,049
1991	0	131	28,732	7,306	5,390	7,996	7,653	2,463	1,539	2,511	63,722
1992	0	11	6,153	37,343	10,677	6,225	6,775	5,961	2,872	5,423	81,439
1993	0	82	2,051	21,080	24,447	3,430	1,918	1,975	559	712	56,254
1994	0	0	6,553	10,533	31,557	47,626	9,076	7,049	3,228	5,404	121,028
1995	0	23	3,298	23,949	11,096	26,765	28,407	4,969	3,188	3,483	105,177
1996	0	0	12,767	15,443	20,775	4,565	8,681	9,465	1,341	1,561	74,598
1997	0	367	8,897	30,662	9,453	8,423	1,621	2,817	2,524	732	65,496
1998	0	37	8,752	23,986	22,898	5,734	5,461	787	1,272	2,305	71,232
1999	0	175	19,794	23,825	29,631	10,527	2,083	1,327	362	517	88,242
2000	0	266	17,184	56,056	14,915	6,279	3,445	668	493	224	99,531
2001	0	516	22,863	28,903	29,781	4,552	2,051	561	175	228	89,628
2002	1	212	21,279	23,278	16,324	8,777	2,292	682	471	187	73,503
2003	0	235	11,578	24,362	16,356	11,533	13,769	3,447	1,512	948	83,741
2004	0	1	23,784	17,748	8,619	5,219	4,049	2,776	638	433	63,268
2005	0	1	5,034	56,213	22,400	8,627	4,759	2,861	2,025	184	102,103
2006	0	5	6,092	37,842	36,714	5,458	1,549	2,922	1,127	602	92,313
2007	0	32	5,160	15,268	34,716	23,879	5,096	951	887	561	86,550
2008	0	403	18,423	11,717	18,718	15,180	14,670	1,778	598	865	82,352
2009	0	532	22,607	38,575	10,619	10,493	6,117	1,701	302	253	91,200
2010	0	0	3,121	26,685	23,029	7,969	5,320	4,186	1,708	199	72,217

Year	2	3	4	5	6	7	8	9	10	11+	Total
2011	0	0	1,657	6,387	26,763	24,243	2,750	3,140	2,850	773	68,564
2012	0	8	156	8,609	17,648	26,305	11,746	2,365	2,749	954	70,539
2013	0	0	1,053	9,007	29,030	20,828	10,692	2,295	183	102	73,191
2014	0	0	91	4,454	9,817	24,496	11,276	7,629	100	60	57,924
2015	0	0	91	2,684	19,072	14,182	17,093	5,314	844	225	59,506
2016	0	23	1,288	5,314	14,491	17,913	12,473	3,986	1,870	318	57,678
2017	0	0	553	5,261	7,935	14,281	16,572	5,793	2,069	364	52,829
2018	0	0	0	849	10,205	12,361	9,637	4,674	1,679	201	39,606
2019	0	0	38	503	8,527	15,957	5,548	3,849	1,235	404	36,061
2020	0	0	153	579	2,079	10,049	8,069	5,047	1,298	192	27,466
2021	0	0	162	2,498	2,571	3,424	8,110	4,140	1,508	261	22,674
2022	0	2	137	664	4,538	3,795	3,731	5,327	3,760	972	22,927
2023	0	54	286	1,224	1,046	2,649	930	859	649	273	7,970

b) MIDDLE

1978	0	38	601	749	220	442	2,005	9	59	1,139	5,262
1979	0	144	3,673	2,048	831	205	100	209	18	161	7,389
1980	0	424	964	2,283	579	271	225	282	107	96	5,232
1981	0	974	6,224	1,910	1,150	460	629	31	83	238	11,699
1982	0	29	1,653	1,559	210	139	116	0	0	31	3,737
1983	0	255	3,998	1,482	1,578	351	130	0	0	0	7,794
1984	0	41	1,908	2,723	937	1,001	315	77	11	6	7,019
1985	0	11	235	1,370	1,010	562	536	200	41	1	3,964
1986	0	47	1,600	1,328	2,455	1,120	435	200	27	46	7,257
1987	0	298	934	1,761	1,532	3,059	289	267	298	19	8,457
1988	0	817	3,091	2,817	2,473	1,135	1,189	886	15	0	12,424
1989	0	16	772	1,431	1,274	694	428	378	171	139	5,303
1990	0	219	1,923	1,390	1,508	2,655	548	382	298	64	8,987

Year	2	3	4	5	6	7	8	9	10	11+	Total
1991	0	17	5,973	1,617	1,332	1,749	2,066	1,271	585	1,335	15,945
1992	0	12	3,880	9,415	1,284	534	304	220	106	249	16,004
1993	0	0	350	6,612	8,298	1,417	597	415	470	716	18,875
1994	0	0	850	1,373	6,908	9,293	1,134	359	439	741	21,099
1995	0	0	214	10,010	3,408	12,249	10,646	1,363	243	4,272	42,404
1996	0	0	3,414	2,107	12,096	1,046	3,144	3,605	833	869	27,113
1997	0	285	4,835	10,979	1,980	4,125	782	938	1,026	639	25,588
1998	0	23	5,113	4,301	8,730	1,761	3,286	596	1,293	2,229	27,332
1999	0	0	9,709	12,903	5,104	3,222	1,303	2,854	278	1,330	36,703
2000	0	13	11,054	21,136	7,789	2,516	1,394	414	369	165	44,850
2001	0	383	5,519	13,581	9,633	2,919	630	208	0	293	33,166
2002	0	275	9,081	8,110	7,171	6,936	1,245	171	145	216	33,352
2003	0	123	5,648	11,842	5,541	3,737	3,739	839	110	156	31,736
2004	0	15	5,579	10,122	7,144	5,096	4,523	2,652	920	175	36,226
2005	0	0	2,355	14,518	11,757	3,536	3,046	2,099	895	66	38,272
2006	0	0	1,697	7,740	13,789	5,094	2,598	1,949	1,544	523	34,934
2007	0	193	1,197	3,429	9,509	9,811	3,736	1,509	733	454	30,571
2008	0	1,426	12,175	2,575	4,491	5,326	8,514	1,536	1,451	332	37,825
2009	0	101	8,185	14,543	3,368	7,438	3,578	1,245	530	245	39,232
2010	0	8	1,529	11,467	17,000	4,954	4,333	2,473	1,154	644	43,562
2011	0	0	405	2,089	12,157	15,610	2,973	2,237	2,101	631	38,202
2012	0	7	147	1,935	8,679	11,646	8,142	925	526	443	32,450
2013	0	7	590	1,125	7,042	10,527	6,451	2,488	201	43	28,474
2014	0	0	41	4,663	1,923	8,176	6,541	1,529	487	0	23,362
2015	0	0	165	1,052	10,058	4,474	7,592	2,986	1,060	0	27,388
2016	0	18	279	1,227	7,869	6,459	3,603	1,610	570	0	21,634
2017	0	25	128	1,032	3,573	6,650	8,169	4,645	638	23	24,883

Year	2	3	4	5	6	7	8	9	10	11+	Total
2018	0	0	76	712	2,951	7,465	5,674	557	302	0	17,737
2019	0	0	103	187	1,689	5,691	2,695	3,532	1,081	216	15,194
2020	0	0	29	265	460	2,674	3,059	1,900	1,185	685	10,256
2021	0	6	80	758	917	1,175	3,145	1,736	437	205	8,460
2022	0	2	24	56	270	231	403	545	288	89	1,909
2023	0	37	271	1,040	1,450	1,525	1,145	870	559	225	7,123

c) SOUTH

1978	41	1,988	1,390	632	154	75	119	22	0	13	4,434
1979	16	267	4,634	2,198	773	263	292	175	52	205	9,785
1980	38	4,404	1,939	2,352	294	923	129	164	154	77	10,474
1981	42	1,158	5,336	2,185	1,049	531	310	88	99	24	10,822
1982	0	353	7,029	3,634	3,226	2,345	819	332	81	37	17,857
1983	0	467	7,485	5,047	3,237	1,011	1,266	477	47	161	19,198
1984	0	397	15,010	5,562	4,586	2,288	703	381	110	23	29,060
1985	0	89	3,442	15,465	6,385	3,221	2,234	509	333	29	31,706
1986	383	871	20,436	5,746	12,066	3,350	1,635	487	106	164	45,245
1987	0	1,083	11,141	12,821	6,139	14,100	6,213	4,292	1,851	1,323	58,964
1988	0	377	4,361	16,703	9,665	4,750	6,641	3,036	985	665	47,183
1989	0	33	1,355	2,076	8,332	4,204	1,803	2,446	622	300	21,171
1990	0	875	6,772	6,732	7,712	36,015	9,853	4,322	4,591	2,472	79,345
1991	0	11	4,956	1,670	1,339	1,201	3,899	1,365	840	1,190	16,471
1992	0	0	1,335	7,461	1,081	631	1,510	3,338	1,241	1,316	17,913
1993	0	0	302	3,227	3,902	982	405	586	485	1,123	11,013
1994	0	0	1,463	310	10,000	13,800	1,873	2,460	5,256	8,730	43,892
1995	0	1	341	7,908	2,733	12,171	10,382	2,759	3,036	7,345	46,676
1996	0	4	3,477	2,082	13,644	4,899	11,411	10,891	2,781	8,448	57,638
1997	0	454	3,780	22,567	2,027	8,585	1,488	3,105	2,920	2,597	47,522

Year	2	3	4	5	6	7	8	9	10	11+	Total
1998	0	0	9,390	4,415	15,711	3,964	8,891	1,751	3,429	4,223	51,773
1999	0	89	8,880	32,161	4,365	9,706	1,899	3,102	1,152	1,593	62,949
2000	0	77	8,101	31,645	18,887	3,076	3,685	715	1,148	717	68,049
2001	0	56	1,816	22,486	21,033	13,536	1,991	1,593	433	824	63,768
2002	0	0	18,025	7,625	17,279	14,378	4,329	1,101	928	552	64,218
2003	0	61	5,076	41,894	6,513	13,669	8,690	1,700	262	381	78,245
2004	0	0	4,823	11,134	24,501	4,842	4,452	2,175	600	312	52,839
2005	0	3	424	12,345	20,406	31,839	6,051	6,169	1,732	385	79,354
2006	0	51	2,825	7,738	20,291	20,875	15,511	5,119	2,721	760	75,890
2007	0	492	206	9,238	13,512	24,751	15,373	4,948	2,939	938	72,397
2008	0	292	4,858	1,774	6,585	12,063	15,009	6,873	3,646	2,818	53,919
2009	0	411	2,398	20,655	10,345	20,618	6,815	3,615	5,240	2,610	72,706
2010	0	0	2,080	8,755	32,103	8,352	10,398	6,809	3,819	2,439	74,755
2011	0	1	312	7,530	7,478	25,275	8,102	4,030	2,350	4,185	59,262
2012	0	0	24	1,139	12,787	14,800	15,466	1,741	498	1,641	48,097
2013	0	15	341	1,024	9,165	19,571	7,271	3,448	110	108	41,053
2014	0	0	173	2,842	2,276	8,974	15,939	3,502	1,700	57	35,464
2015	0	0	0	1,224	8,409	4,406	12,483	3,358	1,923	208	32,011
2016	0	10	305	3,417	10,631	5,817	4,280	1,938	548	38	26,985
2017	0	0	368	337	3,865	7,831	2,963	1,216	208	18	16,807
2018	0	0	25	875	4,046	3,837	4,573	856	326	77	14,615
2019	0	0	54	80	3,369	8,388	3,536	2,599	826	352	19,204
2020	0	0	0	199	612	1,759	1,980	979	585	21	6,135
2021	0	0	39	477	3,374	2,678	6,285	2,678	341	446	16,319
2022	0	0	56	746	4,290	4,820	1,661	3,279	1,714	1,396	17,962
2023	0	156	712	1,326	879	3,027	2,582	1,652	1,208	218	11,761

Table 11. Fall spawner weight-at-age (kg) for mobile gear in the 4T Herring fishery.

Year	2	3	4	5	6	7	8	9	10	11+
1978	0.100	0.149	0.214	0.253	0.278	0.293	0.331	0.332	0.316	0.388
1979	0.123	0.180	0.232	0.266	0.293	0.291	0.340	0.365	0.355	0.380
1980	0.108	0.139	0.174	0.224	0.245	0.290	0.338	0.379	0.388	0.423
1981	0.111	0.181	0.226	0.256	0.314	0.366	0.234	0.261	0.470	-
1982	0.095	0.168	0.221	0.259	0.279	0.374	0.334	0.355	0.455	0.434
1983	0.103	0.170	0.213	0.246	0.283	0.316	0.375	0.349	0.222	0.456
1984	0.096	0.146	0.208	0.248	0.279	0.305	0.329	0.373	0.392	0.433
1985	0.090	0.190	0.215	0.258	0.281	0.311	0.327	0.382	0.419	-
1986	0.116	0.158	0.207	0.252	0.276	0.306	0.328	0.335	0.362	0.404
1987	0.111	0.172	0.218	0.250	0.284	0.319	0.341	0.351	0.391	0.393
1988	0.095	0.157	0.220	0.261	0.307	0.327	0.341	0.341	0.414	0.382
1989	0.099	0.159	0.213	0.250	0.279	0.319	0.323	0.327	0.360	0.377
1990	0.105	0.171	0.213	0.236	0.288	0.310	0.323	0.329	0.338	0.386
1991	-	0.149	0.191	0.221	0.263	0.279	0.307	0.310	0.327	0.380
1992	0.071	0.128	0.171	0.211	0.237	0.261	0.282	0.290	0.301	0.335
1993	0.076	0.128	0.156	0.199	0.225	0.258	0.279	0.310	0.323	0.354
1994	0.086	0.134	0.159	0.174	0.204	0.222	0.262	0.274	0.302	0.336
1995	0.072	0.118	0.163	0.177	0.198	0.224	0.239	0.271	0.310	0.341
1996	0.089	0.133	0.165	0.183	0.209	0.222	0.248	0.269	0.291	0.331
1997	0.082	0.141	0.165	0.191	0.224	0.226	0.241	0.262	0.296	0.339
1998	0.076	0.126	0.165	0.187	0.224	0.248	0.244	0.303	0.300	0.387
1999	0.072	0.128	0.155	0.189	0.214	0.248	0.271	0.289	0.317	0.356
2000	0.077	0.131	0.162	0.185	0.208	0.231	0.262	0.263	0.275	0.318
2001	0.078	0.127	0.156	0.184	0.200	0.215	0.240	0.251	0.237	0.295
2002	0.084	0.148	0.188	0.222	0.245	0.272	0.290	0.321	0.329	0.360
2003	0.081	0.138	0.169	0.197	0.219	0.240	0.260	0.276	0.318	0.310
2004	0.080	0.131	0.160	0.181	0.204	0.224	0.248	0.265	0.278	0.290

Year	2	3	4	5	6	7	8	9	10	11+
2005	0.078	0.125	0.151	0.177	0.202	0.228	0.282	0.284	0.301	0.349
2006	0.079	0.132	0.164	0.181	0.206	0.215	0.228	0.264	0.301	0.345
2007	0.086	0.127	0.152	0.165	0.184	0.202	0.215	0.226	0.258	0.205
2008	0.093	0.133	0.153	0.159	0.179	0.184	0.197	0.210	0.218	-
2009	0.092	0.123	0.146	0.166	0.179	0.195	0.220	0.231	-	-
2010	0.094	0.118	0.137	0.155	0.166	0.176	0.198	0.194	0.205	0.309
2011	0.069	0.104	0.123	0.141	0.153	0.168	0.179	0.200	0.186	0.234
2012	0.076	0.107	0.125	0.142	0.162	0.163	0.206	0.228	0.219	0.245
2013	0.077	0.111	0.130	0.149	0.167	0.185	0.206	0.215	0.234	0.253
2014	0.066	0.110	0.136	0.150	0.169	0.186	0.204	0.222	0.225	-
2015	0.102	0.102	0.125	0.148	0.164	0.190	0.194	0.205	0.214	0.231
2016	0.096	0.115	0.125	0.167	0.165	0.171	0.186	0.194	0.186	0.196
2017	0.071	0.103	0.128	0.172	0.197	0.220	0.254	0.250	-	-
2018	0.097	0.097	0.107	0.131	0.151	0.168	0.198	0.191	0.224	0.232
2019	-	0.107	0.115	0.135	0.159	0.173	0.178	0.200	0.241	0.234
2020	0.087	0.099	0.125	0.139	0.163	0.181	0.178	0.183	0.196	0.220
2021	-	-	-	-	-	-	-	-	-	-
2022	-	0.130	0.143	0.169	0.187	0.214	0.215	0.232	0.229	0.244

Table 12. Percent of fishing days with no gillnet catch derived from the telephone survey for main fishing areas in the spring and fall fishery.

Year	Spring fishing season (%)	Fall fishing season (%)
2006	46.7	16.7
2007	40.0	28.8
2008	49.4	28.8
2009	23.2	17.5
2010	34.1	19.9
2011	26.2	27.3
2012	43.1	24.2
2013	36.3	22.8
2014	29.6	31.5
2015	16.2	40.9
2016	27.8	23.9
2017	39.8	40.5
2018	37.2	40.7
2019	25.5	30.3
2020	24.3	37.3
2021	24.3	37.3
2022	-	47.6
2023	-	43.4

Table 13. Spring spawner fixed gear catch-per-unit-effort values (number per net-haul) for FO area 4T.

Year	4	5	6	7	8	9	10	11
1990	114.7	63.8	33.8	39.3	61.0	28.4	11.4	4.8
1991	160.7	193.9	125.4	43.4	39.7	61.0	22.5	15.0
1992	464.3	178.4	117.1	53.5	24.6	30.2	22.0	35.0
1993	59.5	438.0	199.4	53.2	26.1	14.9	7.7	29.6
1994	47.1	198.4	390.9	72.8	28.9	9.8	3.5	8.3
1995	137.2	110.9	182.8	297.4	65.9	18.4	11.9	23.4
1996	15.2	435.2	82.5	128.0	85.2	28.1	5.3	9.8
1997	71.7	53.6	498.4	91.7	54.7	51.9	13.4	2.4
1998	81.9	167.0	23.9	315.9	36.2	25.9	20.8	9.3
1999	66.1	94.2	103.1	22.6	160.6	25.9	13.4	11.6
2000	111.8	149.1	142.3	70.7	41.6	109.0	27.2	16.4
2001	98.6	114.0	85.9	42.9	29.3	12.1	57.4	15.1
2002	58.3	152.0	63.1	29.9	17.2	9.5	8.7	10.1
2003	131.7	135.5	157.0	48.0	30.4	12.2	8.4	9.3
2004	22.5	130.4	46.6	73.4	27.8	10.1	3.6	8.7
2005	64.1	56.5	101.9	45.1	35.6	10.0	2.2	3.1
2006	52.7	189.0	67.1	21.4	11.6	15.7	1.1	3.0
2007	93.3	71.6	106.4	79.6	36.8	9.0	6.8	5.0
2008	139.2	154.1	56.4	62.4	13.3	2.6	1.2	0.6
2009	84.9	196.0	243.1	27.6	28.0	7.3	0.4	1.1
2010	39.8	31.0	56.1	27.6	13.2	12.9	0.1	0.5
2011	6.4	48.8	44.8	60.8	28.2	43.1	15.9	0.3
2012	43.9	43.8	66.8	73.6	37.3	24.7	20.4	9.2
2013	33.4	106.2	127.6	164.6	125.9	89.8	5.5	4.3
2014	12.7	58.2	99.2	111.3	138.3	71.8	28.4	8.6
2015	12.9	19.5	97.8	149.2	66.8	49.5	9.5	5.1
2016	3.0	34.2	95.9	139.4	98.9	35.1	4.0	0.6

Year	4	5	6	7	8	9	10	11
2017	46.4	49.2	130.4	106.6	79.6	18.2	3.2	0.2
2018	4.8	70.4	54.8	79.5	29.3	9.1	0.3	0.0
2019	30.6	70.8	156.8	50.1	63.2	12.5	1.8	0.0
2020	30.9	62.8	56.6	62.2	46.5	5.4	4.8	1.6
2021	15.9	81.2	109.0	207.9	182.5	30.0	7.3	2.5

Table 14. Fall spawner fixed gear catch-per-unit-effort values (number per net-haul) by region: a) North, b) Middle, and c) South.

Year	4	5	6	7	8	9	10	11
a) NORTH								
1986	40.0	39.3	88.5	62.0	29.4	13.4	1.8	3.1
1987	161.0	97.2	88.1	131.5	60.2	36.5	16.0	5.0
1988	69.7	119.8	46.0	40.8	37.4	19.9	9.6	9.4
1989	146.6	239.3	255.7	124.3	57.0	71.6	32.1	25.6
1990	68.0	62.1	96.4	102.3	38.6	27.1	28.5	20.5
1991	472.5	120.1	88.6	131.5	125.8	40.5	25.3	41.3
1992	64.6	391.8	112.0	65.3	71.1	62.5	30.1	56.9
1993	28.9	296.7	344.1	48.3	27.0	27.8	7.9	10.0
1994	41.0	65.8	197.3	297.7	56.7	44.1	20.2	33.8
1995	17.2	124.8	57.8	139.5	148.1	25.9	16.6	18.2
1996	75.7	91.6	123.2	27.1	51.5	56.1	8.0	9.3
1997	86.3	297.3	91.7	81.7	15.7	27.3	24.5	7.1
1998	49.9	136.8	130.6	32.7	31.1	4.5	7.3	13.1
1999	104.2	125.4	156.0	55.4	11.0	7.0	1.9	2.7
2000	157.1	512.4	136.3	57.4	31.5	6.1	4.5	2.0
2001	135.0	170.6	175.8	26.9	12.1	3.3	1.0	1.3
2002	179.1	195.9	137.4	73.9	19.3	5.7	4.0	1.6
2003	73.2	154.1	103.4	72.9	87.1	21.8	9.6	6.0
2004	176.6	131.8	64.0	38.7	30.1	20.6	4.7	3.2

Year	4	5	6	7	8	9	10	11
2005	44.1	492.9	196.4	75.6	41.7	25.1	17.8	1.6
2006	15.2	94.3	91.5	13.6	3.9	7.3	2.8	1.5
2007	16.1	47.6	108.2	74.5	15.9	3.0	2.8	1.7
2008	65.0	41.3	66.0	53.6	51.8	6.3	2.1	3.1
2009	109.0	186.0	51.2	50.6	29.5	8.2	1.5	1.2
2010	15.9	135.6	117.1	40.5	27.0	21.3	8.7	1.0
2011	8.0	31.0	129.7	117.5	13.3	15.2	13.8	3.7
2012	0.9	47.0	96.3	143.5	64.1	12.9	15.0	5.2
2013	9.2	78.3	252.5	181.1	93.0	20.0	1.6	0.9
2014	1.5	74.7	164.6	410.7	189.1	127.9	1.7	1.0
2015	2.1	61.2	434.7	323.3	389.6	121.1	19.2	5.1
2016	19.4	79.8	217.7	269.1	187.4	59.9	28.1	4.8
2017	7.5	70.9	107.0	192.6	223.4	78.1	27.9	4.9
2018	0.0	19.2	230.9	279.7	218.1	105.8	38.0	4.6
2019	1.0	13.3	225.2	421.5	146.5	101.7	32.6	10.7
2020	7.5	28.5	102.3	494.4	397.0	248.3	63.8	9.4
2021	7.1	109.5	112.8	150.2	355.6	181.6	66.1	11.4
2022	2.5	12.3	83.9	70.1	69.0	98.5	69.5	18.0
2023	10.0	42.9	36.6	92.8	32.6	30.1	22.7	9.6
b) MIDDLE								
1986	66.1	54.9	101.5	46.3	18.0	8.3	1.1	1.9
1987	42.3	79.7	69.4	138.6	13.1	12.1	13.5	0.8
1988	39.3	35.8	31.4	14.4	15.1	11.3	0.2	0.0
1989	13.3	24.7	22.0	12.0	7.4	6.5	3.0	2.4
1990	26.9	19.4	21.1	37.1	7.7	5.3	4.2	0.9
1991	97.9	26.5	21.8	28.7	33.9	20.8	9.6	21.9
1992	67.8	164.5	22.4	9.3	5.3	3.8	1.9	4.4

Year	4	5	6	7	8	9	10	11
1993	5.4	102.6	128.8	22.0	9.3	6.4	7.3	11.1
1994	9.1	14.7	73.8	99.3	12.1	3.8	4.7	7.9
1995	1.6	75.6	25.7	92.5	80.4	10.3	1.8	32.3
1996	35.0	21.6	124.2	10.7	32.3	37.0	8.5	8.9
1997	77.7	176.4	31.8	66.3	12.6	15.1	16.5	10.3
1998	20.3	17.1	34.6	7.0	13.0	2.4	5.1	8.8
1999	59.8	79.5	31.5	19.9	8.0	17.6	1.7	8.2
2000	40.2	76.9	28.4	9.2	5.1	1.5	1.3	0.6
2001	60.1	147.9	104.9	31.8	6.9	2.3	0.0	3.2
2002	74.1	66.2	58.5	56.6	10.2	1.4	1.2	1.8
2003	45.5	95.4	44.6	30.1	30.1	6.8	0.9	1.3
2004	66.9	121.3	85.6	61.1	54.2	31.8	11.0	2.1
2005	27.0	166.4	134.8	40.5	34.9	24.1	10.3	0.8
2006	25.5	116.1	206.9	76.4	39.0	29.3	23.2	7.8
2007	27.2	77.9	216.1	223.0	84.9	34.3	16.7	10.3
2008	173.4	36.7	63.9	75.8	121.2	21.9	20.7	4.7
2009	86.7	154.1	35.7	78.8	37.9	13.2	5.6	2.6
2010	7.3	54.4	80.7	23.5	20.6	11.7	5.5	3.1
2011	2.3	12.0	69.7	89.5	17.0	12.8	12.0	3.6
2012	1.3	16.8	75.3	101.1	70.7	8.0	4.6	3.8
2013	9.1	17.3	108.5	162.2	99.4	38.3	3.1	0.7
2014	0.3	35.3	14.6	61.9	49.5	11.6	3.7	0.0
2015	3.8	24.4	233.7	104.0	176.4	69.4	24.6	0.0
2016	9.3	40.8	262.0	215.0	119.9	53.6	19.0	0.0
2017	1.2	9.4	32.6	60.6	74.5	42.4	5.8	0.2
2018	2.2	20.6	85.3	215.7	164.0	16.1	8.7	0.0
2019	2.3	4.2	38.3	129.0	61.1	80.1	24.5	4.9

Year	4	5	6	7	8	9	10	11
2020	1.1	10.4	18.1	105.0	120.1	74.6	46.5	26.9
2021	4.7	44.7	54.1	69.3	185.5	102.4	25.8	12.1
2022	5.7	13.2	64.0	54.8	95.5	129.2	68.2	21.1
2023	13.0	49.8	69.4	73.0	54.8	41.6	26.8	10.8
c) SOUTH								
1986	481.5	135.4	284.2	78.9	38.5	11.5	2.5	3.9
1987	138.9	159.9	76.5	175.8	77.5	53.5	23.1	16.5
1988	55.9	214.3	124.0	60.9	85.2	38.9	12.6	8.5
1989	118.2	181.1	726.8	366.7	157.3	213.3	54.3	26.2
1990	118.8	118.1	135.3	631.9	172.9	75.8	80.6	43.4
1991	433.8	146.2	117.2	105.1	341.3	119.5	73.5	104.2
1992	133.0	743.3	107.7	62.8	150.5	332.6	123.7	131.1
1993	32.9	350.9	424.3	106.8	44.0	63.8	52.7	122.1
1994	37.9	8.0	259.2	357.7	48.5	63.8	136.2	226.3
1995	4.5	105.5	36.5	162.4	138.5	36.8	40.5	98.0
1996	51.3	30.7	201.2	72.2	168.2	160.6	41.0	124.6
1997	138.8	828.6	74.4	315.2	54.6	114.0	107.2	95.4
1998	80.5	37.8	134.7	34.0	76.2	15.0	29.4	36.2
1999	171.1	619.6	84.1	187.0	36.6	59.8	22.2	30.7
2000	143.0	558.7	333.4	54.3	65.1	12.6	20.3	12.7
2001	43.8	541.9	506.9	326.2	48.0	38.4	10.4	19.9
2002	415.8	175.9	398.6	331.6	99.9	25.4	21.4	12.7
2003	105.9	874.3	135.9	285.3	181.4	35.5	5.5	8.0
2004	115.6	266.8	587.2	116.1	106.7	52.1	14.4	7.5
2005	8.9	257.6	425.7	664.2	126.2	128.7	36.1	8.0
2006	79.8	218.6	573.2	589.7	438.1	144.6	76.9	21.5
2007	7.9	354.5	518.5	949.9	590.0	189.9	112.8	36.0

Year	4	5	6	7	8	9	10	11
2008	131.7	48.1	178.6	327.1	407.0	186.4	98.9	76.4
2009	57.1	491.9	246.4	491.0	162.3	86.1	124.8	62.2
2010	50.2	211.1	774.1	201.4	250.7	164.2	92.1	58.8
2011	7.6	184.4	183.1	618.9	198.4	98.7	57.6	102.5
2012	0.3	13.0	145.6	168.5	176.1	19.8	5.7	18.7
2013	8.5	25.5	228.6	488.1	181.3	86.0	2.7	2.7
2014	3.6	59.4	47.5	187.4	332.8	73.1	35.5	1.2
2015	0.0	15.3	104.9	55.0	155.7	41.9	24.0	2.6
2016	4.3	48.6	151.3	82.8	60.9	27.6	7.8	0.5
2017	8.6	7.9	90.8	183.9	69.6	28.5	4.9	0.4
2018	0.5	16.9	78.3	74.3	88.5	16.6	6.3	1.5
2019	2.8	4.2	175.5	437.0	184.2	135.4	43.1	18.4
2020	0.0	21.7	66.5	191.4	215.4	106.5	63.6	2.3
2021	2.1	25.5	180.8	143.5	336.8	143.5	18.3	23.9
2022	2.7	35.8	205.7	231.1	79.6	157.2	82.2	66.9
2023	35.4	65.9	43.7	150.4	128.3	82.1	60.0	10.8

Table 15. Spring spawner and fall spawner catch-at-age from the fishery-independent acoustic survey in FO area 4Tmno.

Year	2	3	4	5	6	7	8	9	10
Spring spawners									
1994	2,547	231,932	100,062	109,616	104,269	28,072	6,411	7,225	1,024
1995	47,469	7,752	77,135	21,658	25,178	21,111	5,125	777	74
1996	329,351	141,503	16,356	185,039	48,168	28,919	30,631	8,004	3,670
1997	152,556	77,939	79,058	11,239	84,989	5,522	12,954	14,803	2,649
1998	156,804	30,320	31,992	19,717	5,617	38,122	6,424	5,439	3,585
1999	242,522	109,075	56,091	19,839	6,280	3,669	18,022	2,749	1,380
2000	29,470	27,667	25,372	10,178	10,278	1,905	9,706	2,278	174
2001	90,893	14,967	8,109	5,734	3,180	1,844	2,784	500	440

Year	2	3	4	5	6	7	8	9	10
2002	93,284	27,633	8,130	11,464	3,494	5,131	1,684	271	123
2003	246,068	41,734	57,655	26,041	17,349	5,255	1,878	4,847	3,520
2004	234,172	62,441	9,350	10,956	556	0	0	0	0
2005	164,552	158,638	36,213	1,838	2,708	426	1	0	0
2006	100,682	39,313	24,601	26,314	2,909	885	572	257	338
2007	49,662	39,444	8,005	12,403	8,158	1,172	1,456	0	0
2008	71,227	25,129	7,599	9,225	5,760	3,091	2,294	532	0
2009	47,324	39,979	16,155	7,852	2,439	1,225	1,774	0	0
2010	37,879	67,721	73,493	8,786	8,471	8,815	2,434	1,518	0
2011	20,722	39,956	14,879	16,260	10,975	4,134	107	3,540	105
2012	14,698	108,634	29,893	9,947	7,664	2,497	1,244	260	379
2013	604	8,851	21,555	21,928	13,612	4,517	1,456	0	0
2014	24,060	16,243	12,988	7,263	6,592	7,212	667	0	872
2015	57,318	66,879	30,345	26,148	8,972	22,891	16,167	1,244	1,713
2016	6,910	45,251	12,587	7,921	6,040	2,515	1,261	2,222	0
2017	977	21,838	45,743	9,670	7,939	15,162	900	0	0
2018	518	2,936	11,737	20,955	4,220	5,134	3,251	4,081	287
2019	121	5,731	11,451	8,947	11,241	5,955	1,975	1,027	12
2020	98	9,066	7,900	10,749	5,941	13,653	6,531	2,279	209
2021	69	4,462	29,259	6,812	6,191	14,206	11,485	4,029	3,024
2022	955	12,905	4,913	12,924	2,854	3,135	3,901	2,237	0
2023	6,354	14,841	15,046	4,169	10,412	1,974	2,003	680	140
Fall spawners									
1994	2,158	4,438	201,347	61,950	33,097	17,261	2,309	0	12
1995	13,019	23,465	12,113	53,151	11,242	20,084	27,317	2,837	1,218
1996	276,352	252,600	203,213	33,859	120,271	32,486	27,044	11,945	3,001
1997	234,213	383,380	238,803	115,428	16,302	45,772	15,375	14,488	6,536

Year	2	3	4	5	6	7	8	9	10
1998	73,764	198,120	111,466	55,624	39,510	9,352	27,411	3,700	6,706
1999	60,379	324,816	231,524	103,099	69,007	82,061	34,685	30,956	11,048
2000	110,711	162,188	221,369	191,640	83,573	29,020	31,824	21,602	9,898
2001	130,505	430,408	119,004	55,366	38,313	11,522	14,404	10,217	3,448
2002	265,717	65,241	75,329	58,917	69,959	46,732	11,739	2,050	4,002
2003	57,266	418,557	236,961	221,302	85,137	135,133	133,898	56,417	21,343
2004	61,445	92,759	104,325	41,494	36,813	47,659	14,412	17,158	5,750
2005	63,739	161,176	312,191	157,578	66,904	30,826	8,659	13,351	6,933
2006	650,350	192,891	96,550	134,036	187,251	88,039	40,815	38,326	13,275
2007	146,879	306,699	71,436	34,344	42,814	34,105	3,974	1,952	1,419
2008	163,628	155,365	98,999	20,089	11,055	10,438	7,404	2,007	467
2009	102,959	169,914	96,966	50,111	6,429	2,552	1,186	421	160
2010	36,511	153,069	248,431	270,698	132,928	6,743	7,316	1,353	213
2011	29,023	42,605	88,110	68,702	51,739	22,614	4,811	2,910	1,078
2012	306	295,095	159,558	122,679	69,179	29,584	3,985	4,273	191
2013	4,293	19,530	173,691	70,667	99,171	41,761	10,859	7,683	11,321
2014	141,494	74,428	22,540	101,232	54,411	47,750	29,964	8,753	1,712
2015	9,286	475,924	140,252	51,570	218,422	46,387	28,011	15,334	1,606
2016	30,861	45,012	186,763	49,395	64,463	59,738	27,587	6,224	0
2017	20,902	41,151	64,915	148,495	61,294	18,119	30,775	1,596	642
2018	26,033	19,047	19,463	9,213	34,181	19,088	3,859	1,351	1,948
2019	1,740	25,628	23,653	7,543	11,636	16,265	5,023	308	749
2020	34,493	52,083	43,604	29,954	5,786	7,494	17,243	2,715	2,381
2021	46,115	58,467	23,210	28,444	12,497	6,936	14,642	12,386	2,240
2022	63,824	133,111	22,953	8,794	6,397	4,095	2,993	5,093	2,872
2023	19,933	32,346	31,943	17,388	3,178	481	2,316	916	2,767

Table 16. Relative selectivity-at-age for 2⁵/₈" and 2³/₄" mesh calculated from the experimental netting survey and commercial gillnet fishery.

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2 5/8 inches														
1985	0.243	0.310	0.567	0.813	0.924	0.933	0.911	0.777	0.790	0.571	0.483	0.432	0.410	0.398
1986	0.150	0.329	0.594	0.831	0.943	0.930	0.918	0.834	0.519	0.768	0.531	0.455	0.449	0.439
1987	0.382	0.464	0.579	0.802	0.940	0.945	0.893	0.830	0.767	0.670	0.554	0.382	0.382	0.382
1988	0.170	0.329	0.642	0.825	0.922	0.945	0.902	0.876	0.778	0.723	0.662	0.483	0.434	0.406
1989	0.265	0.380	0.632	0.875	0.960	0.961	0.855	0.829	0.735	0.773	0.553	0.582	0.508	0.406
1990	0.014	0.290	0.587	0.814	0.933	0.934	0.854	0.751	0.757	0.695	0.645	0.594	0.520	0.418
1991	0.196	0.354	0.492	0.738	0.903	0.934	0.925	0.898	0.785	0.741	0.664	0.519	0.416	0.403
1992	0.217	0.234	0.445	0.695	0.926	0.877	0.915	0.860	0.808	0.760	0.678	0.541	0.415	0.382
1993	0.140	0.140	0.417	0.614	0.822	0.932	0.909	0.866	0.830	0.769	0.703	0.711	0.629	0.382
1994	0.035	0.050	0.309	0.606	0.769	0.912	0.952	0.918	0.852	0.807	0.669	0.535	0.724	0.481
1995	0.105	0.401	0.384	0.512	0.662	0.849	0.934	0.914	0.862	0.805	0.835	0.688	0.572	0.427
1996	0.063	0.177	0.380	0.592	0.674	0.801	0.911	0.955	0.862	0.773	0.705	0.744	0.568	0.639
1997	0.024	0.086	0.295	0.538	0.713	0.851	0.931	0.951	0.959	0.832	0.685	0.625	0.701	0.463
1998	0.028	0.123	0.346	0.504	0.704	0.856	0.928	0.945	0.941	0.929	0.751	0.732	0.682	0.566
1999	0.056	0.074	0.301	0.515	0.613	0.800	0.889	0.950	0.929	0.920	0.755	0.596	0.682	0.435
2000	0.007	0.088	0.310	0.478	0.670	0.804	0.909	0.950	0.958	0.901	0.833	0.799	0.709	0.461
2001	0.007	0.059	0.277	0.457	0.610	0.775	0.881	0.953	0.943	0.951	0.897	0.797	0.570	0.494
2002	0.001	0.118	0.265	0.427	0.567	0.714	0.844	0.931	0.942	0.935	0.944	0.876	0.748	0.721
2003	0.042	0.200	0.270	0.410	0.569	0.710	0.816	0.901	0.931	0.959	0.914	0.926	0.692	0.383
2004	0.005	0.088	0.255	0.402	0.559	0.683	0.828	0.902	0.938	0.936	0.899	0.837	0.573	0.504
2005	0.000	0.051	0.220	0.407	0.519	0.623	0.783	0.862	0.908	0.917	0.930	0.847	0.583	0.504
2006	0.364	0.112	0.229	0.377	0.539	0.639	0.753	0.881	0.919	0.956	0.912	0.726	0.916	0.720
2007	0.017	0.042	0.263	0.375	0.536	0.669	0.750	0.826	0.901	0.888	0.899	0.969	0.656	0.349
2008	0.013	0.030	0.168	0.360	0.506	0.635	0.731	0.782	0.870	0.898	0.929	0.954	0.806	0.800
2009	0.019	0.072	0.198	0.297	0.493	0.633	0.738	0.818	0.843	0.873	0.940	0.940	0.957	0.811

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2010	0.001	0.023	0.135	0.303	0.365	0.569	0.637	0.725	0.799	0.793	0.891	0.955	0.970	0.771
2011	0.000	0.020	0.087	0.252	0.407	0.447	0.653	0.709	0.793	0.852	0.844	0.915	0.900	0.728
2012	0.000	0.050	0.081	0.193	0.325	0.466	0.519	0.694	0.804	0.885	0.931	0.864	0.653	0.606
2013	0.003	0.027	0.084	0.237	0.320	0.421	0.528	0.580	0.738	0.904	0.840	0.970	0.959	0.951
2014	0.003	0.044	0.154	0.244	0.335	0.381	0.470	0.559	0.607	0.978	0.961	0.938	0.888	0.823
2015	0.006	0.060	0.132	0.276	0.319	0.442	0.494	0.584	0.644	0.782	0.788	0.731	0.697	0.678
2016	0.002	0.060	0.183	0.331	0.423	0.489	0.564	0.630	0.681	0.785	0.893	0.804	0.592	0.574
2017	0.004	0.249	0.194	0.290	0.423	0.503	0.576	0.651	0.759	0.772	0.821	0.748	0.646	0.551
2018	0.003	0.024	0.112	0.283	0.388	0.480	0.547	0.606	0.695	0.768	0.849	0.919	0.905	0.896
2019	0.008	0.014	0.082	0.182	0.329	0.430	0.529	0.584	0.661	0.747	0.828	0.904	0.885	0.885
2020	0.000	0.030	0.089	0.200	0.375	0.451	0.541	0.606	0.678	0.745	0.959	0.897	0.892	0.889
2021	0.004	0.029	0.158	0.284	0.382	0.519	0.602	0.663	0.753	0.795	0.836	0.739	0.829	0.826
2022	0.008	0.032	0.194	0.313	0.438	0.485	0.593	0.676	0.718	0.750	0.741	0.843	0.881	0.551
2023	0.002	0.034	0.142	0.290	0.451	0.574	0.615	0.729	0.734	0.791	0.717	0.804	0.874	0.753
2 ¾ inches														
1985	0.113	0.154	0.329	0.583	0.744	0.932	0.962	0.946	0.956	0.834	0.761	0.716	0.695	0.684
1986	0.059	0.160	0.353	0.609	0.792	0.934	0.965	0.949	0.802	0.959	0.813	0.743	0.736	0.726
1987	0.063	0.245	0.340	0.562	0.795	0.892	0.960	0.940	0.900	0.894	0.821	0.667	0.667	0.667
1988	0.068	0.159	0.397	0.592	0.759	0.890	0.919	0.985	0.928	0.940	0.903	0.765	0.719	0.691
1989	0.117	0.187	0.390	0.674	0.808	0.938	0.965	0.957	0.927	0.951	0.824	0.859	0.788	0.692
1990	0.004	0.149	0.348	0.576	0.844	0.943	0.959	0.935	0.942	0.906	0.872	0.858	0.794	0.700
1991	0.080	0.173	0.271	0.486	0.696	0.927	0.954	0.960	0.956	0.928	0.890	0.793	0.702	0.689
1992	0.092	0.102	0.232	0.442	0.709	0.716	0.947	0.963	0.959	0.946	0.896	0.812	0.701	0.667
1993	0.053	0.053	0.213	0.369	0.580	0.758	0.869	0.968	0.961	0.920	0.905	0.917	0.880	0.667
1994	0.011	0.017	0.145	0.364	0.517	0.714	0.890	0.957	0.958	0.948	0.906	0.811	0.904	0.764
1995	0.053	0.202	0.194	0.284	0.431	0.632	0.760	0.897	0.966	0.948	0.970	0.900	0.842	0.713
1996	0.021	0.072	0.194	0.349	0.425	0.567	0.747	0.868	0.955	0.928	0.910	0.918	0.814	0.897

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1997	0.007	0.030	0.139	0.309	0.458	0.620	0.750	0.843	0.924	0.932	0.900	0.871	0.927	0.751
1998	0.008	0.048	0.169	0.280	0.455	0.637	0.754	0.858	0.929	0.945	0.921	0.904	0.914	0.837
1999	0.018	0.025	0.142	0.287	0.374	0.564	0.667	0.868	0.908	0.942	0.938	0.854	0.875	0.722
2000	0.002	0.032	0.148	0.260	0.420	0.565	0.716	0.814	0.910	0.944	0.976	0.956	0.907	0.743
2001	0.002	0.020	0.128	0.244	0.364	0.527	0.663	0.803	0.905	0.904	0.942	0.936	0.823	0.763
2002	0.000	0.050	0.121	0.223	0.329	0.464	0.613	0.750	0.780	0.939	0.928	0.976	0.956	0.942
2003	0.013	0.092	0.125	0.212	0.332	0.460	0.583	0.705	0.811	0.909	0.973	0.973	0.897	0.667
2004	0.001	0.033	0.115	0.207	0.324	0.438	0.596	0.705	0.804	0.891	0.934	0.894	0.845	0.782
2005	0.000	0.018	0.099	0.211	0.293	0.380	0.548	0.651	0.730	0.836	0.900	0.806	0.828	0.770
2006	0.001	0.042	0.102	0.190	0.311	0.396	0.512	0.680	0.746	0.820	0.862	0.949	0.965	0.945
2007	0.005	0.014	0.120	0.189	0.308	0.423	0.507	0.608	0.719	0.754	0.790	0.926	0.901	0.171
2008	0.004	0.011	0.070	0.182	0.286	0.394	0.488	0.543	0.659	0.718	0.813	0.930	0.956	0.949
2009	0.005	0.026	0.086	0.141	0.278	0.395	0.497	0.598	0.622	0.667	0.839	0.854	0.936	0.985
2010	0.000	0.007	0.056	0.145	0.184	0.342	0.406	0.489	0.572	0.583	0.745	0.872	0.917	0.968
2011	0.000	0.008	0.032	0.119	0.214	0.240	0.424	0.475	0.566	0.674	0.705	0.865	0.939	0.941
2012	0.000	0.019	0.029	0.082	0.158	0.254	0.292	0.456	0.574	0.699	0.835	0.796	0.891	0.860
2013	0.001	0.008	0.032	0.108	0.155	0.220	0.296	0.337	0.495	0.683	0.591	0.952	0.969	0.981
2014	0.001	0.014	0.061	0.111	0.163	0.192	0.254	0.322	0.362	0.926	0.798	0.937	0.944	0.950
2015	0.001	0.021	0.051	0.128	0.153	0.236	0.272	0.343	0.396	0.562	0.949	0.937	0.926	0.918
2016	0.001	0.022	0.081	0.162	0.223	0.271	0.329	0.384	0.430	0.561	0.738	0.603	0.855	0.846
2017	0.001	0.116	0.089	0.139	0.225	0.282	0.337	0.403	0.522	0.578	0.953	0.918	0.862	0.806
2018	0.001	0.007	0.042	0.136	0.199	0.263	0.311	0.359	0.440	0.520	0.642	0.981	0.989	0.995
2019	0.002	0.004	0.031	0.079	0.160	0.227	0.300	0.343	0.410	0.496	0.578	0.663	1.000	1.000
2020	0.000	0.009	0.032	0.086	0.191	0.240	0.308	0.363	0.427	0.498	0.788	0.995	0.997	0.998
2021	0.001	0.009	0.068	0.132	0.193	0.293	0.361	0.416	0.508	0.557	0.658	0.468	0.989	0.988
2022	0.002	0.010	0.086	0.150	0.230	0.265	0.356	0.426	0.472	0.509	0.506	0.634	0.672	0.830
2023	0.000	0.011	0.058	0.137	0.241	0.332	0.372	0.475	0.483	0.553	0.463	0.568	0.909	0.958

Table 17. Multi-species bottom trawl survey fall spawning Herring stratified mean numbers per tow at age.

Year	1	2	3	4	5	6	7	8	9	10	11+
1994	0.43	1.46	3.89	48.32	12.34	17.06	17.80	4.69	2.93	8.36	6.67
1995	2.69	3.17	27.91	15.75	51.73	11.28	18.52	14.96	2.19	3.18	7.79
1996	4.44	1.12	0.60	2.06	0.72	3.37	1.44	2.18	1.27	0.48	1.36
1997	10.84	10.57	8.20	8.55	28.58	11.46	22.60	6.04	5.60	2.78	4.36
1998	2.40	4.17	2.55	15.72	5.85	9.14	3.36	5.97	1.38	1.63	2.62
1999	42.60	60.15	12.94	8.52	5.53	1.71	2.21	1.27	1.06	0.65	0.89
2000	14.21	12.43	17.18	32.82	20.53	8.25	1.56	3.12	0.98	0.74	0.18
2001	0.53	8.69	41.15	22.70	22.64	16.55	7.62	3.18	2.44	0.98	1.90
2002	1.82	36.29	39.48	102.42	26.97	21.96	15.86	4.12	2.41	0.61	0.63
2003	5.68	2.32	6.43	25.38	33.44	8.37	4.48	3.14	0.47	0.19	0.26
2004	6.51	4.57	16.84	26.49	17.57	17.97	12.22	8.09	4.03	0.90	0.82
2005	7.06	1.18	6.61	32.64	48.92	22.29	9.75	7.79	4.14	3.45	1.54
2006	37.10	11.55	2.23	7.79	6.02	9.66	4.73	2.61	0.24	0.11	0.27
2007	31.69	146.87	110.27	10.97	18.69	12.61	14.99	5.95	3.58	1.08	1.07
2008	23.84	15.63	24.81	18.50	3.37	6.36	6.54	4.09	3.09	1.10	1.11
2009	2.26	16.36	25.53	25.27	20.78	5.18	2.96	1.56	1.62	0.06	0.44
2010	3.16	38.96	46.17	71.07	50.75	49.98	6.44	6.53	4.77	3.50	2.83
2011	3.89	70.08	10.82	58.62	66.92	34.08	17.12	8.01	5.01	1.69	1.43
2012	0.16	50.47	243.65	59.90	159.89	131.15	63.86	29.16	5.07	1.37	0.38
2013	1.54	5.61	15.38	66.46	23.06	24.28	16.18	8.30	1.01	0.31	0.21
2014	4.14	21.58	10.55	20.35	87.41	15.48	11.74	7.77	0.39	0.09	0.01
2015	4.07	29.33	68.04	20.07	16.37	33.13	11.28	14.45	5.81	1.43	0.22
2016	7.58	8.87	13.64	21.29	10.41	20.79	11.18	2.07	1.42	0.30	0.08
2017	2.13	15.30	12.18	14.45	9.81	6.30	10.11	2.20	0.50	0.03	0.00
2018	2.34	23.91	6.36	3.59	5.42	8.26	3.11	2.29	0.70	0.49	0.02
2019	4.38	3.26	2.60	2.05	0.68	0.81	0.75	0.38	0.10	0.06	0.00
2020	0.06	6.71	0.58	0.51	0.26	0.18	0.19	0.23	0.08	0.02	0.03

Year	1	2	3	4	5	6	7	8	9	10	11+
2021	12.80	9.36	10.93	9.47	13.03	9.70	3.45	6.70	2.85	1.35	0.08
2022	11.03	56.32	32.01	12.24	5.23	2.64	1.14	0.57	0.60	0.35	0.05
2023	21.21	4.06	2.39	2.10	1.27	0.47	0.32	0.28	0.18	0.10	0.01

Table 18. Maximum likelihood estimates (MLEs) of January 1 spring spawner biomass (t).

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	15,974	12,149	47,501	12,818	12,483	6,096	2,990	3,021	3,131	7,743	95,783
1979	29,819	14,292	9,393	28,395	7,270	7,388	3,641	1,884	1,760	6,181	65,912
1980	27,314	18,693	9,311	5,069	13,229	3,191	3,356	1,636	921	3,531	40,244
1981	63,104	20,432	11,677	5,006	2,782	6,418	1,529	1,554	757	2,157	31,881
1982	73,125	50,817	15,268	8,793	3,741	2,075	4,365	1,066	1,138	1,848	38,294
1983	61,390	62,826	40,379	11,637	5,956	2,699	1,069	3,009	722	2,003	67,473
1984	48,343	55,614	53,969	30,538	9,036	4,510	1,843	640	1,876	1,649	104,062
1985	28,287	59,164	48,751	47,636	25,274	7,501	3,205	1,186	549	2,186	136,290
1986	19,190	29,640	60,452	42,254	40,393	21,625	5,133	1,929	721	1,846	174,354
1987	31,944	19,583	27,001	47,980	34,382	31,564	13,796	2,983	1,123	1,502	160,331
1988	25,046	26,465	17,031	21,060	36,859	25,558	19,360	8,351	1,691	1,501	131,410
1989	49,028	32,089	22,215	12,553	15,666	27,035	14,618	10,877	4,584	1,713	109,262
1990	163,487	51,018	32,577	18,573	9,649	11,400	15,325	8,193	6,058	3,289	105,065
1991	64,226	123,657	45,205	26,020	13,243	6,478	6,338	8,105	4,379	5,158	114,925
1992	31,511	50,592	95,169	33,981	17,483	8,123	3,470	3,330	4,241	4,870	170,666
1993	91,009	30,978	42,029	72,796	23,961	11,713	4,690	1,957	1,867	4,946	163,959
1994	18,243	96,735	27,901	33,672	51,679	15,703	6,492	2,707	1,052	3,678	142,884
1995	20,670	14,569	91,885	22,294	24,043	35,122	8,803	3,560	1,486	2,397	189,590
1996	23,043	25,308	12,610	71,614	15,831	15,741	18,312	4,336	1,801	1,820	142,065
1997	27,951	23,189	24,304	9,982	50,613	10,436	8,296	9,472	2,101	1,811	117,016
1998	24,234	23,521	20,073	17,781	6,581	33,735	5,686	4,466	4,929	2,016	95,267
1999	35,271	22,514	18,995	14,699	11,722	4,166	17,986	3,075	2,311	3,520	76,473

Year	2	3	4	5	6	7	8	9	10	11+	4+
2000	19,710	29,908	18,333	13,462	9,079	6,563	2,228	9,250	1,532	2,846	63,293
2001	24,208	14,404	22,637	11,854	6,956	4,183	2,818	939	3,848	1,733	54,969
2002	11,081	19,448	10,173	14,138	5,968	3,107	1,759	1,170	375	2,238	38,929
2003	23,792	9,536	14,201	6,393	7,277	2,769	1,344	742	487	1,065	34,279
2004	19,333	20,914	6,924	8,403	3,064	3,083	1,101	518	276	566	23,935
2005	29,478	15,860	15,823	3,976	3,821	1,189	1,140	385	183	292	26,810
2006	30,466	21,232	11,379	10,214	2,365	1,874	475	386	132	133	26,957
2007	33,241	24,622	15,328	7,518	6,446	1,314	913	231	168	110	32,028
2008	50,644	24,349	18,071	9,992	4,524	3,437	620	372	98	108	37,221
2009	27,961	33,183	17,046	11,405	5,747	2,427	1,811	340	170	91	39,038
2010	29,594	18,412	21,286	10,528	6,971	3,382	1,508	1,059	189	145	45,068
2011	12,728	19,890	11,565	14,080	6,416	4,326	2,185	944	587	173	40,275
2012	10,050	12,790	14,538	7,959	8,902	4,056	2,376	1,154	506	398	39,889
2013	11,866	10,152	11,151	10,971	5,966	5,965	2,361	1,322	633	525	38,895
2014	13,959	9,969	9,205	8,382	7,922	4,151	3,269	1,242	697	560	35,427
2015	28,725	11,665	8,098	6,947	6,185	5,612	2,054	1,641	589	624	31,750
2016	16,070	24,142	9,972	6,289	5,215	4,350	2,447	876	698	462	30,309
2017	14,522	15,226	19,838	8,111	5,056	3,951	1,837	989	360	466	40,607
2018	13,134	12,183	12,207	16,129	6,321	3,855	1,578	718	401	320	41,529
2019	15,671	11,590	9,843	9,007	12,515	4,714	1,646	684	315	307	39,032
2020	10,977	13,417	8,884	7,516	7,118	9,067	2,270	736	358	287	36,237
2021	6,289	9,218	10,733	6,633	5,529	5,315	4,814	1,187	374	338	34,923
2022	8,690	6,102	7,735	8,252	5,507	4,705	3,107	2,910	669	337	33,222
2023	14,548	7,145	4,975	5,965	7,011	4,074	2,867	1,696	1,675	591	28,854

Table 19. Maximum likelihood estimates (MLEs) of January 1 spring spawner abundance (number in thousands).

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	141,366	85,556	223,116	55,368	48,685	21,058	10,072	9,084	8,547	20,939	396,870
1979	168,565	94,710	51,443	120,777	29,314	25,707	12,108	5,791	5,223	16,954	267,317
1980	183,071	110,218	50,520	22,518	50,705	12,245	11,587	5,457	2,610	9,995	165,637
1981	432,515	120,683	58,829	21,967	9,376	21,002	5,352	5,064	2,385	5,509	129,484
1982	581,743	302,303	78,098	35,327	12,984	5,532	12,515	3,189	3,017	4,704	155,367
1983	461,925	420,239	207,923	51,217	22,936	8,420	3,464	7,837	1,997	4,835	308,629
1984	509,942	341,401	295,721	139,508	34,020	15,216	5,179	2,131	4,821	4,202	500,798
1985	236,318	386,695	252,989	214,289	100,615	24,522	9,802	3,336	1,373	5,812	612,738
1986	153,028	181,506	288,418	183,395	154,408	72,446	15,309	6,119	2,083	4,486	726,664
1987	212,394	118,252	133,667	202,703	127,624	107,324	42,527	8,986	3,592	3,856	630,279
1988	287,225	164,791	85,753	90,775	135,761	85,334	59,115	23,424	4,950	4,102	489,213
1989	401,541	222,685	117,418	56,292	58,565	87,406	44,991	31,167	12,350	4,772	412,962
1990	935,815	311,085	159,849	78,269	36,940	38,360	47,698	24,552	17,008	9,343	412,018
1991	452,935	729,110	238,675	116,159	52,034	23,352	20,673	25,632	13,186	14,150	503,861
1992	304,747	349,393	552,985	170,502	75,228	31,879	12,499	11,029	13,666	14,573	882,360
1993	979,649	234,150	264,836	399,537	113,884	48,062	17,889	6,996	6,170	15,796	873,170
1994	128,654	753,978	177,599	190,774	264,480	71,865	25,960	9,636	3,766	11,824	755,903
1995	248,139	98,908	570,357	126,889	124,127	163,204	36,850	13,270	4,923	7,964	1,047,584
1996	229,284	190,574	74,616	403,916	81,019	74,742	78,291	17,618	6,340	6,156	742,697
1997	240,540	174,222	142,462	52,650	259,290	49,298	36,038	37,633	8,463	6,002	591,836
1998	253,490	177,922	126,967	98,510	33,405	156,690	24,614	17,943	18,727	7,197	484,053
1999	333,376	180,254	124,394	83,613	58,814	18,867	77,862	12,192	8,882	12,831	397,456
2000	158,312	225,718	119,508	76,576	45,580	29,929	9,092	37,374	5,848	10,412	334,318
2001	228,809	104,148	143,638	67,624	35,746	19,082	11,992	3,620	14,862	6,464	303,029
2002	121,366	148,687	65,335	79,560	30,545	14,385	7,309	4,563	1,376	8,102	211,174
2003	284,254	77,976	92,634	36,511	37,205	12,914	5,809	2,934	1,830	3,799	193,635

Year	2	3	4	5	6	7	8	9	10	11+	4+
2004	199,518	178,901	47,327	49,458	15,800	14,295	4,761	2,127	1,073	2,058	136,900
2005	264,381	125,176	107,639	24,560	20,142	5,610	4,741	1,567	699	1,028	165,984
2006	315,059	164,335	76,266	62,356	12,765	8,829	2,022	1,536	483	520	164,778
2007	309,223	195,567	101,044	45,784	35,554	6,713	4,192	913	678	438	195,315
2008	410,405	189,195	118,031	58,916	24,787	17,133	2,876	1,670	352	423	224,188
2009	253,956	247,451	113,113	69,078	32,936	12,894	8,607	1,381	786	361	239,156
2010	285,935	149,329	144,803	65,391	38,902	17,801	7,324	4,765	756	624	280,364
2011	192,855	172,657	89,859	86,380	38,284	22,116	10,343	4,178	2,695	777	254,634
2012	149,325	122,511	109,311	56,408	53,240	22,927	12,297	5,649	2,263	1,874	263,968
2013	131,550	98,655	80,806	71,797	36,716	34,166	12,708	6,756	3,091	2,259	248,299
2014	157,912	89,328	66,750	54,179	47,208	23,413	16,949	6,184	3,259	2,570	220,513
2015	298,290	109,843	61,962	45,973	36,750	31,262	10,967	7,821	2,834	2,663	200,232
2016	177,960	212,327	77,970	43,673	31,917	24,914	13,143	4,542	3,217	2,254	201,630
2017	144,349	128,057	152,597	55,860	31,078	22,472	10,091	5,288	1,822	2,192	281,398
2018	137,965	103,685	91,710	108,467	39,070	21,193	8,711	3,850	2,003	1,515	276,519
2019	162,902	98,803	74,122	65,267	76,452	27,124	8,733	3,556	1,565	1,427	258,244
2020	116,037	114,868	69,519	51,868	45,136	51,900	12,256	3,900	1,580	1,326	237,484
2021	71,218	80,298	79,388	47,892	35,486	30,546	26,323	6,174	1,959	1,457	229,224
2022	90,424	48,625	54,778	54,041	32,451	23,871	16,351	14,026	3,283	1,814	200,615
2023	156,429	62,077	33,366	37,542	36,941	22,093	12,696	8,674	7,432	2,700	161,443

Table 20. Maximum likelihood estimates of the instantaneous rate of fishing mortality (F) of spring spawners by age. F6-8 is the January 1 abundance-weighted average F for ages 6 to 8 years.

Year	2	3	4	5	6	7	8	9	10	11+	F6-8
1978	0.027	0.135	0.240	0.262	0.265	0.265	0.265	0.265	0.265	0.265	0.265
1979	0.051	0.254	0.452	0.494	0.499	0.499	0.499	0.499	0.499	0.499	0.499
1980	0.053	0.264	0.469	0.512	0.517	0.518	0.518	0.518	0.518	0.518	0.517
1981	0.019	0.096	0.171	0.187	0.189	0.189	0.189	0.189	0.189	0.189	0.189
1982	0.012	0.061	0.109	0.119	0.120	0.120	0.120	0.120	0.120	0.120	0.120
1983	0.012	0.061	0.109	0.119	0.120	0.120	0.120	0.120	0.120	0.120	0.120
1984	0.006	0.029	0.051	0.056	0.056	0.057	0.057	0.057	0.057	0.057	0.056
1985	0.007	0.037	0.065	0.071	0.072	0.072	0.072	0.072	0.072	0.072	0.072
1986	0.012	0.060	0.107	0.117	0.118	0.118	0.118	0.118	0.118	0.118	0.118
1987	0.017	0.084	0.150	0.164	0.166	0.166	0.166	0.166	0.166	0.166	0.166
1988	0.021	0.105	0.187	0.205	0.207	0.207	0.207	0.207	0.207	0.207	0.207
1989	0.019	0.095	0.169	0.185	0.187	0.187	0.187	0.187	0.187	0.187	0.187
1990	0.004	0.019	0.074	0.163	0.213	0.227	0.230	0.230	0.230	0.230	0.224
1991	0.005	0.021	0.081	0.179	0.235	0.250	0.253	0.254	0.254	0.254	0.243
1992	0.004	0.017	0.065	0.144	0.188	0.200	0.203	0.203	0.203	0.203	0.193
1993	0.004	0.018	0.070	0.155	0.202	0.216	0.218	0.219	0.219	0.219	0.208
1994	0.004	0.020	0.078	0.171	0.224	0.239	0.242	0.242	0.242	0.242	0.228
1995	0.005	0.023	0.086	0.189	0.248	0.264	0.267	0.268	0.268	0.268	0.258
1996	0.004	0.021	0.078	0.173	0.227	0.241	0.244	0.245	0.245	0.245	0.237
1997	0.004	0.019	0.071	0.157	0.206	0.219	0.222	0.223	0.223	0.223	0.210
1998	0.005	0.021	0.081	0.179	0.235	0.250	0.253	0.254	0.254	0.254	0.248
1999	0.006	0.027	0.101	0.222	0.291	0.310	0.314	0.315	0.315	0.315	0.305
2000	0.009	0.042	0.160	0.352	0.461	0.491	0.497	0.498	0.498	0.498	0.475
2001	0.009	0.045	0.169	0.373	0.489	0.520	0.527	0.528	0.528	0.528	0.504
2002	0.008	0.039	0.148	0.326	0.427	0.454	0.460	0.461	0.461	0.461	0.439
2003	0.010	0.046	0.174	0.384	0.503	0.536	0.542	0.544	0.544	0.544	0.515

Year	2	3	4	5	6	7	8	9	10	11+	F6-8
2004	0.011	0.053	0.201	0.443	0.580	0.618	0.626	0.627	0.628	0.628	0.602
2005	0.012	0.032	0.082	0.191	0.361	0.530	0.637	0.686	0.705	0.712	0.435
2006	0.006	0.015	0.039	0.090	0.171	0.252	0.302	0.326	0.335	0.338	0.213
2007	0.008	0.022	0.056	0.130	0.247	0.362	0.435	0.469	0.482	0.487	0.280
2008	0.005	0.013	0.035	0.081	0.153	0.224	0.269	0.290	0.298	0.301	0.187
2009	0.003	0.008	0.020	0.046	0.087	0.128	0.154	0.166	0.170	0.172	0.107
2010	0.002	0.005	0.014	0.033	0.062	0.091	0.110	0.118	0.122	0.123	0.076
2011	0.002	0.005	0.014	0.032	0.061	0.090	0.108	0.116	0.119	0.120	0.077
2012	0.001	0.003	0.007	0.016	0.030	0.044	0.053	0.057	0.059	0.059	0.037
2013	0.002	0.006	0.015	0.034	0.065	0.095	0.115	0.123	0.127	0.128	0.085
2014	0.002	0.004	0.012	0.027	0.051	0.075	0.090	0.096	0.099	0.100	0.065
2015	0.002	0.004	0.011	0.027	0.050	0.074	0.089	0.096	0.098	0.099	0.065
2016	0.001	0.002	0.005	0.012	0.023	0.033	0.040	0.043	0.044	0.044	0.030
2017	0.002	0.005	0.012	0.028	0.054	0.079	0.095	0.102	0.105	0.106	0.069
2018	0.001	0.003	0.007	0.017	0.032	0.047	0.057	0.061	0.063	0.063	0.040
2019	0.001	0.003	0.009	0.021	0.039	0.058	0.069	0.075	0.077	0.077	0.046
2020	0.001	0.002	0.005	0.012	0.023	0.034	0.041	0.044	0.045	0.045	0.030
2021	0.000	0.001	0.003	0.008	0.015	0.023	0.027	0.029	0.030	0.030	0.021
2022	0.000	0.001	0.002	0.005	0.009	0.013	0.015	0.016	0.017	0.017	0.011
2023	0.000	0.000	0.001	0.002	0.004	0.005	0.006	0.007	0.007	0.007	0.005

Table 21. Risk analysis table of annual catch options (between 0 and 500 t) for 2024, 2025, 2026 and 2029, with predicted resulting SSB (kt) in 2025, 2026 and 2029, resulting probabilities (%) of SSB being greater than the LRP, resulting probabilities of increases in SSB by 5%, and resulting abundance weighted fishing mortality rate (F6-8) for the spring spawner component of Atlantic Herring from the southern Gulf of St. Lawrence.

Year	0 t	100 t	250 t	50 t	
SSB(kt)	2025	29.7	29.6	29.5	29.3
	2026	33.1	32.9	32.7	32.4
	2029	39.8	39.5	39.2	38.6
SSB>LRP 40%BMSY _{proxy} (%)	2025	3.3	3.3	3.2	3.2
	2026	5.6	5.5	5.5	5.2
	2029	15.3	15.1	14.6	14.0
5% increase in SSB(%)	2025	72.3	72.0	71.4	70.7
	2026	58.6	58.3	57.9	57.3
	2029	49.1	49.0	49.0	48.7
F6-8	2024	0.0	0.0	0.0	0.0
	2025	0.0	0.0	0.0	0.0

Table 22. SCA maximum likelihood estimates of August 1 biomass (t) of fall spawners in the North region of the southern Gulf of St. Lawrence.

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	17,555	9,457	7,954	7,216	3,469	2,859	3,810	894	487	2,710	29,398
1979	25,575	12,086	8,011	2,966	1,726	701	746	896	229	675	15,949
1980	15,505	29,257	8,704	3,984	1,058	564	255	268	315	338	15,487
1981	47,906	25,227	30,439	5,981	2,100	551	324	151	149	351	40,045
1982	23,126	40,560	30,766	26,866	4,060	1,244	352	206	97	301	63,892
1983	14,347	35,042	38,187	25,498	18,342	2,551	850	220	142	253	86,043
1984	20,374	22,453	44,202	35,475	19,447	13,177	2,005	653	159	321	115,438
1985	23,161	28,822	26,004	41,865	28,285	14,831	10,806	1,601	515	375	124,282
1986	22,638	37,393	34,792	23,076	31,449	20,357	11,288	7,975	1,173	615	130,725
1987	22,179	36,596	48,104	30,167	16,384	19,674	13,599	7,413	5,175	1,123	141,640
1988	15,123	23,756	43,323	40,973	18,075	9,021	11,740	7,869	4,251	3,599	138,850
1989	46,476	21,611	26,787	34,724	27,011	11,026	5,862	7,408	5,001	4,836	122,653
1990	31,990	66,956	26,685	24,613	21,858	15,803	6,897	3,579	4,513	5,944	109,890
1991	11,346	33,424	76,936	21,952	13,848	11,168	8,539	3,643	1,844	5,354	143,284
1992	14,195	11,281	35,318	64,861	13,941	8,210	6,866	5,128	2,159	4,183	140,666
1993	6,438	20,664	12,117	32,160	42,906	8,534	5,086	4,182	2,979	3,652	111,616

Year	2	3	4	5	6	7	8	9	10	11+	4+
1994	12,903	8,042	27,365	12,384	23,780	29,371	5,875	3,502	2,747	4,444	109,468
1995	9,037	16,817	10,310	24,437	7,025	11,854	14,126	2,836	1,672	3,334	75,593
1996	11,560	13,462	21,907	9,722	10,990	2,627	4,228	4,952	1,008	1,740	57,174
1997	17,494	16,014	17,888	19,507	4,680	4,491	1,001	1,558	1,811	941	51,877
1998	12,792	26,786	19,542	16,097	9,883	2,084	1,808	414	619	1,053	51,501
1999	10,601	18,713	37,203	16,656	8,255	4,393	813	725	160	617	68,822
2000	8,909	17,531	25,483	33,914	7,921	3,322	1,588	282	255	261	73,025
2001	8,660	13,347	25,142	23,869	17,825	3,582	1,345	617	116	199	72,695
2002	26,081	15,190	19,152	24,274	14,171	9,318	1,642	627	277	144	69,606
2003	19,342	37,895	20,856	19,090	14,714	7,775	4,475	780	297	193	68,178
2004	17,937	28,966	47,563	17,375	9,353	6,275	2,835	1,632	287	175	85,496
2005	10,205	22,842	36,116	45,241	11,940	5,750	3,249	1,422	800	216	104,734
2006	30,076	15,470	29,782	35,490	30,725	7,348	2,748	1,578	670	472	108,813
2007	51,954	43,620	20,596	31,987	30,715	18,658	2,850	1,019	558	404	106,787
2008	50,153	73,695	59,526	22,301	26,991	20,557	7,870	1,132	402	371	139,151
2009	50,172	62,182	97,082	65,985	20,671	20,916	9,854	3,475	506	313	218,801
2010	28,292	59,584	72,480	103,963	58,772	16,156	10,019	4,552	1,601	378	267,922
2011	31,813	29,097	70,229	79,274	97,575	49,600	7,639	4,599	2,036	930	311,881
2012	15,319	45,930	32,561	79,594	82,563	88,488	21,662	3,295	1,915	1,257	311,334
2013	16,841	21,021	61,270	40,519	83,921	78,109	33,143	8,021	1,242	1,133	307,357
2014	18,627	22,556	26,959	75,917	46,238	81,638	29,684	12,232	2,966	898	276,533
2015	19,250	27,367	27,885	33,218	84,147	44,559	31,880	11,434	4,352	1,434	238,907
2016	5,835	20,345	39,350	34,449	36,817	77,868	17,593	12,475	4,383	2,141	225,076
2017	3,814	7,189	25,178	49,996	38,919	34,290	32,857	7,207	5,253	2,799	196,500
2018	8,399	4,707	7,728	29,839	51,886	35,381	15,224	14,535	3,209	3,608	161,411
2019	4,054	9,921	5,626	9,043	29,072	48,412	16,395	6,863	6,604	3,011	125,026
2020	6,387	4,690	11,603	6,723	11,433	27,847	24,046	7,972	3,285	4,639	97,548

Year	2	3	4	5	6	7	8	9	10	11+	4+
2021	6,518	6,984	6,901	15,114	8,414	11,827	15,066	12,644	4,131	4,185	78,281
2022	15,327	10,052	9,313	9,016	17,262	8,502	6,194	7,765	6,433	4,062	68,549
2023	13,723	22,993	13,207	11,659	8,156	15,097	4,071	2,965	3,678	4,803	63,636

Table 23. SCA maximum likelihood estimates of January 1 abundance (number in thousands) of fall spawners in the North region of the southern Gulf of St. Lawrence.

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	81,927	55,126	36,700	29,460	11,805	10,215	11,286	2,807	1,656	6,756	110,685
1979	250,096	63,246	36,379	11,384	6,169	2,378	2,269	2,507	623	1,868	63,578
1980	215,323	193,809	43,899	14,858	3,528	1,861	792	755	834	829	67,357
1981	294,479	167,456	140,974	23,142	6,625	1,547	901	383	366	806	174,744
1982	343,571	230,060	129,370	97,887	12,679	3,408	875	509	217	662	245,607
1983	200,124	268,482	178,328	92,809	59,134	7,317	2,165	556	323	558	341,190
1984	255,024	156,434	208,944	133,049	63,052	39,184	5,348	1,582	406	644	452,210
1985	366,763	199,367	121,884	157,665	93,505	43,481	29,822	4,070	1,204	799	452,430
1986	300,520	286,667	154,967	89,857	103,351	59,405	30,452	20,881	2,849	1,403	463,166
1987	221,746	234,830	222,086	110,584	53,428	58,536	37,033	18,978	13,013	2,650	516,308
1988	216,013	173,124	181,304	154,126	60,570	27,476	33,075	20,916	10,718	8,846	497,030
1989	639,106	168,114	133,519	128,228	89,938	33,580	16,793	20,208	12,779	11,952	446,997
1990	321,118	498,298	129,715	93,248	71,776	47,461	19,424	9,710	11,684	14,299	397,316
1991	123,230	252,638	386,923	88,854	48,357	34,561	24,634	10,076	5,037	13,478	611,921
1992	266,464	98,217	199,501	279,669	52,770	27,254	20,609	14,684	6,006	11,036	611,530
1993	104,859	215,561	78,727	146,469	168,955	30,266	16,140	12,200	8,692	10,089	471,538
1994	519,991	164,928	427,183	113,770	221,779	108,503	19,648	10,475	7,918	12,189	921,464
1995	313,175	401,794	128,906	304,513	63,248	45,189	49,266	8,916	4,753	9,123	613,914
1996	518,552	250,813	314,413	88,475	152,398	10,442	14,772	16,090	2,912	4,531	604,031
1997	758,206	413,748	201,552	221,683	41,874	17,420	3,505	4,954	5,396	2,496	498,880
1998	696,172	620,944	332,294	145,125	116,568	7,740	6,627	1,332	1,883	3,000	614,570

Year	2	3	4	5	6	7	8	9	10	11+	4+
1999	493,884	571,317	508,992	243,786	71,576	16,632	2,888	2,471	497	1,821	848,663
2000	1,015,530	412,913	469,659	366,111	117,986	12,952	5,569	966	827	775	974,845
2001	802,692	845,489	344,620	353,909	190,988	13,652	4,820	2,071	359	596	911,014
2002	1,116,460	677,020	707,885	264,888	211,487	35,172	5,759	2,032	873	402	1,228,497
2003	727,664	953,894	573,141	568,899	162,204	28,758	15,533	2,542	897	563	1,352,536
2004	672,907	629,050	815,516	460,419	385,801	24,396	10,089	5,445	891	512	1,703,068
2005	398,641	586,513	546,335	674,324	343,965	22,770	11,948	4,939	2,665	687	1,607,633
2006	1,725,750	351,729	513,932	450,235	483,867	30,338	10,372	5,440	2,249	1,526	1,497,958
2007	1,498,960	1,530,710	311,489	446,281	360,834	78,310	11,400	3,669	1,896	1,310	1,215,189
2008	1,382,010	1,347,630	1,365,970	273,550	369,198	88,784	31,767	4,399	1,398	1,218	2,136,284
2009	1,058,660	1,250,340	1,216,390	1,216,320	229,932	88,136	39,228	13,510	1,853	1,099	2,806,468
2010	537,619	966,907	1,136,070	1,092,100	1,047,680	70,181	40,594	17,551	6,001	1,309	3,411,486
2011	949,550	494,662	887,395	1,031,850	957,003	233,501	31,988	18,151	7,810	3,249	3,170,948
2012	562,933	879,473	457,569	815,876	927,212	418,128	97,398	13,198	7,469	4,547	2,741,398
2013	464,786	522,128	817,815	423,421	740,108	377,119	150,144	34,656	4,685	4,263	2,552,211
2014	631,502	433,571	485,393	758,312	383,352	382,181	132,210	52,049	11,980	3,091	2,208,568
2015	465,639	590,366	405,004	450,280	689,308	201,696	140,420	48,084	18,882	5,464	1,959,138
2016	178,891	434,616	552,199	376,856	408,558	369,444	78,349	53,982	18,437	9,329	1,867,152
2017	215,595	167,319	405,710	514,280	343,281	159,083	149,297	31,321	21,521	11,062	1,635,556
2018	262,240	200,888	156,425	377,246	468,992	171,347	68,131	63,266	13,237	13,761	1,332,405
2019	164,016	245,177	187,183	145,732	345,150	235,962	76,726	30,218	27,992	11,938	1,060,901
2020	285,954	153,329	229,165	173,962	133,407	135,178	110,463	35,577	13,978	18,460	850,190
2021	455,572	267,087	143,272	213,507	159,895	54,874	66,367	53,718	17,260	15,726	724,618
2022	891,141	424,628	249,326	133,410	195,556	39,772	27,566	33,017	26,659	16,360	721,665
2023	191,905	216,730	395,648	232,017	122,261	72,671	19,447	13,317	15,902	20,703	891,966

Table 24. SCA maximum likelihood estimates of August 1 biomass (t) of fall spawners in the Middle region of the southern Gulf of St. Lawrence.

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	7,019	6,412	4,442	2,212	962	1,689	1,779	723	329	2,717	14,853
1979	5,942	4,823	5,080	3,121	1,121	357	845	802	289	1,084	12,699
1980	3,391	7,614	3,560	3,311	751	130	46	127	105	181	8,211
1981	4,762	4,779	7,811	2,540	1,469	229	47	18	46	98	12,258
1982	6,410	6,378	5,076	5,436	688	248	47	9	4	28	11,536
1983	4,270	7,727	5,929	3,481	3,097	357	170	28	4	18	13,084
1984	4,697	5,740	7,881	3,724	1,090	713	106	46	8	5	13,572
1985	5,902	6,465	6,044	6,512	2,071	506	400	57	23	9	15,623
1986	4,454	7,506	5,945	4,245	4,124	1,314	401	300	42	22	16,394
1987	3,626	7,085	7,475	4,108	2,148	2,124	785	250	151	39	17,080
1988	3,987	4,888	7,813	6,047	2,858	1,272	1,578	536	146	110	20,360
1989	19,920	6,329	4,809	5,303	3,574	1,433	844	939	346	160	17,407
1990	13,492	25,351	6,846	3,560	3,426	2,168	1,002	593	650	360	18,605
1991	2,952	16,641	26,497	5,030	2,108	1,998	1,395	647	399	631	38,703
1992	11,511	4,158	17,231	20,136	2,713	929	1,019	713	329	533	43,603
1993	3,072	15,720	4,479	14,123	13,321	1,588	667	666	474	548	35,866
1994	5,995	4,279	16,893	3,612	9,808	8,529	1,091	458	470	703	41,564
1995	4,276	8,682	4,802	14,100	2,421	6,018	5,444	759	296	738	34,579
1996	3,189	4,606	9,976	3,960	7,429	1,058	2,614	2,301	347	439	28,124
1997	9,700	7,149	5,142	8,118	2,115	3,238	491	1,206	1,040	347	21,698
1998	7,242	11,855	10,722	4,879	4,371	940	1,385	214	521	605	23,638
1999	5,080	10,443	14,650	9,129	2,176	1,478	315	444	71	354	28,618
2000	6,274	5,918	13,556	14,194	4,123	743	476	100	141	132	33,464
2001	6,564	10,411	7,916	12,781	7,134	1,606	273	168	36	88	30,002
2002	8,827	10,614	13,994	9,278	8,111	3,985	792	140	82	59	36,441
2003	6,709	15,618	14,336	13,277	6,202	4,528	2,016	390	72	74	40,895

Year	2	3	4	5	6	7	8	9	10	11+	4+
2004	5,847	10,163	21,345	14,190	9,248	3,797	2,469	1,075	205	77	52,406
2005	3,151	7,711	12,550	20,074	10,022	5,847	2,038	1,327	559	157	52,576
2006	34,593	5,649	10,390	12,861	13,475	5,732	2,733	945	609	311	47,056
2007	21,151	30,623	7,860	11,828	12,020	8,966	2,662	1,233	410	404	45,383
2008	15,386	22,905	30,214	7,981	10,383	8,387	4,165	1,212	562	365	63,268
2009	15,260	20,696	27,817	32,552	7,326	7,326	3,880	1,875	529	395	81,700
2010	9,869	16,888	24,344	32,480	30,734	5,314	3,342	1,719	849	394	99,176
2011	16,137	8,811	19,155	24,899	30,726	24,489	2,353	1,554	769	565	104,511
2012	9,964	15,740	9,775	20,082	23,566	25,431	10,912	1,060	701	594	92,122
2013	7,517	11,062	17,501	12,373	19,184	20,376	10,960	4,617	461	551	86,023
2014	9,207	7,544	12,753	21,262	12,933	17,289	8,888	4,693	1,966	397	80,181
2015	6,021	9,556	9,472	15,253	22,426	11,731	7,724	3,933	2,022	1,047	73,608
2016	2,811	6,707	11,575	12,148	16,009	20,103	5,269	3,431	1,730	1,330	71,595
2017	3,708	3,259	7,952	13,929	11,532	13,470	9,198	2,360	1,586	1,451	61,477
2018	3,642	4,102	3,916	9,019	13,481	9,490	6,099	4,085	1,043	1,385	48,516
2019	3,475	4,108	4,845	4,235	8,823	11,591	4,895	3,142	2,107	1,169	40,807
2020	6,327	3,933	4,676	5,561	4,129	7,991	6,593	2,743	1,779	1,874	35,344
2021	8,877	8,692	4,561	5,408	5,643	3,960	4,943	4,019	1,683	2,211	32,429
2022	18,292	11,900	10,149	5,112	5,675	5,120	2,451	3,009	2,417	2,320	36,253
2023	7,246	24,079	13,961	10,207	5,305	5,429	3,341	1,601	1,928	2,946	44,718

Table 25. SCA maximum likelihood estimates of January 1 abundance (number in thousands) of fall spawners in the Middle region of the southern Gulf of St. Lawrence.

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	40,792	38,586	21,743	9,605	3,520	6,468	5,446	2,015	1,121	6,582	56,499
1979	81,890	26,906	25,075	12,714	3,983	1,159	2,606	2,183	807	3,085	51,612
1980	48,338	53,825	16,982	11,867	2,358	393	130	288	241	429	32,688
1981	63,001	31,863	34,792	9,552	4,246	622	125	41	91	212	49,683

Year	2	3	4	5	6	7	8	9	10	11+	4+
1982	92,369	41,619	20,857	19,503	2,209	649	118	24	8	57	43,425
1983	60,044	61,045	27,454	13,329	10,400	1,082	404	73	15	40	52,798
1984	63,076	39,671	40,052	16,008	3,962	2,256	293	109	20	15	62,715
1985	81,155	41,682	26,126	24,900	7,161	1,520	1,093	142	53	17	61,012
1986	66,918	53,636	27,514	16,886	14,271	3,880	1,048	754	98	48	64,499
1987	44,299	44,225	35,384	17,608	9,085	7,079	2,445	660	475	92	72,828
1988	64,543	29,645	29,536	22,843	9,364	4,412	4,301	1,485	401	344	72,687
1989	259,004	43,457	19,907	18,970	11,374	4,139	2,420	2,358	814	409	60,390
1990	169,962	177,662	29,775	13,381	11,431	6,512	2,899	1,694	1,651	856	68,199
1991	40,614	119,223	124,392	20,201	7,584	5,955	4,043	1,799	1,052	1,556	166,582
1992	150,924	29,266	85,645	84,810	10,220	3,337	3,017	2,047	911	1,321	191,309
1993	40,386	111,108	21,514	61,437	52,902	5,971	2,204	1,992	1,352	1,473	148,845
1994	79,942	30,332	83,315	15,698	38,365	30,714	3,824	1,411	1,275	1,809	176,411
1995	48,465	61,336	23,229	61,828	9,733	21,866	18,784	2,338	863	1,886	140,526
1996	86,927	37,930	47,796	16,824	29,480	3,816	8,886	7,627	949	1,116	116,494
1997	133,880	69,085	30,027	35,409	8,535	12,526	1,648	3,834	3,291	891	96,162
1998	113,801	107,501	55,243	22,384	17,685	3,534	5,194	683	1,589	1,733	108,044
1999	76,904	92,343	86,711	40,274	9,160	5,523	1,081	1,587	209	1,015	145,559
2000	105,083	63,252	75,494	64,012	16,599	2,874	1,658	324	476	367	161,804
2001	110,152	87,530	52,411	57,244	29,243	5,982	971	560	109	284	146,804
2002	155,598	92,767	73,480	41,680	33,414	14,770	2,790	452	261	184	167,031
2003	107,435	132,360	78,664	59,074	24,712	17,180	6,863	1,296	210	206	188,206
2004	87,358	92,377	113,531	64,743	38,400	14,384	8,816	3,520	665	214	244,272
2005	58,390	75,960	80,138	94,700	43,162	23,052	7,365	4,512	1,801	449	255,180
2006	248,766	51,307	66,542	66,639	58,486	23,193	10,157	3,243	1,987	991	231,239
2007	233,763	220,883	45,506	58,372	53,518	36,689	10,328	4,456	1,421	1,304	211,595
2008	178,559	209,521	197,798	40,387	48,217	36,162	17,157	4,772	2,056	1,257	347,806

Year	2	3	4	5	6	7	8	9	10	11+	4+
2009	146,957	161,363	189,154	176,819	33,359	31,920	15,655	7,329	2,036	1,413	457,685
2010	91,538	133,812	146,798	170,573	148,583	23,007	13,778	6,678	3,122	1,469	514,008
2011	152,594	83,976	122,680	133,743	147,762	111,772	10,264	6,095	2,951	2,029	537,296
2012	99,163	140,985	77,554	112,817	118,861	119,349	49,184	4,491	2,665	2,177	487,099
2013	72,001	92,141	130,954	71,783	101,514	98,823	50,033	20,521	1,873	2,019	477,520
2014	89,013	67,176	85,933	121,667	64,686	83,980	40,192	20,244	8,298	1,574	426,574
2015	60,196	83,305	62,846	80,112	110,273	54,181	34,872	16,610	8,362	4,078	371,334
2016	28,717	56,463	78,107	58,685	72,404	90,953	22,566	14,444	6,876	5,149	349,185
2017	36,935	26,980	53,029	73,114	53,494	61,270	40,314	9,957	6,371	5,304	302,852
2018	36,631	34,730	25,358	49,626	66,072	43,839	27,707	18,124	4,474	5,245	240,444
2019	35,019	34,455	32,656	23,758	45,168	55,461	22,088	13,892	9,082	4,870	206,975
2020	70,237	32,940	32,399	30,610	21,711	38,446	30,205	11,978	7,530	7,563	180,443
2021	97,360	66,059	30,972	30,385	28,115	18,812	22,244	17,414	6,903	8,698	163,542
2022	198,782	91,561	62,109	29,052	27,968	24,548	11,179	13,176	10,312	9,238	187,583
2023	79,548	186,977	86,118	58,385	27,189	25,852	15,656	7,125	8,397	12,459	241,181

Table 26. SCA maximum likelihood estimates of August 1 biomass (t) of fall spawners in the South region of the southern Gulf of St. Lawrence.

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	7,942	14,432	8,129	5,179	2,272	1,900	1,443	529	506	1,226	21,183
1979	31,172	9,836	15,459	6,769	2,876	1,094	904	617	211	559	28,490
1980	12,771	18,939	8,500	12,129	4,420	1,596	749	580	390	484	28,849
1981	28,099	18,673	14,874	5,168	4,620	980	308	99	79	112	26,240
1982	47,716	34,567	22,249	14,242	3,192	1,997	522	156	46	86	42,488
1983	19,167	56,112	33,262	17,035	7,760	1,340	1,042	265	81	67	60,852
1984	43,399	26,167	55,164	24,271	9,755	3,824	893	657	170	102	94,836
1985	57,955	52,561	26,629	42,336	14,887	5,156	2,650	612	441	177	92,888
1986	48,032	65,910	51,414	19,379	27,119	8,379	3,788	1,903	426	382	112,792
1987	15,288	42,005	65,171	38,614	12,080	14,637	5,880	2,588	1,270	567	140,807

Year	2	3	4	5	6	7	8	9	10	11+	4+
1988	13,252	19,159	32,985	52,032	24,154	6,390	9,892	3,883	1,693	1,165	132,195
1989	64,705	15,724	17,920	22,736	34,246	13,978	4,789	7,325	2,767	2,076	105,838
1990	36,915	64,829	16,639	13,215	16,425	22,708	11,677	3,961	5,904	3,760	94,290
1991	11,926	38,690	58,788	13,229	7,560	7,882	12,802	6,480	2,135	5,226	114,101
1992	34,249	9,582	35,186	44,852	8,981	4,645	6,029	9,612	4,851	5,298	119,455
1993	7,825	33,487	9,327	28,230	30,574	5,600	3,672	4,673	7,312	7,795	97,183
1994	36,567	5,577	28,724	7,509	20,681	20,885	4,633	3,000	3,788	11,769	100,990
1995	2,185	15,784	5,138	23,226	4,831	11,687	12,991	3,061	1,855	9,284	72,073
1996	4,200	5,949	15,366	4,966	17,214	3,227	7,585	8,233	1,860	6,508	64,958
1997	21,709	15,082	10,316	20,638	3,323	8,748	1,625	3,719	4,038	3,857	56,263
1998	11,592	21,325	29,768	10,063	14,145	1,915	4,519	845	1,838	3,811	66,903
1999	17,615	23,850	26,364	27,665	6,592	7,238	906	2,109	396	2,466	73,737
2000	48,292	18,722	36,959	29,552	16,556	2,934	2,844	351	810	1,074	91,079
2001	32,417	62,817	20,804	37,710	20,120	8,960	1,366	1,307	156	774	91,197
2002	39,631	49,216	83,437	22,263	27,970	11,971	4,348	654	613	431	151,687
2003	20,002	50,547	60,802	89,878	17,456	17,622	6,157	2,173	329	514	194,930
2004	17,336	26,015	62,543	60,116	69,762	11,775	9,623	3,230	1,142	422	218,613
2005	10,880	35,498	34,634	70,101	55,081	55,602	7,381	5,938	1,977	963	231,677
2006	58,581	15,434	47,488	39,183	65,037	45,980	33,172	4,468	3,418	1,707	240,453
2007	30,943	92,961	19,160	43,053	35,763	53,494	24,519	17,369	2,315	2,565	198,237
2008	42,933	47,344	117,452	21,191	40,024	29,663	26,975	12,028	8,519	2,349	258,200
2009	22,308	59,241	64,766	124,359	22,118	36,484	15,581	13,902	6,021	5,283	288,515
2010	9,615	24,330	68,906	70,661	125,979	19,211	17,081	7,070	6,357	5,147	320,411
2011	16,943	11,359	29,132	69,294	65,781	109,012	8,095	6,955	2,803	4,502	295,576
2012	16,479	20,978	13,086	34,013	69,653	58,311	40,170	2,901	2,569	2,547	223,249
2013	10,241	19,784	23,772	14,468	34,806	65,195	19,884	13,365	942	1,689	174,121
2014	17,096	11,771	23,807	25,586	15,354	32,752	22,373	6,707	4,428	864	131,872

Year	2	3	4	5	6	7	8	9	10	11+	4+
2015	15,221	14,453	13,132	26,510	27,342	14,164	11,312	7,619	2,180	1,779	104,039
2016	6,526	18,822	16,321	16,296	28,351	26,283	5,260	4,171	2,712	1,372	100,767
2017	6,688	6,214	23,881	22,311	18,624	27,276	10,736	2,131	1,719	1,567	108,245
2018	10,930	8,892	6,651	24,952	23,151	15,778	12,058	4,707	963	1,511	89,770
2019	5,938	10,777	12,840	8,046	24,589	21,650	7,715	5,830	2,292	1,128	84,091
2020	10,476	6,312	12,456	16,675	8,969	25,746	12,328	4,329	3,177	1,833	85,514
2021	21,741	11,578	7,927	15,471	17,243	9,141	15,363	7,433	2,625	2,924	78,128
2022	32,449	22,792	15,434	10,223	16,218	16,076	5,216	8,576	4,080	2,897	78,720
2023	18,473	45,674	27,658	18,254	9,986	14,894	8,766	2,805	4,609	3,579	90,552

Table 27. SCA maximum likelihood estimates of January 1 abundance (number in thousands) of fall spawners in the South region of the southern Gulf of St. Lawrence.

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	121,364	142,453	57,838	25,202	10,825	7,327	5,104	1,828	1,695	3,248	113,069
1979	235,670	77,344	87,153	32,080	11,587	3,910	2,937	1,850	635	1,685	141,837
1980	251,654	152,121	48,980	52,717	17,774	5,734	2,377	1,703	1,052	1,307	131,643
1981	346,088	155,832	86,114	22,352	15,926	3,160	900	299	195	260	129,207
1982	604,683	225,798	101,107	52,635	9,899	5,365	1,371	389	129	197	171,092
1983	273,305	394,573	146,761	62,991	26,092	4,041	2,855	727	206	173	243,847
1984	556,257	178,357	256,744	92,543	33,529	12,026	2,447	1,725	439	229	399,682
1985	731,760	363,016	116,084	162,350	50,080	15,896	7,502	1,523	1,074	416	354,926
1986	324,803	477,578	236,431	73,944	91,727	25,555	10,723	5,054	1,026	1,004	445,463
1987	181,696	211,975	310,962	150,172	41,079	45,479	16,719	7,004	3,301	1,326	576,042
1988	187,307	119,437	138,948	197,736	81,055	19,291	27,760	10,186	4,266	2,818	482,060
1989	622,701	123,606	78,670	89,696	114,494	42,792	13,228	19,011	6,974	4,851	369,716
1990	408,941	414,958	82,300	51,910	56,368	69,033	33,266	10,277	14,769	9,187	327,109
1991	116,346	274,399	277,365	52,778	26,619	23,906	36,391	17,490	5,402	12,592	452,543
1992	348,128	78,720	185,483	185,592	33,430	16,093	18,067	27,486	13,209	13,590	492,950
1993	69,132	239,378	54,080	126,184	119,759	20,625	12,091	13,566	20,636	20,121	387,062

Year	2	3	4	5	6	7	8	9	10	11+	4+
1994	246,224	48,622	168,280	37,821	85,817	79,538	16,153	9,466	10,621	31,910	439,606
1995	108,245	179,358	35,328	118,946	23,042	46,081	47,046	9,538	5,589	25,109	310,678
1996	274,330	81,287	134,337	25,723	74,361	12,655	26,558	27,066	5,486	17,657	323,844
1997	294,317	211,001	62,249	98,136	14,570	33,935	5,745	12,020	12,246	10,472	249,372
1998	362,242	230,738	164,764	46,574	58,296	7,115	15,976	2,697	5,642	10,664	311,728
1999	209,527	289,300	183,480	125,058	27,496	27,802	3,148	7,049	1,190	7,192	382,415
2000	755,392	170,384	233,917	139,536	68,322	11,342	10,148	1,145	2,562	3,047	470,020
2001	529,604	623,804	140,131	184,128	86,689	34,717	4,989	4,452	502	2,460	458,068
2002	583,579	443,147	520,115	112,455	120,213	47,498	15,979	2,291	2,044	1,360	821,955
2003	305,002	493,386	373,568	424,933	77,589	71,850	23,283	7,818	1,121	1,665	981,827
2004	337,799	260,330	420,149	310,294	308,584	50,268	37,202	12,036	4,041	1,440	1,144,014
2005	171,021	291,084	224,080	357,365	247,501	233,063	29,592	21,884	7,080	3,224	1,123,788
2006	991,892	149,078	253,475	192,982	289,943	190,883	132,351	16,793	12,418	5,847	1,094,691
2007	508,509	873,279	131,213	222,533	166,091	230,518	100,109	68,516	8,680	9,438	937,098
2008	574,966	451,803	775,672	116,253	193,305	133,343	114,631	49,143	33,581	8,878	1,424,807
2009	292,296	514,872	404,483	692,963	102,150	158,986	64,128	54,536	23,349	20,170	1,520,765
2010	128,339	263,509	464,011	363,482	608,887	82,062	67,878	26,980	22,903	18,273	1,654,476
2011	225,904	116,415	238,967	419,889	323,409	506,445	33,086	27,066	10,744	16,394	1,576,000
2012	220,341	206,095	106,188	217,644	377,912	277,620	183,524	11,897	9,723	9,748	1,194,256
2013	132,929	201,899	188,816	97,152	196,998	327,727	91,854	60,297	3,905	6,391	973,140
2014	189,640	122,153	185,498	173,197	87,994	169,632	107,060	29,759	19,515	3,332	775,987
2015	204,857	174,615	112,448	170,398	156,484	74,417	55,499	34,650	9,619	7,384	620,898
2016	69,043	188,865	160,941	103,401	153,858	131,382	25,470	18,770	11,702	5,741	611,264
2017	119,892	63,696	174,201	148,175	93,848	131,909	50,145	9,631	7,089	6,587	621,586
2018	116,404	110,608	58,756	160,504	135,286	82,627	59,347	22,427	4,304	6,112	529,363
2019	73,485	107,441	102,079	54,167	146,732	119,606	39,982	28,561	10,786	5,009	506,922
2020	137,121	67,872	99,220	94,154	49,491	129,094	59,722	19,841	14,162	7,831	473,515

Year	2	3	4	5	6	7	8	9	10	11+	4+
2021	259,962	126,662	62,692	91,608	86,642	44,940	71,108	32,825	10,902	12,085	412,801
2022	463,354	240,097	116,967	57,820	83,665	76,090	24,279	38,171	17,607	12,329	426,927
2023	240,884	427,977	221,729	107,861	52,716	72,891	40,741	12,903	20,268	15,893	545,002

Table 28. SCA maximum likelihood estimates of August 1 total biomass (t) of fall spawners in the southern Gulf of St. Lawrence.

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	32,516	30,301	20,525	14,607	6,704	6,448	7,031	2,146	1,322	6,653	65,435
1979	62,689	26,745	28,550	12,856	5,723	2,153	2,495	2,315	729	2,318	57,138
1980	31,668	55,810	20,764	19,424	6,229	2,290	1,050	975	811	1,003	52,547
1981	80,767	48,679	53,124	13,688	8,189	1,761	678	269	273	561	78,542
1982	77,252	81,505	58,091	46,543	7,940	3,488	922	371	147	415	117,916
1983	37,784	98,882	77,378	46,013	29,198	4,248	2,062	513	228	338	159,979
1984	68,470	54,360	107,247	63,470	30,293	17,713	3,004	1,357	336	427	223,847
1985	87,018	87,849	58,677	90,713	45,244	20,492	13,856	2,270	980	561	232,793
1986	75,124	110,809	92,151	46,700	62,691	30,051	15,478	10,178	1,641	1,019	259,910
1987	41,093	85,686	120,750	72,889	30,613	36,435	20,264	10,251	6,597	1,730	299,528
1988	32,362	47,803	84,120	99,052	45,087	16,683	23,210	12,288	6,089	4,875	291,405
1989	131,101	43,664	49,516	62,763	64,831	26,437	11,494	15,672	8,114	7,072	245,899
1990	82,396	157,136	50,171	41,387	41,709	40,678	19,575	8,134	11,068	10,064	222,785
1991	26,224	88,755	162,220	40,211	23,515	21,048	22,736	10,769	4,378	11,211	296,088
1992	59,954	25,021	87,735	129,849	25,636	13,784	13,914	15,453	7,339	10,014	303,724
1993	17,335	69,870	25,923	74,513	86,801	15,722	9,425	9,521	10,765	11,996	244,665
1994	55,465	17,898	72,982	23,506	54,269	58,784	11,599	6,960	7,006	16,916	252,022
1995	15,498	41,283	20,249	61,762	14,276	29,560	32,562	6,656	3,823	13,357	182,245
1996	18,949	24,018	47,248	18,647	35,633	6,912	14,427	15,486	3,215	8,687	150,255
1997	48,902	38,245	33,346	48,263	10,118	16,476	3,117	6,484	6,889	5,145	129,838
1998	31,626	59,966	60,032	31,039	28,399	4,939	7,712	1,473	2,978	5,469	142,042

Year	2	3	4	5	6	7	8	9	10	11+	4+
1999	33,295	53,006	78,217	53,451	17,023	13,109	2,034	3,277	627	3,437	171,176
2000	63,476	42,171	75,997	77,660	28,600	6,999	4,908	732	1,206	1,466	197,569
2001	47,641	86,575	53,861	74,359	45,079	14,149	2,984	2,093	308	1,061	193,894
2002	74,539	75,020	116,582	55,814	50,252	25,274	6,782	1,421	973	634	257,734
2003	46,054	104,060	95,994	122,244	38,371	29,924	12,648	3,343	699	780	304,003
2004	41,120	65,144	131,451	91,682	88,363	21,847	14,927	5,937	1,634	674	356,515
2005	24,236	66,051	83,301	135,416	77,043	67,199	12,669	8,687	3,336	1,336	388,987
2006	123,250	36,554	87,660	87,535	109,238	59,060	38,653	6,990	4,696	2,491	396,323
2007	104,048	167,204	47,615	86,868	78,498	81,118	30,031	19,621	3,282	3,373	350,407
2008	108,472	143,944	207,192	51,472	77,398	58,607	39,010	14,372	9,483	3,085	460,619
2009	87,740	142,119	189,664	222,896	50,115	64,726	29,315	19,252	7,056	5,991	589,016
2010	47,776	100,803	165,730	207,104	215,486	40,681	30,442	13,340	8,807	5,919	687,509
2011	64,893	49,267	118,517	173,467	194,082	183,102	18,088	13,108	5,609	5,997	711,969
2012	41,762	82,648	55,421	133,689	175,782	172,231	72,744	7,256	5,185	4,398	626,705
2013	34,599	51,866	102,542	67,360	137,911	163,680	63,988	26,003	2,645	3,373	567,501
2014	44,929	41,870	63,520	122,766	74,525	131,679	60,945	23,632	9,360	2,159	488,586
2015	40,493	51,376	50,488	74,981	133,916	70,454	50,916	22,985	8,554	4,260	416,553
2016	15,172	45,874	67,246	62,893	81,177	124,254	28,123	20,077	8,826	4,843	397,439
2017	14,209	16,662	57,011	86,236	69,075	75,036	52,791	11,698	8,558	5,818	366,223
2018	22,971	17,701	18,294	63,810	88,519	60,649	33,380	23,327	5,215	6,503	299,697
2019	13,466	24,807	23,311	21,325	62,484	81,653	29,005	15,835	11,003	5,308	249,924
2020	23,190	14,935	28,735	28,958	24,531	61,584	42,967	15,043	8,241	8,346	218,406
2021	37,136	27,255	19,388	35,993	31,301	24,928	35,371	24,095	8,440	9,321	188,837
2022	66,068	44,744	34,896	24,352	39,155	29,698	13,861	19,350	12,930	9,279	183,522
2023	39,443	92,746	54,826	40,120	23,447	35,421	16,178	7,371	10,216	11,327	198,906

Table 29. SCA maximum likelihood estimates of January 1 total abundance (number in thousands) of fall spawners in the southern Gulf of St. Lawrence.

Year	2	3	4	5	6	7	8	9	10	11+	4+
1978	244,083	236,164	116,281	64,267	26,150	24,011	21,837	6,650	4,472	16,586	280,253
1979	567,656	167,496	148,607	56,178	21,740	7,447	7,813	6,539	2,066	6,637	257,027
1980	515,315	399,755	109,861	79,442	23,660	7,989	3,298	2,746	2,127	2,565	231,688
1981	703,568	355,151	261,880	55,046	26,798	5,330	1,927	724	652	1,277	353,634
1982	1,040,623	497,477	251,334	170,026	24,788	9,422	2,363	922	354	916	460,124
1983	533,473	724,100	352,543	169,129	95,626	12,440	5,424	1,356	545	771	637,835
1984	874,357	374,462	505,740	241,600	100,543	53,466	8,088	3,416	865	888	914,607
1985	1,179,678	604,065	264,094	344,915	150,747	60,897	38,417	5,735	2,331	1,232	868,368
1986	692,241	817,881	418,912	180,687	209,350	88,840	42,223	26,689	3,973	2,454	973,127
1987	447,741	491,030	568,432	278,364	103,592	111,095	56,198	26,642	16,788	4,067	1,165,178
1988	467,863	322,206	349,788	374,705	150,989	51,179	65,137	32,587	15,385	12,008	1,051,776
1989	1,520,811	335,177	232,097	236,894	215,806	80,511	32,440	41,576	20,567	17,212	877,103
1990	900,021	1,090,918	241,790	158,539	139,574	123,006	55,588	21,681	28,104	24,342	792,624
1991	280,190	646,260	788,680	161,833	82,559	64,422	65,068	29,366	11,491	27,627	1,231,046
1992	765,516	206,202	470,629	550,071	96,420	46,684	41,694	44,217	20,127	25,947	1,295,789
1993	214,377	566,047	154,321	334,090	341,616	56,862	30,434	27,758	30,681	31,683	1,007,445
1994	846,157	243,882	678,778	167,290	345,961	218,754	39,625	21,352	19,814	45,907	1,537,481
1995	469,885	642,488	187,463	485,287	96,022	113,136	115,097	20,792	11,204	36,118	1,065,119
1996	879,809	370,030	496,546	131,021	256,240	26,913	50,215	50,782	9,347	23,305	1,044,370
1997	1,186,403	693,834	293,827	355,229	64,979	63,882	10,898	20,808	20,933	13,859	844,414
1998	1,172,215	959,183	552,301	214,083	192,549	18,389	27,798	4,712	9,114	15,396	1,034,341
1999	780,315	952,960	779,183	409,118	108,231	49,957	7,117	11,107	1,895	10,028	1,376,637
2000	1,876,005	646,550	779,070	569,659	202,908	27,169	17,375	2,435	3,865	4,189	1,606,670
2001	1,442,448	1,556,823	537,162	595,281	306,920	54,351	10,780	7,082	971	3,340	1,515,886
2002	1,855,637	1,212,934	1,301,480	419,023	365,114	97,439	24,528	4,775	3,177	1,946	2,217,482
2003	1,140,101	1,579,640	1,025,373	1,052,906	264,506	117,789	45,679	11,655	2,227	2,434	2,522,569

Year	2	3	4	5	6	7	8	9	10	11+	4+
2004	1,098,064	981,757	1,349,196	835,456	732,785	89,049	56,107	21,001	5,596	2,165	3,091,354
2005	628,052	953,557	850,553	1,126,389	634,628	278,885	48,905	31,335	11,547	4,360	2,986,602
2006	2,966,408	552,114	833,949	709,856	832,296	244,414	152,880	25,476	16,653	8,364	2,823,888
2007	2,241,232	2,624,872	488,208	727,186	580,443	345,516	121,837	76,641	11,996	12,053	2,363,881
2008	2,135,535	2,008,954	2,339,440	430,190	610,720	258,289	163,555	58,314	37,036	11,353	3,908,897
2009	1,497,913	1,926,575	1,810,027	2,086,102	365,441	279,042	119,012	75,375	27,237	22,683	4,784,918
2010	757,496	1,364,228	1,746,879	1,626,155	1,805,150	175,250	122,250	51,209	32,026	21,051	5,579,970
2011	1,328,048	695,053	1,249,042	1,585,482	1,428,174	851,718	75,338	51,313	21,505	21,672	5,284,245
2012	882,437	1,226,553	641,311	1,146,337	1,423,985	815,097	330,107	29,586	19,857	16,473	4,422,753
2013	669,716	816,168	1,137,585	592,356	1,038,620	803,669	292,031	115,473	10,463	12,674	4,002,872
2014	910,155	622,900	756,824	1,053,176	536,031	635,793	279,462	102,052	39,793	7,997	3,411,128
2015	730,692	848,286	580,298	700,790	956,065	330,294	230,791	99,345	36,862	16,925	2,951,370
2016	276,651	679,944	791,247	538,942	634,820	591,779	126,385	87,196	37,014	20,219	2,827,602
2017	372,422	257,995	632,940	735,569	490,623	352,262	239,756	50,910	34,981	22,953	2,559,994
2018	415,275	346,226	240,539	587,376	670,350	297,812	155,185	103,816	22,015	25,118	2,102,212
2019	272,520	387,073	321,918	223,656	537,050	411,029	138,797	72,671	47,860	21,817	1,774,798
2020	493,312	254,140	360,784	298,726	204,609	302,718	200,390	67,397	35,671	33,854	1,504,148
2021	812,894	459,808	236,936	335,500	274,651	118,625	159,719	103,956	35,065	36,509	1,300,962
2022	1,553,277	756,286	428,402	220,282	307,189	140,409	63,024	84,365	54,577	37,927	1,336,175
2023	512,337	831,684	703,495	398,263	202,165	171,414	75,844	33,345	44,567	49,055	1,678,148

Table 30. SCA maximum likelihood estimates of the instantaneous rate of fishing mortality (F) of fall spawners in the North region of the southern Gulf of St. Lawrence. F5-10 is the January 1 abundance-weighted average F for ages 5 to 10 years.

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
1978	0.013	0.170	0.925	1.318	1.356	1.359	1.359	1.359	1.359	1.359	1.340
1979	0.009	0.119	0.650	0.925	0.953	0.954	0.955	0.955	0.955	0.955	0.941
1980	0.005	0.072	0.394	0.562	0.578	0.579	0.580	0.580	0.580	0.580	0.568
1981	0.001	0.012	0.119	0.356	0.419	0.425	0.425	0.425	0.425	0.425	0.375

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
1982	0.001	0.009	0.086	0.258	0.304	0.308	0.308	0.308	0.308	0.308	0.265
1983	0.000	0.005	0.047	0.141	0.166	0.168	0.168	0.168	0.168	0.168	0.151
1984	0.000	0.004	0.036	0.107	0.126	0.127	0.128	0.128	0.128	0.128	0.116
1985	0.000	0.006	0.059	0.176	0.208	0.211	0.211	0.211	0.211	0.211	0.193
1986	0.001	0.009	0.092	0.274	0.323	0.327	0.327	0.327	0.327	0.327	0.310
1987	0.001	0.012	0.119	0.355	0.418	0.424	0.425	0.425	0.425	0.425	0.397
1988	0.001	0.010	0.096	0.289	0.340	0.345	0.345	0.345	0.345	0.345	0.316
1989	0.001	0.011	0.111	0.332	0.391	0.397	0.397	0.397	0.397	0.397	0.368
1990	0.001	0.014	0.140	0.418	0.492	0.499	0.499	0.499	0.499	0.499	0.467
1991	0.001	0.010	0.099	0.295	0.347	0.352	0.352	0.352	0.352	0.352	0.327
1992	0.001	0.010	0.098	0.293	0.345	0.349	0.350	0.350	0.350	0.350	0.309
1993	0.001	0.007	0.069	0.208	0.245	0.248	0.248	0.248	0.248	0.248	0.231
1994	0.001	0.017	0.166	0.498	0.586	0.594	0.595	0.595	0.595	0.595	0.573
1995	0.002	0.026	0.255	0.764	0.900	0.912	0.913	0.913	0.913	0.913	0.841
1996	0.002	0.025	0.245	0.734	0.864	0.876	0.877	0.877	0.877	0.877	0.825
1997	0.002	0.021	0.208	0.622	0.733	0.743	0.743	0.744	0.744	0.744	0.665
1998	0.002	0.022	0.211	0.633	0.745	0.755	0.756	0.756	0.756	0.756	0.683
1999	0.002	0.025	0.240	0.720	0.848	0.859	0.860	0.860	0.860	0.860	0.776
2000	0.002	0.021	0.210	0.630	0.741	0.752	0.752	0.752	0.752	0.752	0.658
2001	0.001	0.018	0.175	0.523	0.616	0.624	0.625	0.625	0.625	0.625	0.566
2002	0.001	0.016	0.159	0.476	0.561	0.568	0.569	0.569	0.569	0.569	0.518
2003	0.002	0.022	0.218	0.653	0.768	0.779	0.780	0.780	0.780	0.780	0.720
2004	0.001	0.012	0.117	0.351	0.413	0.419	0.419	0.419	0.419	0.419	0.382
2005	0.001	0.013	0.128	0.385	0.453	0.459	0.460	0.460	0.460	0.460	0.406
2006	0.003	0.014	0.057	0.198	0.446	0.621	0.681	0.696	0.700	0.701	0.345
2007	0.003	0.011	0.047	0.164	0.369	0.514	0.564	0.577	0.580	0.580	0.321
2008	0.002	0.009	0.036	0.125	0.282	0.393	0.431	0.441	0.443	0.444	0.274

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
2009	0.002	0.007	0.027	0.095	0.214	0.299	0.328	0.335	0.337	0.337	0.167
2010	0.001	0.004	0.018	0.063	0.142	0.197	0.217	0.221	0.223	0.223	0.106
2011	0.001	0.002	0.010	0.036	0.081	0.112	0.123	0.126	0.127	0.127	0.071
2012	0.000	0.002	0.009	0.030	0.068	0.094	0.103	0.106	0.106	0.106	0.066
2013	0.001	0.003	0.011	0.037	0.083	0.116	0.127	0.130	0.131	0.131	0.090
2014	0.001	0.002	0.010	0.033	0.075	0.105	0.115	0.118	0.118	0.118	0.075
2015	0.001	0.002	0.010	0.034	0.077	0.107	0.118	0.120	0.121	0.121	0.083
2016	0.001	0.002	0.010	0.035	0.080	0.111	0.122	0.125	0.125	0.126	0.089
2017	0.001	0.002	0.010	0.035	0.078	0.109	0.120	0.122	0.123	0.123	0.079
2018	0.000	0.002	0.009	0.031	0.071	0.098	0.108	0.110	0.111	0.111	0.076
2019	0.000	0.002	0.009	0.031	0.071	0.098	0.108	0.110	0.111	0.111	0.086
2020	0.000	0.002	0.009	0.031	0.071	0.098	0.108	0.110	0.111	0.111	0.090
2021	0.001	0.002	0.009	0.032	0.072	0.100	0.110	0.112	0.113	0.113	0.082
2022	0.001	0.003	0.011	0.040	0.089	0.125	0.137	0.140	0.141	0.141	0.103
2023	0.000	0.001	0.004	0.015	0.033	0.046	0.051	0.052	0.052	0.052	0.036

Table 31. SCA maximum likelihood estimates of the instantaneous rate of fishing mortality (F) of fall spawners in the Middle region of the southern Gulf of St. Lawrence. F5-10 is the January 1 abundance-weighted average F for ages 5 to 10 years.

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
1978	0.002	0.017	0.123	0.466	0.697	0.740	0.746	0.746	0.747	0.747	0.643
1979	0.006	0.046	0.334	1.271	1.901	2.019	2.034	2.036	2.036	2.036	1.597
1980	0.003	0.022	0.161	0.614	0.918	0.975	0.982	0.983	0.983	0.983	0.686
1981	0.001	0.010	0.165	1.050	1.465	1.496	1.497	1.497	1.497	1.497	1.197
1982	0.000	0.002	0.034	0.215	0.299	0.306	0.306	0.306	0.306	0.306	0.226
1983	0.000	0.007	0.125	0.799	1.114	1.138	1.139	1.139	1.139	1.139	0.950
1984	0.000	0.004	0.061	0.390	0.544	0.556	0.556	0.557	0.557	0.557	0.437
1985	0.000	0.001	0.022	0.143	0.199	0.203	0.203	0.203	0.203	0.203	0.159
1986	0.000	0.002	0.032	0.206	0.287	0.293	0.293	0.293	0.293	0.293	0.251

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
1987	0.000	0.002	0.036	0.230	0.321	0.327	0.328	0.328	0.328	0.328	0.280
1988	0.000	0.003	0.047	0.302	0.421	0.430	0.430	0.430	0.430	0.430	0.360
1989	0.000	0.001	0.020	0.130	0.181	0.185	0.185	0.185	0.185	0.185	0.158
1990	0.000	0.002	0.033	0.213	0.298	0.304	0.304	0.304	0.304	0.304	0.270
1991	0.000	0.003	0.055	0.354	0.493	0.504	0.504	0.504	0.504	0.504	0.427
1992	0.000	0.002	0.026	0.166	0.231	0.236	0.236	0.236	0.236	0.236	0.178
1993	0.000	0.002	0.029	0.185	0.258	0.263	0.263	0.263	0.263	0.263	0.223
1994	0.000	0.002	0.033	0.213	0.297	0.304	0.304	0.304	0.304	0.304	0.286
1995	0.000	0.005	0.078	0.496	0.691	0.706	0.707	0.707	0.707	0.707	0.592
1996	0.000	0.004	0.070	0.449	0.626	0.640	0.640	0.640	0.640	0.640	0.587
1997	0.000	0.004	0.075	0.475	0.662	0.677	0.677	0.677	0.677	0.677	0.565
1998	0.000	0.006	0.107	0.685	0.955	0.975	0.977	0.977	0.977	0.977	0.841
1999	0.000	0.006	0.108	0.691	0.964	0.984	0.986	0.986	0.986	0.986	0.777
2000	0.000	0.006	0.094	0.601	0.838	0.856	0.857	0.857	0.857	0.857	0.663
2001	0.000	0.003	0.058	0.367	0.511	0.522	0.523	0.523	0.523	0.523	0.424
2002	0.000	0.003	0.057	0.361	0.504	0.514	0.515	0.515	0.515	0.515	0.442
2003	0.000	0.003	0.044	0.280	0.390	0.399	0.399	0.399	0.399	0.399	0.333
2004	0.000	0.002	0.042	0.266	0.371	0.379	0.379	0.379	0.379	0.379	0.320
2005	0.000	0.003	0.055	0.353	0.492	0.502	0.503	0.503	0.503	0.503	0.419
2006	0.000	0.001	0.012	0.101	0.348	0.459	0.474	0.475	0.475	0.475	0.275
2007	0.000	0.001	0.010	0.082	0.283	0.373	0.385	0.386	0.387	0.387	0.242
2008	0.000	0.001	0.011	0.090	0.311	0.411	0.424	0.426	0.426	0.426	0.294
2009	0.000	0.001	0.010	0.080	0.278	0.367	0.379	0.380	0.380	0.380	0.167
2010	0.000	0.001	0.007	0.057	0.199	0.262	0.271	0.271	0.272	0.272	0.141
2011	0.000	0.000	0.005	0.039	0.134	0.177	0.183	0.184	0.184	0.184	0.117
2012	0.000	0.000	0.004	0.032	0.111	0.147	0.152	0.152	0.152	0.152	0.105
2013	0.000	0.000	0.004	0.035	0.120	0.159	0.164	0.164	0.165	0.165	0.123

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
2014	0.000	0.000	0.004	0.032	0.111	0.146	0.151	0.152	0.152	0.152	0.100
2015	0.000	0.000	0.005	0.037	0.129	0.170	0.175	0.176	0.176	0.176	0.121
2016	0.000	0.000	0.004	0.030	0.105	0.138	0.143	0.143	0.143	0.143	0.106
2017	0.000	0.000	0.005	0.040	0.138	0.182	0.187	0.188	0.188	0.188	0.131
2018	0.000	0.000	0.004	0.033	0.114	0.150	0.155	0.156	0.156	0.156	0.112
2019	0.000	0.000	0.004	0.029	0.100	0.132	0.136	0.137	0.137	0.137	0.110
2020	0.000	0.000	0.003	0.024	0.082	0.108	0.112	0.112	0.112	0.112	0.087
2021	0.000	0.000	0.003	0.021	0.074	0.098	0.101	0.102	0.102	0.102	0.075
2022	0.000	0.000	0.001	0.005	0.017	0.023	0.024	0.024	0.024	0.024	0.017
2023	0.000	0.000	0.002	0.017	0.059	0.078	0.081	0.081	0.081	0.081	0.050

Table 32. SCA maximum likelihood estimates of the instantaneous rate of fishing mortality (F) of fall spawners in the South region of the southern Gulf of St. Lawrence. F5-10 is the January 1 abundance-weighted average F for ages 5 to 10 years.

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
1978	0.024	0.065	0.163	0.351	0.592	0.782	0.883	0.925	0.941	0.947	0.553
1979	0.011	0.030	0.076	0.164	0.277	0.366	0.413	0.433	0.440	0.443	0.230
1980	0.053	0.142	0.358	0.770	1.301	1.720	1.941	2.033	2.068	2.081	1.031
1981	0.001	0.006	0.066	0.388	0.662	0.703	0.707	0.708	0.708	0.708	0.523
1982	0.000	0.004	0.047	0.275	0.469	0.499	0.502	0.502	0.502	0.502	0.326
1983	0.000	0.003	0.035	0.204	0.348	0.370	0.372	0.372	0.372	0.372	0.256
1984	0.000	0.003	0.032	0.188	0.320	0.340	0.342	0.342	0.342	0.342	0.236
1985	0.000	0.002	0.024	0.144	0.246	0.262	0.263	0.263	0.263	0.263	0.179
1986	0.000	0.003	0.027	0.161	0.275	0.292	0.294	0.294	0.294	0.294	0.238
1987	0.000	0.003	0.033	0.197	0.337	0.358	0.360	0.360	0.360	0.360	0.263
1988	0.000	0.002	0.022	0.131	0.223	0.237	0.239	0.239	0.239	0.239	0.172
1989	0.000	0.001	0.010	0.059	0.100	0.106	0.107	0.107	0.107	0.107	0.089
1990	0.000	0.004	0.046	0.269	0.459	0.488	0.491	0.491	0.491	0.491	0.434
1991	0.000	0.001	0.011	0.066	0.113	0.120	0.120	0.121	0.121	0.121	0.101

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
1992	0.000	0.001	0.011	0.064	0.109	0.115	0.116	0.116	0.116	0.116	0.082
1993	0.000	0.001	0.006	0.034	0.057	0.061	0.061	0.061	0.061	0.061	0.049
1994	0.000	0.003	0.030	0.179	0.305	0.325	0.326	0.326	0.326	0.326	0.295
1995	0.000	0.003	0.031	0.184	0.313	0.333	0.335	0.335	0.335	0.335	0.261
1996	0.000	0.005	0.052	0.306	0.522	0.556	0.558	0.559	0.559	0.559	0.505
1997	0.000	0.004	0.047	0.278	0.474	0.504	0.507	0.507	0.507	0.507	0.376
1998	0.000	0.005	0.051	0.303	0.516	0.549	0.552	0.552	0.552	0.552	0.451
1999	0.001	0.006	0.068	0.398	0.679	0.722	0.726	0.726	0.726	0.726	0.505
2000	0.000	0.004	0.048	0.285	0.486	0.517	0.520	0.520	0.520	0.520	0.369
2001	0.000	0.004	0.042	0.248	0.424	0.451	0.453	0.453	0.453	0.453	0.325
2002	0.000	0.003	0.034	0.204	0.347	0.369	0.371	0.371	0.371	0.371	0.298
2003	0.000	0.003	0.027	0.162	0.276	0.293	0.295	0.295	0.295	0.295	0.199
2004	0.000	0.001	0.013	0.077	0.132	0.140	0.141	0.141	0.141	0.141	0.110
2005	0.000	0.001	0.012	0.072	0.123	0.130	0.131	0.131	0.131	0.131	0.105
2006	0.000	0.000	0.003	0.023	0.102	0.168	0.181	0.182	0.182	0.182	0.114
2007	0.000	0.000	0.003	0.023	0.101	0.167	0.179	0.181	0.181	0.181	0.116
2008	0.000	0.000	0.002	0.019	0.085	0.140	0.151	0.152	0.152	0.152	0.105
2009	0.000	0.000	0.003	0.026	0.115	0.189	0.204	0.206	0.206	0.206	0.081
2010	0.000	0.000	0.002	0.019	0.087	0.142	0.153	0.155	0.155	0.155	0.076
2011	0.000	0.000	0.002	0.014	0.061	0.100	0.108	0.109	0.109	0.109	0.063
2012	0.000	0.000	0.002	0.012	0.055	0.090	0.097	0.098	0.098	0.098	0.064
2013	0.000	0.000	0.002	0.014	0.065	0.107	0.115	0.116	0.116	0.116	0.086
2014	0.000	0.000	0.002	0.019	0.085	0.140	0.150	0.152	0.152	0.152	0.099
2015	0.000	0.000	0.003	0.021	0.094	0.154	0.166	0.167	0.167	0.167	0.092
2016	0.000	0.000	0.002	0.016	0.073	0.120	0.130	0.131	0.131	0.131	0.081
2017	0.000	0.000	0.001	0.010	0.047	0.077	0.083	0.083	0.084	0.084	0.049
2018	0.000	0.000	0.001	0.010	0.043	0.071	0.076	0.077	0.077	0.077	0.043

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
2019	0.000	0.000	0.001	0.011	0.049	0.080	0.086	0.087	0.087	0.087	0.060
2020	0.000	0.000	0.000	0.004	0.017	0.028	0.030	0.031	0.031	0.031	0.021
2021	0.000	0.000	0.001	0.011	0.050	0.083	0.089	0.090	0.090	0.090	0.057
2022	0.000	0.000	0.002	0.013	0.058	0.096	0.103	0.104	0.104	0.104	0.071
2023	0.000	0.000	0.001	0.009	0.040	0.066	0.071	0.072	0.072	0.072	0.043

Table 33. SCA maximum likelihood estimates of the instantaneous rate of fishing mortality (F) of fall spawners in the southern Gulf of St. Lawrence. F5-10 is the January 1 abundance-weighted average F for ages 5 to 10 years.

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
1978	0.004	0.019	0.046	0.052	0.025	0.024	0.024	0.007	0.005	0.017	0.929
1979	0.005	0.011	0.039	0.032	0.017	0.006	0.009	0.008	0.003	0.009	0.722
1980	0.015	0.037	0.038	0.056	0.027	0.011	0.005	0.004	0.003	0.004	0.899
1981	0.000	0.003	0.028	0.027	0.020	0.004	0.001	0.000	0.000	0.001	0.579
1982	0.000	0.003	0.017	0.044	0.009	0.004	0.001	0.000	0.000	0.000	0.281
1983	0.000	0.003	0.017	0.037	0.030	0.004	0.002	0.000	0.000	0.000	0.258
1984	0.000	0.001	0.018	0.038	0.021	0.010	0.002	0.001	0.000	0.000	0.176
1985	0.000	0.002	0.011	0.055	0.033	0.014	0.008	0.001	0.001	0.000	0.186
1986	0.000	0.004	0.022	0.040	0.063	0.028	0.013	0.009	0.001	0.001	0.279
1987	0.000	0.004	0.038	0.073	0.039	0.043	0.023	0.011	0.007	0.002	0.330
1988	0.000	0.002	0.022	0.077	0.043	0.016	0.020	0.010	0.005	0.004	0.248
1989	0.001	0.002	0.016	0.050	0.049	0.019	0.009	0.010	0.006	0.005	0.227
1990	0.001	0.009	0.023	0.056	0.065	0.059	0.027	0.010	0.014	0.012	0.438
1991	0.000	0.003	0.048	0.037	0.024	0.018	0.015	0.007	0.003	0.007	0.248
1992	0.000	0.001	0.024	0.108	0.024	0.012	0.010	0.009	0.004	0.006	0.209
1993	0.000	0.002	0.006	0.046	0.062	0.010	0.005	0.004	0.004	0.004	0.160
1994	0.001	0.003	0.079	0.067	0.168	0.100	0.018	0.010	0.009	0.018	0.456
1995	0.001	0.011	0.036	0.285	0.071	0.072	0.074	0.013	0.007	0.018	0.620

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
1996	0.001	0.007	0.087	0.080	0.189	0.019	0.033	0.034	0.006	0.015	0.690
1997	0.001	0.010	0.047	0.182	0.043	0.039	0.007	0.012	0.012	0.008	0.550
1998	0.001	0.015	0.085	0.121	0.134	0.013	0.019	0.003	0.006	0.010	0.635
1999	0.001	0.016	0.144	0.253	0.088	0.040	0.006	0.009	0.001	0.008	0.676
2000	0.002	0.010	0.117	0.309	0.135	0.018	0.011	0.002	0.002	0.002	0.578
2001	0.001	0.018	0.069	0.252	0.169	0.027	0.006	0.004	0.001	0.002	0.470
2002	0.002	0.013	0.135	0.164	0.177	0.045	0.011	0.002	0.001	0.001	0.438
2003	0.001	0.023	0.139	0.457	0.156	0.050	0.022	0.005	0.001	0.001	0.462
2004	0.001	0.008	0.106	0.203	0.214	0.023	0.013	0.005	0.001	0.000	0.264
2005	0.000	0.008	0.077	0.318	0.207	0.052	0.013	0.007	0.003	0.001	0.282
2006	0.005	0.005	0.031	0.100	0.265	0.061	0.036	0.008	0.005	0.003	0.240
2007	0.004	0.018	0.016	0.083	0.165	0.092	0.028	0.016	0.003	0.003	0.208
2008	0.003	0.012	0.053	0.040	0.136	0.068	0.038	0.011	0.007	0.002	0.193
2009	0.002	0.009	0.036	0.148	0.070	0.068	0.032	0.019	0.006	0.005	0.116
2010	0.001	0.004	0.023	0.085	0.231	0.032	0.023	0.010	0.006	0.004	0.101
2011	0.001	0.001	0.010	0.048	0.117	0.097	0.009	0.006	0.003	0.003	0.070
2012	0.000	0.002	0.004	0.031	0.097	0.082	0.035	0.003	0.002	0.002	0.066
2013	0.000	0.001	0.010	0.020	0.087	0.094	0.038	0.015	0.001	0.002	0.089
2014	0.000	0.001	0.005	0.032	0.043	0.076	0.037	0.014	0.006	0.001	0.079
2015	0.000	0.001	0.005	0.022	0.082	0.042	0.032	0.014	0.005	0.003	0.084
2016	0.000	0.001	0.006	0.017	0.051	0.069	0.016	0.011	0.005	0.003	0.084
2017	0.000	0.000	0.005	0.022	0.039	0.039	0.030	0.007	0.004	0.003	0.074
2018	0.000	0.000	0.002	0.015	0.046	0.029	0.016	0.012	0.002	0.003	0.066
2019	0.000	0.001	0.002	0.006	0.036	0.040	0.015	0.008	0.005	0.002	0.077
2020	0.000	0.000	0.002	0.007	0.012	0.021	0.017	0.006	0.003	0.003	0.059
2021	0.000	0.001	0.001	0.008	0.018	0.011	0.016	0.011	0.004	0.004	0.066
2022	0.001	0.001	0.003	0.006	0.023	0.013	0.007	0.009	0.006	0.004	0.073

Year	2	3	4	5	6	7	8	9	10	11+	F5-10
2023	0.000	0.000	0.002	0.005	0.008	0.010	0.005	0.002	0.003	0.003	0.036

Table 34. Risk analysis table from the SCA model of annual catch options (between 2 and 18 kt) for 2024 and 2025 and subsequent years until 2029, with predicted resulting SSB in kilotonnes (kt) in 2025, 2026 and 2029, resulting probabilities (%) of SSB being lower than the LRP, resulting probabilities of increases in SSB by 5%, and resulting fully recruited fishing mortality rate (F5-10) for the fall spawner component of Atlantic Herring from the southern Gulf of St. Lawrence.

	Year	Catch options (kilotonnes)								
		2	4	6	8	10	12	14	16	18
SSB (kt)	2025	407	406	406	405	403	402	399	399	397
	2026	389	387	385	384	381	379	378	375	373
SSB < LRP	2025	0	0	0	0	0	0	0	0	0
	2026	0	0	0	0	0	0	0	0	0
	2029	0	0	0	0	0	0	0	0	0
Increase in SSB	2025	53	52	52	51	50	49	49	47	46
	2026	34	33	33	32	31	30	30	29	28
Average F5-10	2024	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.05	0.06
	2025	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.05	0.05

FIGURES

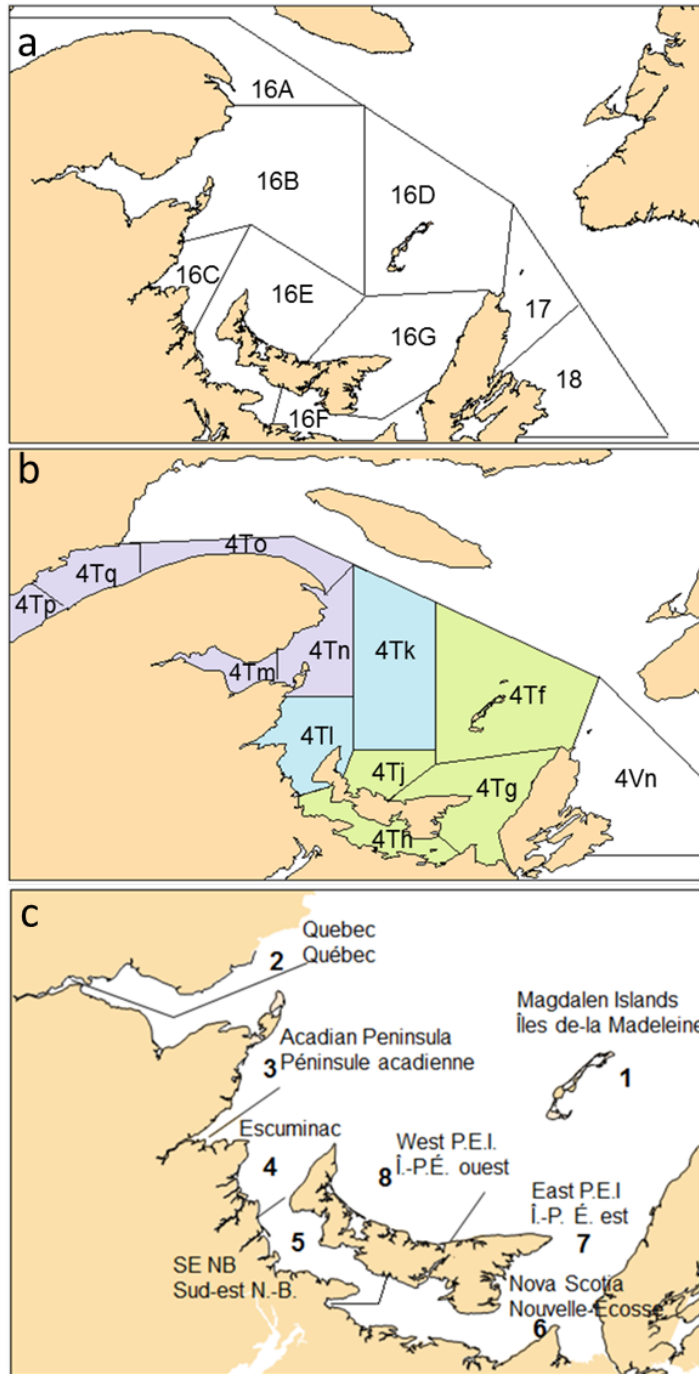


Figure 1. Southern Gulf of St. Lawrence Herring fishery management zones (upper panel, a), Northwest Atlantic Fisheries Organization (NAFO) Divisions 4T and 4Vn, where purple represents the North region, blue = Middle region, and green = South region (middle panel, b), and geographic areas used in the telephone survey of the Herring gillnet fishery (lower panel, c).

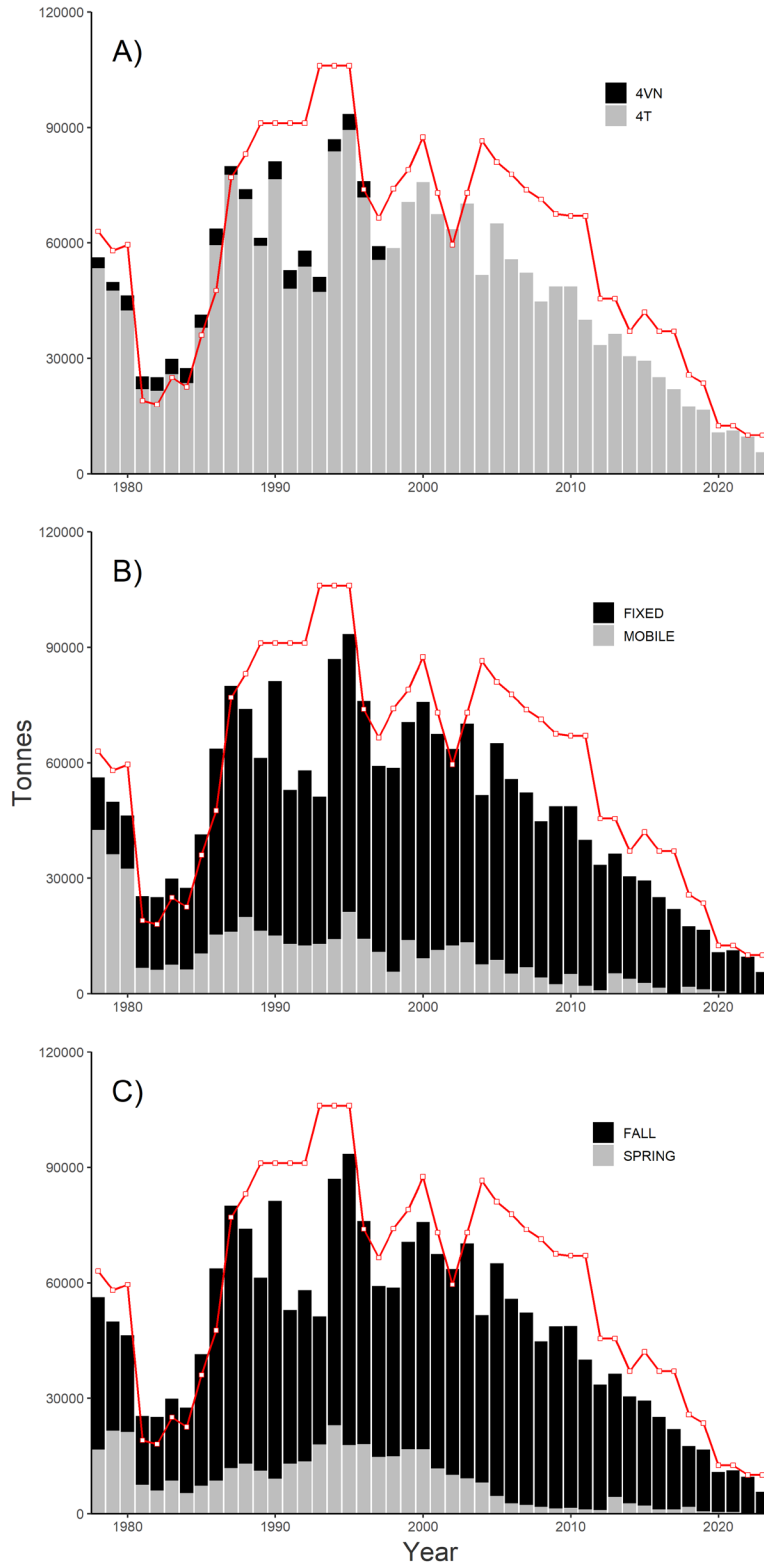


Figure 2. Reported landings (tonnes) of southern Gulf of St. Lawrence Atlantic Herring (spring and fall spawners combined) by NAFO Division (upper panel, A), by gear fleet (middle panel, B), and by fishing season (lower panel, C), 1978 to 2023. In all panels, the corresponding annual TAC (tonnes) is shown in red line. For landings by season, the landings in Div. 4Vn were attributed to the fall fishing season.

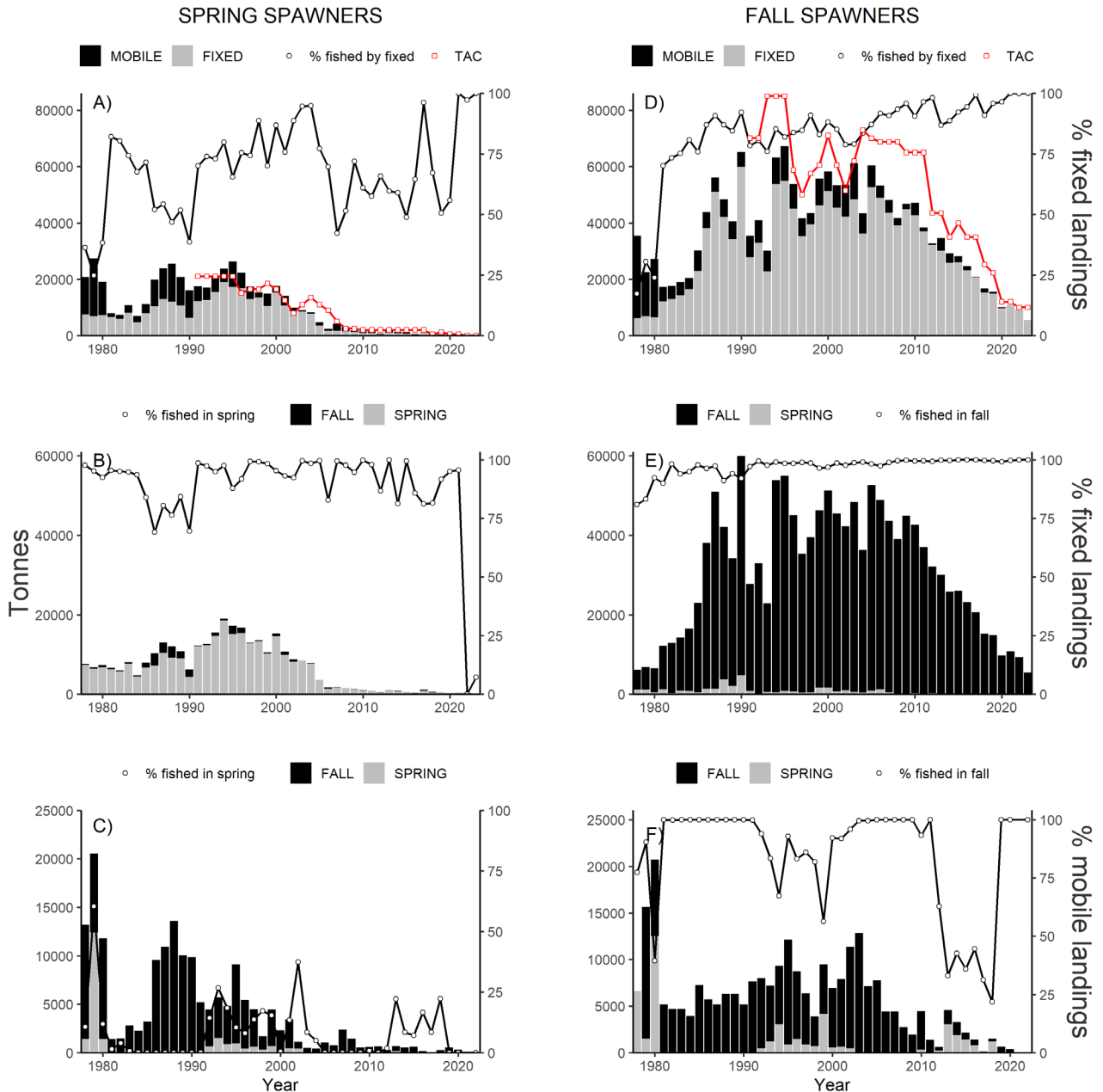


Figure 3. Estimated landings (tonnes) of the spring spawner component (left) and fall spawner component (right) of Atlantic Herring from the southern Gulf of St. Lawrence, 1978 to 2023. Panels A and D show the estimated landings by gear type and the proportion of the landings attributed to the fixed gear fleet and the TAC for the spawner component (red symbols) for 1991 to 2023. Panels B and E show the estimated landings of Herring in the fixed-gear fleet that occurred in the spring fishery season and the fall fishery season as well as the proportion of Herring landed in the matching fishing season. Panels C and F show the estimated landings of Herring in the mobile gear fleet that occurred in the spring fishery season and the fall fishery season as well as the proportion of Herring landed in the matching fishing season. For landings by season, the landings in NAFO Division 4Vn were attributed to the fall fishing season.



Figure 4. Variations in the proportions of gillnets with mesh size $2 \frac{5}{8}$ inches by region, 1986 to 2023. It is assumed that all other nets used were of mesh size $2 \frac{3}{4}$.

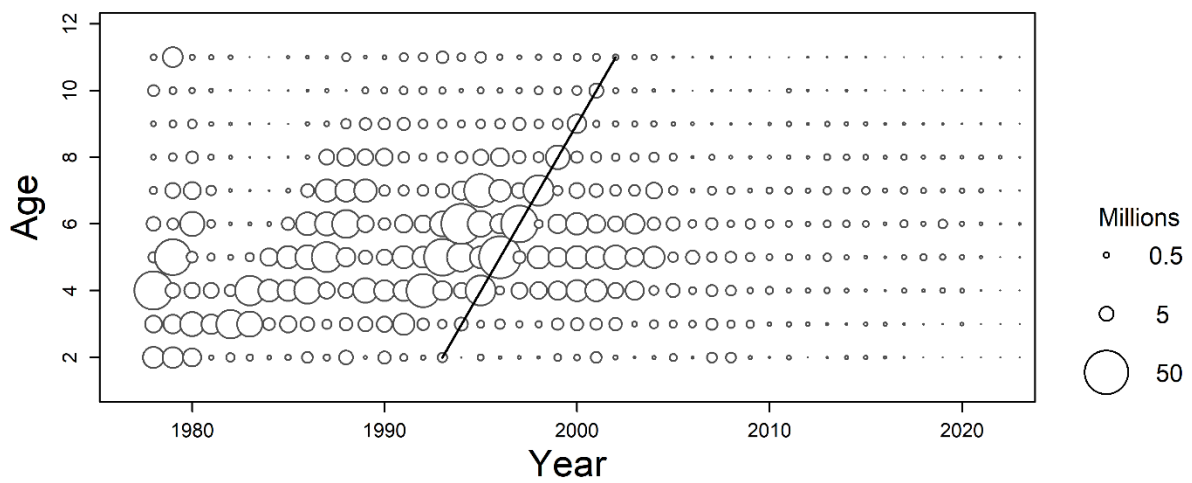


Figure 5. Catch-at-age of the spring spawner component from the fishery, all gears combined, 1978 to 2023. Size of the bubble is proportional to the catch numbers by age and year. The diagonal line represents the most recent strong year class (1991). The values indicated at age 11 represent catches for ages 11 years and older.

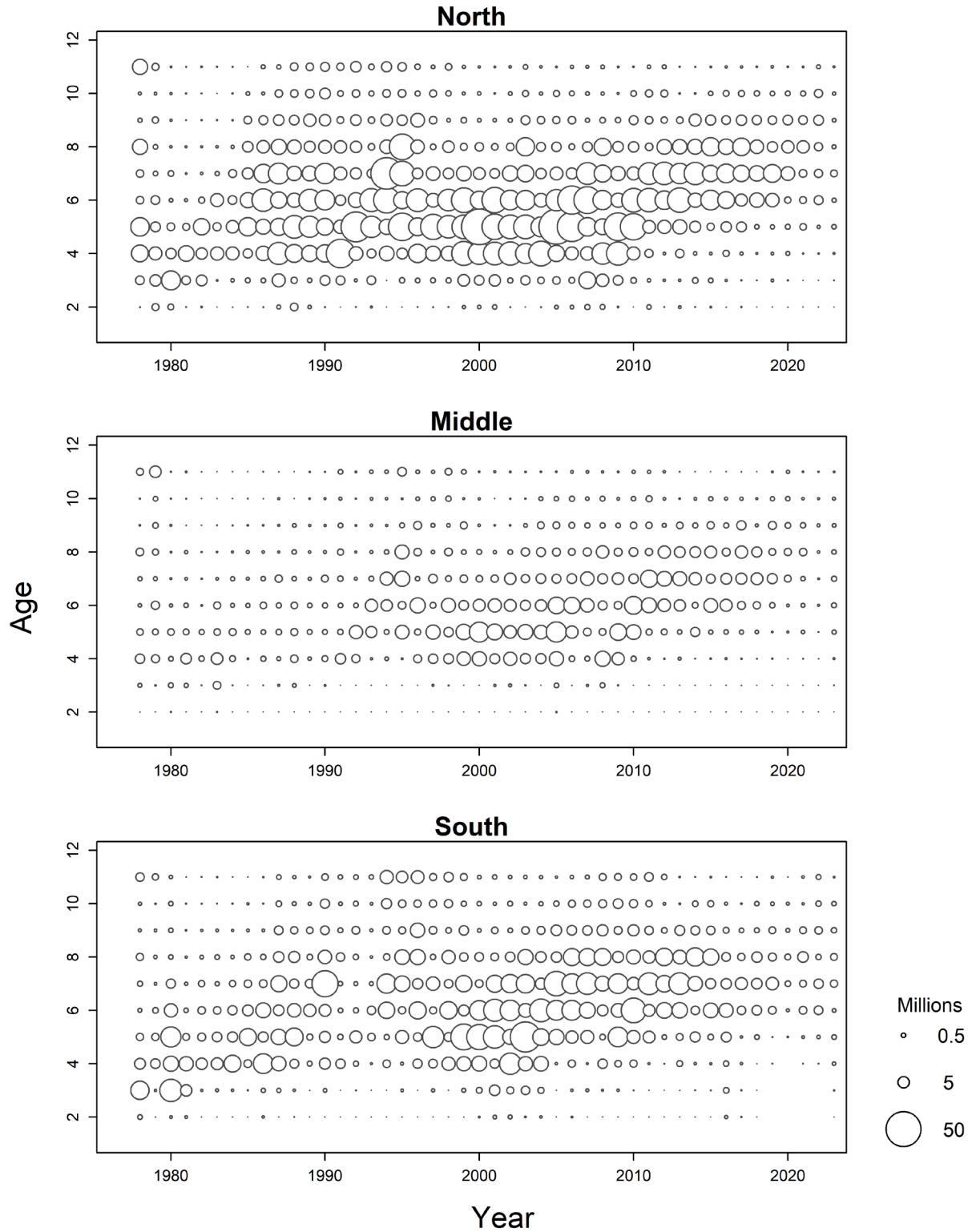


Figure 6. Bubble plots of fishery catch-at-age (number) by region for both mobile and fixed gear combined, 1978 to 2023. The size of the bubble is proportional to the number of fish in the catch by age and year. The values indicated at age 11 represent catches for ages 11 years and older.

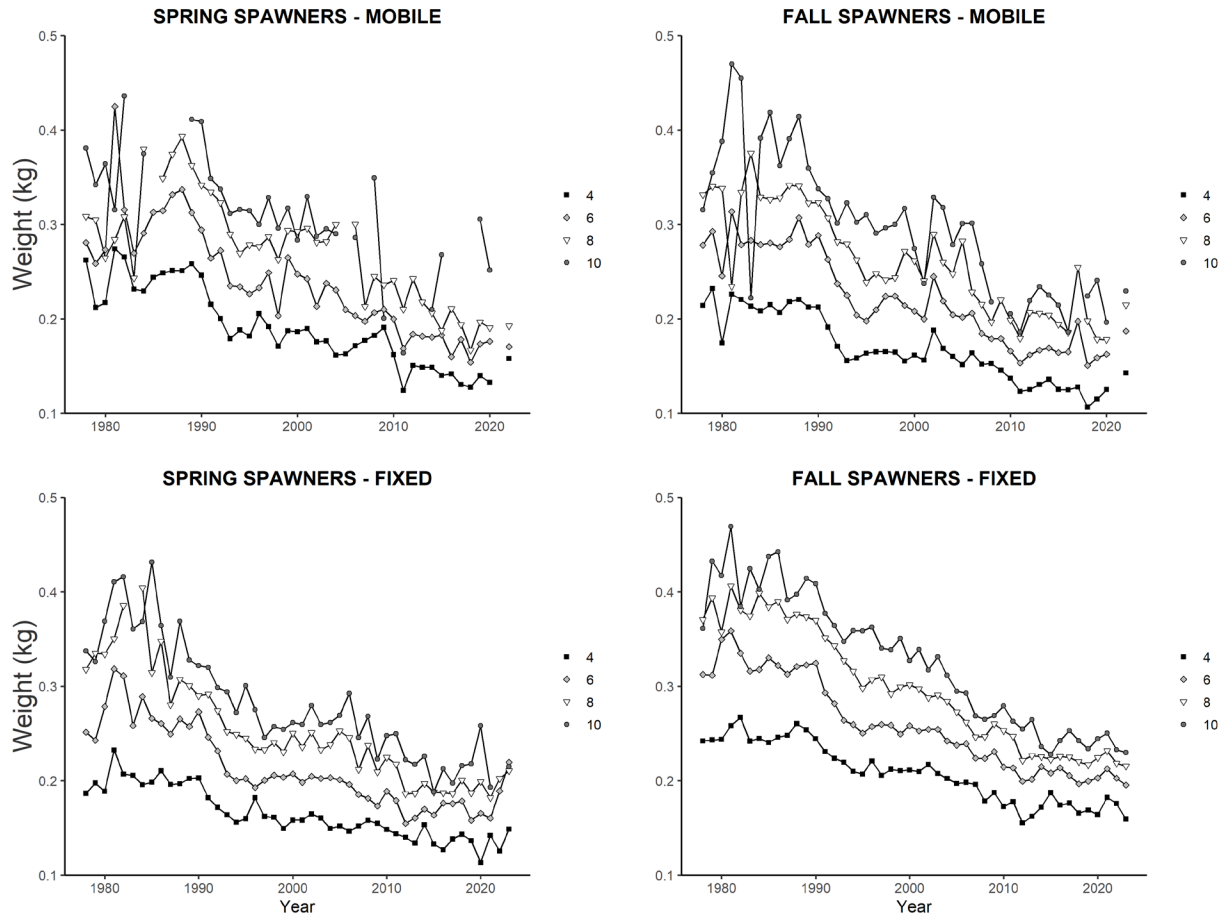


Figure 7. Mean weight (kg) of Atlantic Herring for ages 4, 6, 8, and 10 of spring spawners (left panels) sampled from catches in the spring season and fall spawners (right panels) sampled from catches in the fall season from mobile (upper panels) and fixed (lower panels) commercial gears, in NAFO Div. 4T from 1978 to 2023.

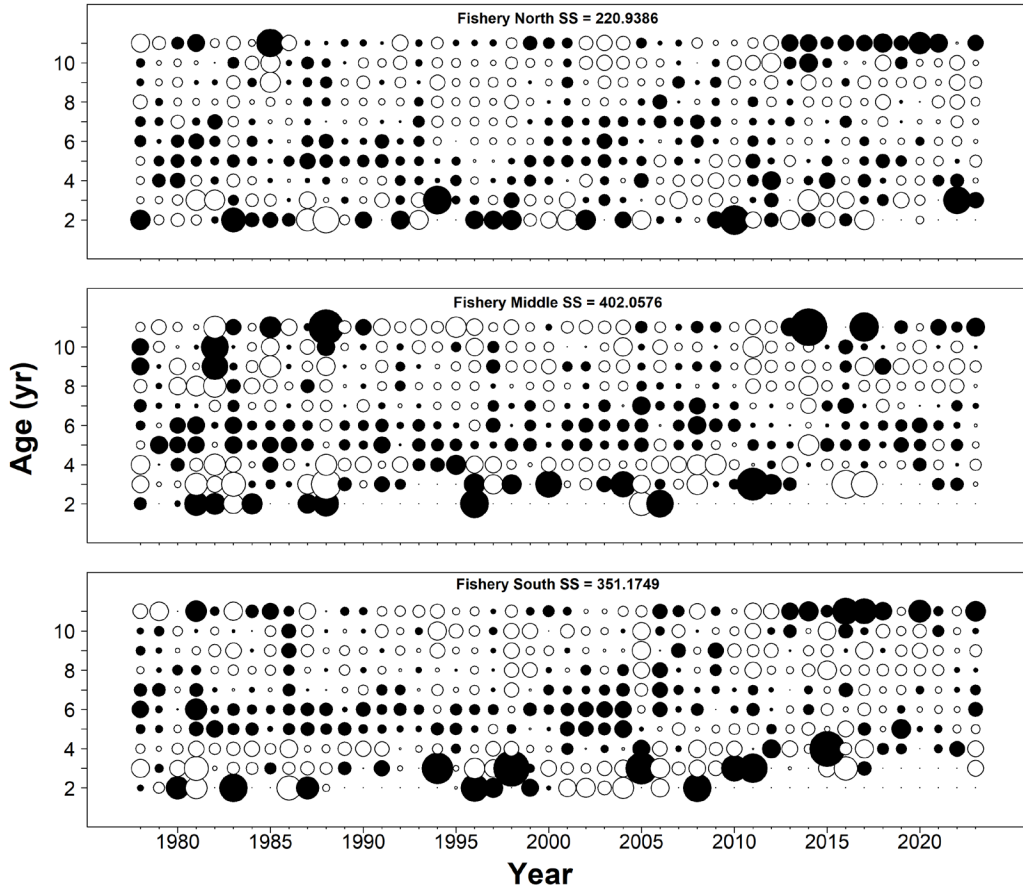


Figure 8. Fishery catch PAA residuals by region (North, Middle and South) from the SCA population model of fall spawning Herring from the southern Gulf of St. Lawrence. Rows are for ages and columns are years. The circle radius is proportional to the absolute value of residuals. Black circles indicate negative residuals (i.e., observed < predicted).

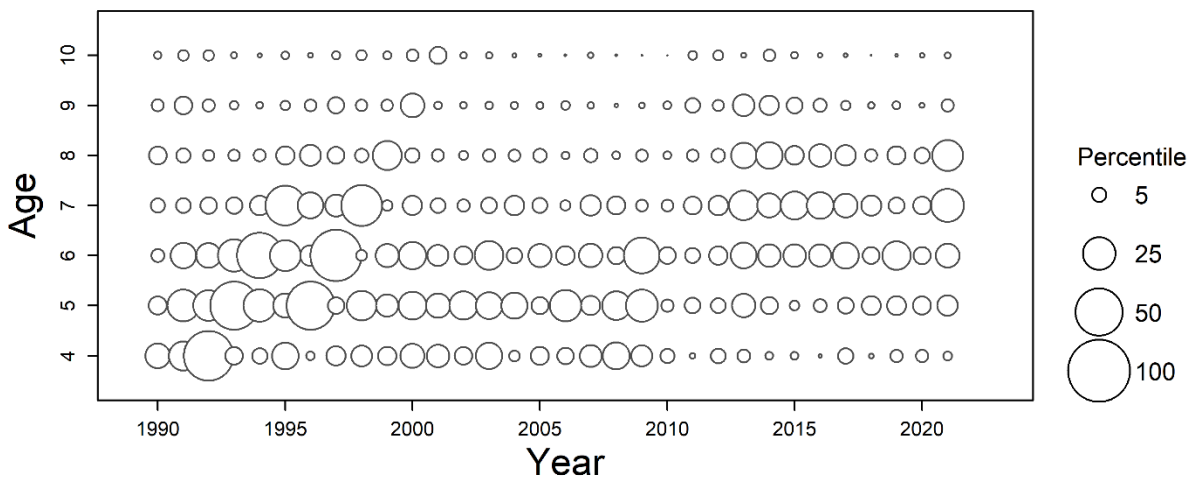


Figure 9. Bubble plot of spring spawner Herring fixed gear catch-per-unit-effort values (number per net-haul per trip) at age, 1990 to 2021. As there was no fishery in 2022 and 2023, CPUE was not estimated for those years. The size of the bubble is proportional to the maximum CPUE index value.

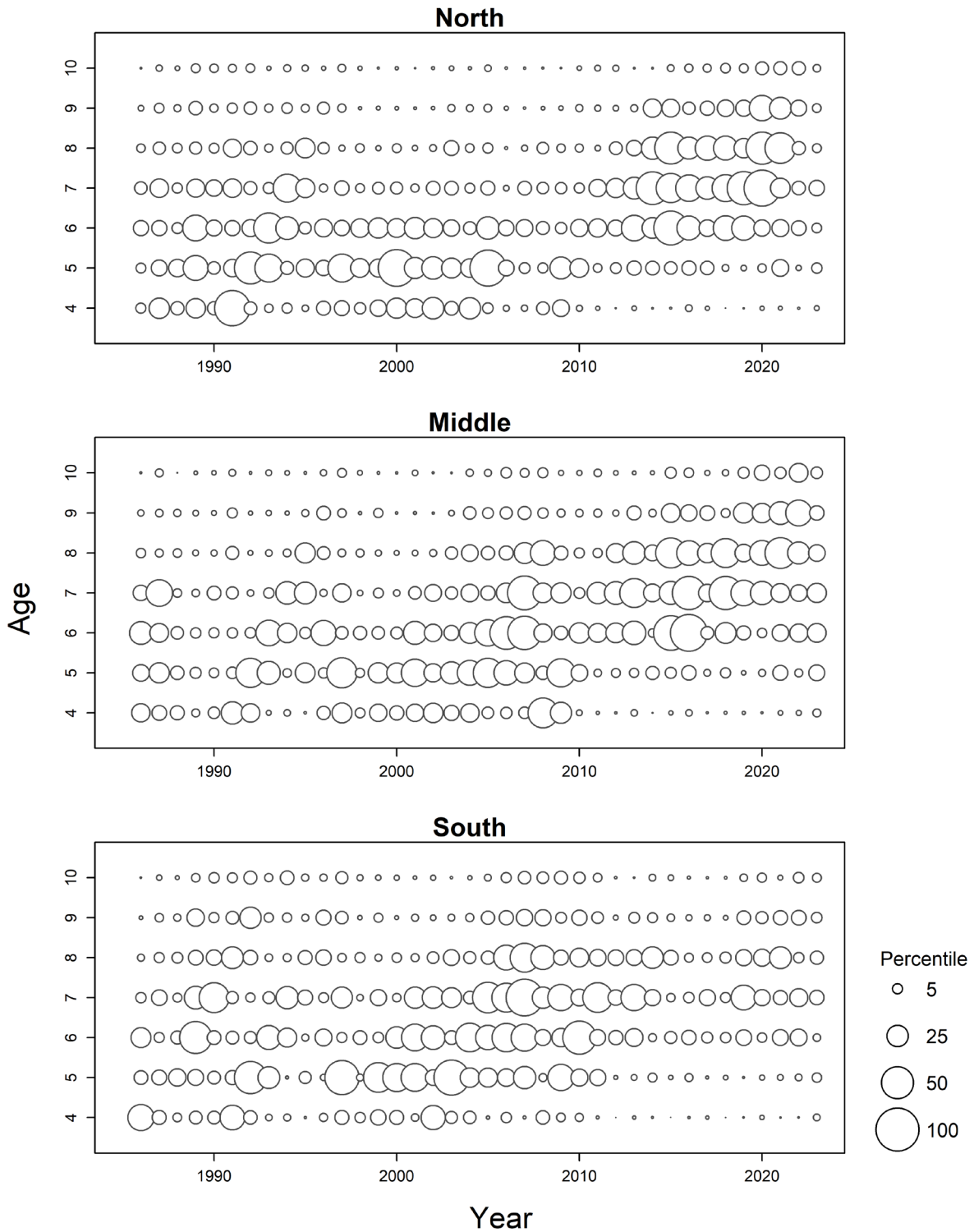


Figure 10. Fall spawner (FS) fixed gear age-disaggregated catch-per-unit-effort values (number per net-haul per trip) by region (upper panel North, middle panel Middle, and lower panel South), 1986 to 2023. The size of the bubble is proportional to the CPUE index value.

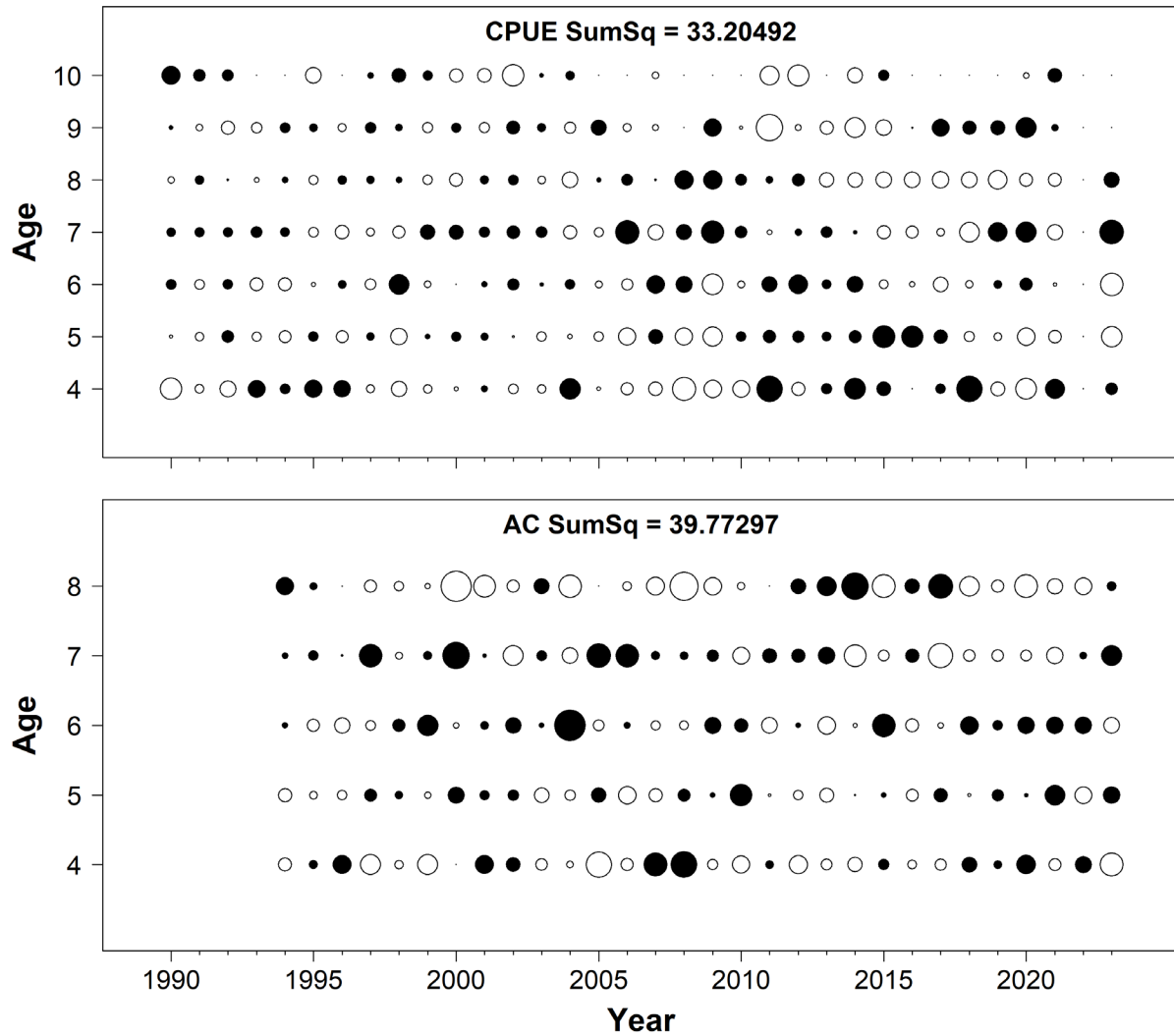


Figure 11. Residuals in PAA (observed – predicted indices) for the population model of spring spawners in the southern Gulf of St. Lawrence. The upper panel shows residuals for the CPUE index and the bottom panel shows residuals for the acoustic index. Rows are for ages and columns for years. Circle radius is proportional to the absolute value of residuals. Black circles indicate negative residuals (i.e., observed < predicted).

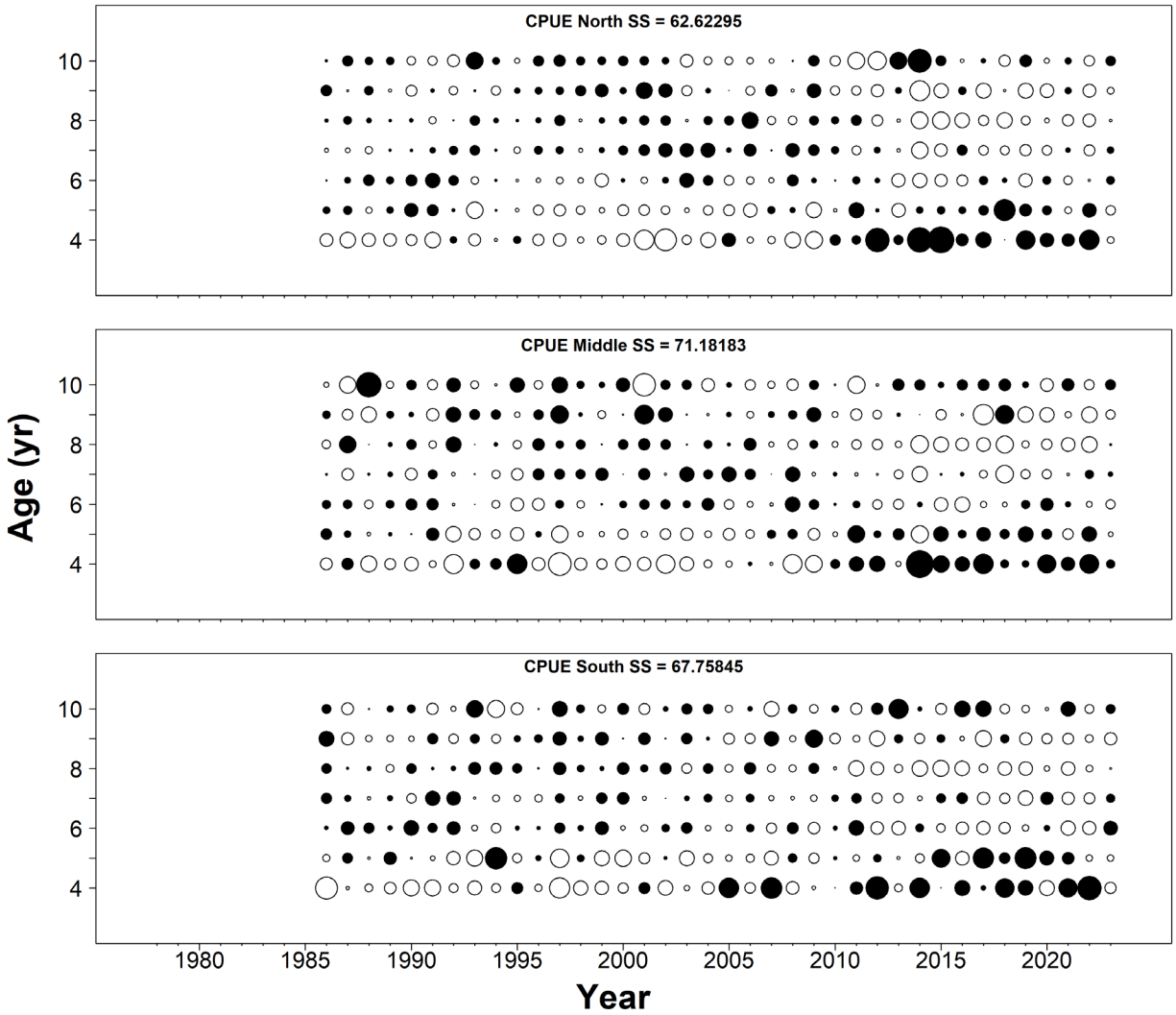


Figure 12. CPUE index PAA residuals by region (North, Middle and South) from the SCA population model of fall spawning Herring from the southern Gulf of St. Lawrence. Rows are for ages and columns are years. The circle radius is proportional to the absolute value of residuals. Black circles indicate negative residuals (i.e., observed < predicted).

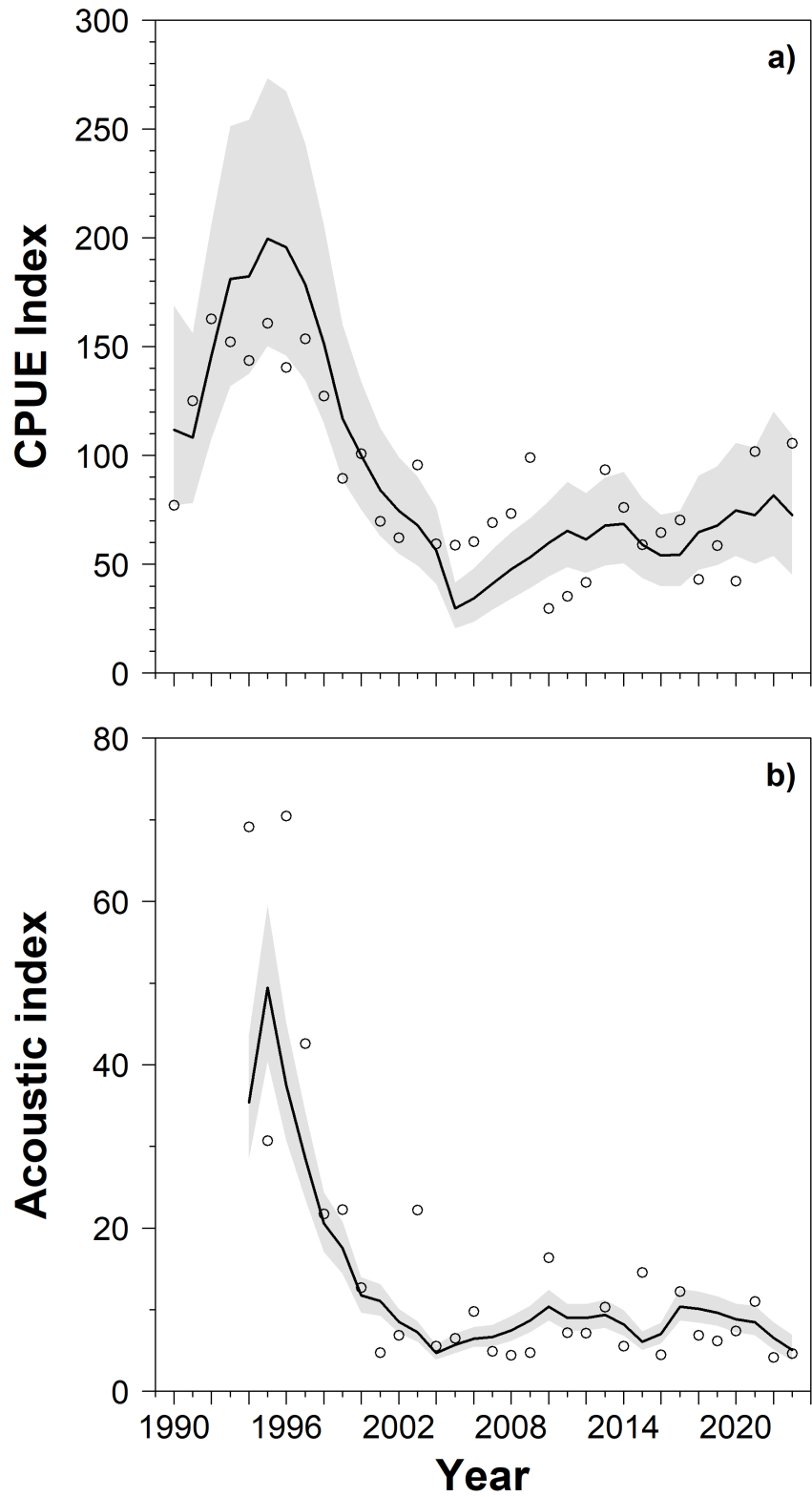


Figure 13. Observed (circles) and predicted (lines and shading) age-aggregated CPUE (upper panels) and acoustic (lower panels) indices (kg) for the population model of spring spawners in the southern Gulf of St. Lawrence. The lines show the median predicted indices and the shading the 95% confidence intervals of the predictions based on MCMC sampling.

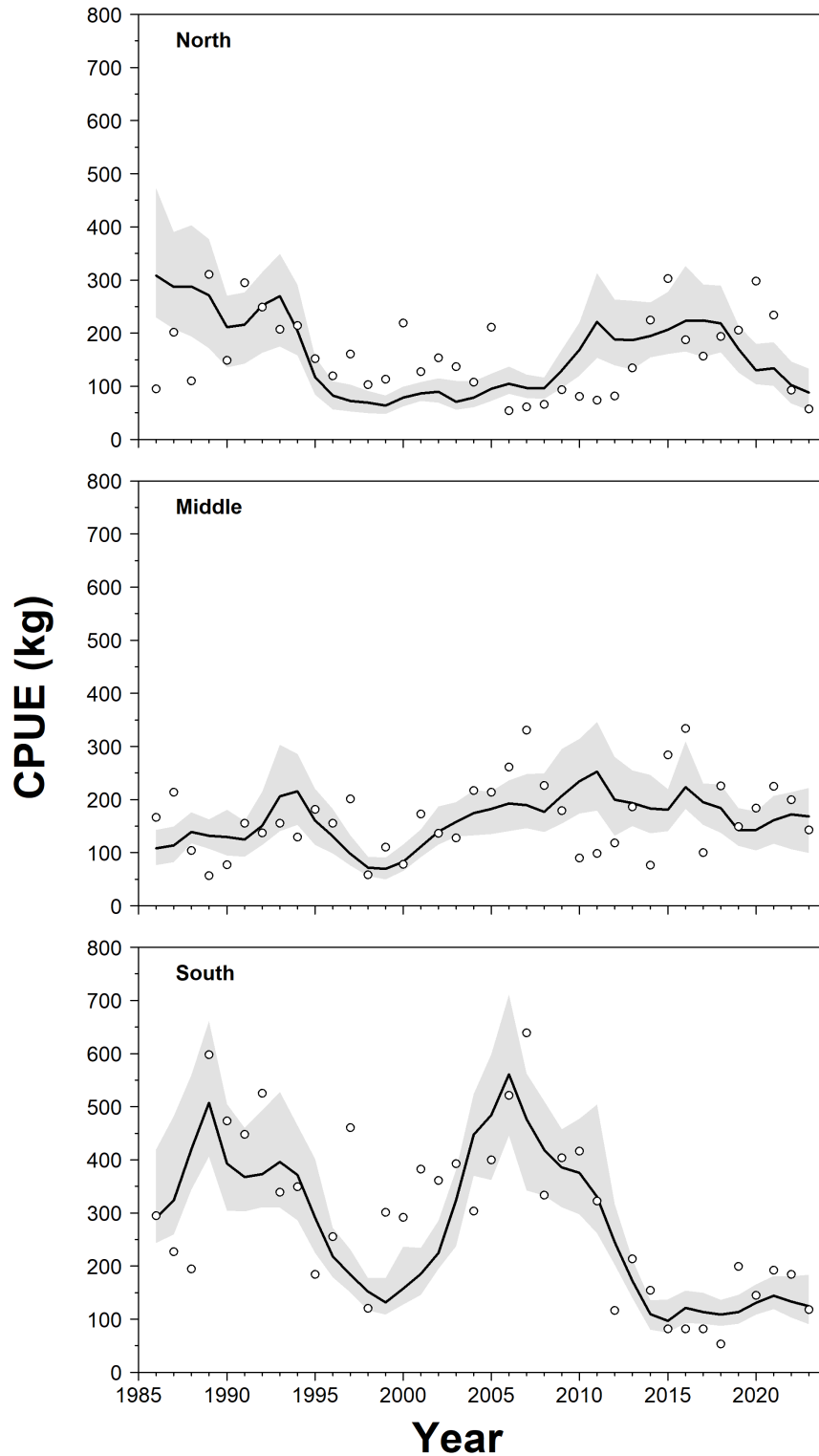


Figure 14. Observed (circles) and predicted (lines and shading) age-aggregated commercial gillnet CPUE indices by region (CPUE North, CPUE Middle, CPUE South) from the SCA population model for fall spawners from the southern Gulf of St. Lawrence. The lines show the median predicted indices and the shading the 95% confidence intervals of the predictions based on MCMC sampling.

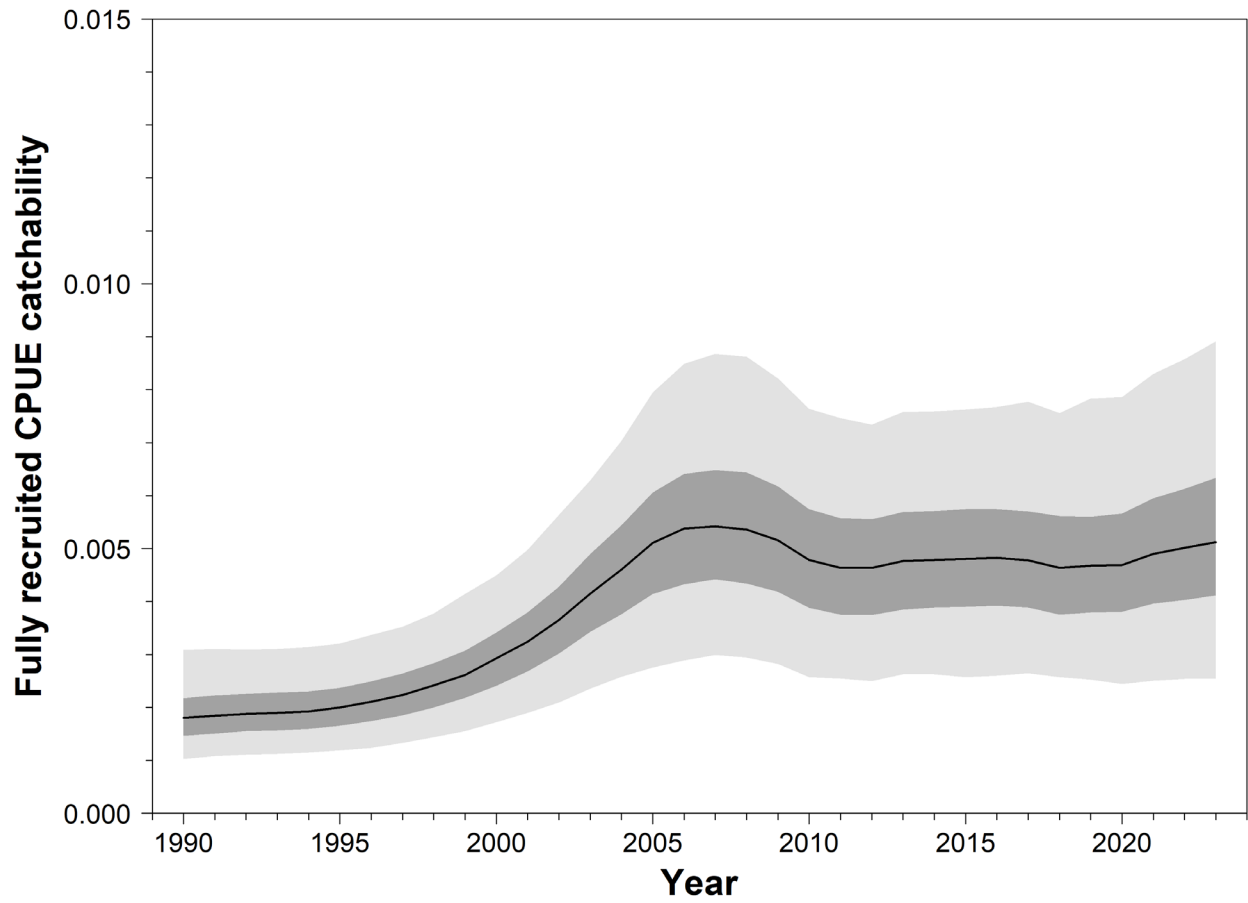


Figure 15. Estimated fully recruited catchability to the CPUE index (q) from the spring spawners population model. Lines show the median estimates and shading their 50% (dark shading) and 95% (light shading) confidence interval based on MCMC sampling.

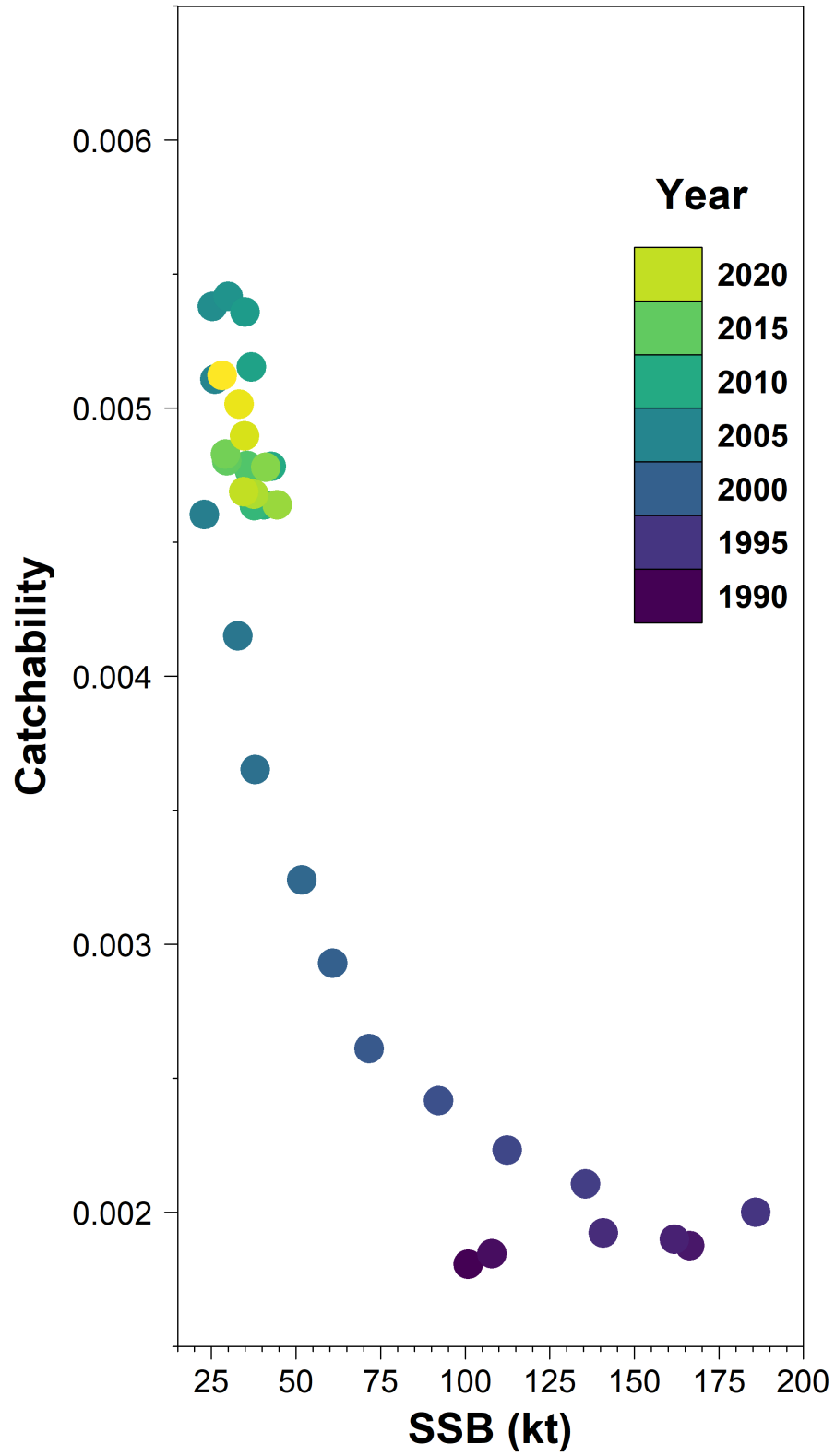


Figure 16. Fully recruited catchability to the CPUE gillnet fishery (q) in function of SSB (kilotonnes) for spring spawning Herring in the southern Gulf of St. Lawrence between 1990 and 2023.

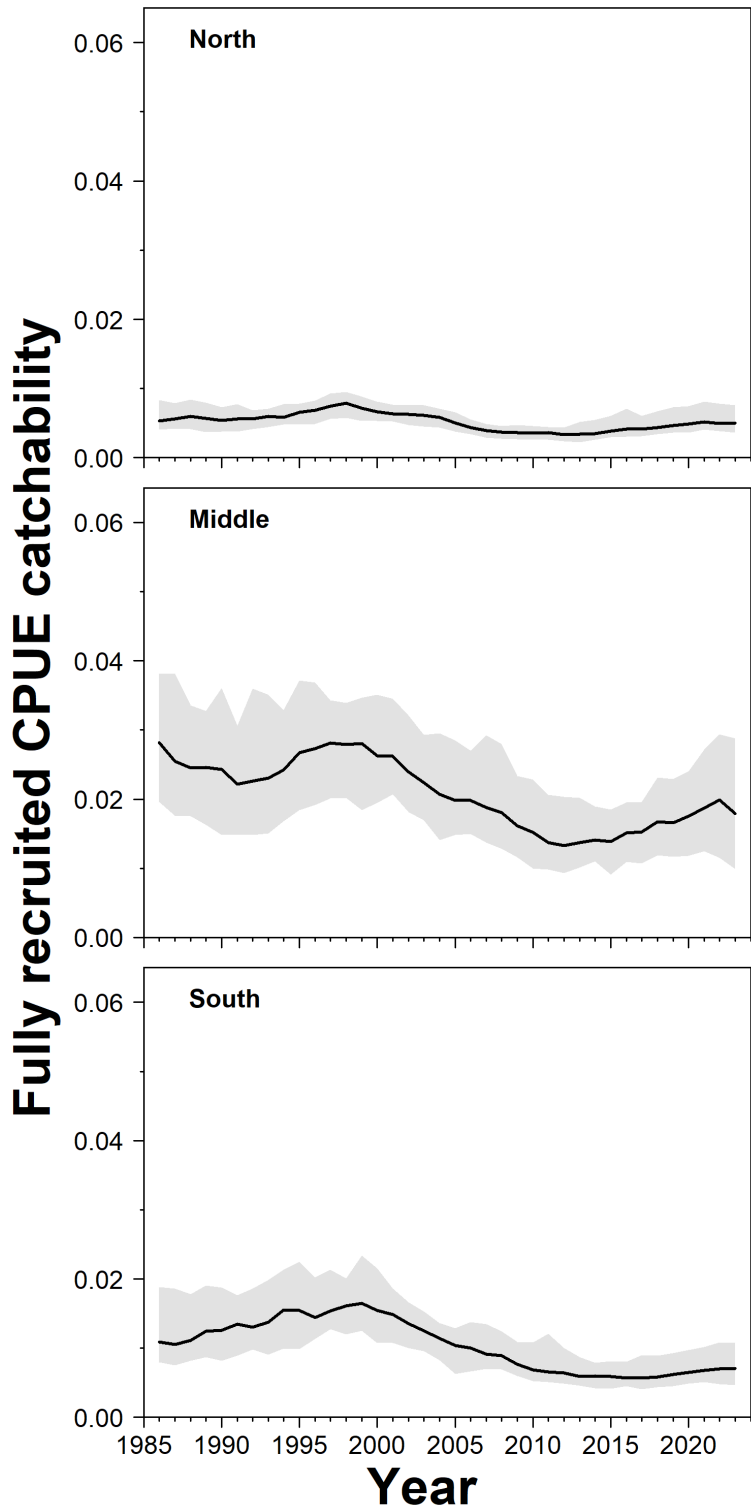


Figure 17. Estimated fully recruited catchability for the commercial gillnet CPUE index by region (North, Middle, South), from the SCA population model of fall spawning Atlantic Herring in the southern Gulf of St. Lawrence. Lines show the median estimates and shading their 95% confidence intervals based on MCMC sampling.

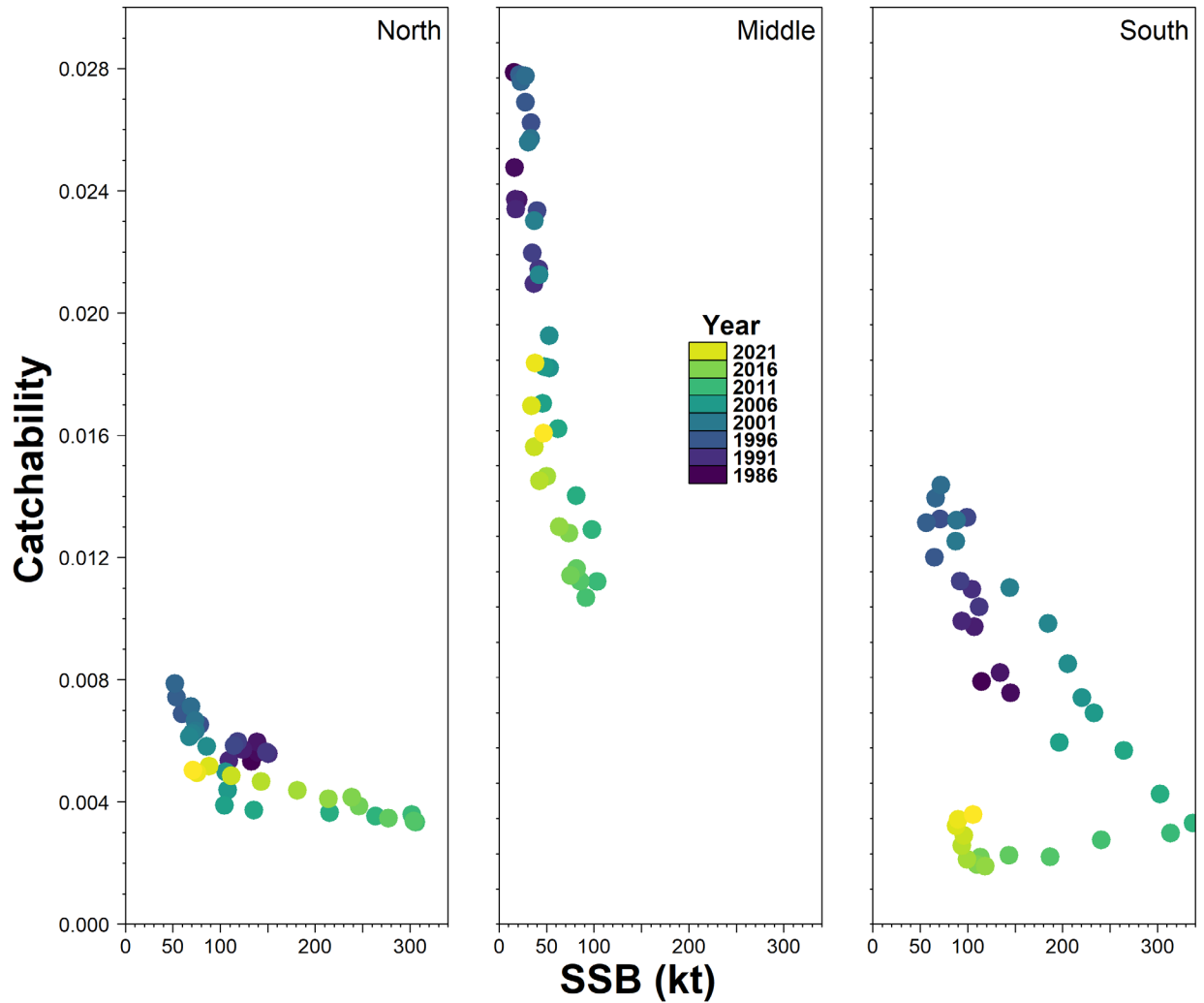


Figure 18. Fully recruited catchability to the CPUE gillnet fishery (q) in function of SSB (kilotonnes) for by region (North, Middle, South) for fall spawning Atlantic Herring in the southern Gulf of St. Lawrence.

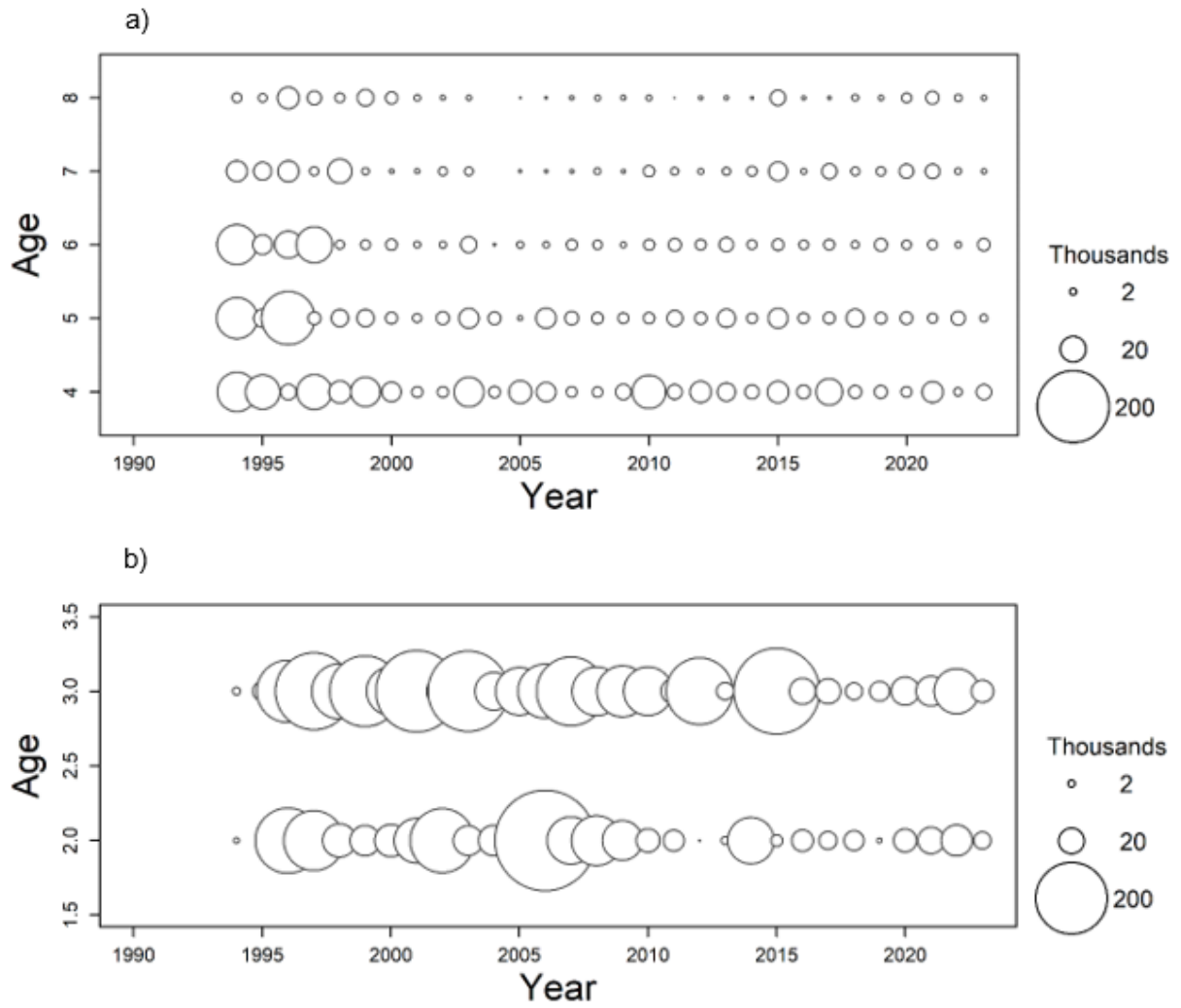


Figure 19. Bubble plot of abundance-at-age (number) from the fisheries-independent acoustic survey for spring spawners (upper panel a); ages 4 to 8) and fall spawners (lower panel b); ages 2 to 3) from 1994 to 2023.

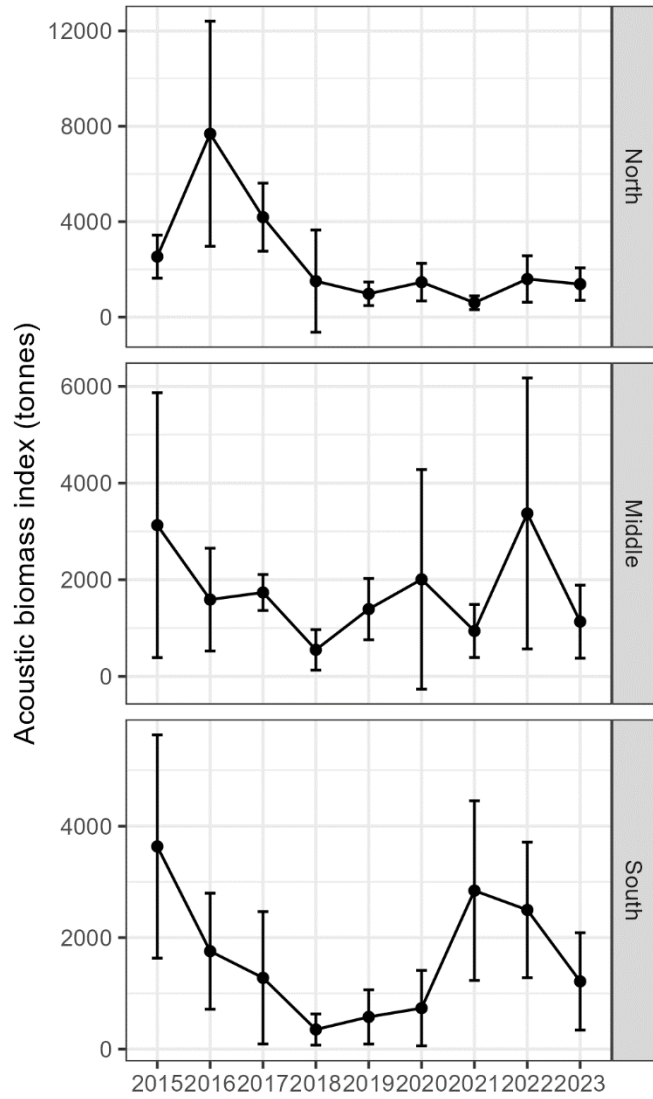


Figure 20. FSCP acoustic biomass indices of NAFO Division 4T fall spawning Atlantic Herring in the North, Middle and South regions between 2015 and 2023. Points are average and vertical lines are 95% confidence intervals.

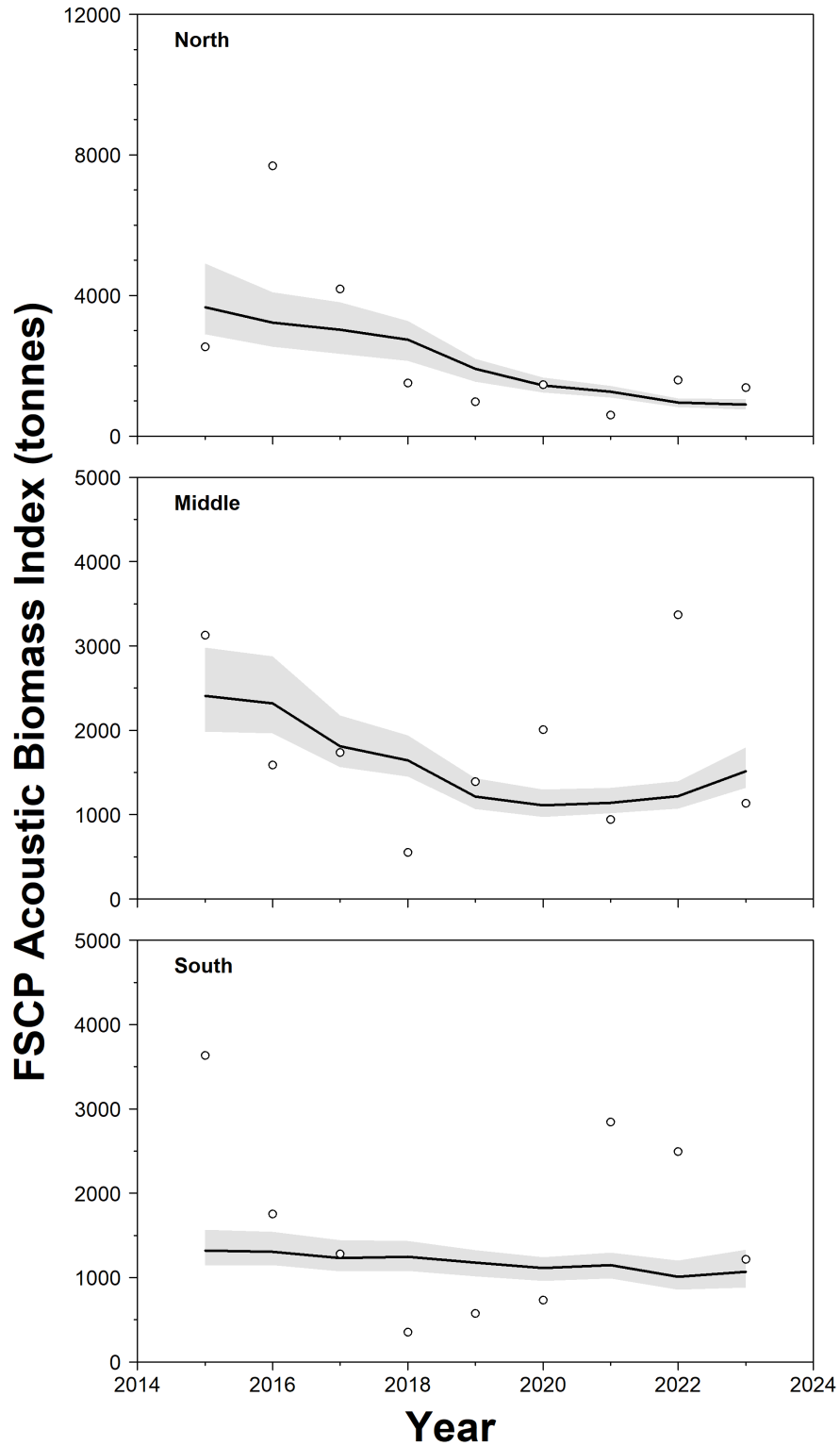


Figure 21. Observed (circles) and predicted (lines and shading) age-aggregated FSCP Acoustic Biomass Index from the SCA population model for fall spawners from the southern Gulf of St. Lawrence. The lines show the median predicted indices and the shading the 95% confidence intervals of the predictions based on MCMC sampling.

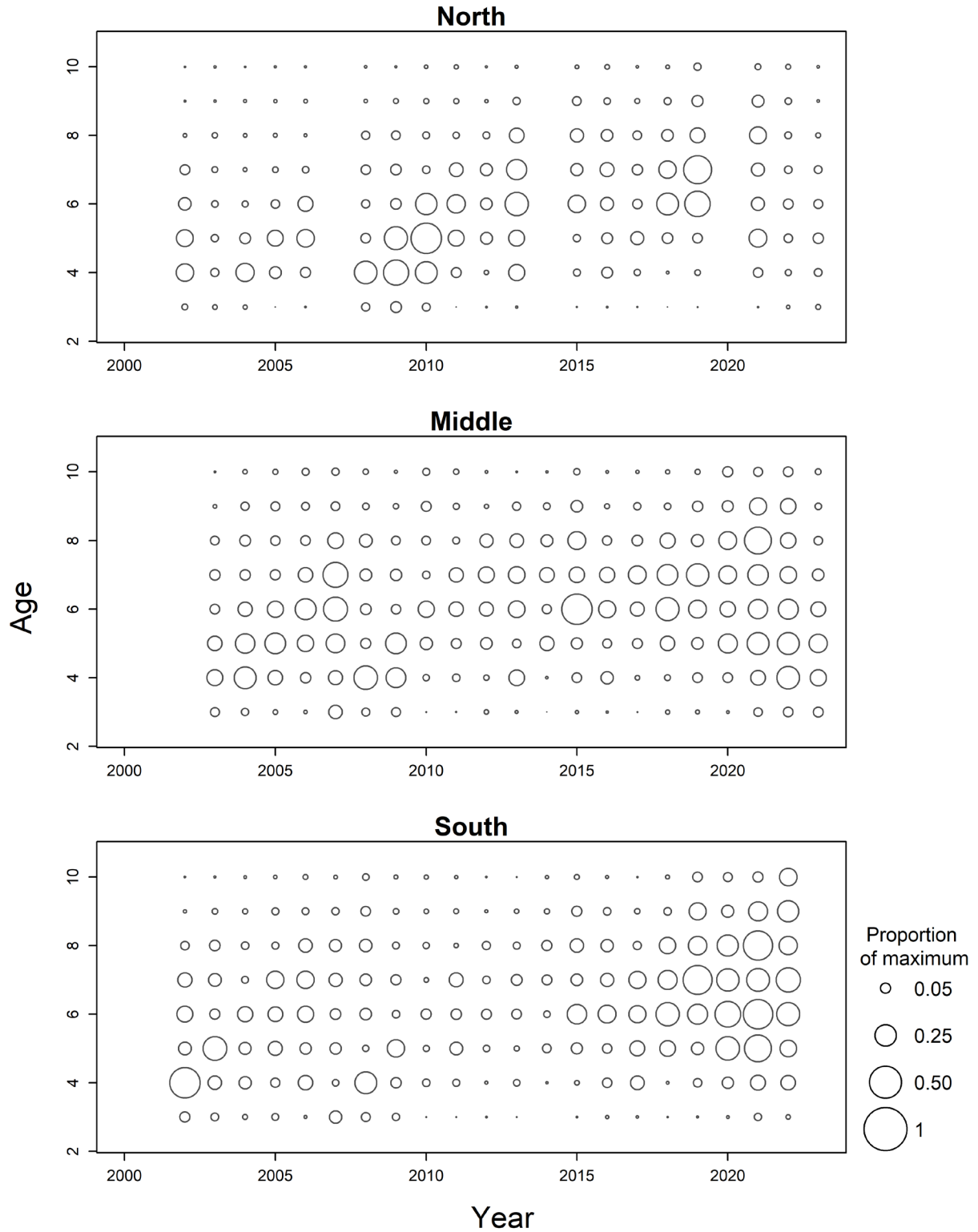


Figure 22. Bubble plots of catch-at-age indices (number) of fall spawners from the experimental netting survey by region (upper panel North, middle panel Middle, and lower panel South) from 2002 to 2023. The size of the bubble is proportional to the index value. South did not have experimental nets in 2023.

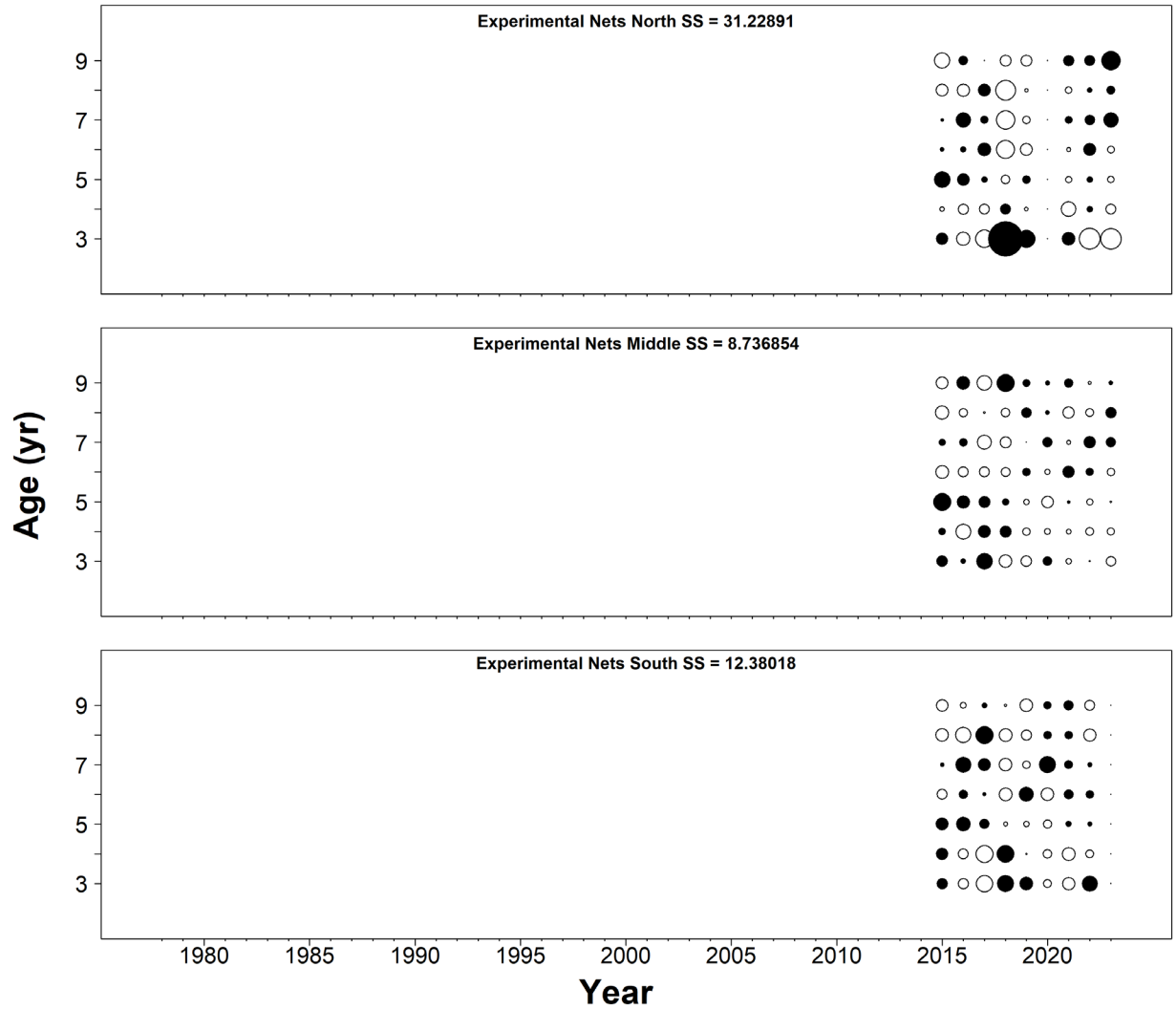


Figure 23. Experimental nets index PAA residuals by region (North, Middle and South) from the SCA population model of fall spawning Herring from the southern Gulf of St. Lawrence. Rows are for ages and columns are years. The circle radius is proportional to the absolute value of residuals. Black circles indicate negative residuals (i.e., observed < predicted). Results are only provided for the years during which the acoustic survey was conducted.

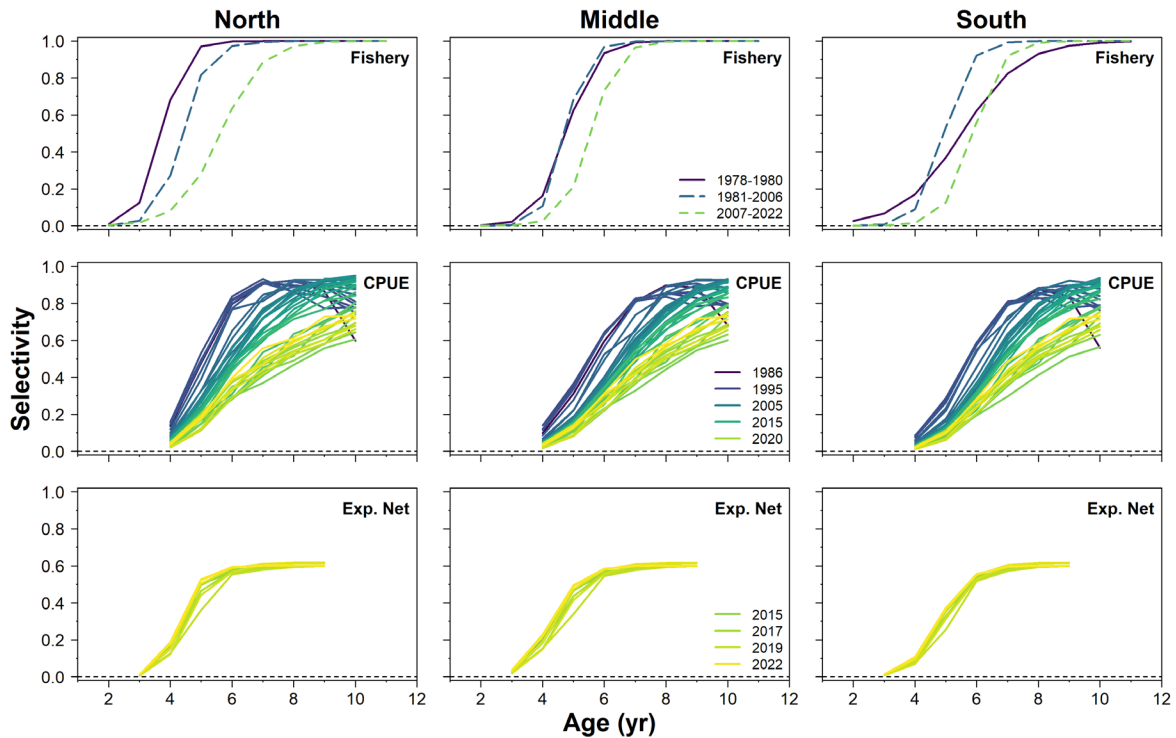


Figure 24. Estimated fishery (top row), CPUE (Middle row) and experimental nets (bottom row) selectivity for three populations of the southern Gulf of St. Lawrence (North in the left column, Middle in the Middle column and South in the right column), from the SCA population model. Lines show the maximum likelihood estimates for years or time-periods identified in respective Figure legends.

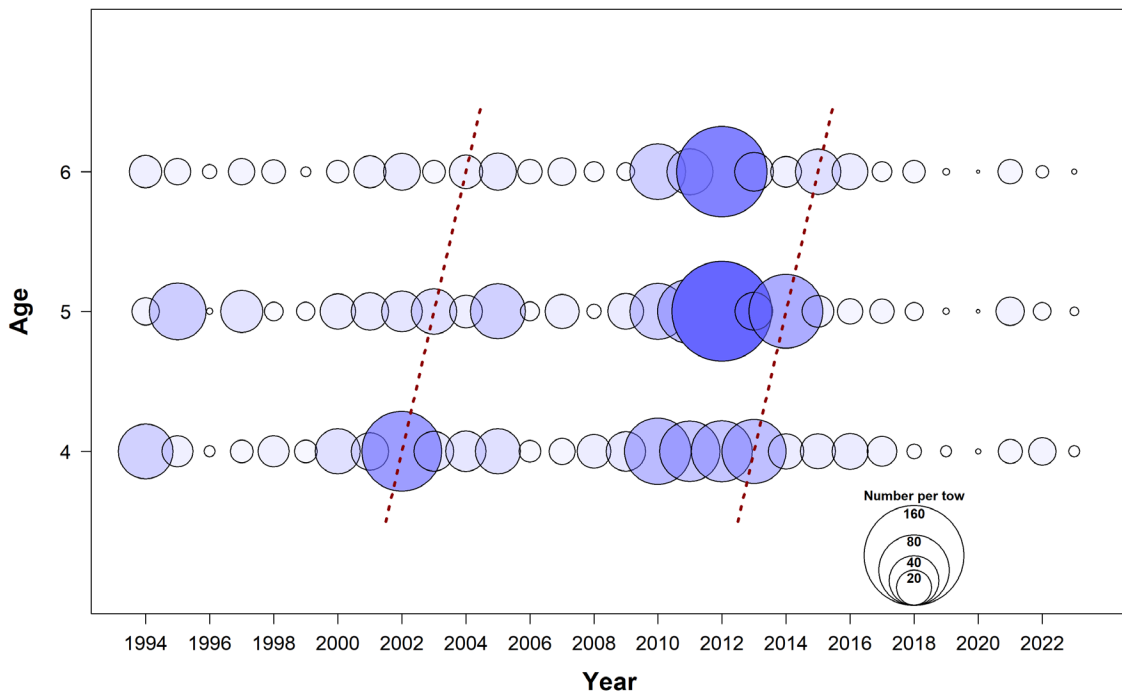


Figure 25. Multispecies bottom trawl survey abundance index (number of fish per standardized tow) for fall spawning Herring ages 4 to 6 years, 1994 to 2023.

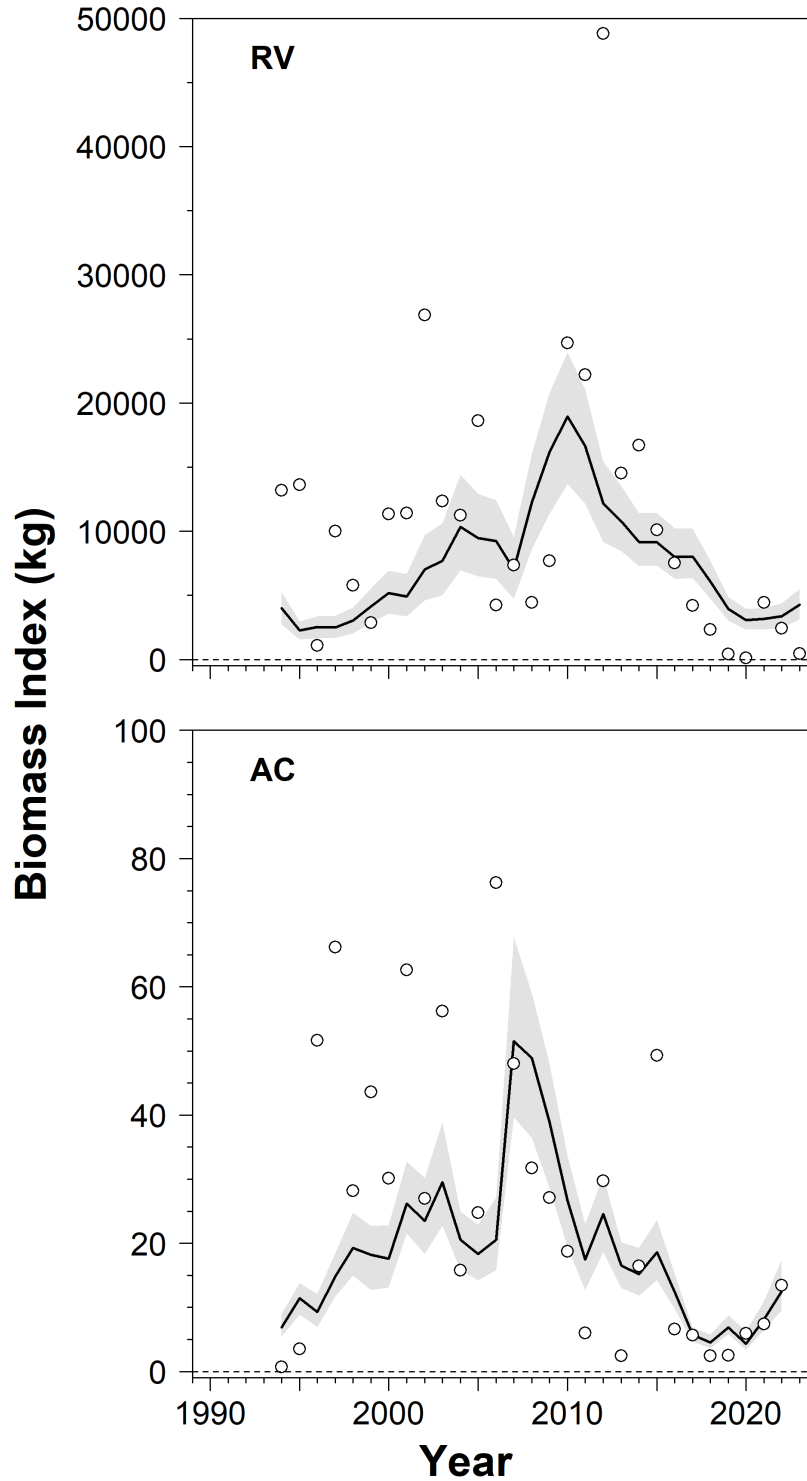


Figure 26. Observed (circles) and predicted (lines and shading) age-aggregated RV indices (RV, all regions combined) and acoustic indices (AC, all regions combined) from the SCA population model for fall spawners from the southern Gulf of St. Lawrence. The lines show the median predicted indices and the shading the 95% confidence intervals of the predictions based on MCMC sampling.

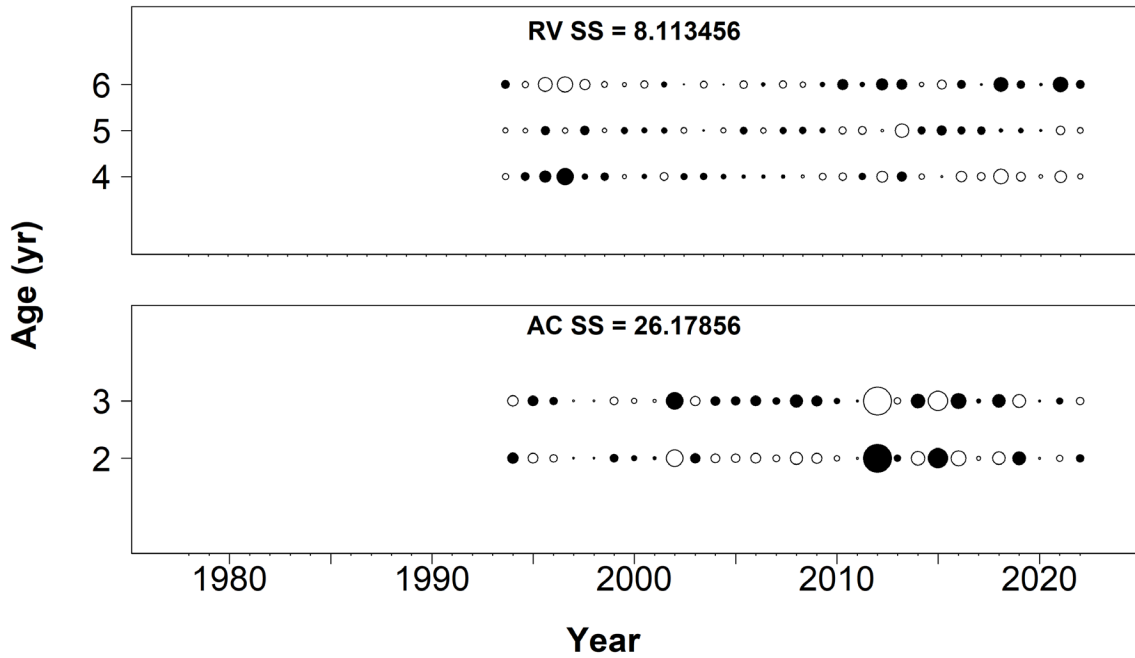


Figure 27. RV survey index (top) and acoustic survey index (AC, bottom) PAA residuals from the SCA population model of fall spawning Herring from the southern Gulf of St. Lawrence. Rows are for ages and columns are years. The circle radius is proportional to the absolute value of residuals. Black circles indicate negative residuals (i.e., observed < predicted).

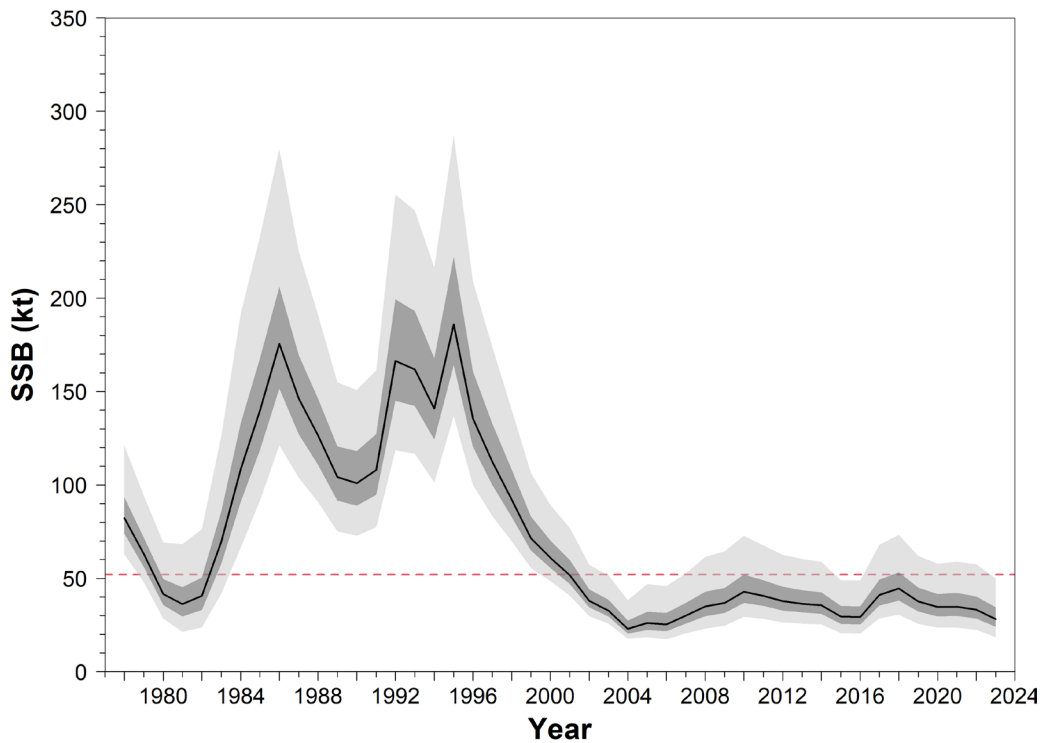


Figure 28. Estimated beginning of the fishing season (April 1) SSB of the spring spawner component of Atlantic Herring in the southern Gulf of St. Lawrence, 1978 to 2023. The solid line is the median MCMC estimate and shading its 50% (dark shading) and 95% (light shading) confidence intervals. The red dashed horizontal line is the Limit Reference Point (LRP) (51,938 t of SSB).

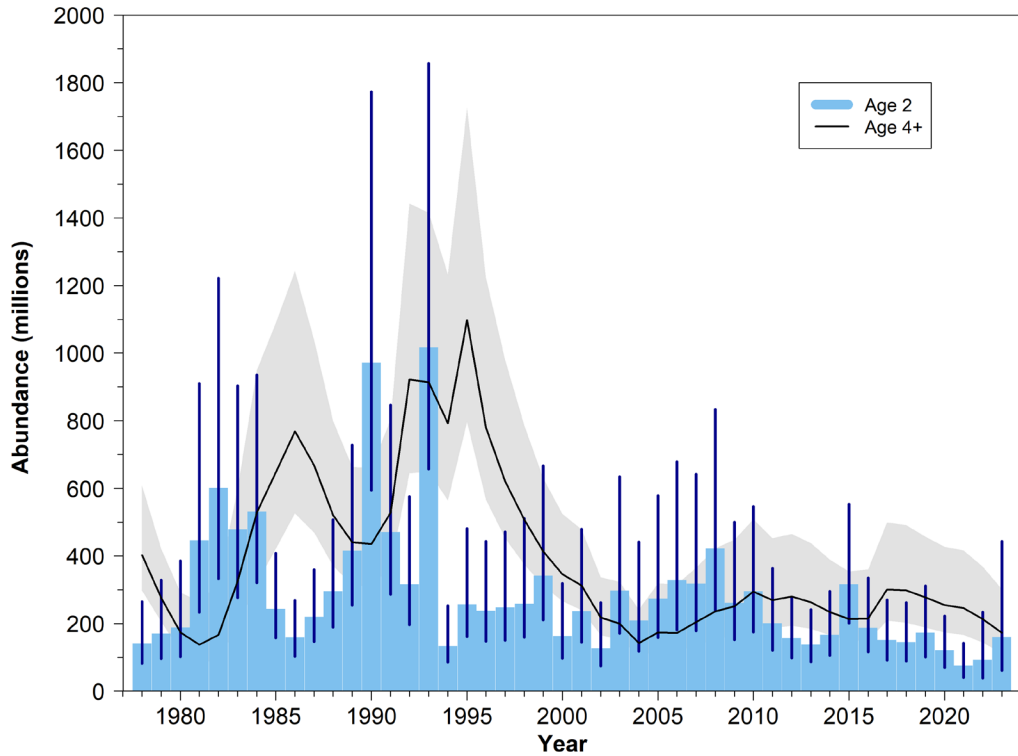


Figure 29. Estimated January 1 abundance of 2-year-old Herring (blue bars), and Herring 4 years and older (black line) of the spring spawner component in the southern Gulf of St. Lawrence. Black line shows the median MCMC estimate and vertical lines and shading show 95% confidence intervals.

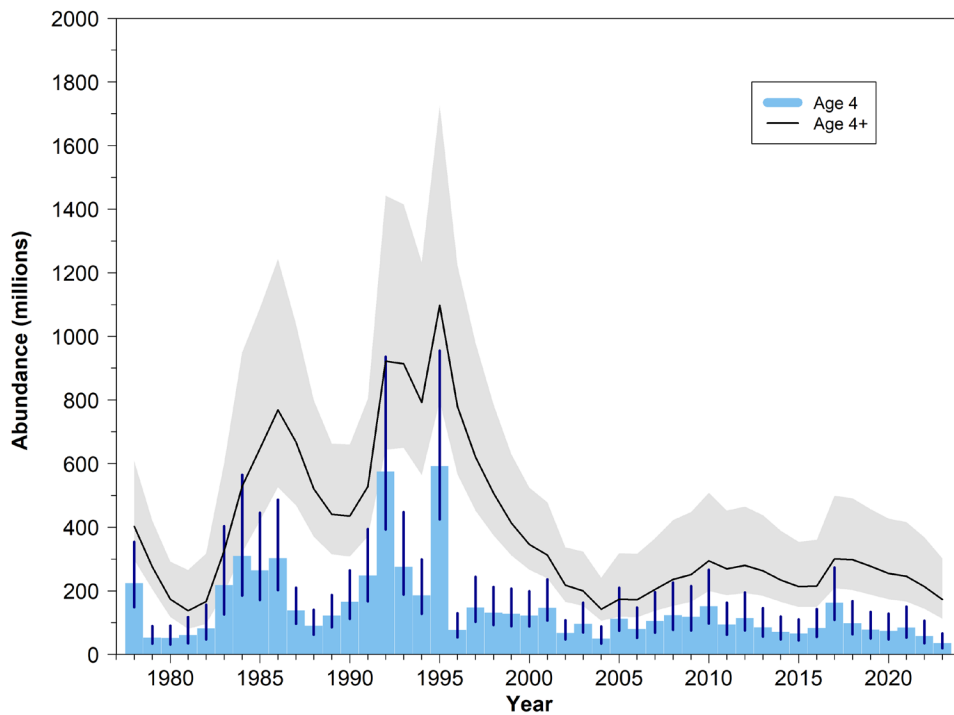


Figure 30. Estimated January 1 abundance of 4-year-old Herring (blue bars), and Herring 4 years and older (black line) of the spring spawner component in the southern Gulf of St. Lawrence. Black line shows the median MCMC estimate and vertical lines and shading show 95% confidence intervals.

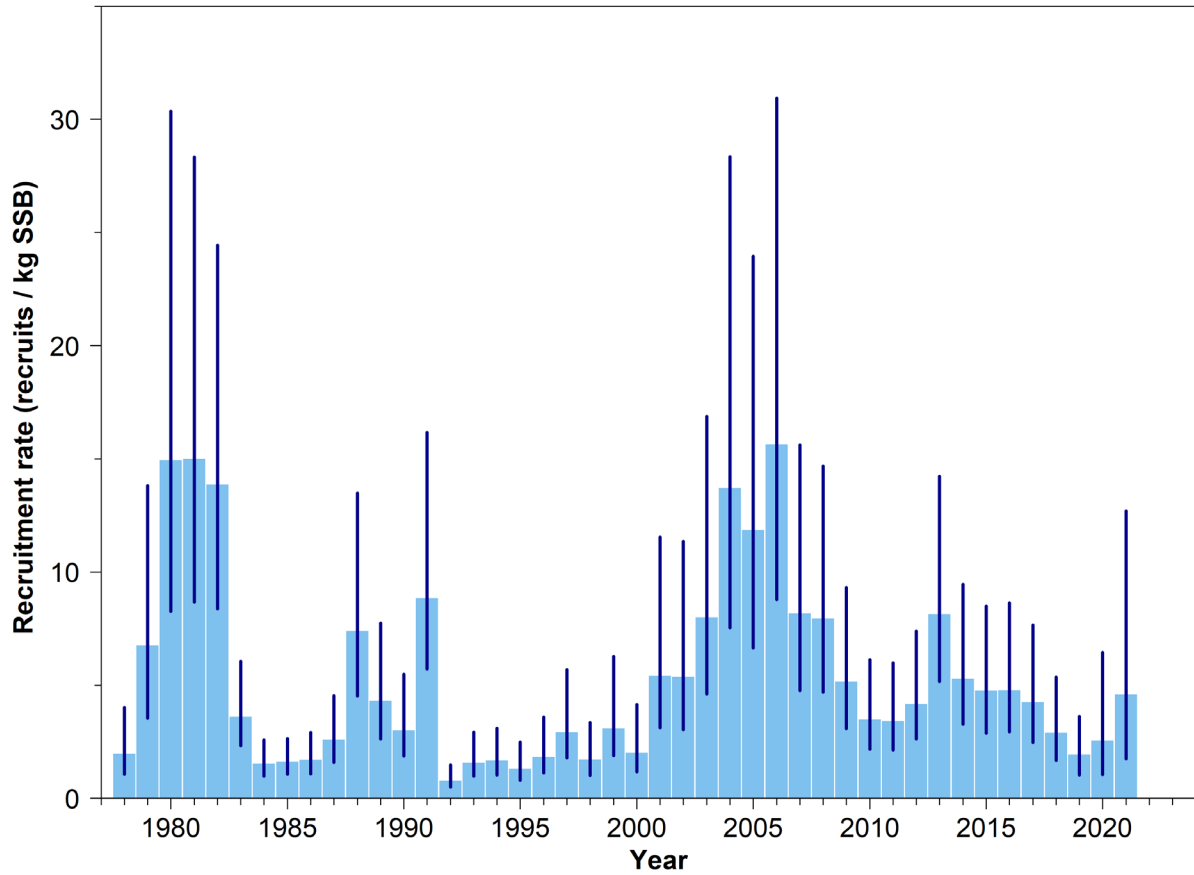


Figure 31. Recruitment rates for age 2 recruits for the 1978 to 2021 cohorts of spring spawning Atlantic Herring in NAFO Div. 4T. Vertical lines indicate 95% confidence intervals.

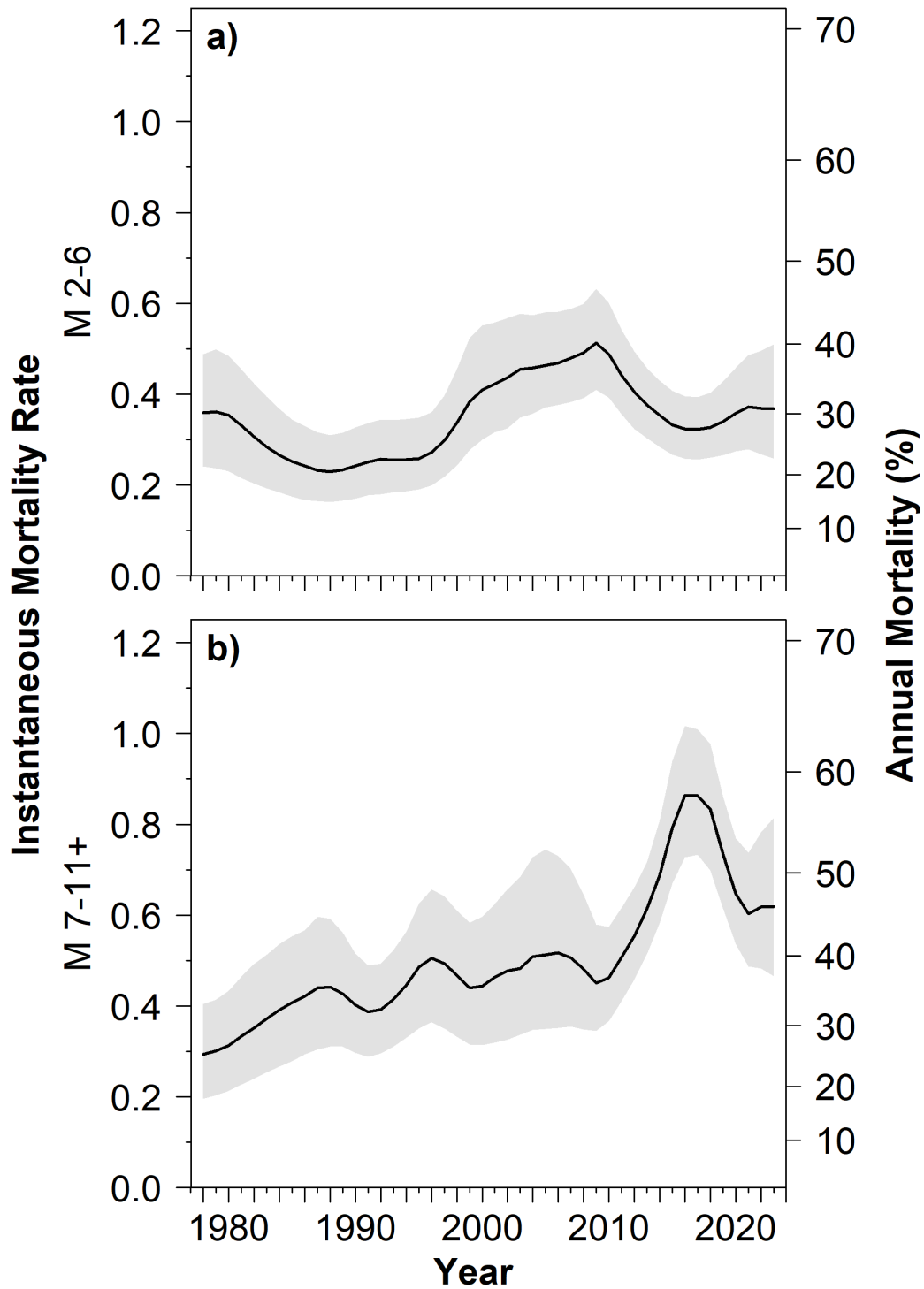


Figure 32. Estimated instantaneous natural mortality rate (left axis) and annual mortality (% , right axis) of spring spawning Atlantic Herring from the population model, for ages 2 to 6 (upper panel) and 7 to 11+ (lower panel). Lines show the median estimates and shading their 95% confidence interval based on MCMC sampling.

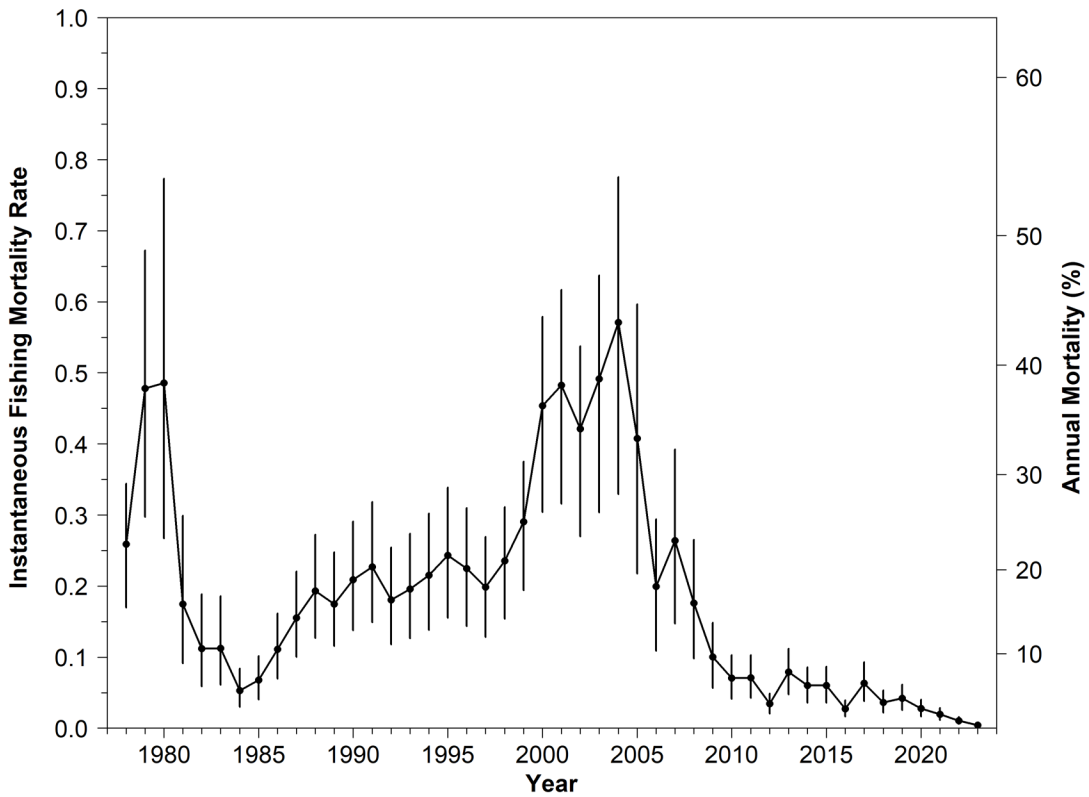


Figure 33. Estimated January 1 abundance weighted ages 6 to 8 fishing mortality (F_{6-8} , left axis; annual exploitation rate, right axis) of spring spawning Herring in the southern Gulf of St. Lawrence. Circles are the median estimates and vertical lines their 95% confidence intervals.

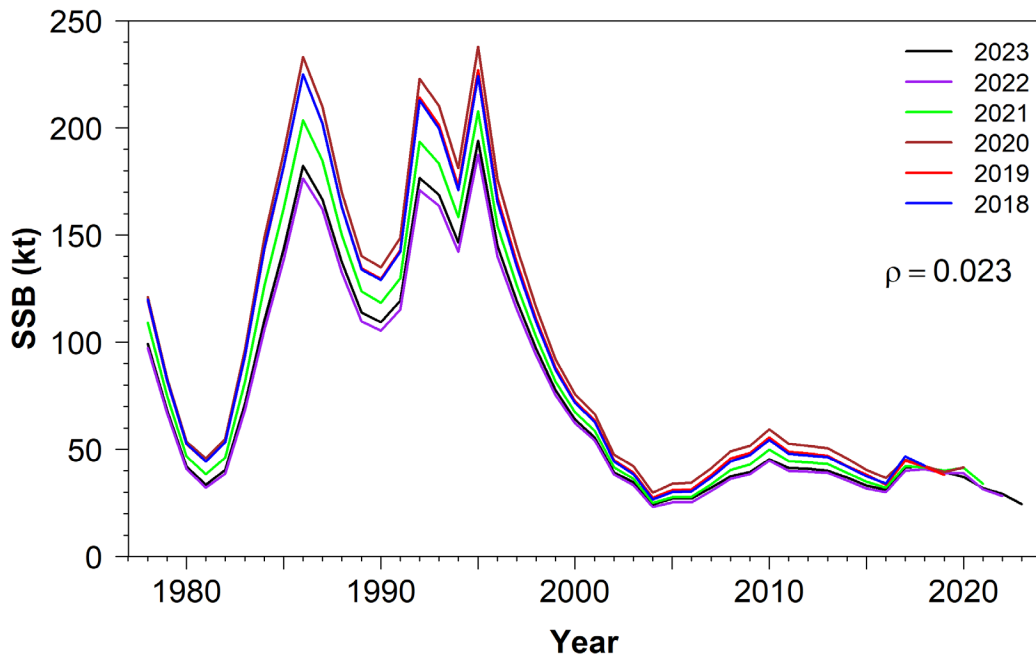


Figure 34. Retrospective patterns in estimated spawning stock biomass (SSB) of ages 4 to 10 and years 2021 to 2015 for spring spawners in the southern Gulf of St. Lawrence. Lined colours correspond to peels between years 2015 and 2023.

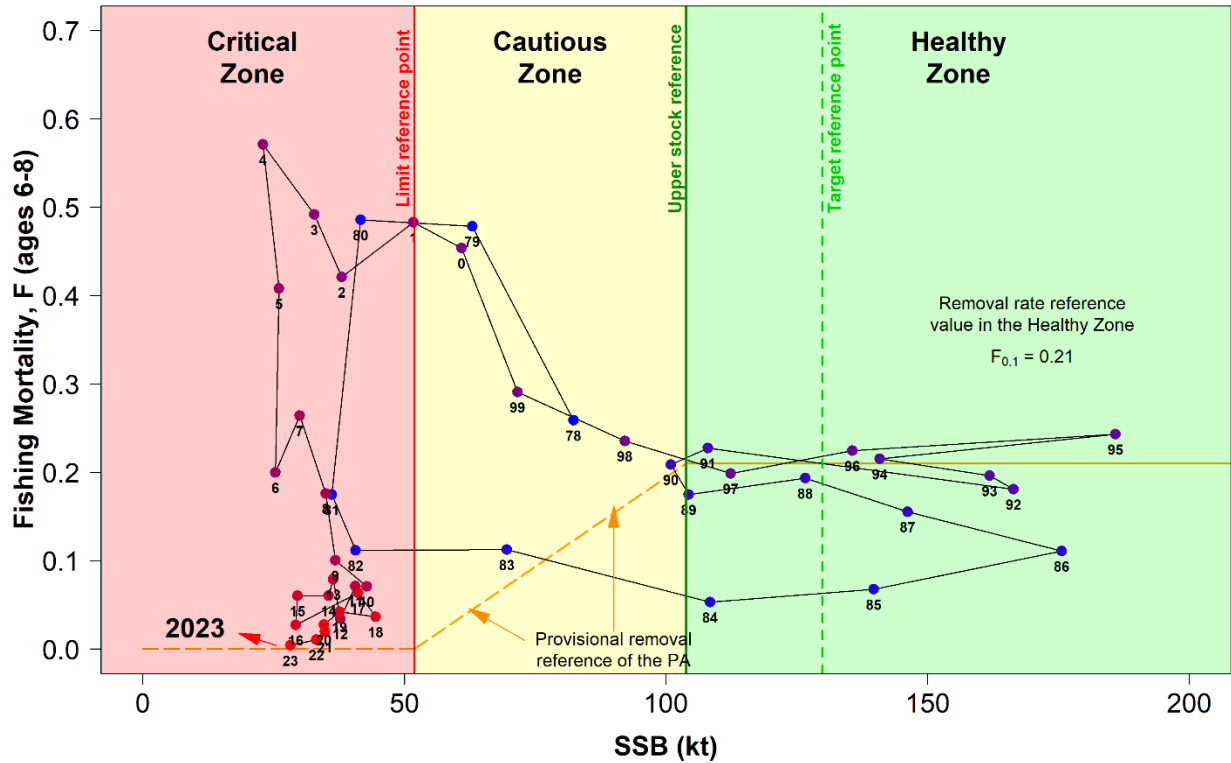


Figure 35. The southern Gulf of St. Lawrence Atlantic Herring spring spawner component trajectory in relation to SSB (kt = thousand t) and abundance weighted fishing mortality rates for ages 6 to 8 years. The red vertical line is the LRP, the green vertical line is the Upper Stock Reference (USR) and the light green dashed vertical line is the Target Reference Point. The orange solid horizontal line is the removal rate reference value ($F_{0.1} = 0.21$) in the Healthy Zone and orange dashed line is the provisional harvest decision rule of the Precautionary Approach Framework in the Cautious and Critical Zones. Point labels are years (83 = 1983, 0 = 2000).

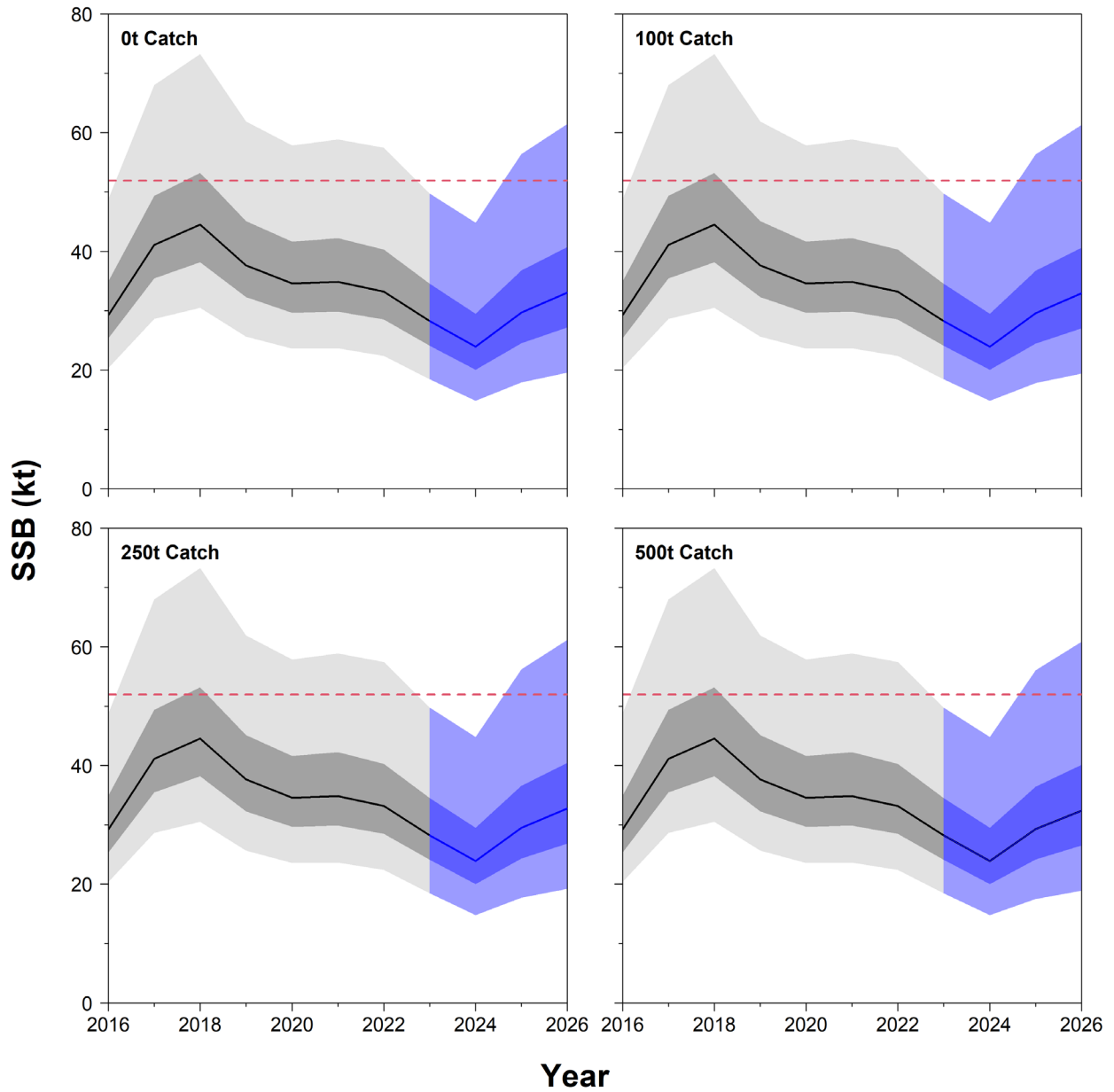


Figure 36. Projected April 1 SSB (in kt) of spring spawning Atlantic Herring from the southern Gulf of St. Lawrence under a recent 5 years average recruitment level and 2-year average natural mortality level at various catch levels in 2024 and 2025. Lines show the median estimates of the April 1 SSB, dark shading the 50% confidence interval and light shading the 95% confidence intervals of these estimates (based on MCMC sampling). Black and grey indicate the historical period and blue the projection period. The red horizontal line is the LRP.

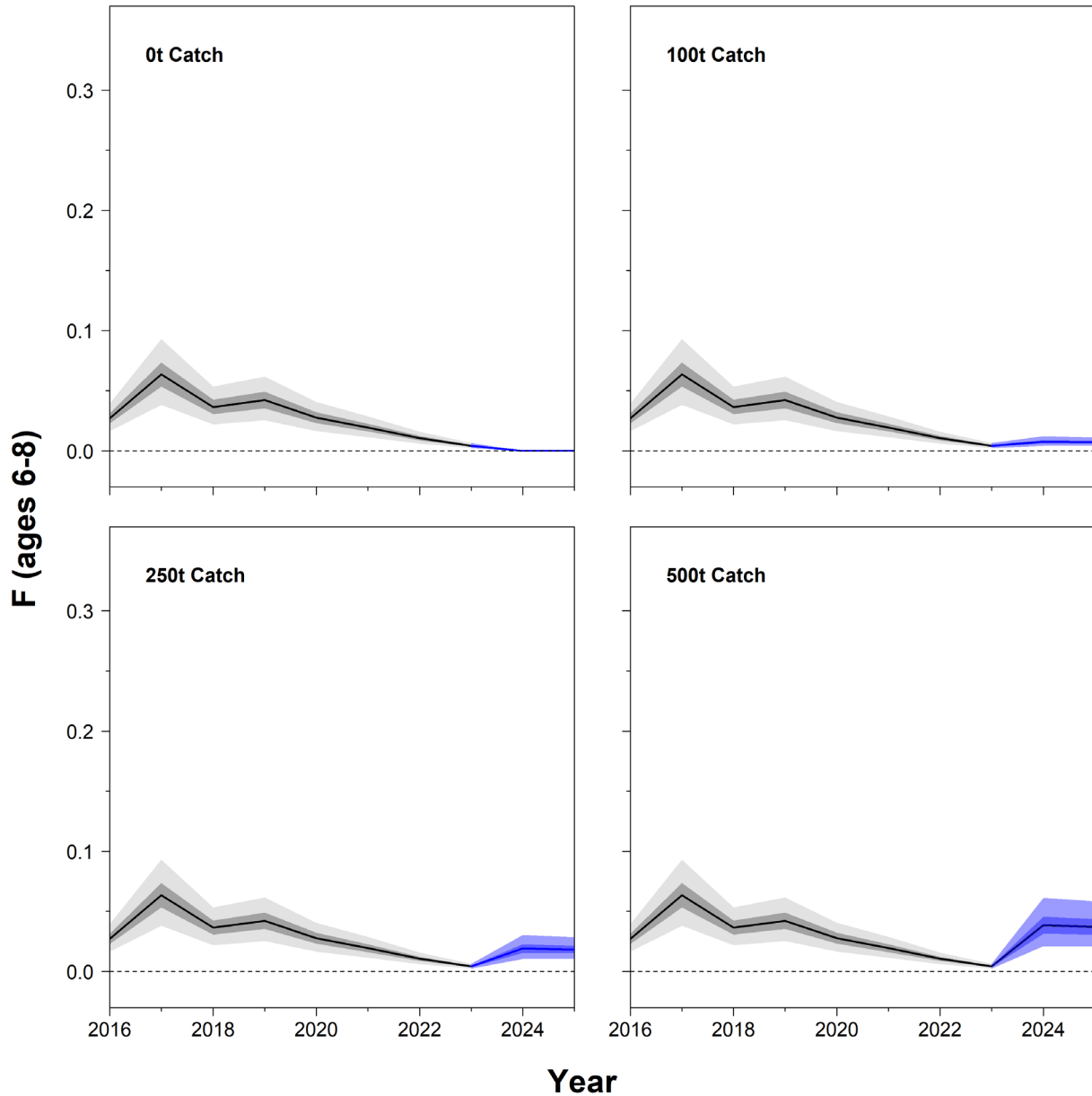


Figure 37. Projected ages 6 to 8 fishing mortality rate (F) of spring spawner Atlantic Herring from the southern Gulf of St. Lawrence at various catch levels in 2024 and 2025. Lines show the median estimates of fishing mortality, dark shading the 50% confidence interval and light shading the 95% confidence intervals of these estimates (based on MCMC sampling). Black and grey indicate the historical period and blue the projection period.

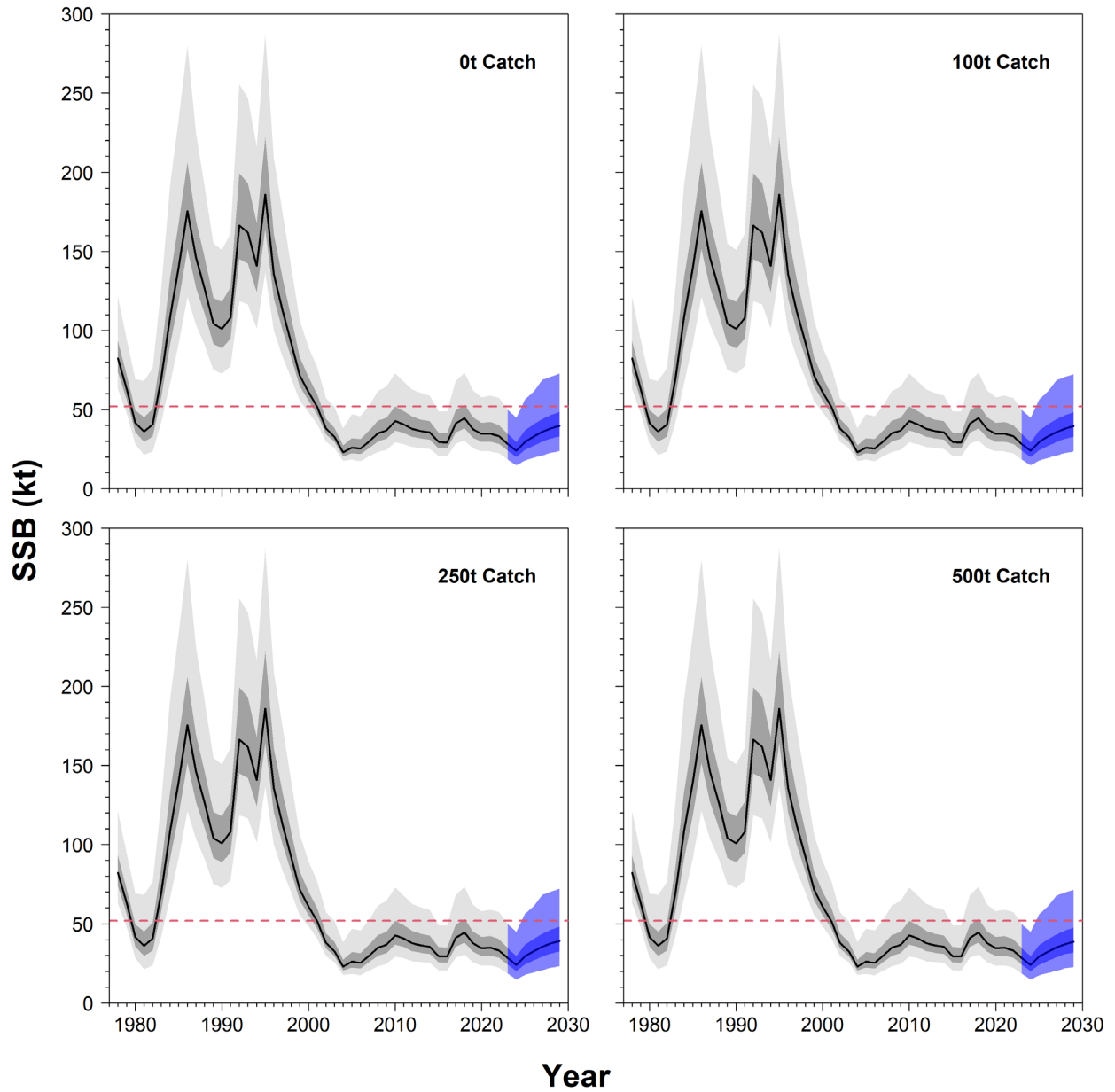


Figure 38. Projected April 1 SSB (in kt) of spring spawner Atlantic Herring from the southern Gulf of St. Lawrence under a recent 5 years average recruitment level and 2-year average natural mortality level at various catch levels in all years between 2024 and 2029. Lines show the median estimates of the April 1 SSB, dark shading the 75% confidence interval and light shading the 95% confidence intervals of these estimates (based on MCMC sampling).

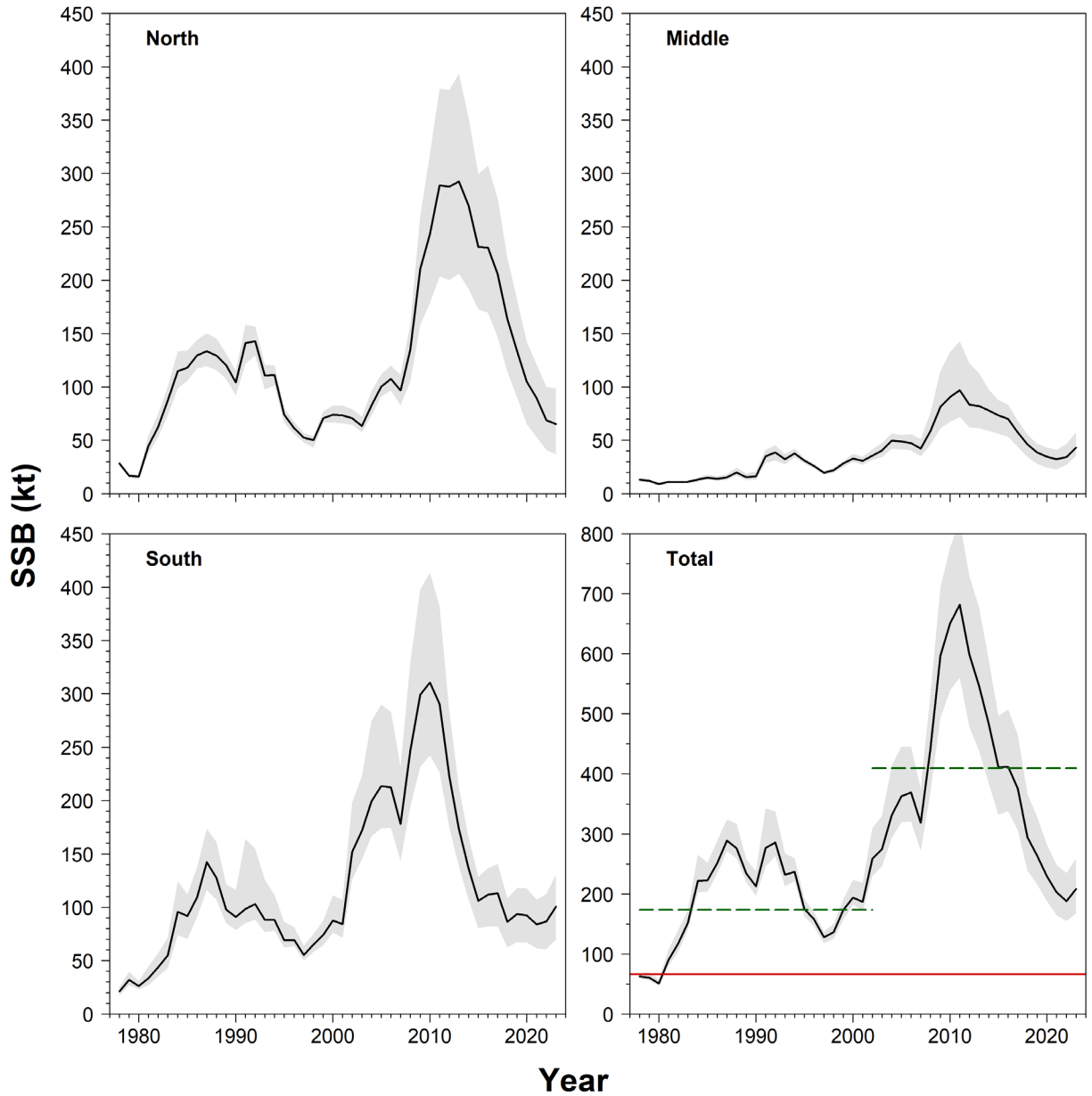


Figure 39. Estimated beginning of fishing season (August 1) SSB of fall spawning Herring by region and overall (Total) for the southern Gulf of St. Lawrence from the SCA population model. The black line shows the median estimates of the MCMC sampling and the shading their 95% confidence intervals. In the bottom right panel for Total, the solid and dashed yellow horizontal lines represent the USR level and the red horizontal line is the LRP. SSB, USR and LRP values are adjusted to August 1st using natural mortality estimates at age for 7 months.

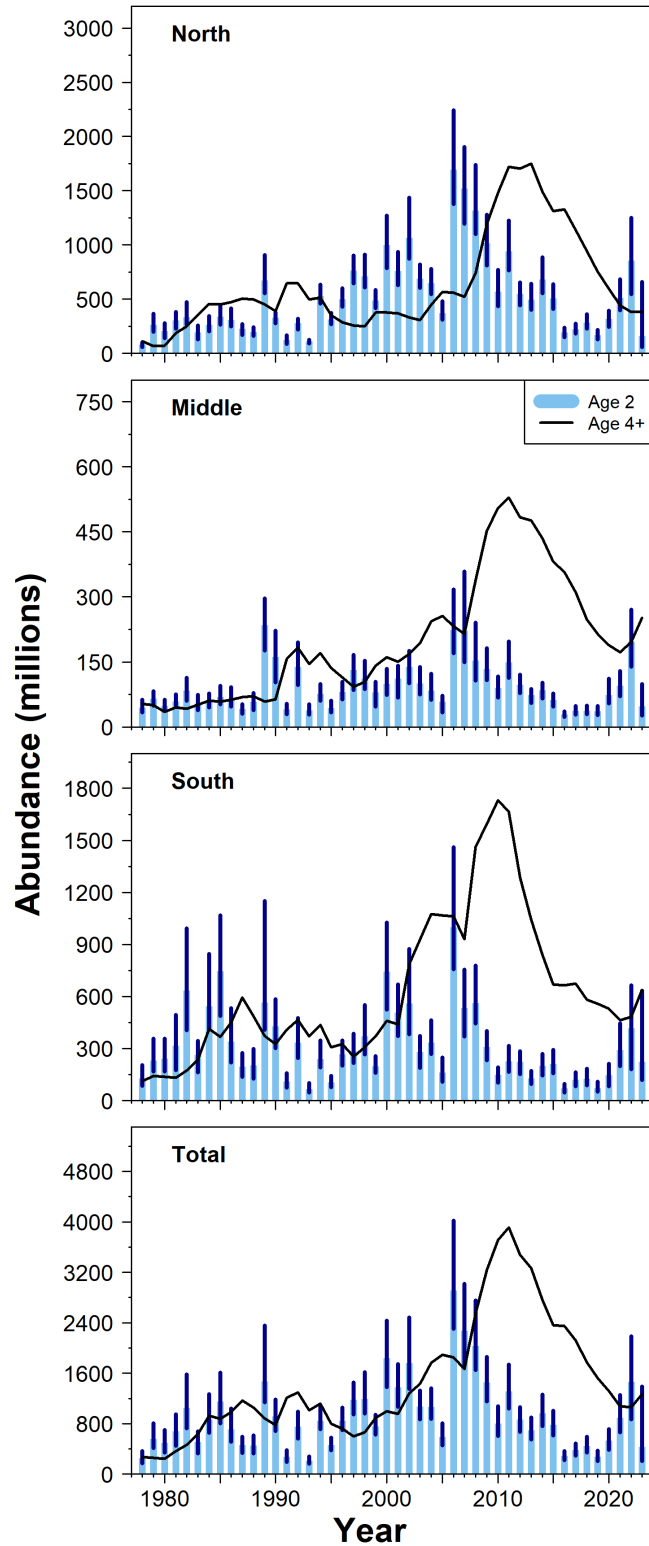


Figure 40. Estimated January 1 abundance of 2-year-old Herring (blue bars), and Herring 4 years and older (black line) of the fall spawner component in three regions (North, Middle, South) in the southern Gulf of St. Lawrence from the SCA population model. Black line shows the median MCMC estimate and vertical lines show 95% confidence intervals.

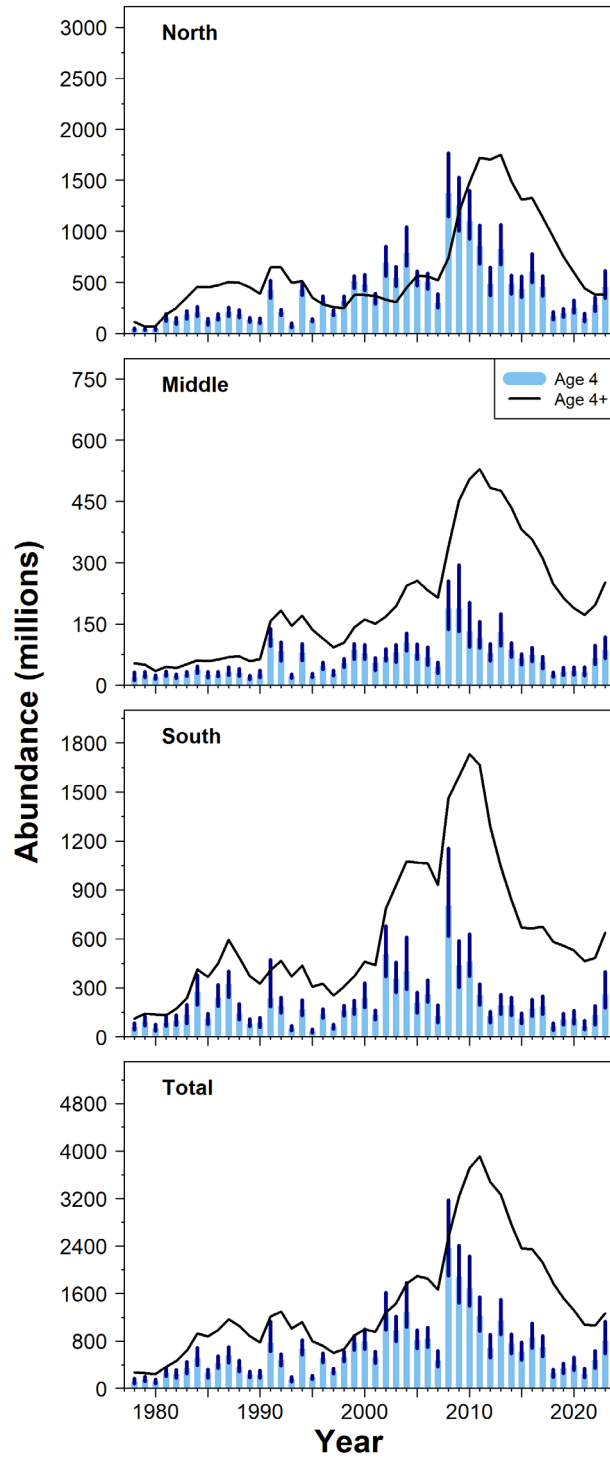


Figure 41. Estimated January 1 abundance of 4-year-old Herring (blue bars), and Herring 4 years and older (black line) of the fall spawner component in three regions (North, Middle, South) in the southern Gulf of St. Lawrence from the SCA population model. Black line shows the median MCMC estimate and vertical lines show 95% confidence intervals.

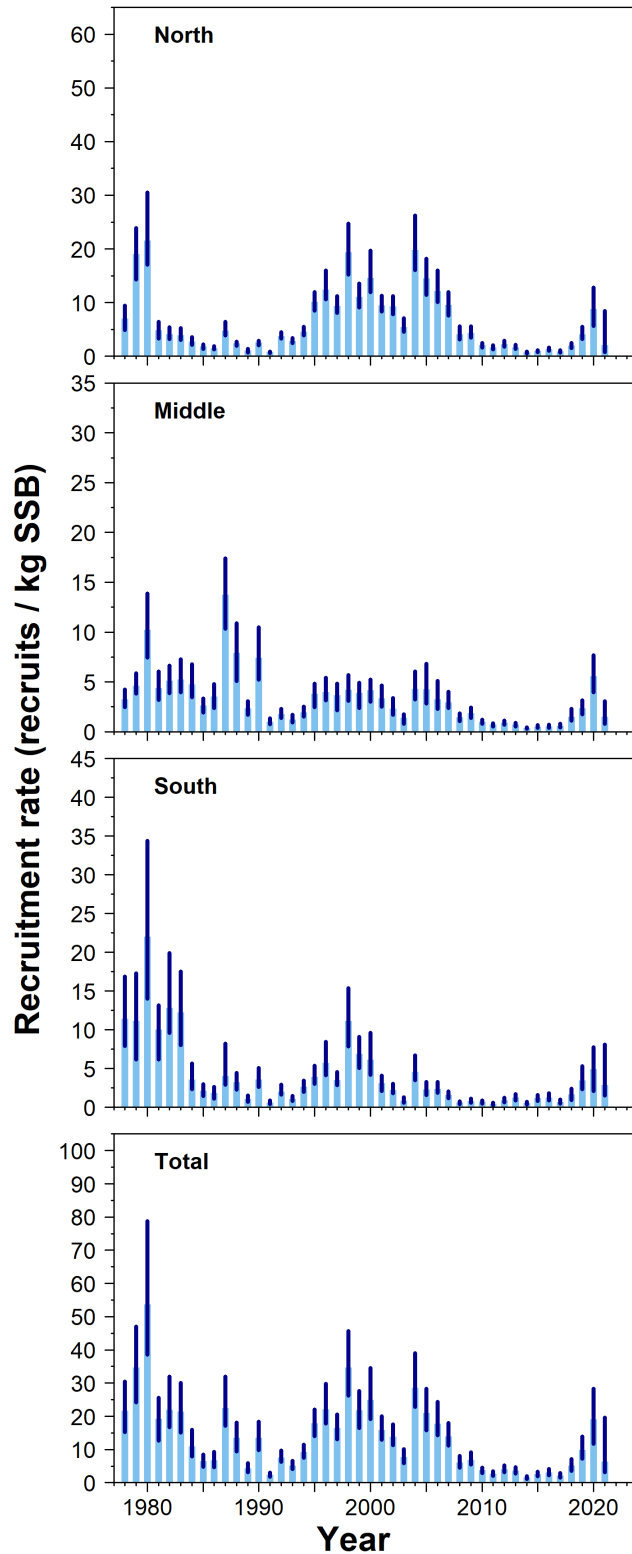


Figure 42. Estimated recruitment rate (recruits per kg of SSB) at age 2 (circles) of fall spawners in the three regions (North, Middle, South) and summed over regions (Total) of the southern Gulf of St. Lawrence, from the SCA population model. Bars show the median estimates and vertical lines show the 95% confidence intervals.

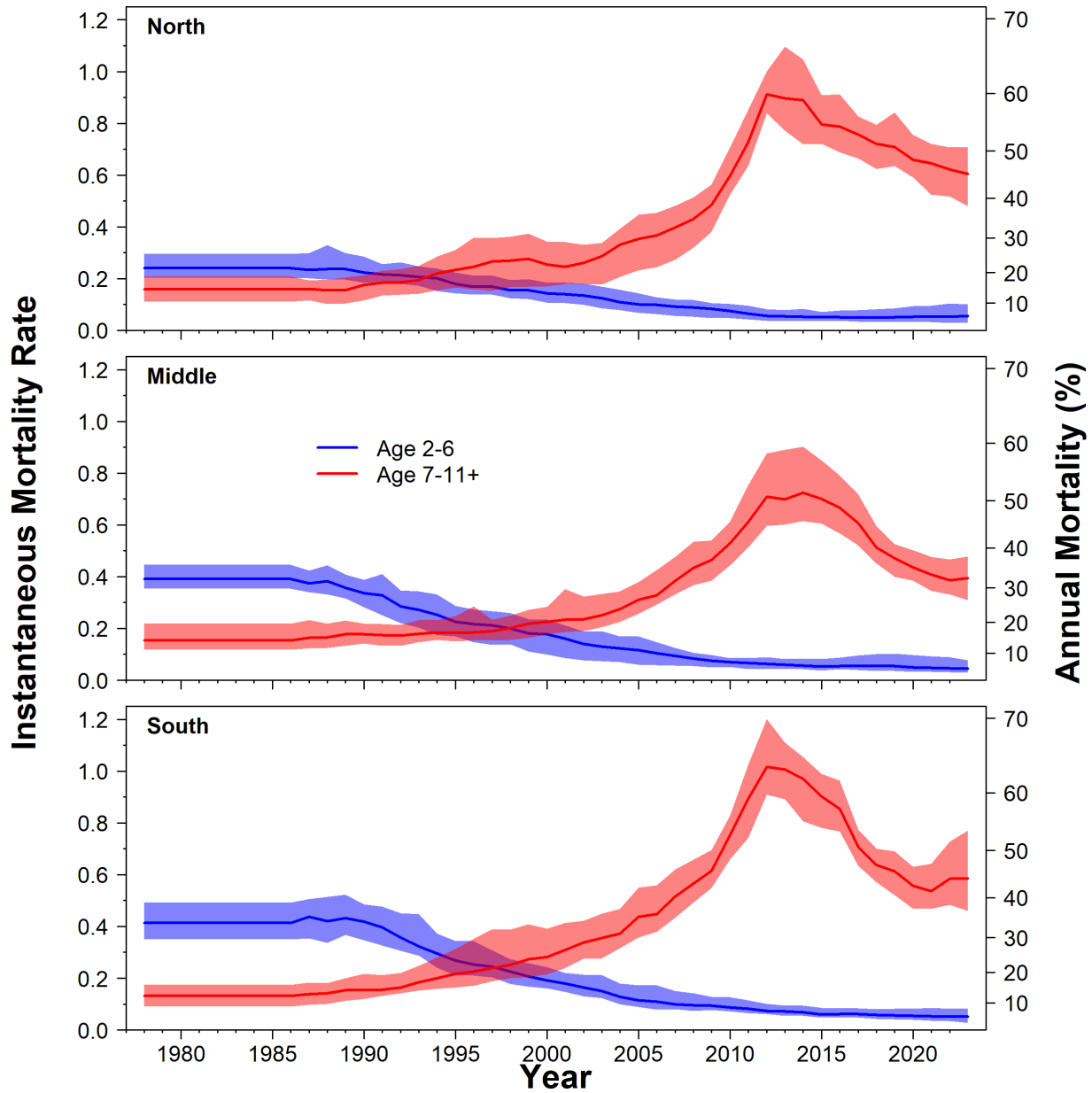


Figure 43. Estimated instantaneous natural mortality rate (left axis) and annual mortality (% , right axis) of fall spawning Atlantic Herring for three regions of the sGSL (North, Middle, South) from the SCA population model, for ages 2 to 6 (blue) and 7 to 11+ (red). Lines show the median estimates and shading their 95% confidence interval based on MCMC sampling.

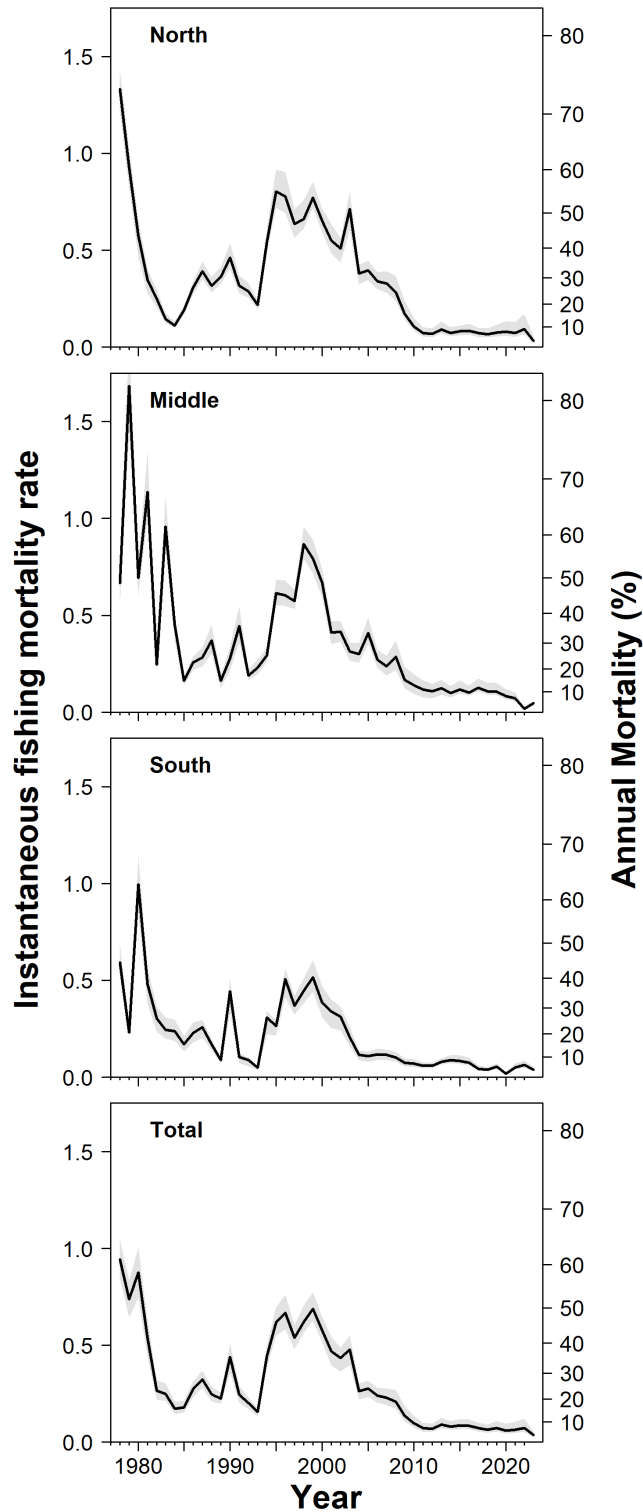


Figure 44. Estimated beginning-of-the-year abundance averaged age 5 to 10 fishing mortality (F5-10, left axis; annual exploitation rate, right axis) of fall spawning Herring by region and averaged over regions (weighted by region-specific abundance at ages 5-10 years) in the southern Gulf of St Lawrence from the SCA model. Lines show the median estimates and shading their 95% confidence intervals.

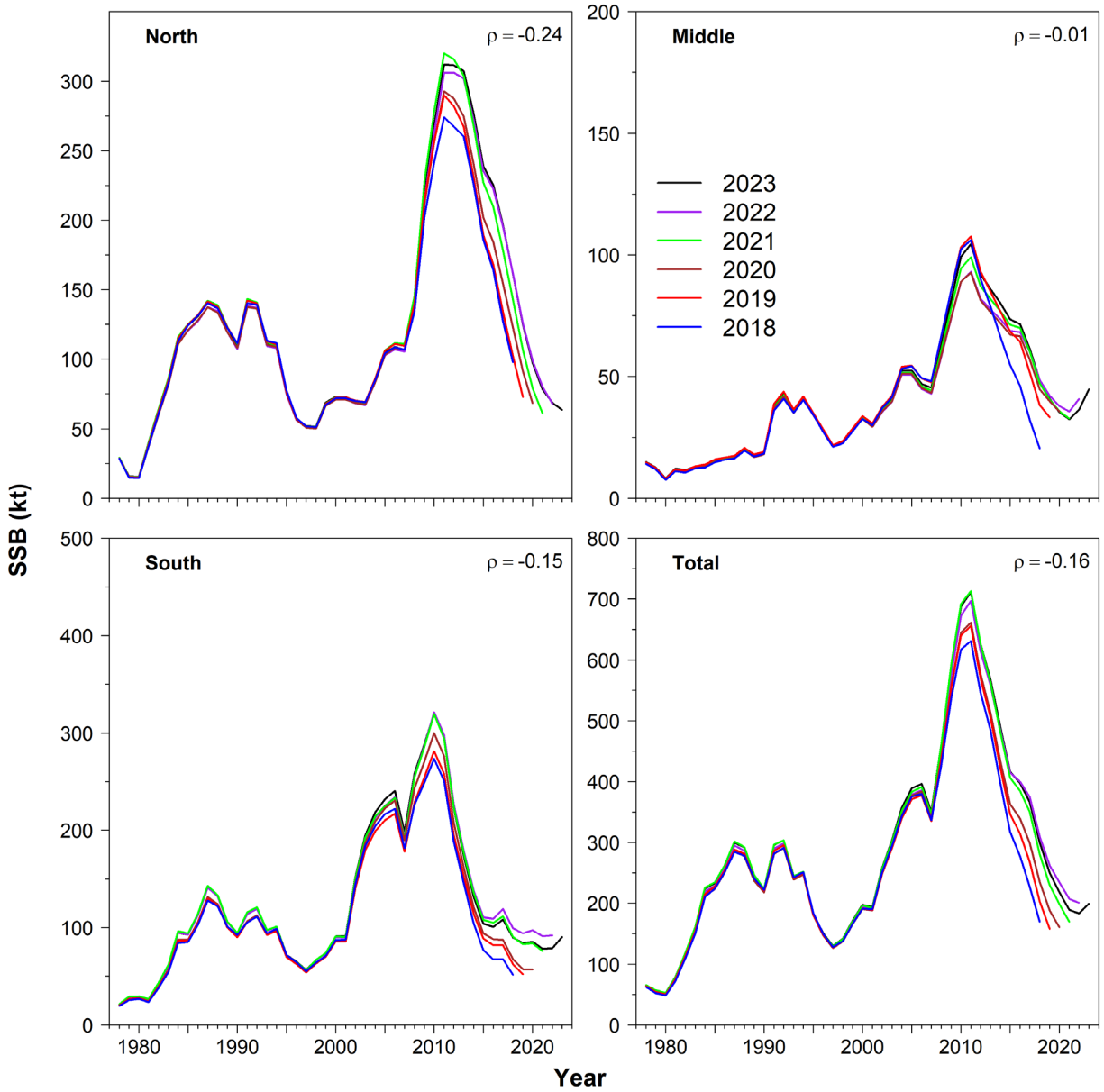


Figure 45. Retrospective patterns in SSB and Mohn's rho of fall spawners within the three regions (North, Middle, South) for the SCA population model of Atlantic Herring of the southern Gulf of St. Lawrence. Coloured lines shows retrospective peels between 2018 and 2023.

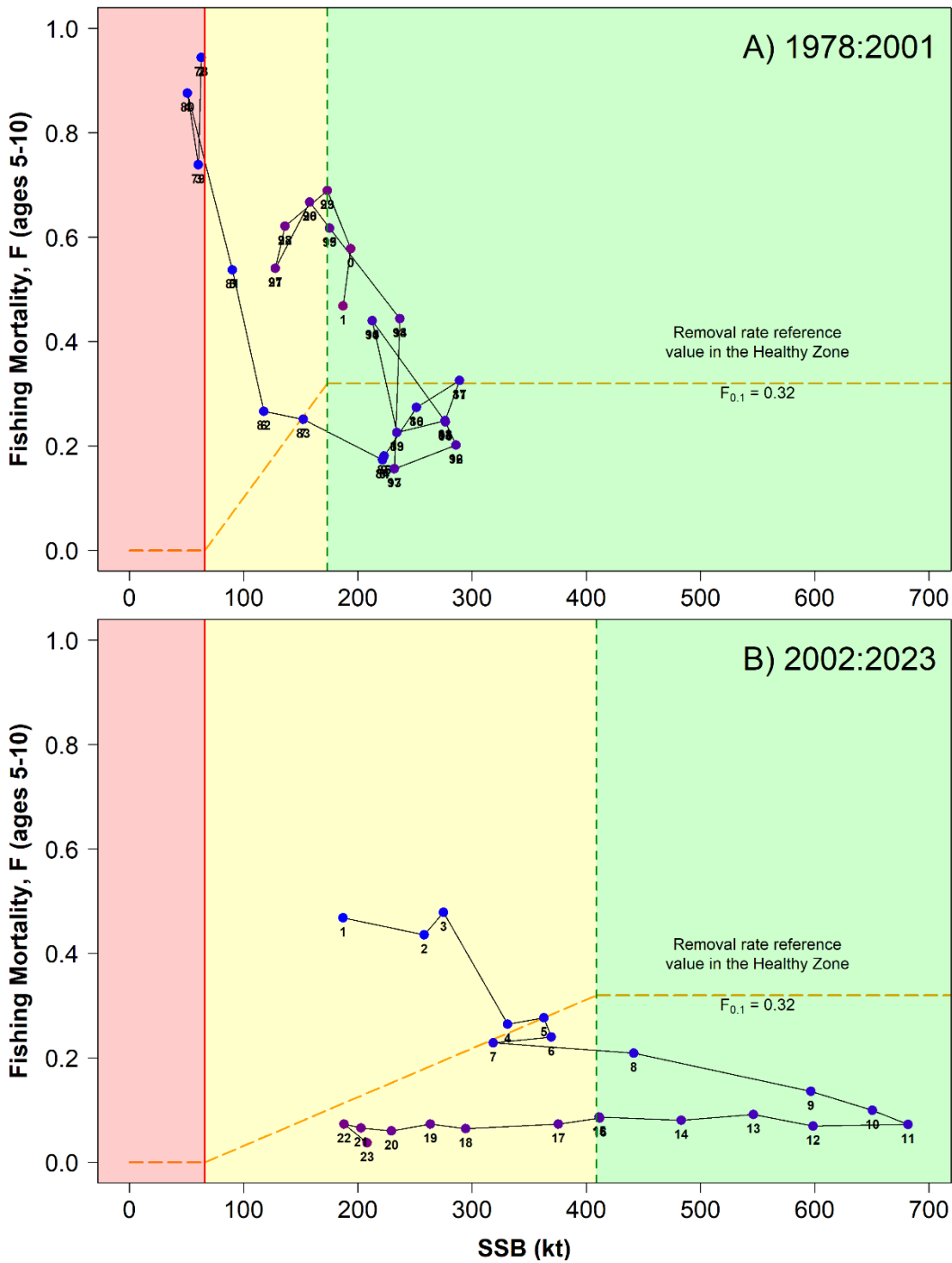


Figure 46. Southern Gulf of St. Lawrence Atlantic Herring fall spawner component trajectory in relation to SSB and fishing mortality rates for ages 5 to 10 years from the SCA population model for 1978-2001 (top) and 2022-2023 (bottom). The red vertical line is the LRP and the green vertical line is the USR. The orange dashed line is the provisional removal reference of the Precautionary Approach Framework.

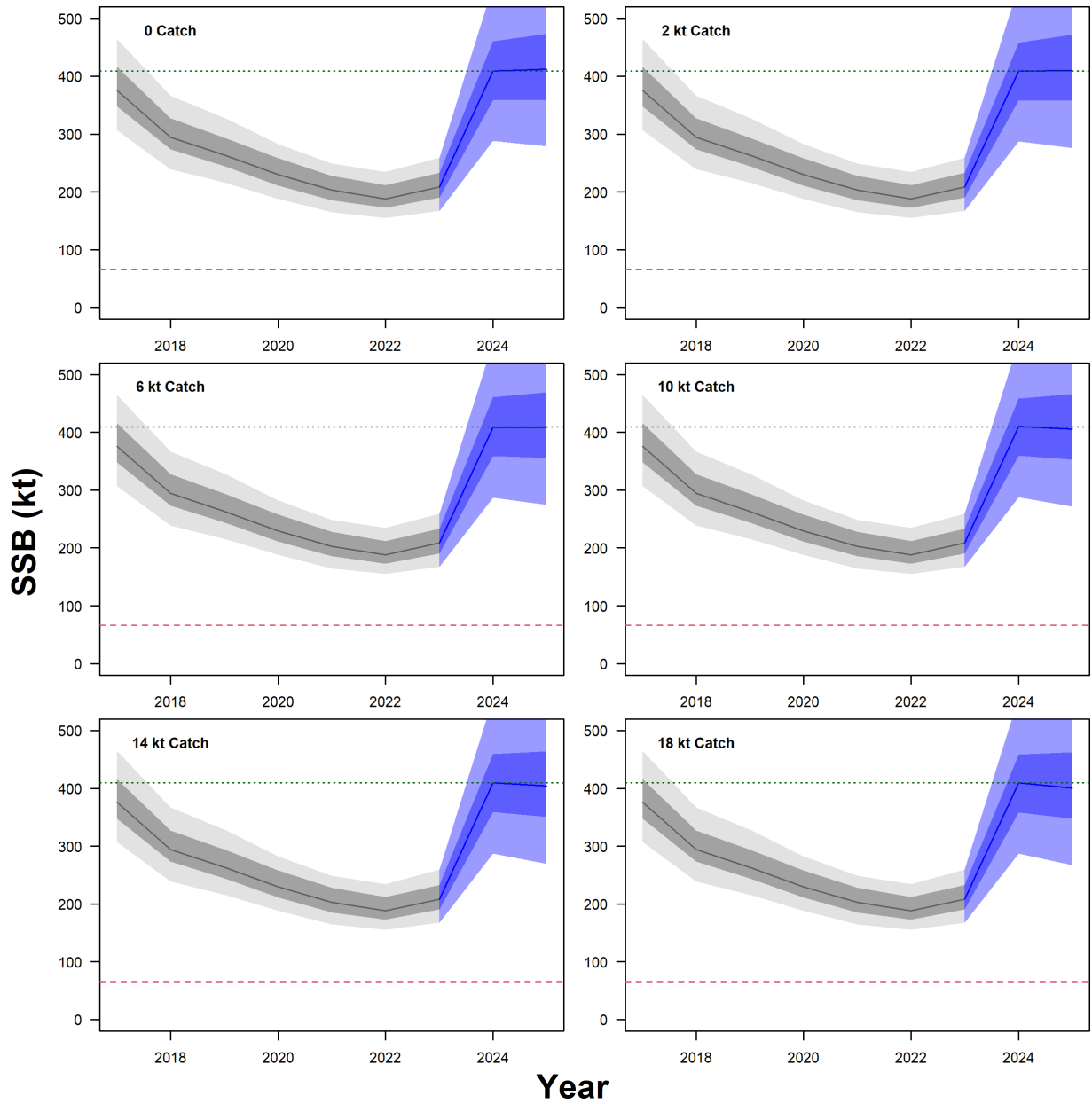


Figure 47. Projected SSB (in kt) of fall spawning Atlantic Herring from the southern Gulf of St. Lawrence at various catch levels in 2024 and 2025, under a 5 recent years average recruitment and 2 recent years average natural mortality scenario. Lines show the median estimates of August 1 SSB, dark shading the 50% confidence intervals and light shading the 95% confidence interval (based on MCMC sampling). Black and grey indicate the historical period and blue the projection period. The red horizontal line is the LRP.

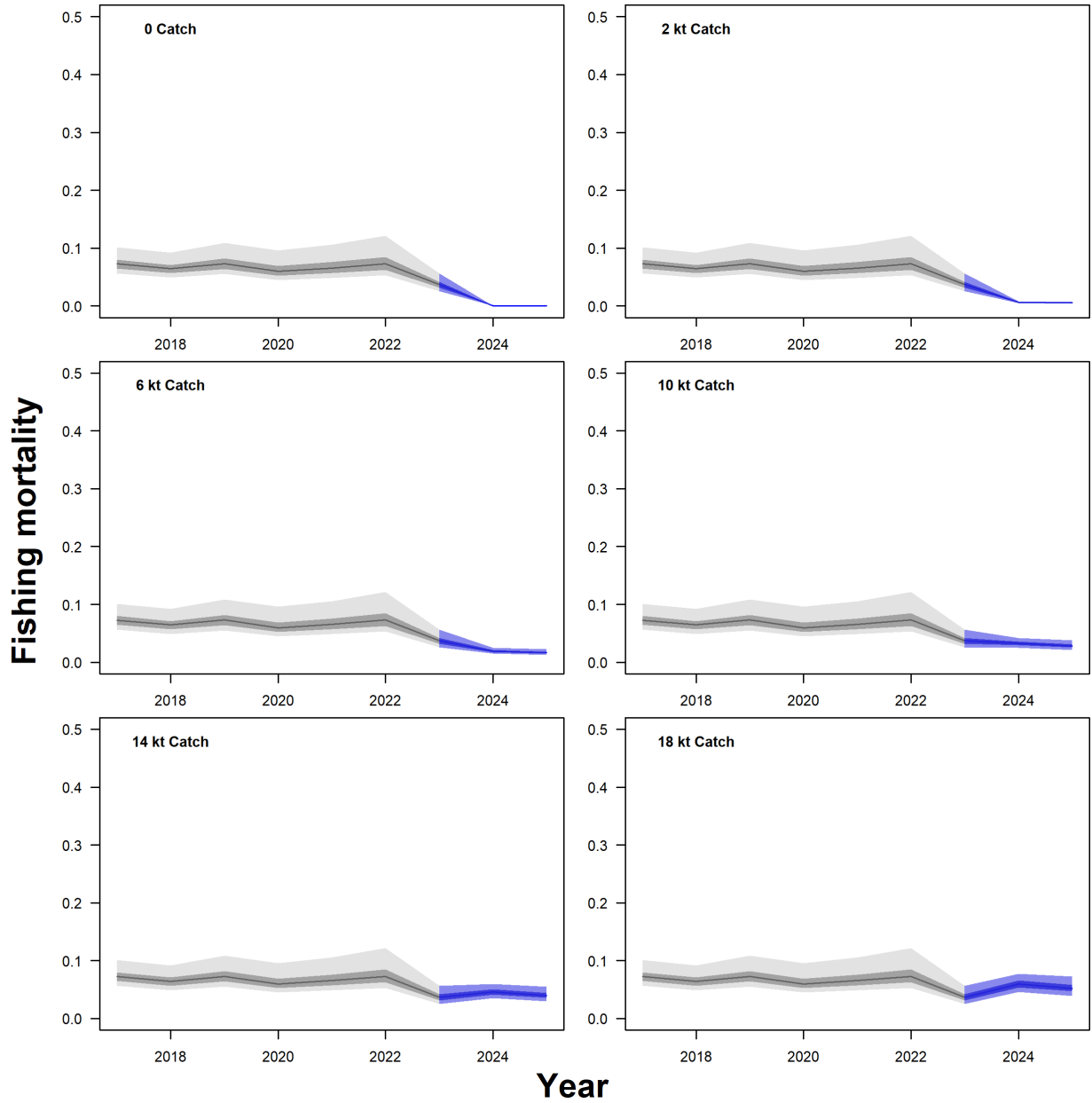


Figure 48. Projected average fishing mortality (F_{5-10}) of fall spawning Atlantic Herring from the southern Gulf of St. Lawrence at various catch levels in 2024 and 2025, under a 5 recent years average recruitment and 2 recent years average natural mortality scenario. Lines show the median estimates of fishing mortality, dark shading the 50% confidence intervals and light shading the 95% confidence interval (based on MCMC sampling). Black and grey indicate the historical period and blue the projection period.

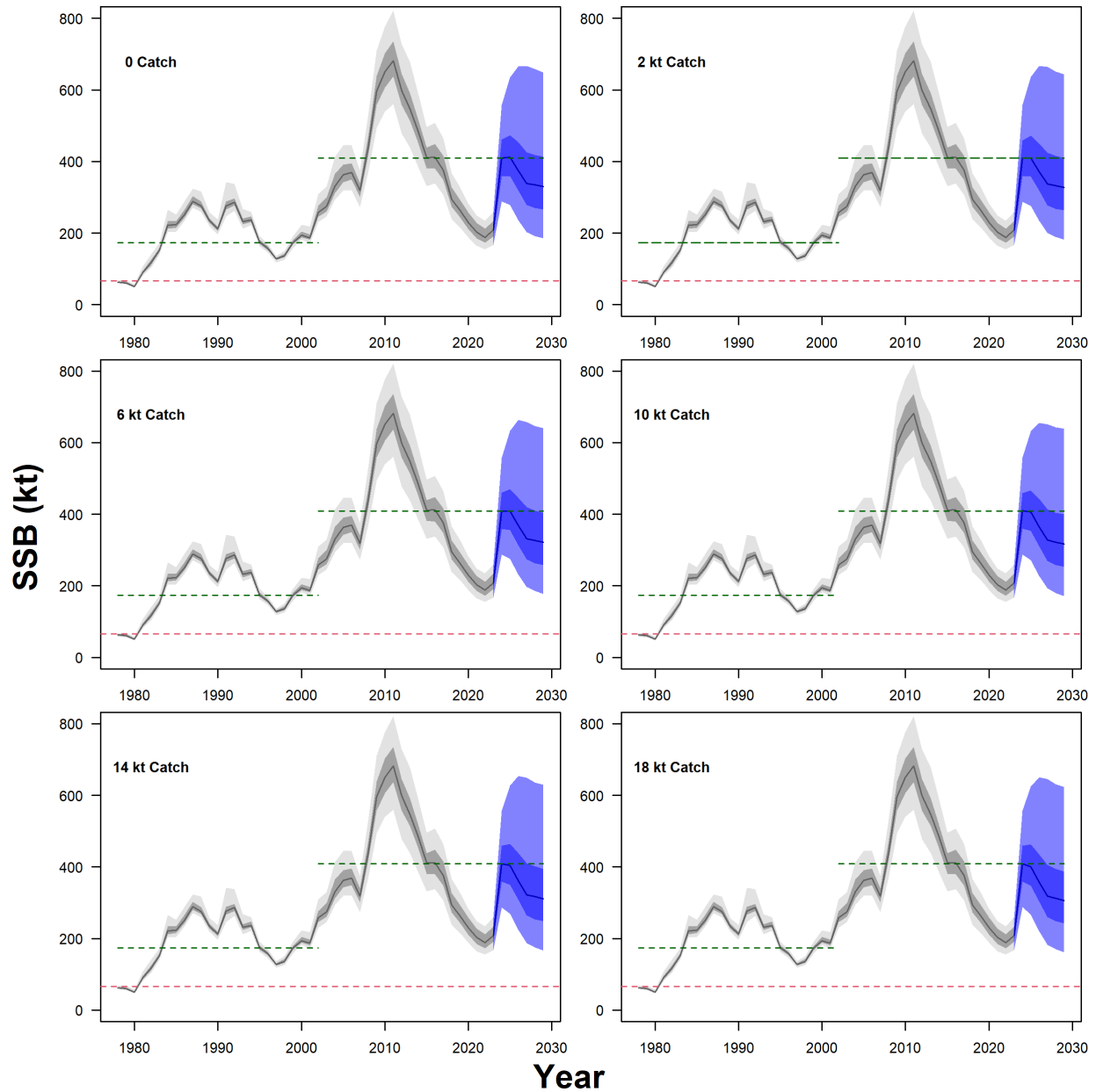


Figure 49. Six years projections of SSB (in kt) of fall spawning Atlantic Herring from the southern Gulf of St. Lawrence at various catch levels from the SCA population model, under a 5 recent years average recruitment and 2 recent years average natural mortality scenario. Lines show the median estimates of August 1 SSB, light shading shows the 50% and dark shading shows the 95% confidence intervals (based on MCMC sampling). The green and red horizontal lines are the USR and LRP, respectively.

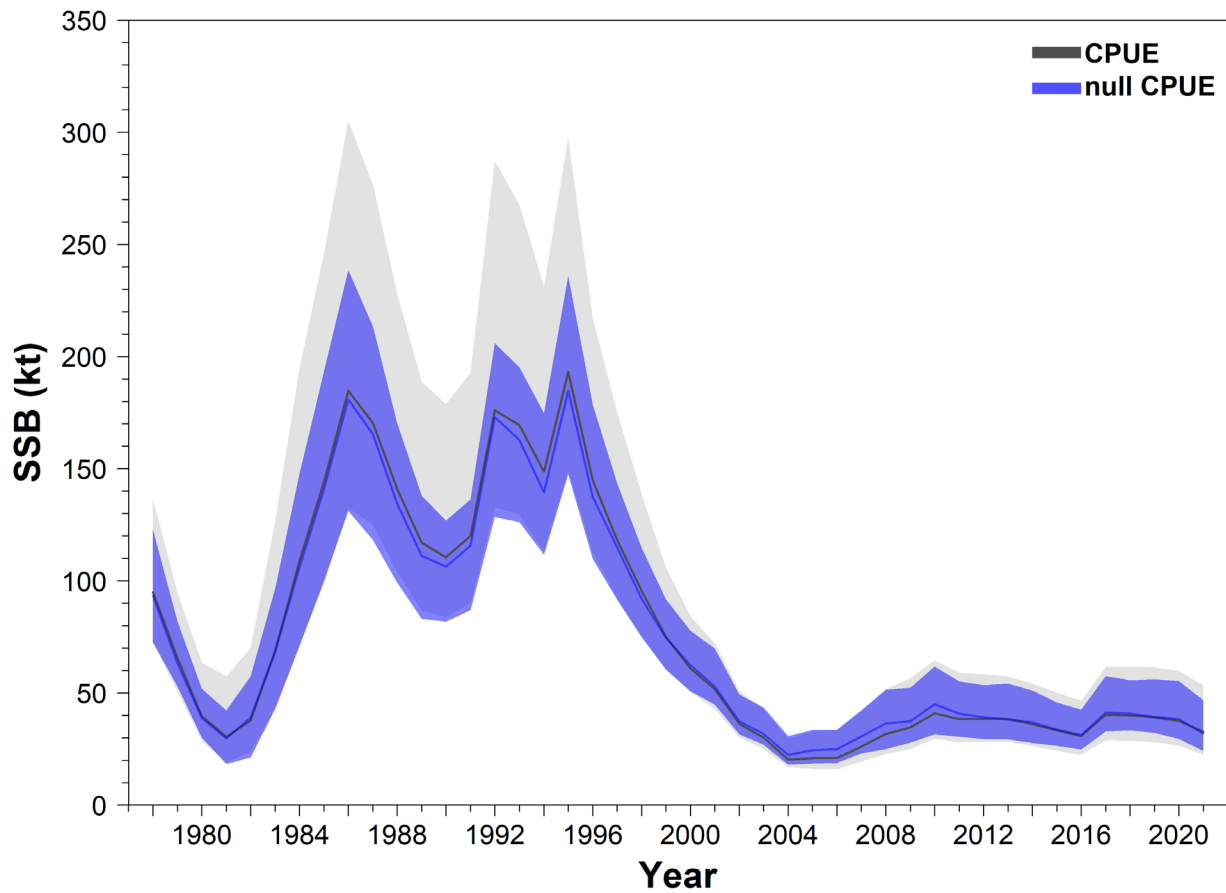


Figure 50. Estimated beginning of fishing season (April 1) SSB of spring spawning Herring for 1978 to 2021 with SCA models including the catch-per-unit-effort index (CPUE; grey) and without the CPUE index (blue). Full line is the median estimate of biomass from MCMC sampling and shading represent the 95% confidence interval.

APPENDIX A. FISHERY-INDEPENDENT ACOUSTIC SURVEY RESULTS

The 2022-2023 acoustic surveys were carried out between September 23 and October 7 in the 4Tmno areas (i.e., Chaleurs-Miscou; Figures B1 and B2) and the biomass of Herring were estimated to be 27,268 t and 19,363 t, respectively. The distribution of Herring in the area can be seen in Figures B1-B2 and Tables B1-B2. The 2022 acoustic biomass index of the Chaleurs-Miscou area for the combined spring and fall spawner groups increased by 44.5% compared to the lowest in the history of the survey that was recorded in 2019. The 2023 biomass was just 2.9% higher than the 2019 biomass (Figure B3).

Bottom trawl samples were collected where Herring densities were found by the hydroacoustic vessel. The catch (length frequency) by set was weighted by the sum of acoustic Herring densities recorded in the stratum or group of strata defined in the catch-at-age parameters as representing the biomass in that area. Using the Herring densities recorded as the weighting factor is considered a better method as it does not depend on an estimated standardized amount of Herring caught in a set of one nautical mile.

Table A1. Herring biomass densities and estimates by stratum and area from the fishery-independent acoustic surveys conducted in 2022.

Stratum	Average TS (dB/kg)	Stratum Area (km ²)	Mean Sa (/m ²)	Density (kg/m ²)	Biomass (tonnes)	SE (tonnes)	SE (%)
Gaspé							
Rivière au Renard	-34.15	124.6	-56.53	0.0058	720.3	345.6	48.0
Cap Bon Ami	-34.15	69.0	-64.33	0.0010	66.2	42.5	64.2
Malbaie	-34.15	95.6	-69.47	0.0003	28.1	29.3	104.1
Anse à Beaufils	-34.15	96.0	-70.05	0.0003	24.7	12.0	48.4
Chaleur							
Grande Rivière	-34.15	106.4	55.70	0.0070	745.2	465.9	62.5
Newport	-34.15	124.9	-58.23	0.0039	488.5	369.3	75.6
Shigawake	-34.15	265.6	-63.07	0.0013	340.7	236.1	69.3
New Carlisle	-34.31	169.0	59.81	0.0028	476.4	133.1	27.9
New Richmond	-33.64	111.6	-55.69	0.0062	696.2	240.9	34.6
Belledune	-33.66	266.0	-57.52	0.0041	1092.4	639.8	58.6
Nepisiguit	-33.98	211.3	-51.87	0.0162	3430.3	1834.3	53.5
Maisonnette	-34.15	145.0	-47.27	0.0488	7072.4	2234.3	31.6
Miscou							
West Miscou	-34.05	330.5	-60.82	0.0021	695.3	99.9	14.4
North Miscou	-33.91	295.7	-55.33	0.0072	2132.1	987.8	46.3
Miscou NW	-34.15	444.0	-55.54	0.0010	4305.6	2398.4	55.7
Miscou NE	-34.15	352.8	-58.56	0.0036	1279.1	378.6	29.6
Miscou SW	-34.30	552.2	-60.66	0.0023	1277.7	522.6	40.9
Miscou SE	-34.11	521.3	-57.48	0.0046	2397.5	1150.3	48.0
Total	-	-	-	-	27,268.7	-	-

Table A2. Herring biomass densities and estimates by stratum and area from the fishery-independent acoustic surveys conducted in 2023.

Stratum	Average TS (dB/kg)	Stratum Area (km ²)	Mean Sa (/m ²)	Density (kg/m ²)	Biomass (tonnes)	SE (tonnes)	SE (%)
Gaspé							
Rivière au Renard	-34.39	124.6	0.00	0.0000	0.0	0.0	0.0
Cap Bon Ami	-34.39	69.0	0.00	0.0000	0.0	0.0	0.0
Malbaie	-34.39	95.6	-79.73	< 0.0001	2.8	1.6	58.3
Anse à Beaufils	-34.39	96.0	-60.73	0.0023	223.1	151.1	67.7
Chaleur							
Grande Rivière	-34.39	106.4	-58.92	0.0035	374.5	177.7	47.5
Newport	-34.39	124.9	-58.92	0.0035	439.9	176.6	40.1
Shigawake	-34.79	265.6	-55.51	0.0085	2254.6	1158.5	51.4
New Carlisle	-34.39	169.0	-53.96	0.0110	1865.9	413.5	22.2
New Richmond	-34.39	111.6	-54.01	0.0109	1216.7	174.4	14.3
Belledune	-34.39	266.0	-58.25	0.0041	1094.2	235.4	21.5
Nepisiguit	-34.39	211.3	-54.58	0.0096	2021.2	842.3	41.7
Maisonnette	-34.79	145.0	-59.16	0.0037	530.3	173.7	32.8
Miscou							
West Miscou	-33.45	330.5	-58.26	0.0033	1092.5	802.1	73.4
North Miscou	-34.39	295.7	-60.93	0.0022	655.6	614.5	93.7
Miscou NW	-34.51	444.0	-55.51	0.0080	3531.6	2379.4	67.4
Miscou NE	-34.39	352.8	-57.48	0.0049	1730.8	773.7	44.7
Miscou SW	-34.39	552.2	-61.78	0.0018	1006.9	525.4	52.2
Miscou SE	-34.39	521.3	-60.34	0.0025	1323.2	533.0	40.3
Total	-	-	-	-	19,363.8	-	-

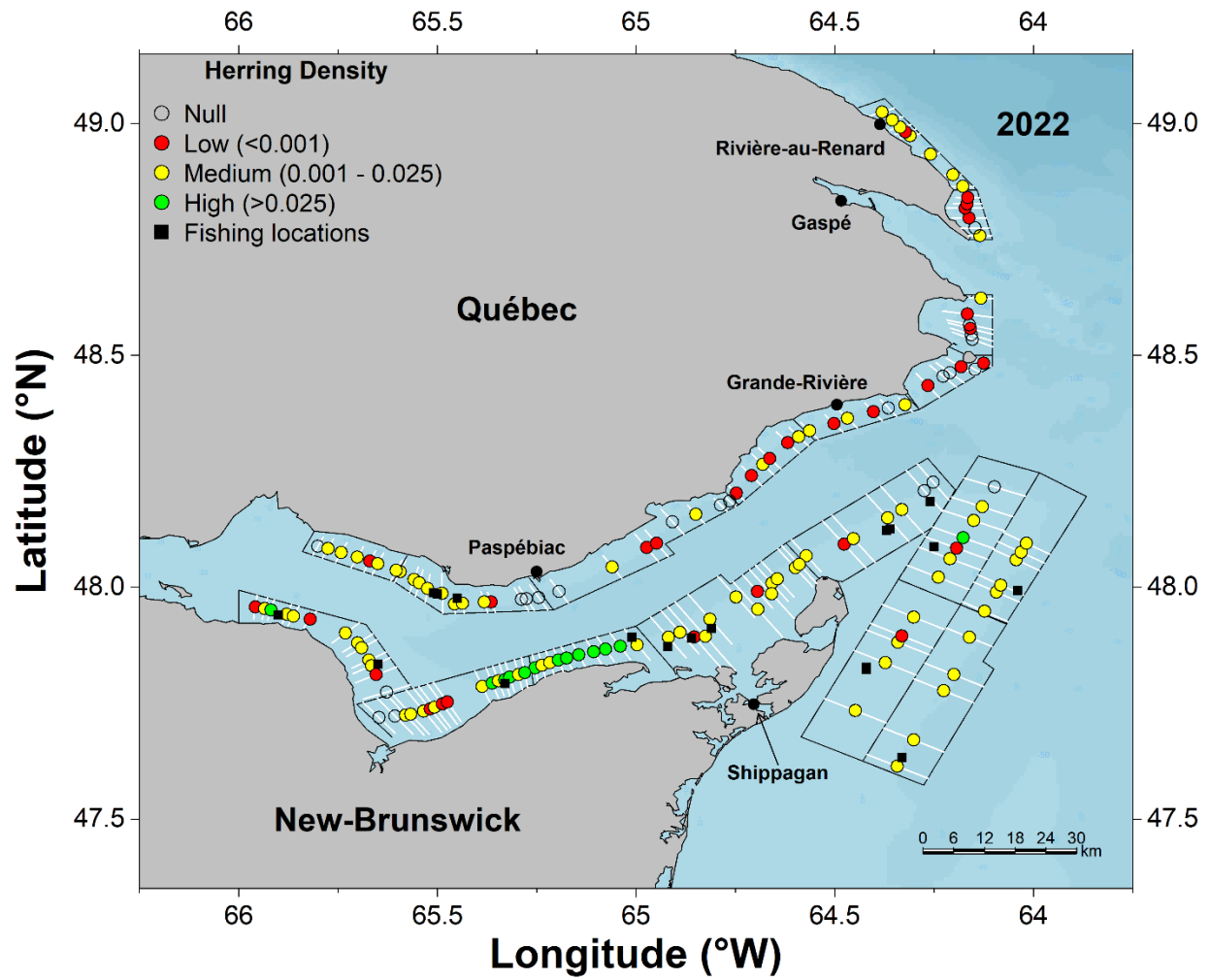


Figure A1. Surveyed transects covered during the 2022 acoustic surveys (whites lines) and Herring biomass density (colored circles, kg/m^2 , Low, Medium or High, by transect).

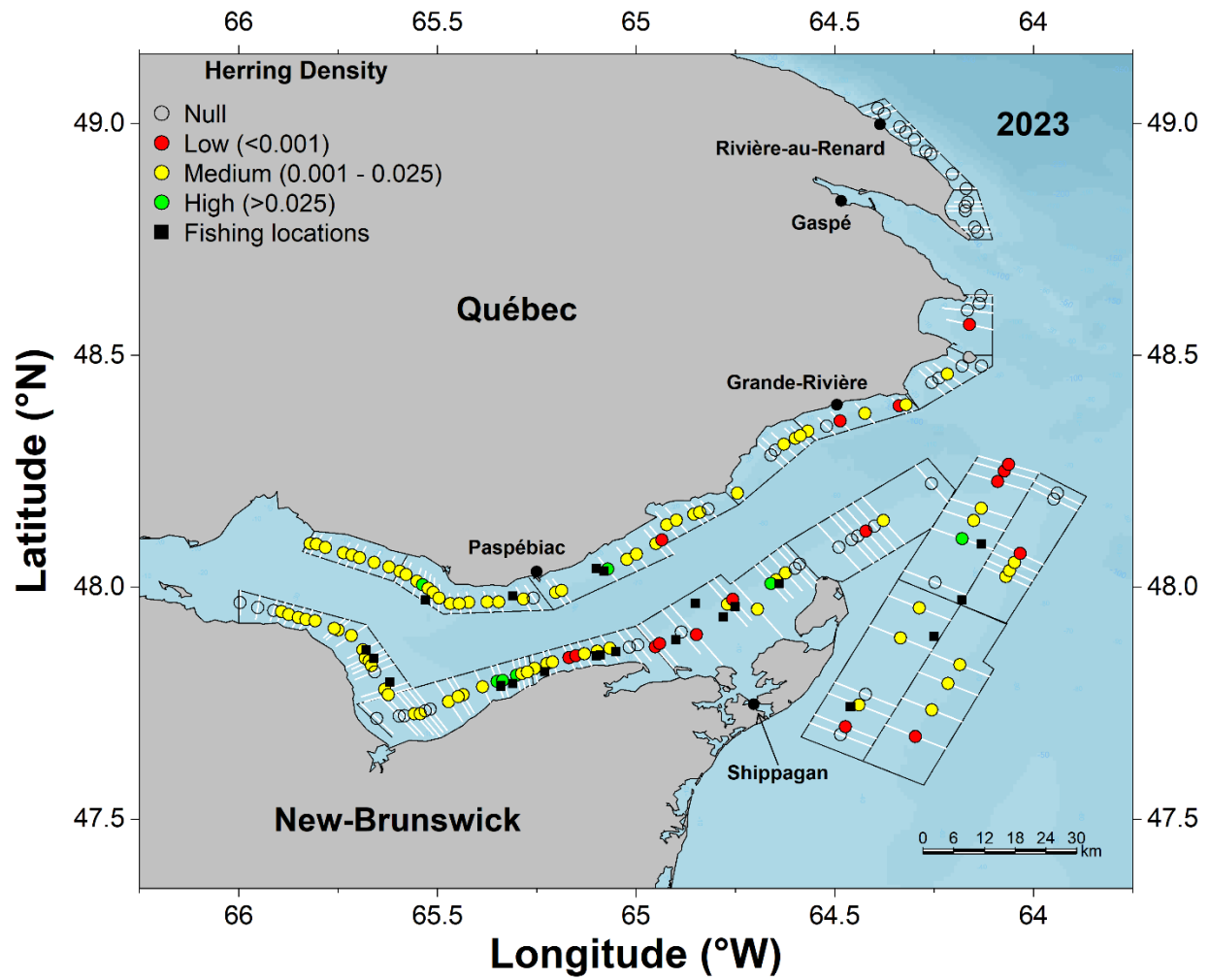


Figure A2. Surveyed transects covered during the 2023 acoustic surveys (whites lines) and Herring biomass density (colored circles, kg/m², Low Medium or High, by transect).

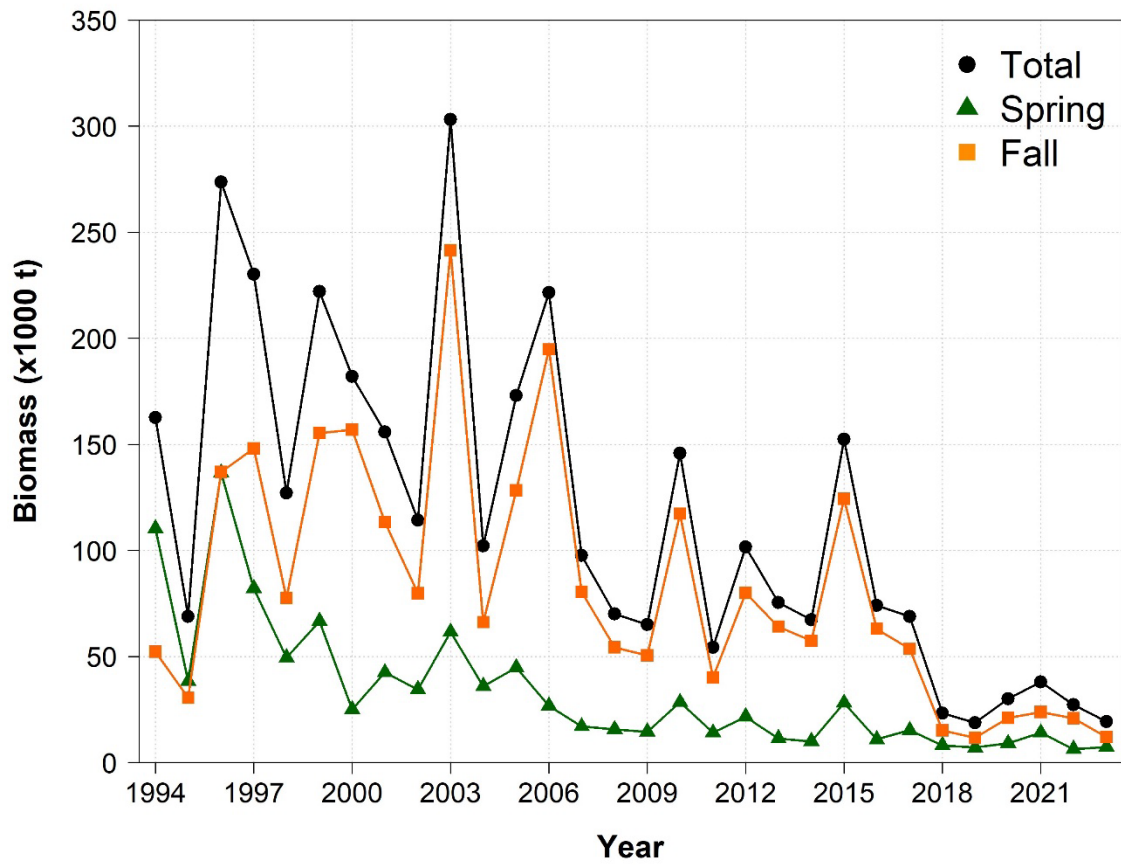


Figure A3. Acoustic survey total biomass (black) of spring (green) and fall (orange) spawners between 1994 and 2023.

APPENDIX B. SPAWNING GROUND ACOUSTIC SURVEY RESULTS

The fall spawning ground acoustic survey began in 2015, and has been conducted each year since. It follows a stratified random design with a protocol consistent with the fishery-independent acoustic survey. Six spawning grounds were identified: Gaspé, Miscou, Escuminac/Richibucto, West PEI, East PEI (Fisherman's Bank/North Lake), and Pictou (Figure B1). Strata were defined for each spawning ground using the acoustic information collected in previous industry partnership studies. Strata were designed to be large enough to encompass the historical spawning grounds in each region. Transects were randomly generated each year within strata at a minimum of 400 m apart (Figure B2).

Each fishing association selected one or two fish harvesters to conduct acoustic surveys to quantify the biomass of fish schools using a hull or side-mounted 120 kHz single beam transducer. Acoustic data from fishing vessels has been used to analyze school morphology characteristics, spatial patterns, relative changes in school density (Shen et al. 2008) and to develop estimates of abundance (Melvin et al. 2002; Honkalehto et al. 2011). In the sGSL, fishery acoustic data collected on Atlantic Herring spawning aggregations can be used to obtain relative nightly biomass estimates (Clayton and Allard 2001; Clayton and Clay 2001). For each region, the goal of the analysis is to estimate the relative spawning biomass from a set of nightly acoustic observations. Surveys were to be conducted once each before and after the fishing season as well as during each weekend fishing closure, where possible. West PEI and Escuminac/Richibucto regions did not have weekend fishing closures until 2018; sampling in these regions was thus only possible before and after the fishing season until the implementation of weekend closures. Fish size and age frequency data used to convert the acoustic data into biomass estimates were obtained from the experimental gillnet surveys. Nightly acoustic data were processed and analyzed for each region in order to obtain a nightly estimate of biomass (Tables B1 to B3), as described in Clayton and Clay 2001.

Figure B3 shows the mean nightly biomass per spawning ground for each year. Some regions/years show great variations in nightly fish biomass (i.e., Miscou and Gaspé 2016, Escuminac 2015). In general, there is a decreasing trend in biomass in most regions over time. Due to weather and other logistical constraints, there are missing sampling trips for some regions and years; the presence or absence of samples, especially at the beginning or end of a fishing season, can have a great impact on the mean nightly biomass of fish observed in an area. Escuminac/Richibucto and West PEI regions are especially sensitive to missing samples prior to 2018 when weekend fishing closures were implemented, as only two trips (one before and one after the fishing season) were able to be completed each year before this time. The proportion of the strata covered and the frequency of survey coverage varied among year and regions from complete strata coverage on a weekly basis to a complete absence of surveys for East PEI in 2015 and 2021 and Escuminac in 2018 (Tables B1 to B6 for details). Coverage in 2022 and 2023 was very good. Gaspé (except for 2017), Miscou and Pictou regions show good coverage over the sampling season with five samples almost every year (Table B4).

The highest mean nightly biomass value in 2015 was in Escuminac, and in 2016 were in Gaspé and Miscou, respectively. Biomass values in Gaspé and Miscou have lowered and remained low, with some fluctuations, after their peak. The lowest biomass values in Gaspé were seen in 2018 and 2023, and the lowest values in Miscou were seen in 2019 and 2021.

Escuminac/Richibucto had a high total nightly biomass in 2015, with decreasing mean biomass values ever since. There was an increase in biomass in 2022 for Escuminac, but the biomass returned to very low values again in 2023. The lowest biomass estimates for the Escuminac/Richibucto region were observed in 2019, 2020, and 2021; however, sampling effort in this region was low in all years up until 2020. Similarly, due to lack of weekend fishing closures in West PEI until 2018, it is difficult to say that the spawning biomass is accurately

estimated in 2015-2017. The mean nightly biomass estimates for West PEI in 2019, 2020, and 2022 were the highest mean nightly biomass estimates of all six sampling regions in those years. Pictou shows a general decreasing trend in biomass from 2015-2020, with the highest biomass level observed in 2015. The biomass estimate in Pictou in 2021 and 2022, however, shows a substantial increase, and these are the second highest biomass estimates for the Pictou region, behind 2015. This 2021 value in Pictou represents the highest nightly estimated biomass in all regions in 2021.

Figure B4 shows the mean nightly biomass per geographic region, where North represents Gaspé and Miscou, Middle represents Escuminac/Richibucto and West PEI, and South represents East PEI and Pictou. Overall, the highest biomass for each geographic region is seen in 2015 (Middle and South regions), or 2016 (North), and the lowest biomass per night of acoustics per region in 2021, 2018, and 2018, for the North, Middle, and South regions, respectively (Figure B4). The results show a general decrease in average nightly biomass in all geographic regions over time, with the exception of an increase in the South region in 2021, followed by its decline again. The North region had higher biomass values than the Middle and South regions in 2016 and 2017, however, the biomass observed in all three regions has become more similar beginning in 2018, with the exception of the South biomass increasing in 2021.

For this index to continue to be included in future assessments, surveys need to be consistent across regions and conscientiously carried out. Weekend closures in West PEI and Escuminac that began in 2018 and remain for future years will allow harvesters to acquire more samples from these spawning beds. In some cases, the first sampling date shows the highest biomass of the season, which could indicate inadequate capture of the spawner biomass estimate for the spawning grounds, however, this is not consistent over time or among areas. This survey is currently aligned with dates of the fishing season.

Table B1. Atlantic Herring biomass densities and estimates by spawning ground from the spawning ground acoustic surveys conducted in 2022.

Herring Fishing Area	Region	Area	Date	Mean Target Strength (dB kg ⁻¹)	Area (km ²)	Mean Backscatter (dB m ⁻²)	Biomass Density (kg m ⁻²)	Biomass Estimate (t)	Biomass Estimate Standard Error (t)
16B	North	Gaspé	2022-08-20	-35.3165	38.6	-49.29	6.51E-02	3008	2565
16B	North	Gaspé	2022-08-27	-35.3165	38.6	-61.00	3.53E-03	121	75
16B	North	Gaspé	2022-09-04	-35.3165	38.6	-57.62	8.77E-03	316	316
16B	North	Gaspé	2022-09-10	-35.3165	38.6	-54.46	2.74E-02	1327	1266
16B	North	Miscou	2022-08-20	-35.4790	386.9	-55.40	2.13E-02	6423	3094
16B	North	Miscou	2022-08-27	-35.4790	386.9	-43.67	5.14E-03	1459	NA
16B	North	Miscou	2022-09-02	-35.4790	386.9	-64.42	2.57E-03	681	389
16B	North	Miscou	2022-09-09	-35.4790	386.9	-62.27	3.46E-03	1327	864
16C	Middle	Escuminac	2022-08-25	-35.7350	145.5	-44.19	9.45E-03	897	734
16C	Middle	Escuminac	2022-09-02	-35.7350	145.5	-59.88	8.00E-03	656	177
16C	Middle	Escuminac	2022-09-09	-35.7350	145.5	-64.01	2.52E-03	406	279
16C	Middle	Escuminac	2022-09-30	-35.7350	145.5	-19.47	2.29E-01	9026	9032
16C	Middle	Escuminac	2022-10-08	-35.7350	145.5	-75.03	1.13E-04	6	5
16E	Middle	West PEI	2022-08-25	-35.4119	111.3	-42.15	3.64E-02	11665	9315
16E	Middle	West PEI	2022-09-02	-35.4119	111.3	-53.36	5.91E-02	10568	6710
16E	Middle	West PEI	2022-09-09	-35.4119	111.3	-63.67	1.66E-03	271	161
16E	Middle	West PEI	2022-10-05	-35.4119	111.3	-33.20	4.08E-04	96	54
16E	Middle	West PEI	2022-10-12	-35.4119	111.3	-45.59	3.74E-03	277	189
16F	South	Pictou	2022-09-07	-35.6167	127.2	-23.43	3.55E-02	1446	1005
16F	South	Pictou	2022-09-30	-35.6167	127.2	-46.50	1.37E-02	4993	4832

Herring Fishing Area	Region	Area	Date	Mean Target Strength (dB kg ⁻¹)	Area (km ²)	Mean Backscatter (dB m ⁻²)	Biomass Density (kg m ⁻²)	Biomass Estimate (t)	Biomass Estimate Standard Error (t)
16F	South	Pictou	2022-10-07	-35.6167	127.2	-20.70	1.84E-02	6862	6667
16F	South	Pictou	2022-10-12	-35.6167	127.2	-41.53	3.29E-02	1599	944
16F	South	Pictou	2022-10-21	-35.6167	127.2	-35.15	3.58E-03	952	409
16G	South	East PEI	2022-09-02	-35.6167	56.1	-54.56	3.47E-02	2138	1269
16G	South	East PEI	2022-09-09	-35.6167	56.1	-44.29	1.42E-01	7407	2742
16G	South	East PEI	2022-10-01	-35.6167	56.1	-58.44	5.24E-03	252	167
16G	South	East PEI	2022-10-07	-35.6167	56.1	-54.28	2.04E-02	754	307
16G	South	East PEI	2022-10-16	-35.6167	56.1	-64.62	2.17E-03	78	45

Table B2. Atlantic Herring biomass densities and estimates by spawning ground from the spawning ground acoustic surveys conducted in 2023.

Herring Fishing Area	Region	Area	Date	Mean Target Strength (dB kg ⁻¹)	Total Area (km ²)	Mean Backscatter (dB m ⁻²)	Mean Biomass Density (kg m ⁻²)	Total Biomass Estimate (t)	Biomass Estimate Standard Error (t)
16B	North	Gaspé	2023-08-26	-35.1098	38.6	-41.45	1.74E-03	73	21
16B	North	Gaspé	2023-09-08	-35.1098	38.6	-36.46	7.15E-03	233	160
16B	North	Gaspé	2023-09-15	-35.1098	38.6	-60.17	3.85E-03	172	133
16B	North	Gaspé	2023-09-23	-35.1098	38.6	-62.34	3.38E-03	158	153
16B	North	Gaspé	2023-09-29	-35.1098	38.6	-56.06	1.72E-02	471	164
16B	North	Miscou	2023-08-16	-35.4708	386.9	-60.24	6.71E-03	3297	1606
16B	North	Miscou	2023-08-26	-35.4708	386.9	-40.45	2.54E-03	440	332
16B	North	Miscou	2023-09-01	-35.4708	386.9	-68.82	8.70E-03	2392	965
16B	North	Miscou	2023-09-07	-35.4708	386.9	-68.19	5.61E-03	2559	1679
16B	North	Miscou	2023-09-13	-35.4708	386.9	-63.63	3.43E-03	998	NA
16B	North	Miscou	2023-09-22	-35.4708	386.9	-35.60	3.41E-03	1511	553*
16B	North	Miscou	2023-09-28	-35.4708	386.9	-46.29	7.75E-03	3402	2063*
16B	North	Miscou	2023-10-12	-35.4708	386.9	-33.92	3.57E-04	135	84*
16B	North	Miscou	2023-10-25	-35.4708	386.9	-50.21	2.57E-03	1262	638*
16B	North	Miscou	2023-10-30	-35.4708	386.9	-40.00	5.36E-04	189	60*
16B	North	Miscou	2023-11-06	-35.4708	386.9	-40.41	2.06E-03	603	NA*
16B	North	Miscou	2023-11-11	-35.4708	386.9	-20.46	8.54E-04	253	128*
16B	North	Miscou	2023-11-14	-35.4708	386.9	-64.60	2.72E-03	1275	788*
16B	North	Miscou	2023-11-21	-35.4708	386.9	-26.77	1.04E-03	479	363*
16C	Middle	Escuminac	2023-09-03	-35.6060	145.5	-62.39	2.01E-03	113	56
16C	Middle	Escuminac	2023-09-08	-35.6060	145.5	-32.01	7.07E-04	165	76
16C	Middle	Escuminac	2023-09-23	-35.6060	145.5	0.00	0.00E+00	0	NA
16C	Middle	Escuminac	2023-09-30	-35.6060	145.5	-15.59	5.06E-04	40	27
16E	Middle	West PEI	2023-08-29	-35.2339	111.3	-27.50	1.09E-02	3643	1534
16E	Middle	West PEI	2023-09-15	-35.2339	111.3	-57.59	5.71E-03	591	512
16E	Middle	West PEI	2023-09-23	-35.2339	111.3	-30.26	1.45E-03	267	139
16E	Middle	West PEI	2023-09-29	-35.2339	111.3	-30.72	2.36E-03	124	66
16E	Middle	West PEI	2023-10-06	-35.2339	111.3	-26.49	1.27E-02	3987	1878
16F	South	Pictou	2023-09-14	-35.3668	127.2	-26.18	4.03E-04	44	47
16F	South	Pictou	2023-09-22	-35.3668	127.2	-53.29	7.09E-04	123	89
16F	South	Pictou	2023-09-29	-35.3668	127.2	-33.17	2.22E-02	5607	4464
16F	South	Pictou	2023-10-05	-35.3668	127.2	-24.49	1.04E-03	305	184
16F	South	Pictou	2023-10-12	-35.3668	127.2	-26.60	5.82E-04	223	70
16G	South	East PEI	2023-09-01	-35.3668	56.1	-55.88	2.00E-02	1225	467
16G	South	East PEI	2023-09-08	-35.3668	56.1	-48.28	5.47E-02	2334	1292
16G	South	East PEI	2023-09-22	-35.3668	56.1	-51.18	2.62E-02	1271	828
16G	South	East PEI	2023-09-29	-35.3668	56.1	-50.07	3.42E-02	1564	348
16G	South	East PEI	2023-10-13	-35.3668	56.1	-55.59	1.00E-02	529	189

**These nightly biomass estimates were conducted after the regular time-sampling grid and are not included in Figures B3 and B4, below.

Table B3. Number of individual acoustic sampling trips per year and region from the spawning ground acoustic surveys.

Region	2015	2016	2017	2018	2019	2020	2021	2022	2023
Gaspé	5	5	1	5	7	5	5	4	5
Miscou	5	5	4	5	7	6	4	4	14
Escuminac	2	2	1	0	1	6	3	5	4
West PEI	2	1	2	6	4	7	4	5	5
Pictou	5	5	4	5	5	5	5	5	5
East PEI	0	3	5	2	2	3	0	5	5
Total	19	21	17	23	26	32	21	28	38

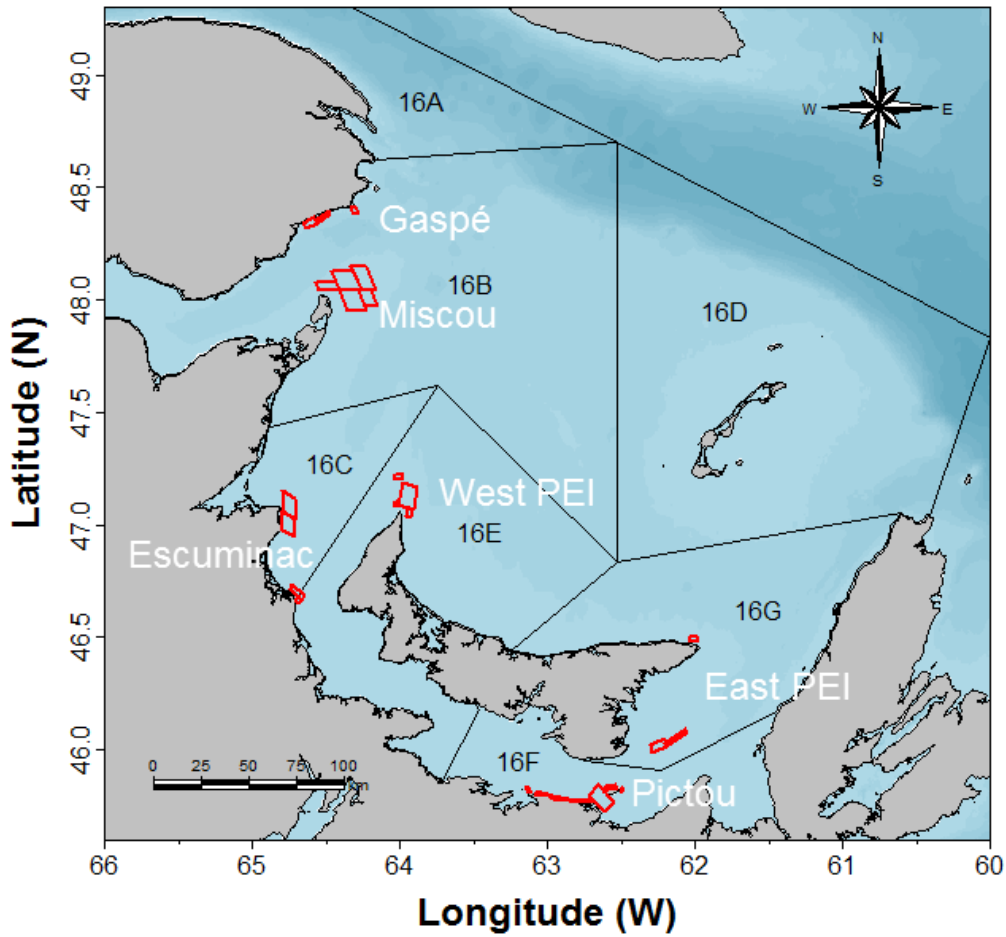


Figure B1. Spawning grounds surveyed during the spawning ground acoustic surveys.

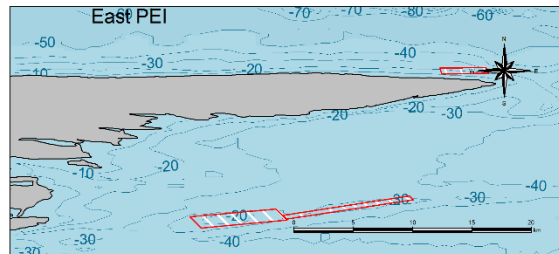
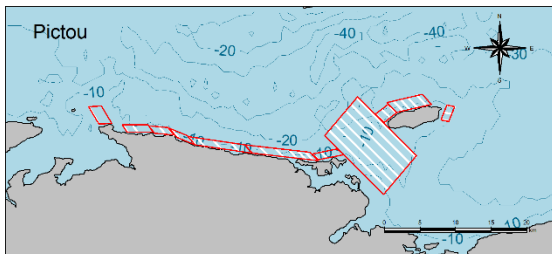
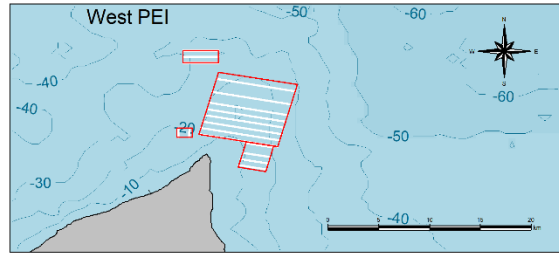
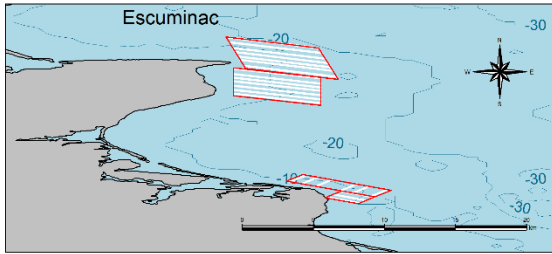
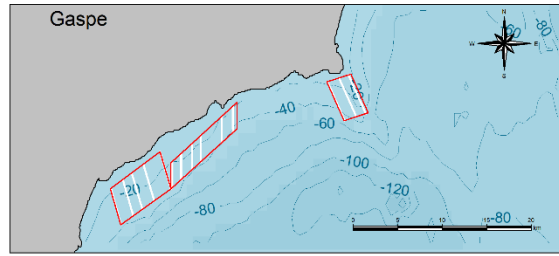
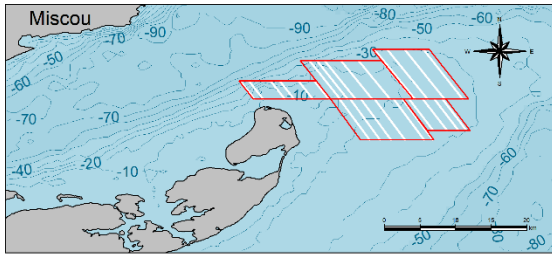


Figure B2. Strata (red boxes) and transects (white lines) surveyed during the spawning ground acoustic surveys.

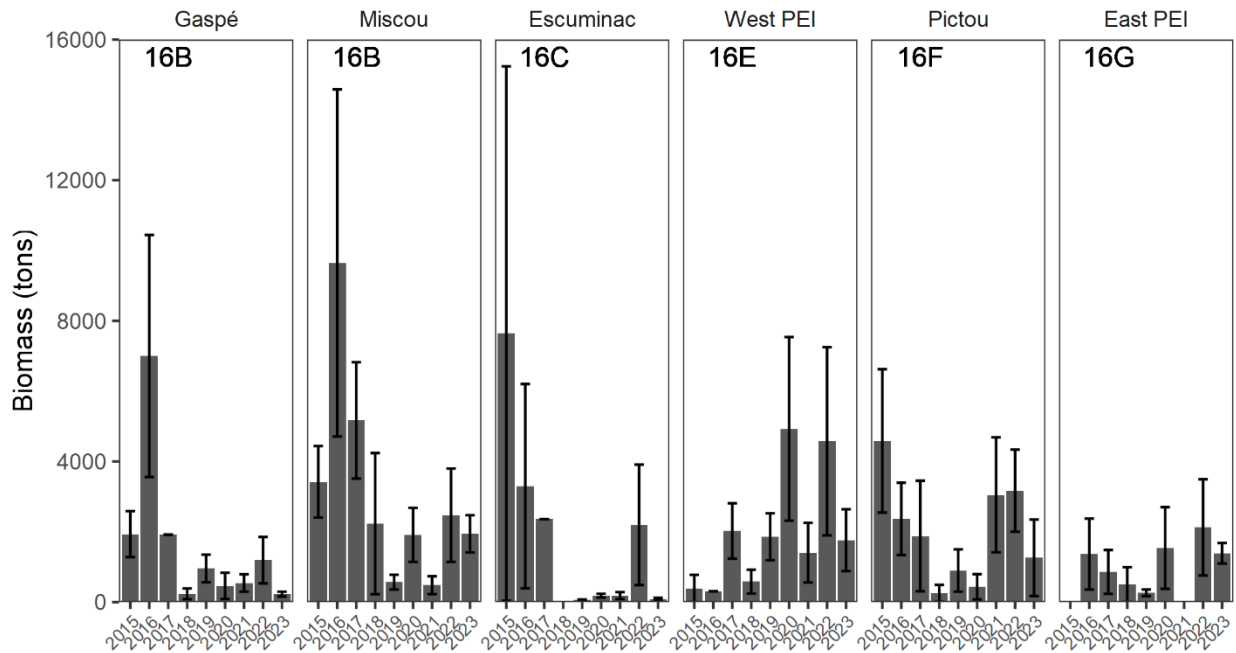


Figure B3. Nightly Atlantic Herring biomass estimates (tonnes; mean \pm one standard error bar) by spawning ground from the spawning ground acoustic surveys for years 2015 to 2023.

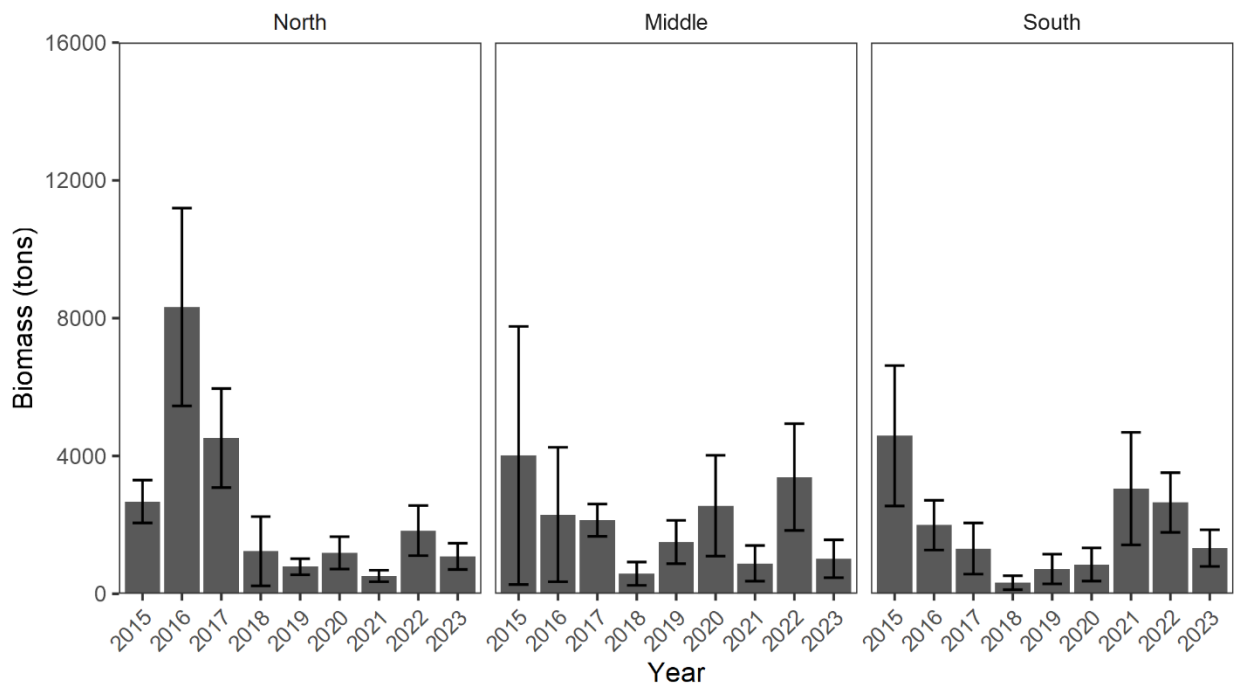


Figure B4. Nightly Atlantic Herring biomass estimates (tonnes; mean \pm one standard error bar) by geographic region (North, Middle, South) from the spawning ground acoustic surveys for years 2015 to 2023.

APPENDIX C. MULTISPECIES BOTTOM-TRAWL SURVEY RESULTS

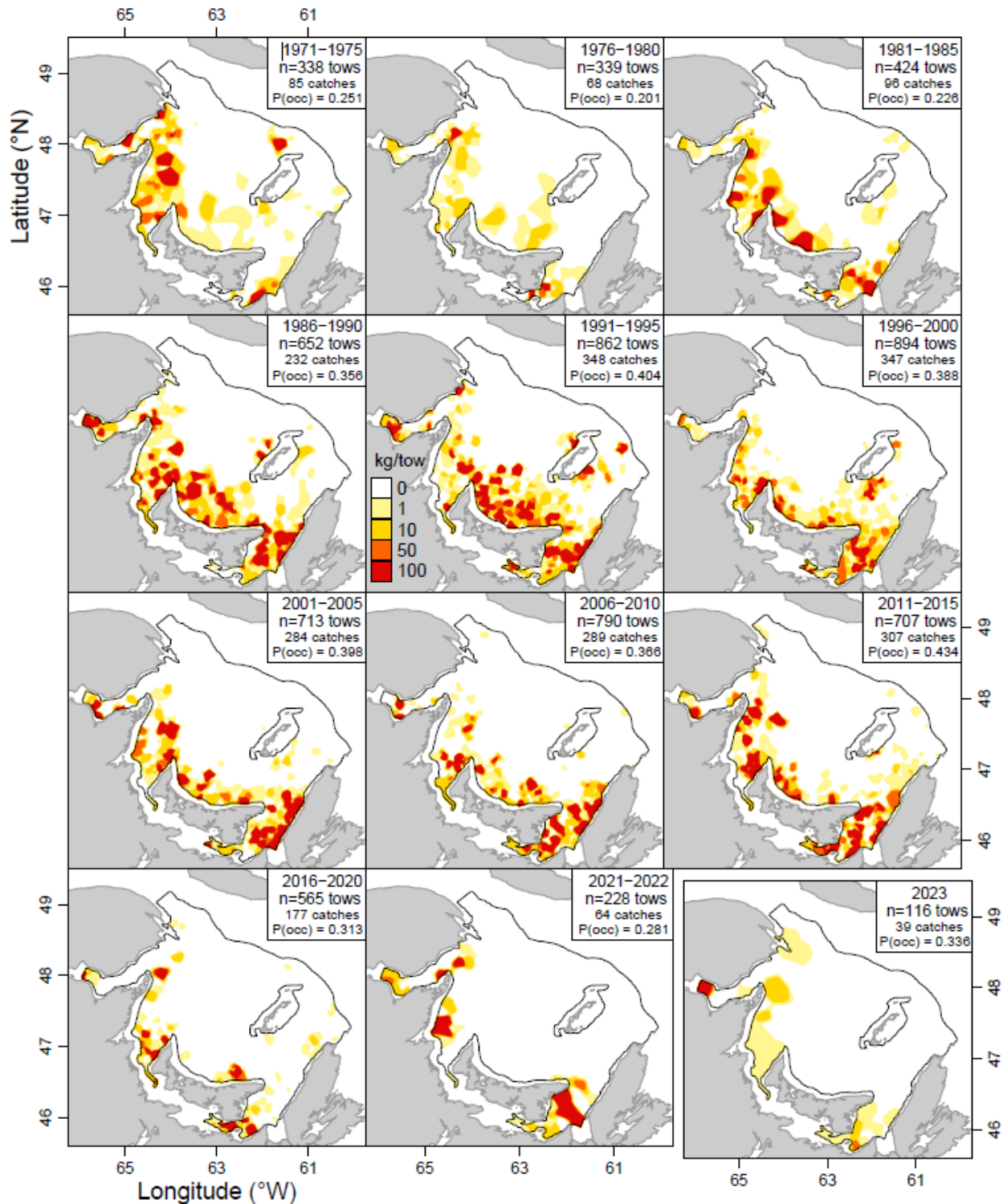


Figure C1. Spatial distribution of Herring catches by blocks of years in the southern Gulf of St. Lawrence bottom trawl research vessel survey from 1971 to 2023. $P(\text{occ})$ indicates probability of occurrence (the number of tows catching Herring divided by the total number of tows).

APPENDIX D. DIFFERENCES IN SSB FROM AUTOMATING PROPORTION-AT-AGE MATRICES

Since 2020, the spawning biomass of Atlantic Herring in the southern Gulf of Saint Lawrence (4TVn) has been assessed using a statistical catch-at-age (SCA) model (Turcotte et al. 2021). Data sources includes commercial landings, experimental netting and acoustics survey biomass from both industry and fishery-independent surveys (Multi-species survey and Baie-des-Chaleurs survey).

- PAA: Proportion at age
- NAA: Number at age
- WAA: Weight at age
- BegWAA : Beginning of the year weight at age

Originally, values were calculated via excel from multiple data sources, steps, sheets, files and pivot tables. Values were then copy-pasted manually in the right format for the model input. This took a long time with manual verification and was prone to typos and copy errors.

We translated these Excel sheet and tables into R functions and scripts that calculate the matrices and create files in the right format for the model input. The outputs of these translated scripts suggested that the translation process only lead to minor differences with previous estimates. This process also lead to the identification and correction of issues in the dataset, in addition to the detection of decisional differences when dealing with very low or absent values. Here is a summary of those differences.

Differences in the fall spawning component model

1. **Number-at-age in North region:** An error was found while calculating the matrices accounting for the edge fishery (Laurentian channel at the edge of 4T) for the North region. For the edge fishery (mobile fleet), ages are proportionally attributed to each region (north, middle and south) based on the landings of the fixed gear fleet. Ages were not summed properly for mobile and fixed fleet to calculate total number at age (and resulting metrics based on it). Age 2 of the fixed fleet was summed with Age 3 of the mobile fleet, and Age 3 of fixed fleet was summed with Age 4 of the mobile fleet, etc. This error resulted in a value difference in proportion-at-age ranging from 0 to 0.41 with an average of 0.06 ± 0.1 (SD). For landings, differences averaged 1802 ± 1068 .
2. **In weight-at-age of the Middle and South regions at age 2,** the weight at age (WAA) pasted across in the Excel sheet was the weight-at-age for all regions instead of being filtered for Middle and South like it should have been. This affected weight-at-age for age 2 but also beginning of the year weight-at-age for ages 2 and 3. The resulting differences averaged 0.017 ± 0.004 for weight-at-age.
3. **For weight-at-age in the North region in 2018 and 2022, ages 3 and 4,** the values in the final Excel file did not match the values in the other Excel files where they originated which suggest an error. The average difference is 0.012 ± 0.001 .
4. **For weight-at-age in 1994 for the North and Middle region,** the weight-at-age combined for fixed and mobile fleet in the Excel sheet corresponded to the fixed gear weight-at-age only. This not only affected weight-at-age but also landings estimates. Average difference for weight-at-age is 0.017 ± 0.018 , ranging from 0.001 to 0.08. Difference in landings is of 485.

-
5. **For weight-at-age in 2016 and 2017 of the South region**, the weight-at-age copy-pasted was from a filter using the fishing season instead of spawning group. The values correspond to the weight-at-age looking at Herring fished in the fall instead of the weight-at-age of the fall spawning component. This resulted in variation in the weight-at-age (mean difference: 0.006 ± 0.01) but created a difference of 75.66 (2016) and 232 (2017) in landings.
 6. **For beginning of the year weight-at-age of the North and Middle region**: The function to calculate beginning of the year is usually for center values :

$$e^{\ln(WAA_{t-1a-1})+\ln(WAA_{ta})/2}$$

and for values at the edge of the table (age 2 and year 1978):

$$e^{2*\ln(WAA_{ta})-\ln(BegWAA_{t+1a+1})}$$

where t = year et a = age. In 2008 and 2009, the 'edge' function was used for all ages. Additionally, the 'edge' function was used for ages 3 and 4 for all years until 2008. This could potentially result from a copy-paste error, as the South region did not have this specification. This error resulted in a mean difference of 0.023 ± 0.16 .

7. **Null values (NA)**: In the Excel version, some NAs in number-at-age of the Middle and South regions were replaced by 0. In the R version, a function was created to replace NAs with a value of choice and we chose to replace those 0 by the average of the three previous years for PAA CPUE. However, since the model would not run without the 0s in paaCatch, we made sure NA in paaCatch was replaced by 0s and not the mean, like all the other parameters. This is something that could be looked into in the future.

Differences in the spring spawning component model

1. **For 1983 and 1984 null values**, the previous number-at-age for commercial data had no data for age 11 and averaging was with data for years before and after. Our new function calculates the average with the previous three years. This resulted in imperceptible difference since the value was so low that it was replaced by a null value.
2. **In CPUE proportion at age**, some values were under 0.01, but were not summed with another age and replaced by a null value, as conditions in other years. We kept the threshold at 0.01 and replaced those values by a null value as well.
3. **In 2004 for proportion at age for the acoustic survey in the Baie-des-Chaleurs**, some data was missing for ages 7 et 8. The Excel version averaged with previous and following years, but we made the decision to average with three previous years and be consistent about it. It resulted in an mean difference of 0.026 ± 0.012 for acoustic proportion-at-age and 0.575 for the acoustic index.

Differences created in SSB estimates

The mean difference in SSB for spring spawners was 10.56 and 10,742 for fall spawners (North = 32,875; Middle =10,095; South = 9,643; Figure D1). For spring spawners, the SSB estimates are now ~ 14% higher. For fall spawners, the SSB is now ~ 30% higher in the North, ~20% lower in the Middle and ~7% lower in the South. Despite these changes in the estimates, this R method is not only more efficient in time and effort, but also reduces risks of human errors.

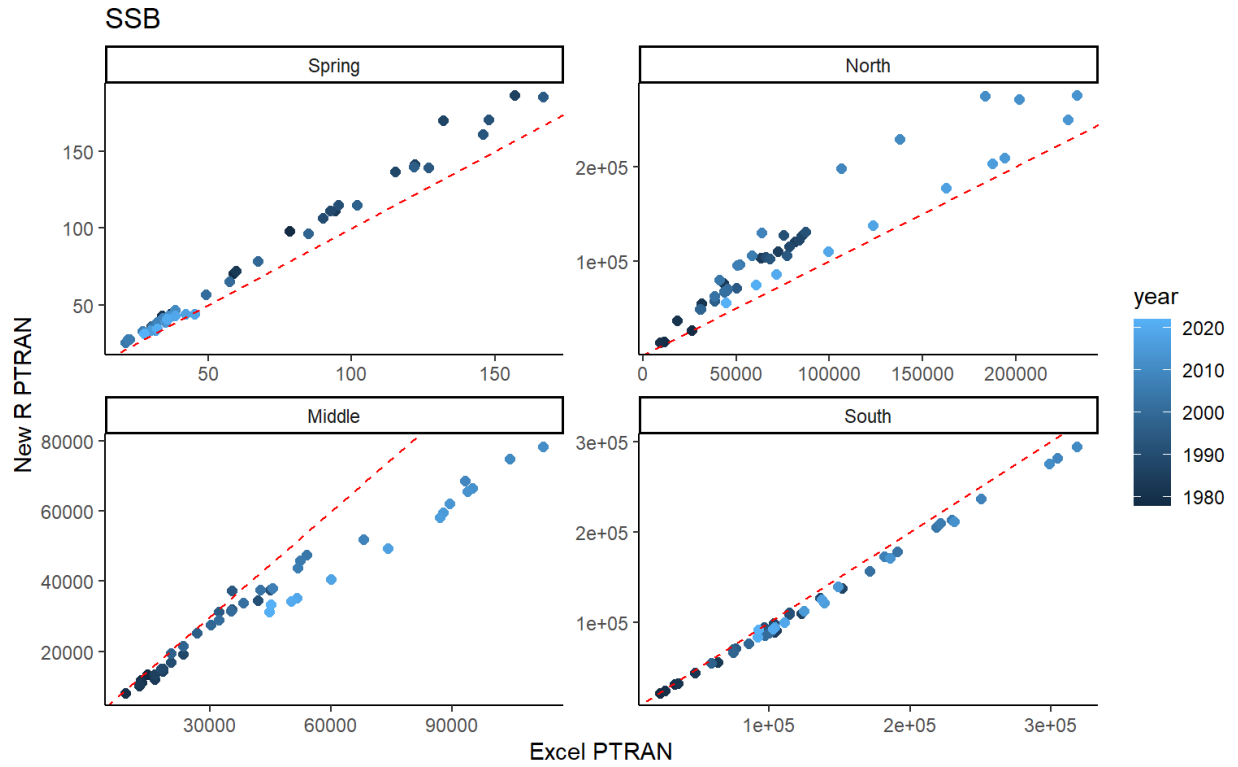


Figure D1. SSB estimates by regions for the automated output from R (y-axis) and Excel output (x-axis). The red dashed line represent a slope of 1 and indicates that new values are equivalent, over (top) or under (bottom) of older values.

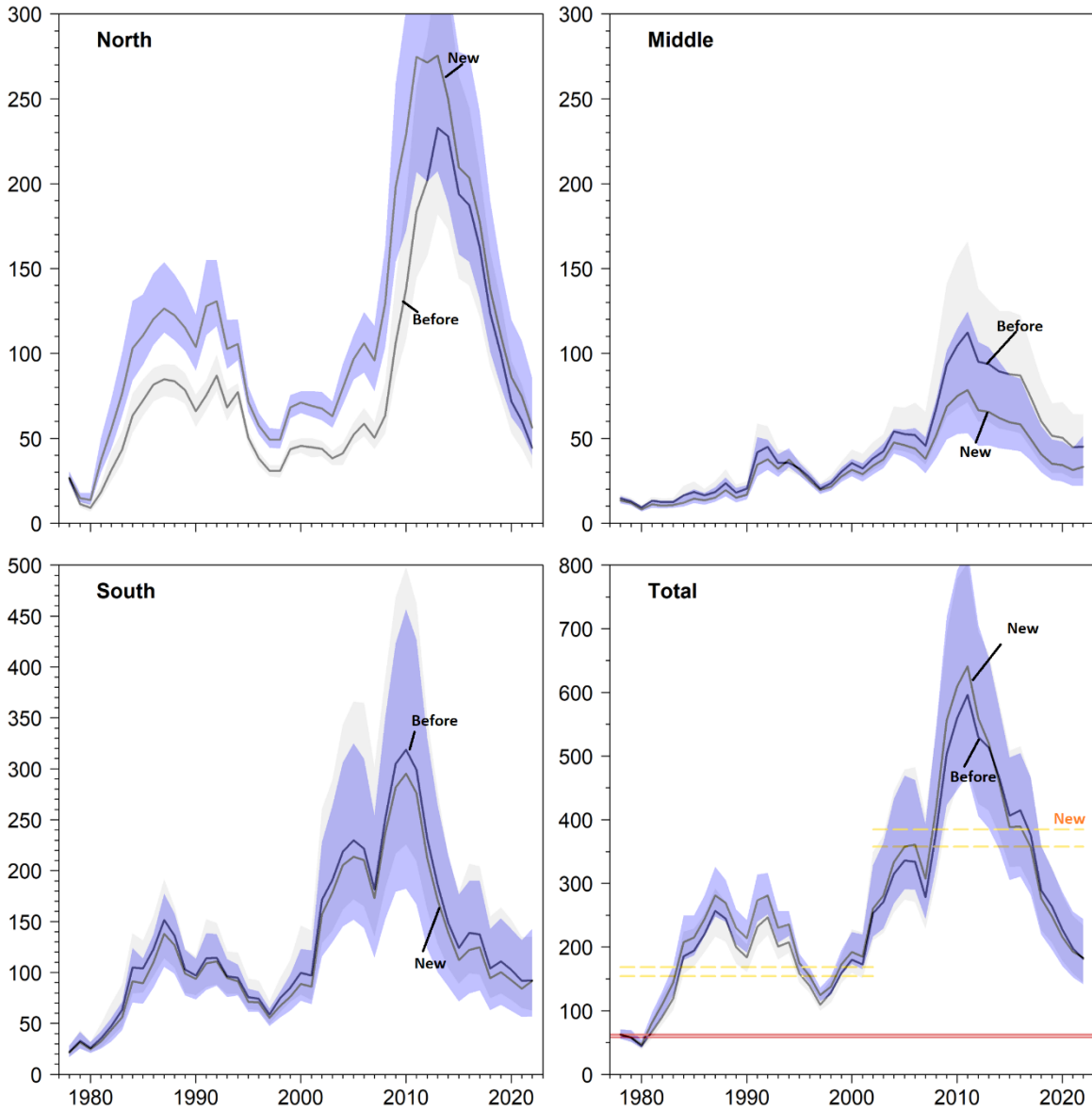


Figure D2. SSB estimates for fall spawners by regions for the automated output from R (grey) and Excel output (blue). The red line represent the LRP and the yellow dashed lines are the USR (R = top, Excel = below).

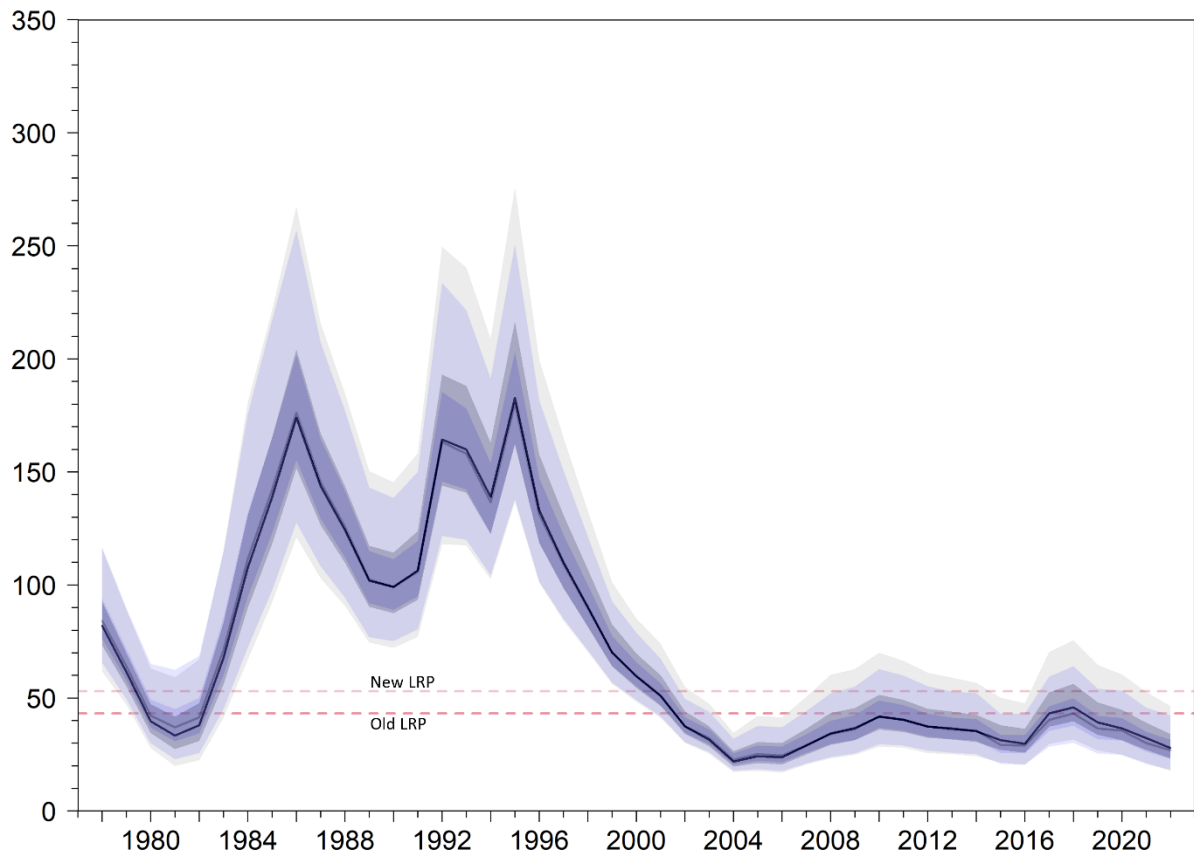


Figure D3. SSB estimates for spring spawners by regions for the automated output from R (grey) and Excel output (blue). The red line represent the LRP (R = top, Excel = below).