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Newfoundland and Labrador Region | Science Response 2022/035

2021 STOCK STATUS UPDATE FOR ATLANTIC HERRING IN NAFO DIV. 3KLPS

Context

This Science Response Report results from the January 26-27, 2021 Science Response Process Stock Status Update of NAFO Subdivisions 3KLPs Herring as requested by Fisheries and Oceans Canada (DFO) Resource Management. In light of the COVID-19 situation and resulting data limitations, a full Regional Peer Review meeting scheduled for December 1-2, 2020 had to be cancelled. Alternatively, it was decided that the Centre for Science Advice (CSA), Newfoundland and Labrador (NL) Region, would coordinate an internal DFO Stock Update.

This stock was last fully assessed in 2019 (DFO 2019) which included stock status updates for Bonavista Bay-Trinity Bay (BBTB) and Fortune Bay (FB) to 2017, and St. Mary's Bay-Placentia Bay (SMBPB) to 2018. Information available for the current update included fishery landings to 2020, estimated bait landings and purse seine discards from DFO telephone surveys to 2020, biological data including ages and spawning components for the Research Gillnet Program to 2018, and biological data without ages or spawning component to 2019. An overview of three recent acoustic surveys was also provided.

Background

Atlantic Herring on the south and northeast coasts of Newfoundland are divided into five stock complexes (Figure 1): White Bay-Notre Dame Bay (WBNDB), Bonavista Bay-Trinity Bay (BBTB), Conception Bay-Southern Shore (CBSS), St. Mary's Bay-Placentia Bay (SMBPB), and Fortune Bay (FB). Herring also occur in southern Labrador and the Pass Island to Cinq Cerf area on the south coast, where there are small commercial fisheries; however, the origin of these herring is not known and they are not assessed as stock complexes. All stock complexes are comprised of a mixture of spring spawners (SS) and fall spawners (FS). During the early 2000s all areas with the exception of FB saw a shift from SS to FS dominance (Bourne et al. 2018); the proportion of SS has remained low in FB in comparison to complexes on the northeast coast in recent years (Figure 2). Herring recruitment dynamics are highly variable and thought to be largely driven by environmental conditions; FS success in the Northwest Atlantic has been linked to warmer water temperatures (Melvin et al. 2009; Bourne et al. 2018) whereas SS recruitment may be driven by prey (plankton) dynamics (Brosset et al. 2018). The commercial fishery in Newfoundland targets mixed aggregations of SS and FS as spawning components within these stock complexes never discretely separate.

Stock status updates (where available) are currently based on the spring research gillnet program, where fishers set and fish a standardized set of gillnets for six weeks to collect catch rates and biological samples that are used to derive catch at age (note that age data from 2019 and 2020 samples were not available at the time of this update), year class strength and recruitment indices (see Bourne et al. 2018 for further details about this program). Since 2013, the spring research gillnet program has occurred only in BBTB and FB; from 2018-20 a similar program has taken place in Placentia Bay as part of the Oceans Protection Plan (OPP), Coastal

Environmental Baseline Program. Typically for stock complexes without a research gillnet program biological updates have been provided (DFO 2019); however these data were not available for this update.

Acoustic herring surveys were conducted in WBNDB, BBTB, SMBPB and FB from 1979-2001 on a rotating basis, with two stock areas being surveyed each year. The results of these surveys were used to derive biomass estimates for stock assessments (Wheeler et al. 2010). In 2019, acoustic surveys were reinstituted using the same survey design and data collection methodology to allow for continuation of the biomass time series. These data will contribute to the development of Limit Reference Points for 3KLPs Atlantic herring. Biomass estimates were not available at the time of this update as results from the 2019 and 2020 acoustic surveys were still being analyzed.

Description of the Commercial Fishery

Purse seines account for the highest proportion of commercial landings in 3KLPs (70-80%), with gillnets, tuck seines, bar seines and traps taking the remainder. The fishery takes place in both the spring and fall, with the exception of FB where there is only a spring fishery. Landings data for 2019 and 2020 were updated on January 6, 2021 (note that landings data are considered preliminary for the most recent two years as data may be reviewed and updated during that time). Approximately 56% of the total combined 12,842 t commercial quota for 3KLPs (excluding bait allocations) was taken in 2019 and 34% in 2020, at the time of this update (Figure 3).

WBNDB has accounted for the highest proportion of landings for the past four years, with the entire 2,568 t quota taken in 2019 and 75% of this quota taken in 2020 as of this update. BBTB has the highest quota (5,990 t) but landings have been low over the past several years largely due to high proportions of small herring, with only 11% and 3% of the quota landed in 2019 and 2020 respectively. Fishing activity in CBSS increased during the 2010s; however, there were no landings in 2019; 76% of the 895 t quota was taken in 2020. In SMBPB landings have increased in recent years, with 89% of the 2,100 t quota taken in 2019 and 32% in 2020. In FB the quota and landings have decreased over the past decade; 56% of the 789 t quota was landed in 2019 and 34% in 2020. See Figure 4 for landings by stock area.

DFO Science conducts an annual telephone survey of purse and tuck seiners in WBNDB, BBTB, CBSS and SMBPB and bar seiners in FB (where there is no purse or tuck seining). In 2019 respondents in all areas indicated that discards (i.e. released sets) were relatively low whereas in 2020 fishers in WBNDB and SMBPB estimated high discards (Figure 5). Fishers generally indicated that small herring (less than the legal size limit of 27cm total length) were abundant and causing an issue in the fishery as sets with more than 20% undersized herring have to be released. Bar seine fishers in FB indicated low discards in 2019 and 2020 (Figure 6). Estimated discard survival rates vary widely by year and stock area, from 25-100%; this is a difficult metric to estimate and it has been shown that herring released from seines can suffer high mortality (Olsen et al. 2012; Tenningen et al. 2012).

Estimated Bait Removals and Bycatch

Each stock area has a bait allocation in addition to a commercial Total Allowable Catch (TAC) but bait removals are not recorded, so a telephone survey is conducted each fall by DFO Science to interview herring bait fishers and obtain estimates of bait removals (See Bourne et al. 2018 for details on methodology). Mandatory bait logbooks were introduced in 2017; however, at the time of this update the telephone survey was providing a larger sample size to derive bait estimates. Bait removal estimates have ranged from 7 to 20% of total fishery

removals since the survey was implemented in 2008; bait removals accounted for an estimated 10% of total removals in 2019 and 2020.

In WBNDB, estimated removals have been well below the 100 t bait allocation throughout the 2010s; in BBTB bait removal estimates have been low from 2018-20, below the 500 t allocation; in CBSS bait removal estimates exceeded the 50 t allocation for the past three years, by more than double in 2020; in SMBPB bait removal estimates have varied, exceeding the 150 t allocation in 2019 but remained well below in 2020; in FB bait removal estimates have been low for the past several years and have not exceeded the 400 t allocation since 2012 (Table 1, Figure 7). During the telephone survey fishers are also asked to report any bycatch and these data are extrapolated to provide overall estimates of bycatch by species/species group (by weight). Reported bycatch was low in 2019-20 compared to the time series (2013-20), with mackerel (largely reported in WBNDB) and “other fish” representing the largest proportions (Figure 8). The “other” category was largely comprised of seals and rock crab in WBNDB, squid in BBTB, and sharks in CBSS.

Analysis and Response

Ecosystem Information

The ecosystem in the NL region observed changes in the 1990s with the collapse of the entire groundfish community. This collapse was more severe in the northern regions and less severe in southern Newfoundland. Starting in the mid-to-late-2000s there have been consistent signals of increasing biomass within the groundfishes. This rebuilding coincided with modest improvements in capelin but also a sharp decline in shellfish. The rebuilding stalled in the 2010s, and declines were observed in 2015-17. These trends could be linked to simultaneous reductions in availability of forage species like capelin and shrimp. There are no clear signals of increases of forage fish species in recent years. Among forage fishes, herring shows a predominantly inshore distribution in the NL region. The offshore biomass level of herring in this ecosystem appears to have improved after 2010 (Bourne et al. 2018), but it is unclear if this reflects an actual increase or redistribution of fish. During this period this system has experienced warming conditions, and underwent structural changes with warm water species such as the Silver Hake, increasing in dominance. Overall, ecosystems in the NL region currently seem be experiencing low productivity conditions.

Research Gillnet Program Results

In BBTB, catch rates increased slightly in 2018 with FS comprising the majority of the catch (Figure 9). The 2018 catch at age was broadly distributed with 68% FS; the influx of SS seen in the 2017 catch at age continued to dominate the younger (age 4 and 5) year classes (YCs) (Figure 10). The relative strength (based on catch rates age 4-6) of FS YCs has been above the reference period (1990-2005) mean since the late-1990s, which is not unexpected given the overall increase in FS recruitment during the 2000s (Figure 10). The relative YC strength of SS has been more variable, with three of five of the most recently evaluated YCs at or above average (Figure 10). With the exception of 2013, the recruitment (based on catch rates of age 4 herring) of FS has been above the reference period mean in BBTB since 2003-again largely due to the overall increase in FS prevalence during the 2000s; SS recruitment has been variable, but the three most recently available YCs (2012-14) have been above average (Figure 11).

In FB, only SS are assessed as FS numbers are too low in that stock area to provide reliable YC and recruitment estimates (Bourne et al. 2018). Catch rates in 2018 remained below both the reference period and decadal means (Figure 12). The age distribution in 2018 was not well distributed, with age 6 SS comprising 69% of the catch, age 11+ comprising 19% and other

cohorts accounting for the remainder (Figure13). While ages from 2019 samples were not available for this update, a length-frequency plot showed no significant signs of incoming YCs, i.e. smaller fish (Figure 13). This skewed age distribution has been typical of FB during the 2000s, where SS recruitment has largely been below average with just a few strong YCs (Figure 14). The 2002 YC dominated the catch at age for almost a decade (Bourne et al. 2018), and the 2012 year class is now comprising almost 70% of the catch in this stock area (Figure 13). Recruitment of the 2013 and 2014 YCs was well below average (Figure 14). This period of low recruitment has also coincided with low catch rates (Figure 12).

Biological Information

The length at age of herring decreased significantly in the 1990s (Wheeler et al. 2009), and has remained low since for both SS and FS; younger fish (ages 3-4) were slightly larger through the 2000s than in the 1990s whereas older fish were smaller (Figure 15). This change coincides with changes in length at 50% maturity (L50), which declined through the early-90s and increased into the 2000s (DFO 2019). L50 could not be updated for this meeting given the data available.

Acoustic Surveys

Acoustic herring surveys were conducted in the NL region through the 1980s and 1990s, the results were used to obtain biomass estimates for the WBNDB, BBTB, SMBPB and FB stock complexes (Wheeler et al. 2010). These surveys were discontinued in 2000 due to reductions in funding and difficulties locating herring, as this was a period of low abundance (Figure 9, Figure 12). In 2019, acoustic surveys were reinstated for 5 years through funding under the new Fish Stock Provisions. The same methodology from previous surveys was used to maintain a comparable time series.

Stock complex areas are divided into strata which are weighted by historic fish density and geographic difficulty; transects are randomly distributed within strata and extend to the 120 m contour line. Transects are surveyed using a chartered purse seine vessel equipped with a Simrad EK60 echosounder and a towed 120 kHz transducer. When schools of herring are encountered, samples are collected using the purse seine or, if not possible, hook and line. An underwater camera system is also used to verify species before sampling or if the seine can’t be deployed, when possible.

Each stock area will be surveyed every second year, with a south coast stock complex surveyed in late-winter/early-spring, and a northeast coast complex surveyed each late-fall/early-winter. A survey was conducted in BBTB in fall 2019; 468 transects (541 nmi) were surveyed (Figure 16) and seven purse seine sets were completed. Data from this survey was still being processed at the time of this update but initial results indicated most herring caught were age 2 SS. FB was surveyed in the winter 2020, with 325 transects (265 nmi) completed (Figure 17), and two purse seine sets done. The most recent survey was completed in WBNDB during the fall of 2020 (Figure 18), with 363 transects (455 nmi) and three purse seine sets completed. The next survey is planned for SMBPB in winter 2021. Acoustic and biological data from these surveys was still being processed at the time of this update and it is anticipated that results will be presented at the next stock assessment.

Stock Status Update

Stock status was calculated for this update using metrics of relative abundance and age composition from the spring research gillnet program (see Bourne et al. 2018 for detailed methodology). Going forward, biomass indices will be derived from acoustic surveys and assessment methodology for these stock complexes will be revised to include these data.

Stock status is calculated using three metrics from the spring research gillnet program: overall catch rates as a percentage of the reference period mean, catch rates of ages 7-10 as a percentage of the reference period mean, and the number of mature YCs above the reference period mean. Each metric is scored and all three are equally weighted to calculate the stock status index value. In BBTB, this is done for both SS and FS, then the values are weighted according to the proportion of each spawning component in the catch to give a combined stock status value. In FB, only SS are evaluated.

An additional year of data was available since the last stock assessment (DFO 2019) at the time of this meeting to update stock status. In BBTB, stock status increased from 2017, for the first time since a sharp decline in 2015-16, but still remains below values seen through the 2010s (Figure 19). This increase is attributable to higher catch rates of FS in 2018. In FB, stock status increased slightly in 2017 due to the incoming strong 2012 YC, there was no change in 2018 (Figure 20). The stock status remains low as a single YC is comprising the majority of the catch.

Future prospects are also evaluated by looking at the catch rates of age 4-6 herring in the research gillnet program, the number of age 4-6 YCs above average, and the trend in the age 4 recruitment index. In BBTB, catch rates of age 4-6 increased in 2018, one YC was above average and both SS and FS recruitment were above average (Figure 11). In FB, catch rates decreased slightly in 2018, one YC was above average, and recruitment was well below average (Figure 14).

Conclusions

- Total finfish biomass in the Newfoundland and Labrador shelves bioregion increased from the mid-2000s to early-2010s, but has declined since. Biomass remains low relative to pre-collapse levels. This recent decrease coincided with a joint reduction in availability of capelin and shrimp in the offshore since 2014. Ecosystems in the NL bioregions seem to be experiencing low productivity conditions. There is limited ability to make connections between offshore ecological data and inshore herring stocks.
- Preliminary commercial landings for 2019 were 7,131 t, 56% of the 13,242 t commercial quota (Southern Labrador to Fortune Bay) and 4,335 t in 2020, 34% of the quota. Landings varied by stock area, with some taking or exceeding their quota and others taking none or very little.
- Purse and tuck seine fishers estimated low discards in 2019. In 2020 fishers reported high discards due to undersized herring in all areas except Conception Bay-Southern Shore, where no discards were reported. Very low discards were reported in the 2019 Fortune Bay bar seine fishery, and none in 2020.
- Total estimated bait removals were 723 t in 2019 and 407 t in 2020, the lowest estimate of the telephone survey time series. In both years estimated bait removals were well below the 1,600 t total bait allocation for all stock areas. Mackerel accounted for the largest proportion of estimated bycatch in the bait fishery in both years.
- Biological data including ages were available for this update from the Bonavista Bay-Trinity Bay and Fortune Bay research gillnet programs to 2018. No new data since the last assessment were available for other stock areas.
- Fall spawners dominated the research gillnet program catch in Bonavista Bay-Trinity Bay during the 2000s. However, recent year classes have been comprised largely of spring

spawners with above average recruitment of this spawning component. This indicates a potential shift in stock composition toward spring spawners.

- In Bonavista Bay-Trinity Bay (with data up to and including 2018), the age distribution was stable with several strong year classes. The stock status index increased in 2018 and recruitment of both spring and fall spawners was above average. Future prospects for Bonavista Bay-Trinity Bay and the overall evaluation of stock status were positive.
- In Fortune Bay (with data up to and including 2018), the age distribution was unstable with a single year class dominating the catch. The stock status index remained low with no change from 2017. Recruitment was below average. Future prospects for Fortune Bay and the overall evaluation of stock status were negative.
- Acoustic surveys were reinstated in the region in 2019. Two surveys will be conducted annually during the fall/herring overwintering period, with White Bay-Notre Dame Bay, Bonavista Bay-Trinity Bay, St. Mary's Bay-Placentia Bay and Fortune Bay each being surveyed every two years. At the time of this update, Bonavista Bay-Trinity Bay, Fortune Bay, and White Bay-Notre Dame Bay had been surveyed with a winter 2021 survey planned for St. Mary's Bay-Placentia Bay. Acoustic and biological data will be processed and presented at the next full stock assessment.

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Sources of Information

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Appendix 1: Tables

Table 1a. 2019 bait fisher telephone survey results

Stock Complex	Total # Licenses and Bait Permits	# Fishers Phoned	Response Rate (%)	% of Fishers Actively Fishing Gillnets	Estimated # Active Bait Fishers	Estimated Bait Landings per Fisher (kg)	Estimated Total Bait Landings (t)
WBNDN	380	48	71	10	110	936	103
BBTB	275	87	49	37	102	1,770	180
CBSS	163	76	82	29	42	1,265	60
SMBPB	107	64	55	17	18	12,335	224
FB	117	66	65	56	66	2,377	156
Total	1,042	341	322	149	343	18,683	723

Table 1b. 2020 bait fisher telephone survey results

Stock Complex	Total # Licenses and Bait Permits	# Fishers Phoned	Response Rate (%)	% of Fishers Actively Fishing Gillnets	Estimated # Active Bait Fishers	Estimated Bait Landings per Fisher (kg)	Estimated Total Bait Landings (t)
WBNDN	391	99	69	28	160	806	129
BBTB	276	91	55	34	94	964	90
CBSS	169	78	53	20	34	3,363	114
SMBPB	116	67	60	12	14	3,363	47
FB	122	68	37	28	34	792	27
Total	1,074	403	274	122	336	9,288	407

Appendix 2: Figures

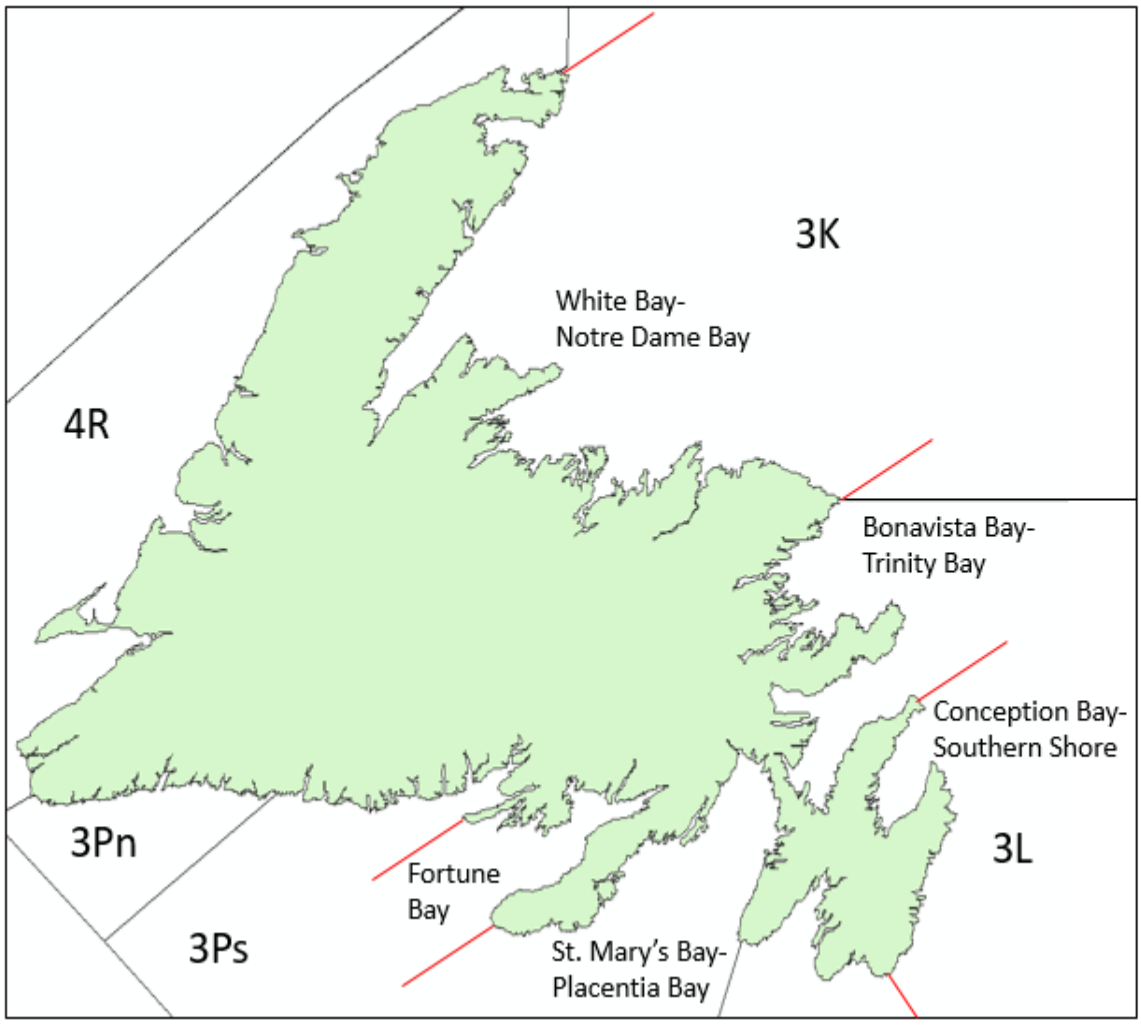

Figure 1. Map of Atlantic herring stock complexes on the south and northeast coasts of Newfoundland (denoted by red lines) and NAFO Divisions (black lines)

Figure 2. Percentage of spring spawners (green/hatched bars) and fall spawners (orange/solid bars) in the spring research gillnet program in Bonavista-Trinity Bay (BBTB) and Fortune Bay (FB).

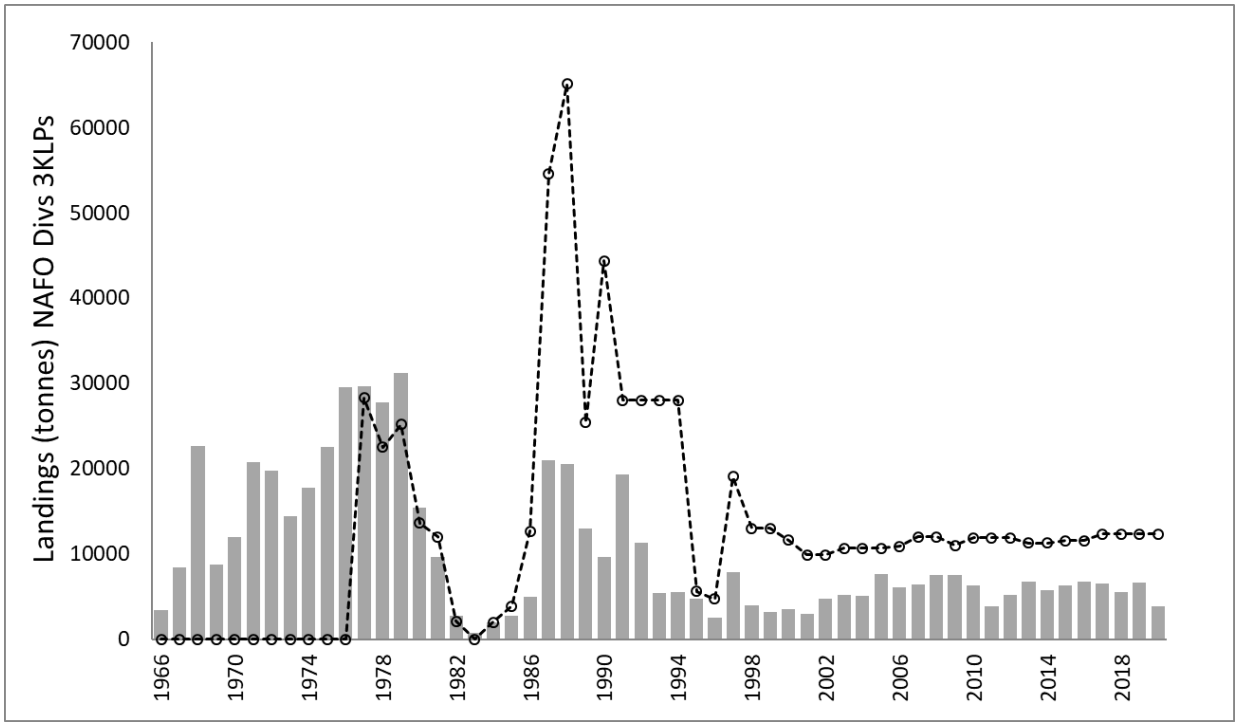

Figure 3. Total landings (bars) and TAC (circles) for NAFO divisions 3KLPs (2019 and 2020 landings data preliminary, updated January 6, 2021).

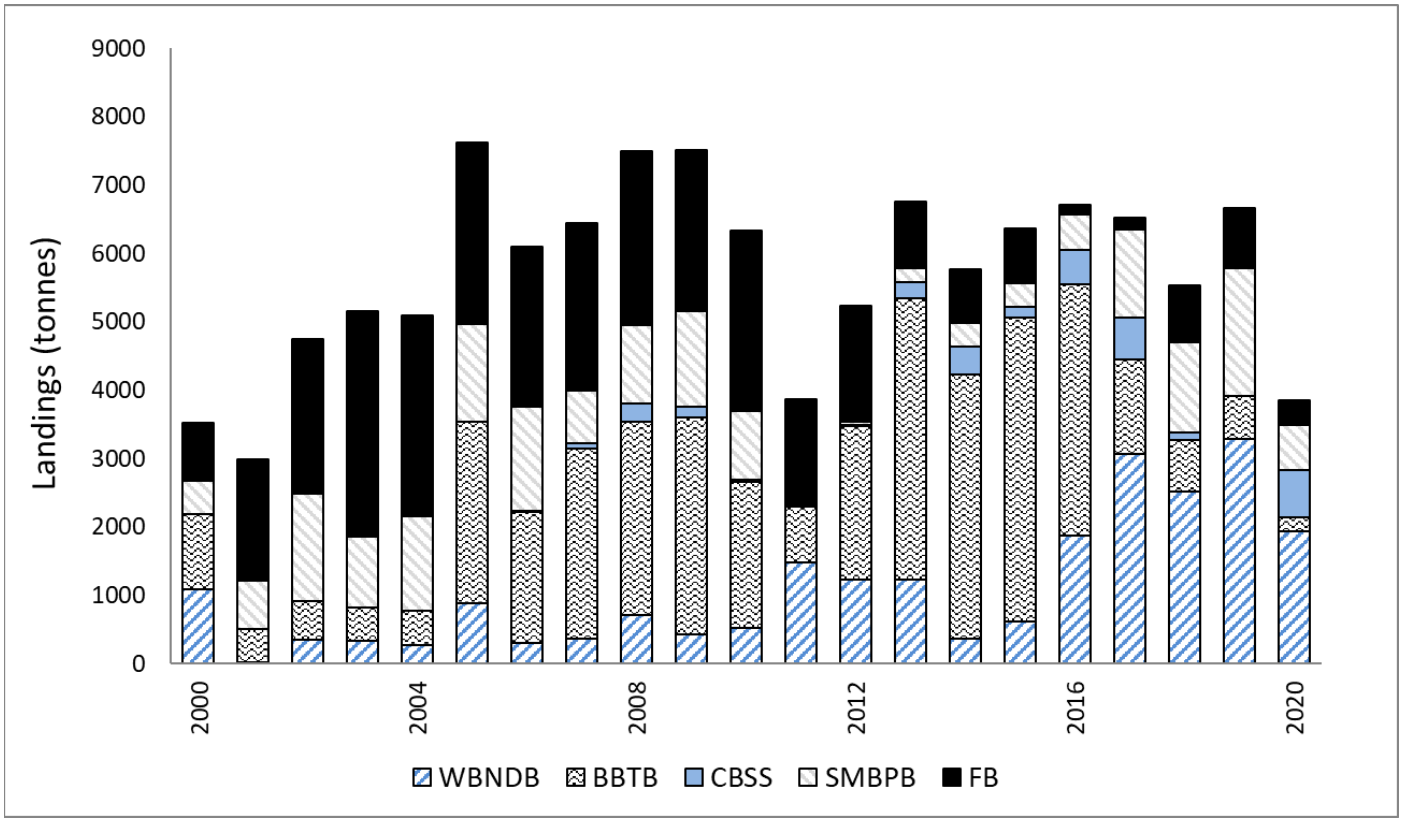

Figure 4. Landings by stock area (2019 and 2020 landings data considered preliminary, updated January 6, 2021).

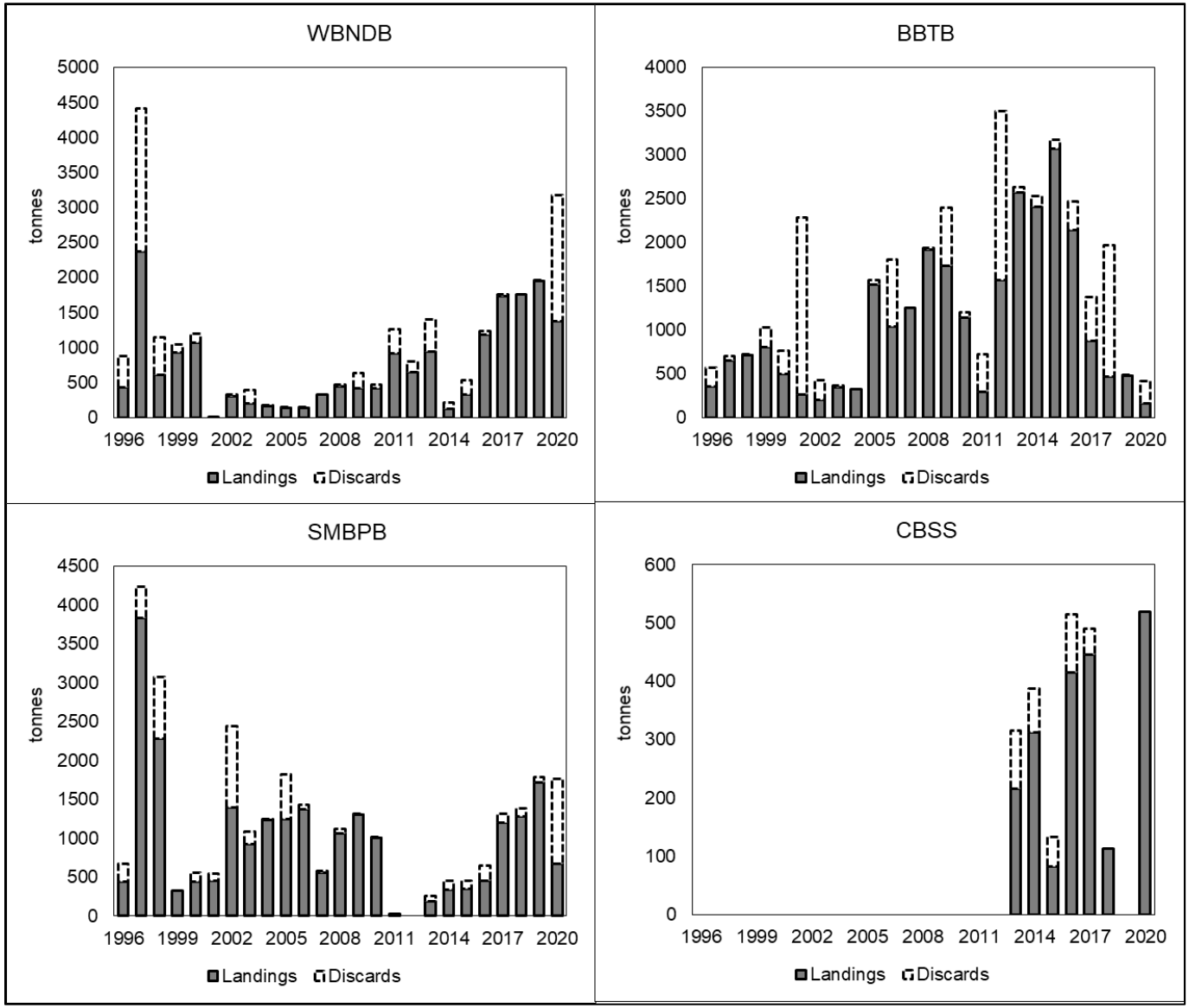

Figure 5. Total landings (solid bars) and estimated discards (white bars) in the purse seine fishery based on annual telephone survey.

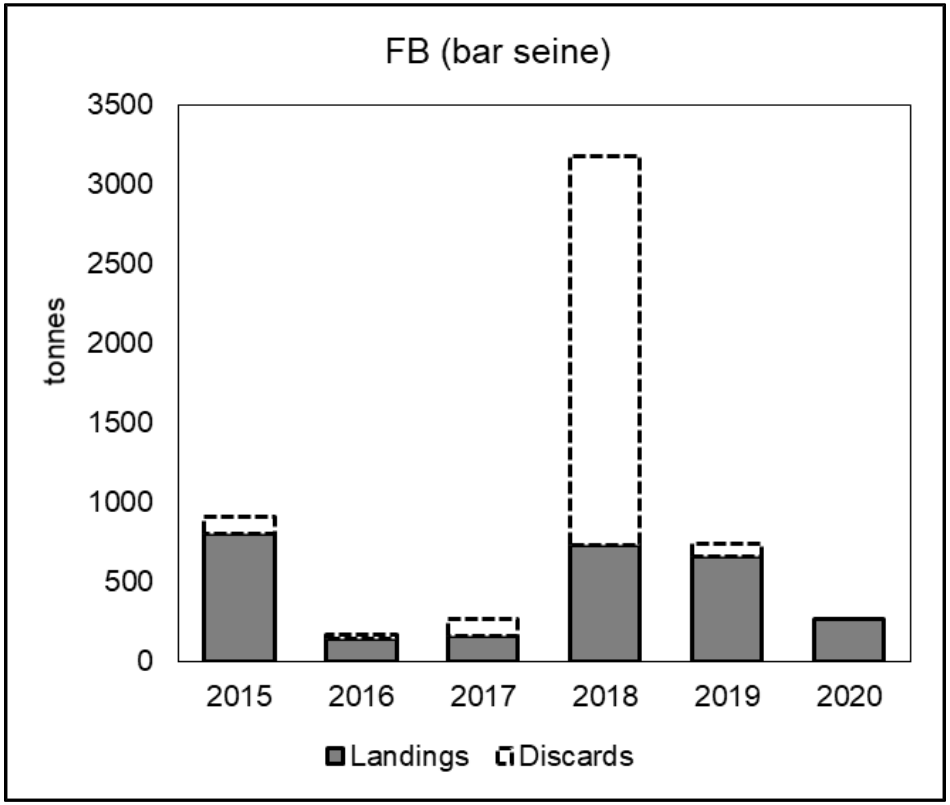

Figure 6. Total landings (solid bars) and estimated discards (white bars) in the bar seine fishery in Fortune Bay based on annual telephone survey.

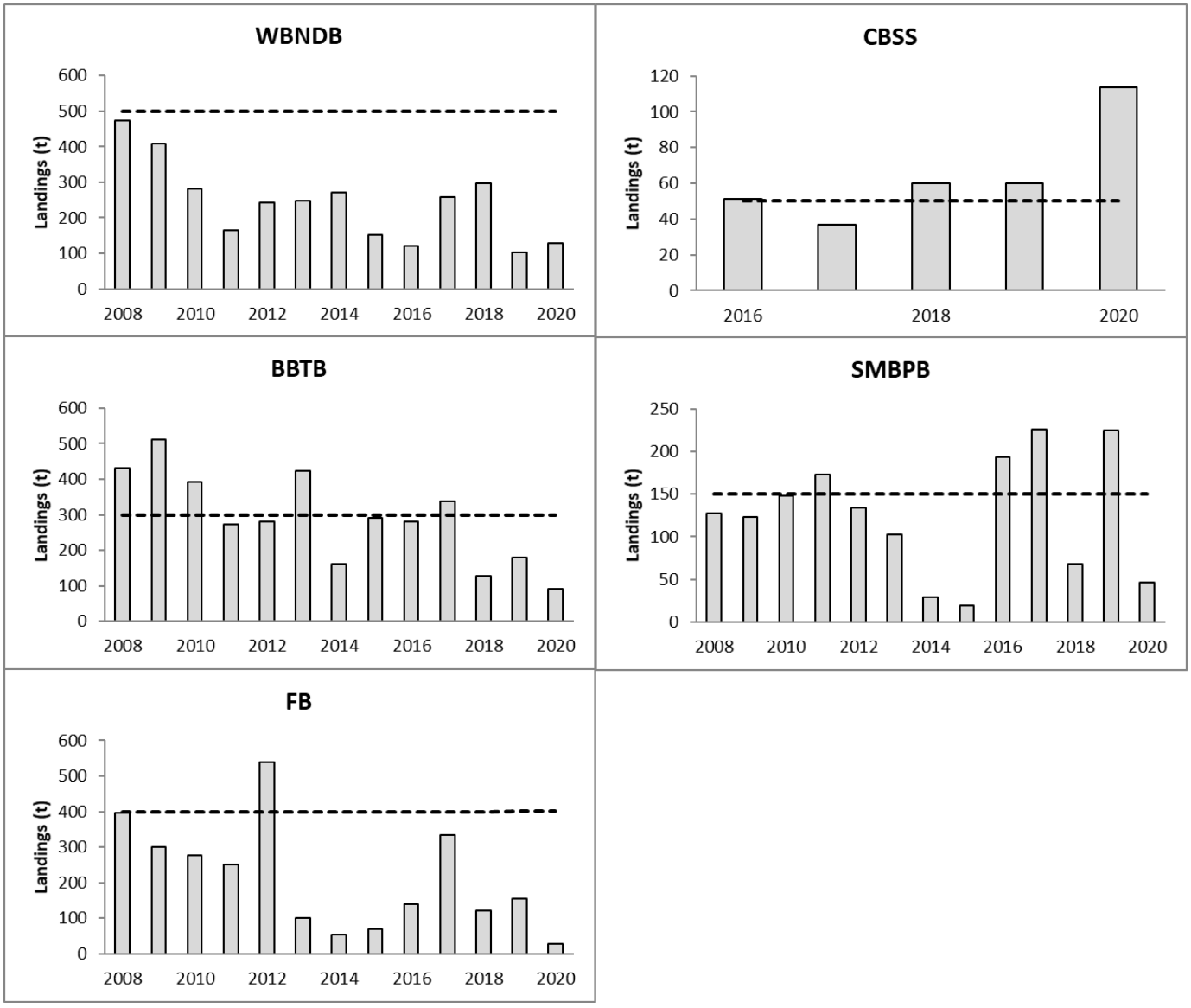

Figure 7. Estimated bait removals (t) (bars) and bait allocations (broken line) by stock area based on annual telephone survey.

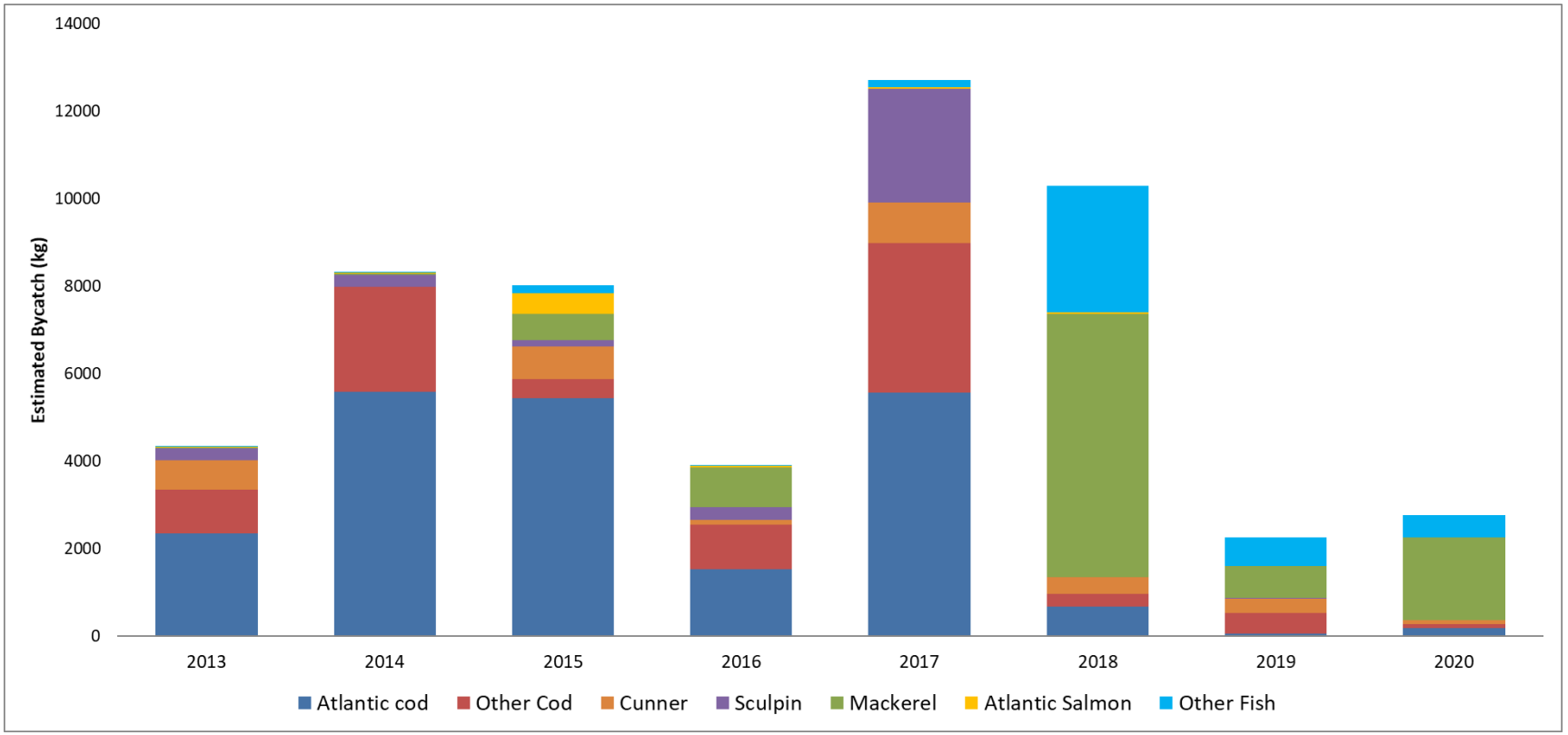

Figure 8. Estimated bycatch (kg) in the herring gillnet bait fishery based on annual telephone survey.

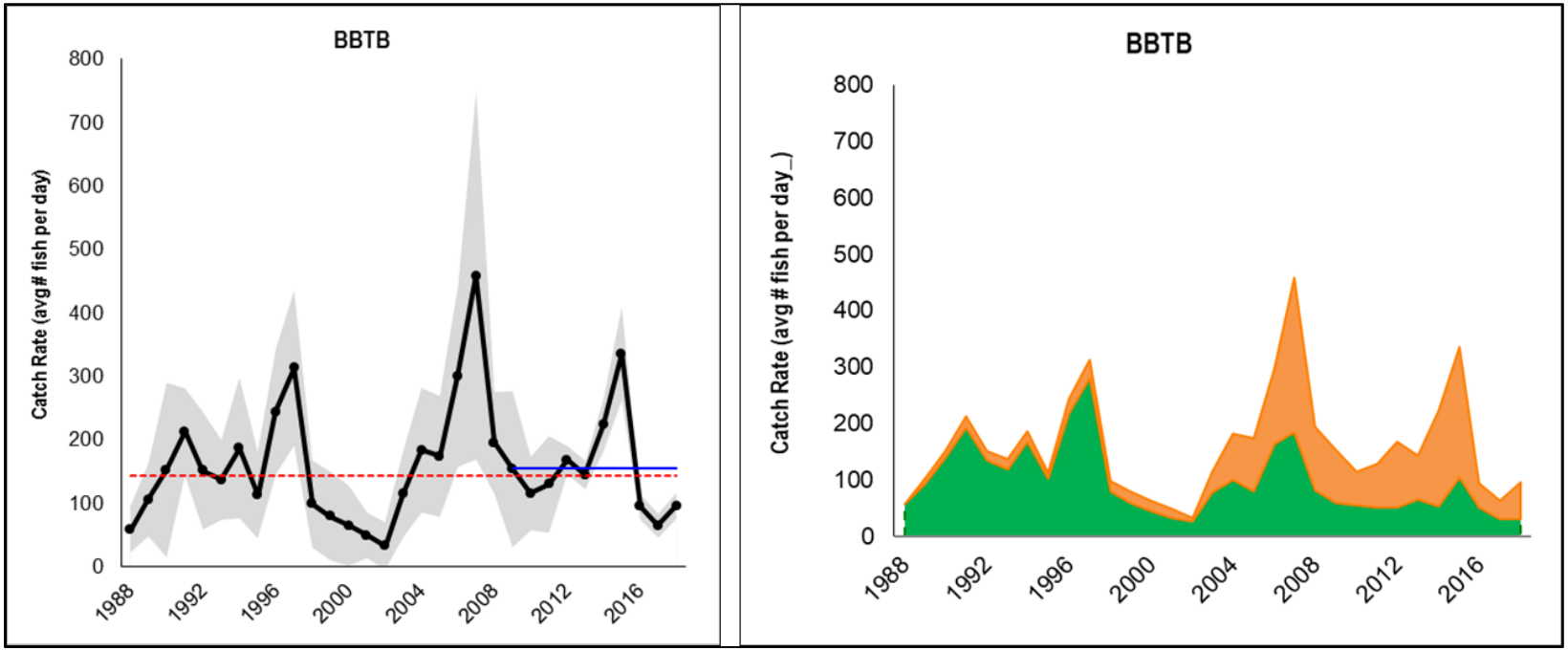

Figure 9. Catch rates in the Bonavista Bay-Trinity Bay research gillnet program to 2018; left panel shows total combined with 95% confidence intervals (shaded area), reference period (1990-2005) mean (red/broken line) and decadal mean (blue/solid line); right panel shows catch composition by spring spawners (bottom/green) and fall spawners (top/orange).

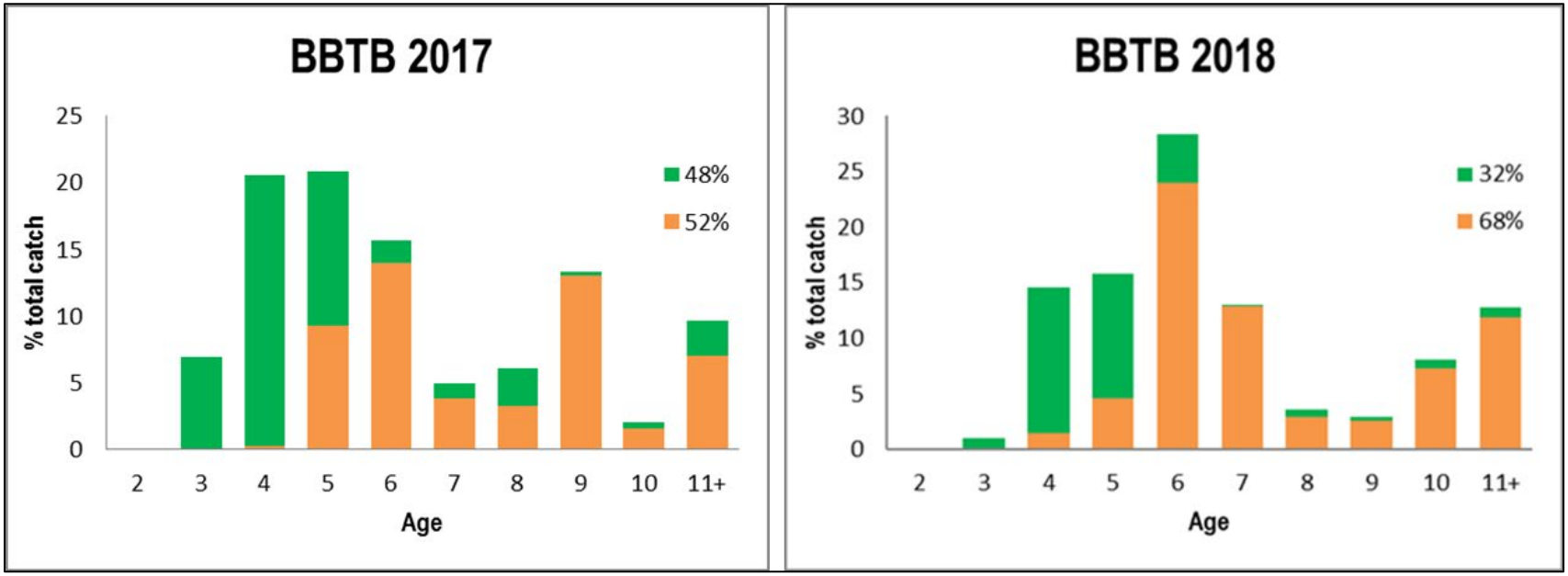

Figure 10. Catch at age in the Bonavista Bay-Trinity Bay spring research gillnet program by spawning component (green bars=spring spawners, orange bars=fall spawners) in 2017 (left panel) and 2018 (right panel).

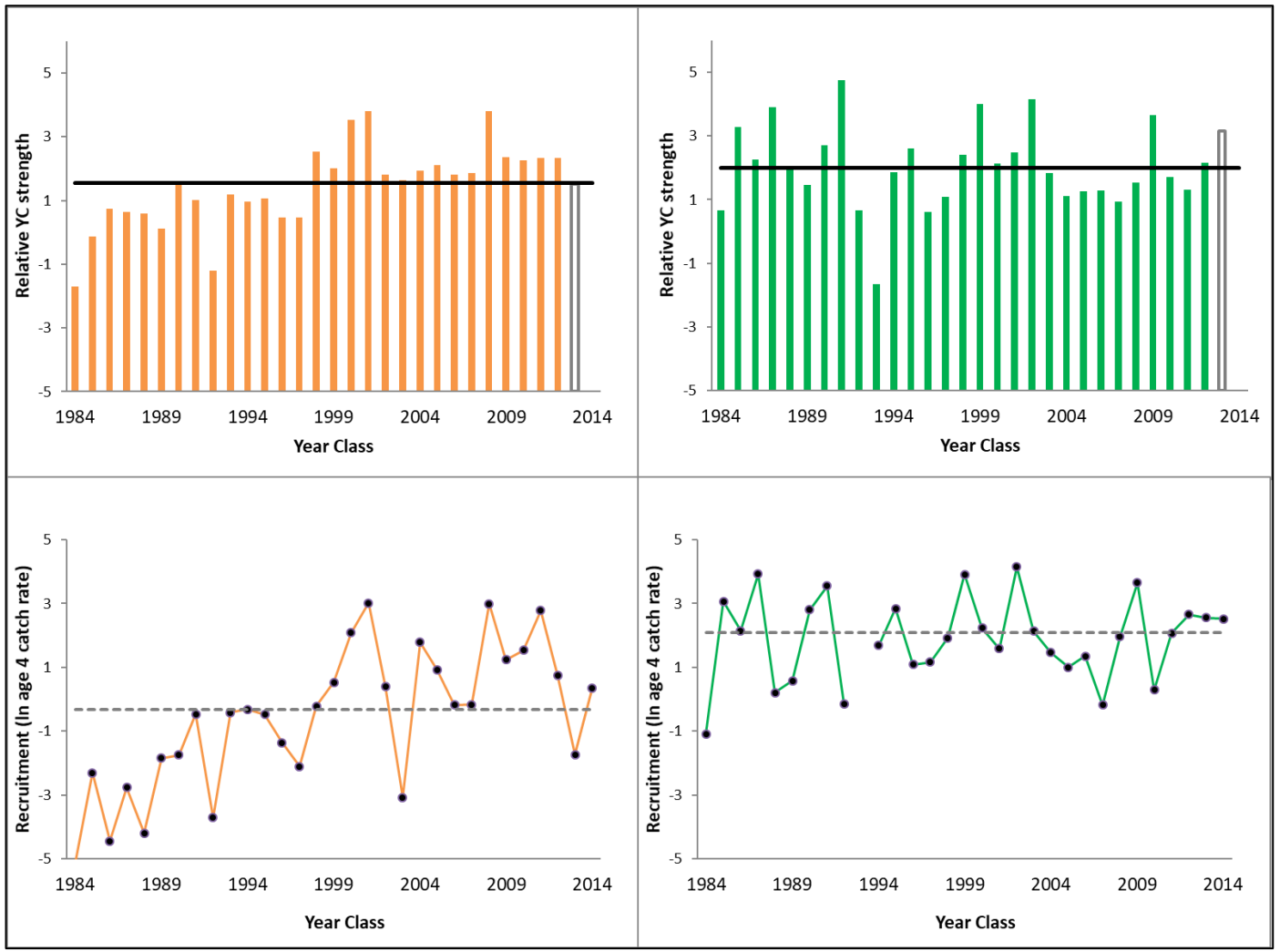

Figure 11. Year class strength and recruitment of fall spawners (left panels) and spring spawners (right panels) in the Bonavista Bay-Trinity Bay research gillnet program. Top panels: relative year class strength based on research gillnet program catch rates (ages 4-6, solid bars; ages 4-5, white bar) and reference period (1990-2005) mean (solid line). Bottom panels: recruitment (ln age 4 catch rate) and reference period mean (broken line)

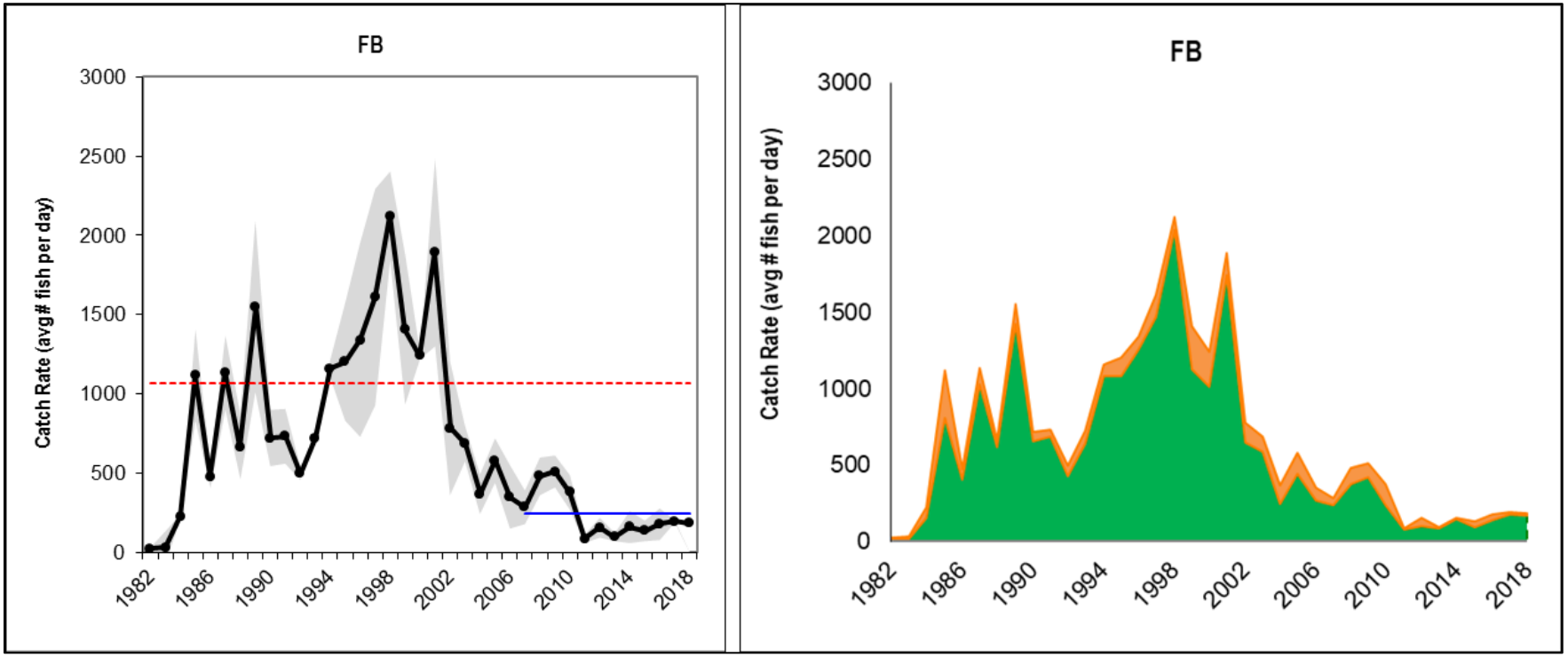

Figure 12. Catch rates in the Fortune Bay research gillnet program to 2018; left panel shows total combined with 95% confidence interval (shaded area), reference period (1990-2005) mean (red/broken line) and decadal mean (blue/solid line); right panel shows catch composition by spring spawners (bottom/green) and fall spawners (top/orange).

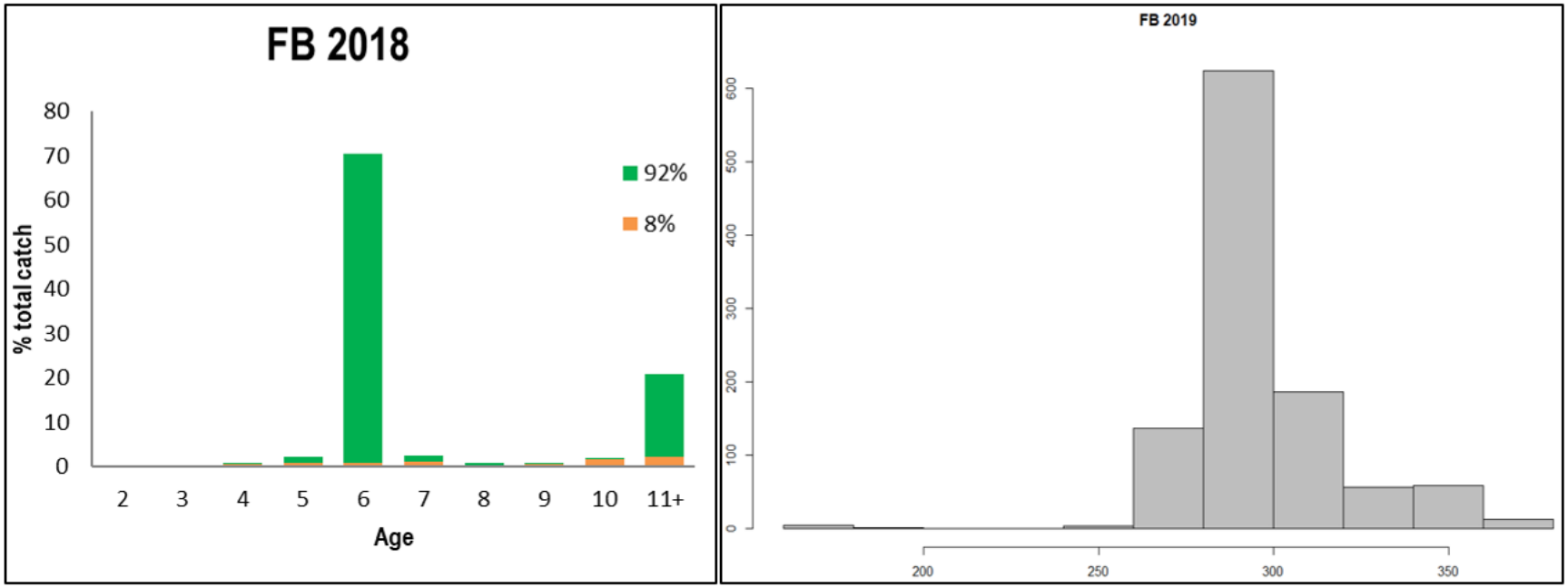

Figure 13. Left panel: catch at age in the Fortune Bay spring research gillnet program by spawning component (green bars=spring spawners, orange bars=fall spawners). Right panel: length-frequency distribution (total length mm) of un-aged herring samples collected in the 2019 research gillnet program.

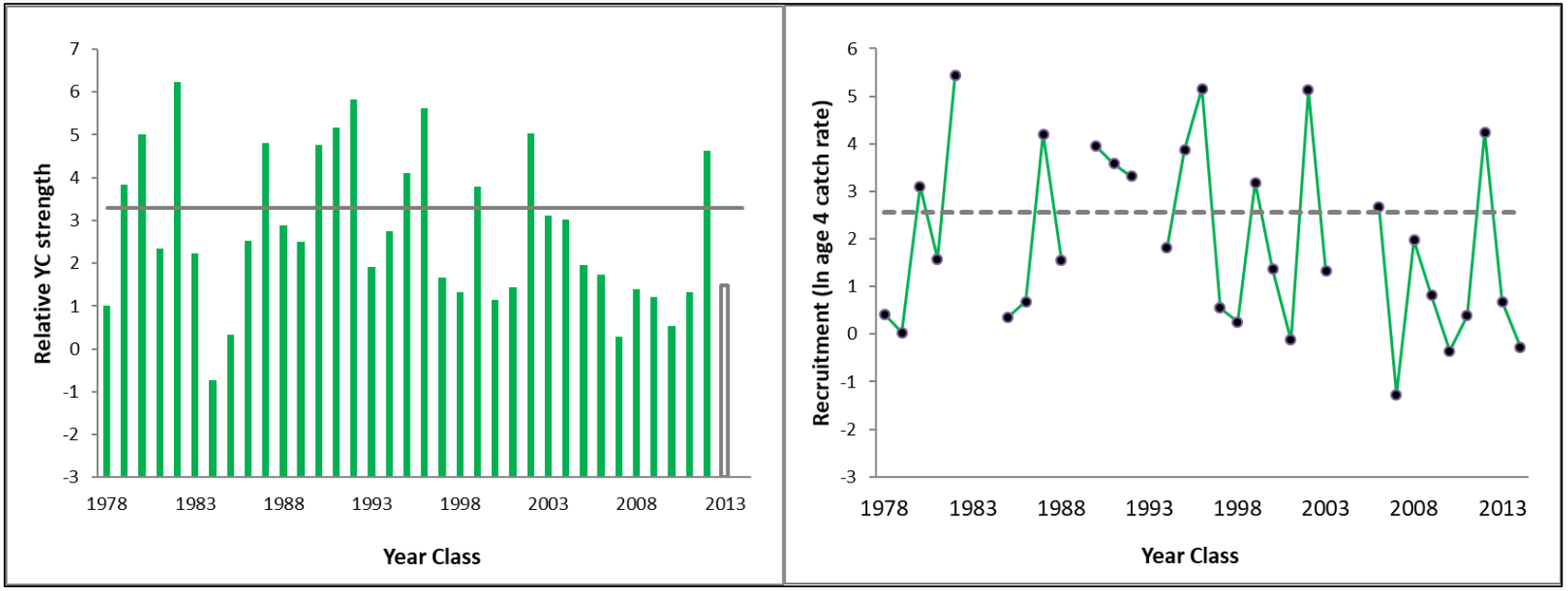

Figure 14. Year class strength and recruitment of spring spawners in the Fortune Bay research gillnet program. Left panel: relative year class strength based on research gillnet program catch rates (ages 4-6, solid bars; ages 4-5, white bar) and reference period (1990-2005) mean (solid line). Right panel: recruitment (ln age 4 catch rate) and reference period mean (broken line).

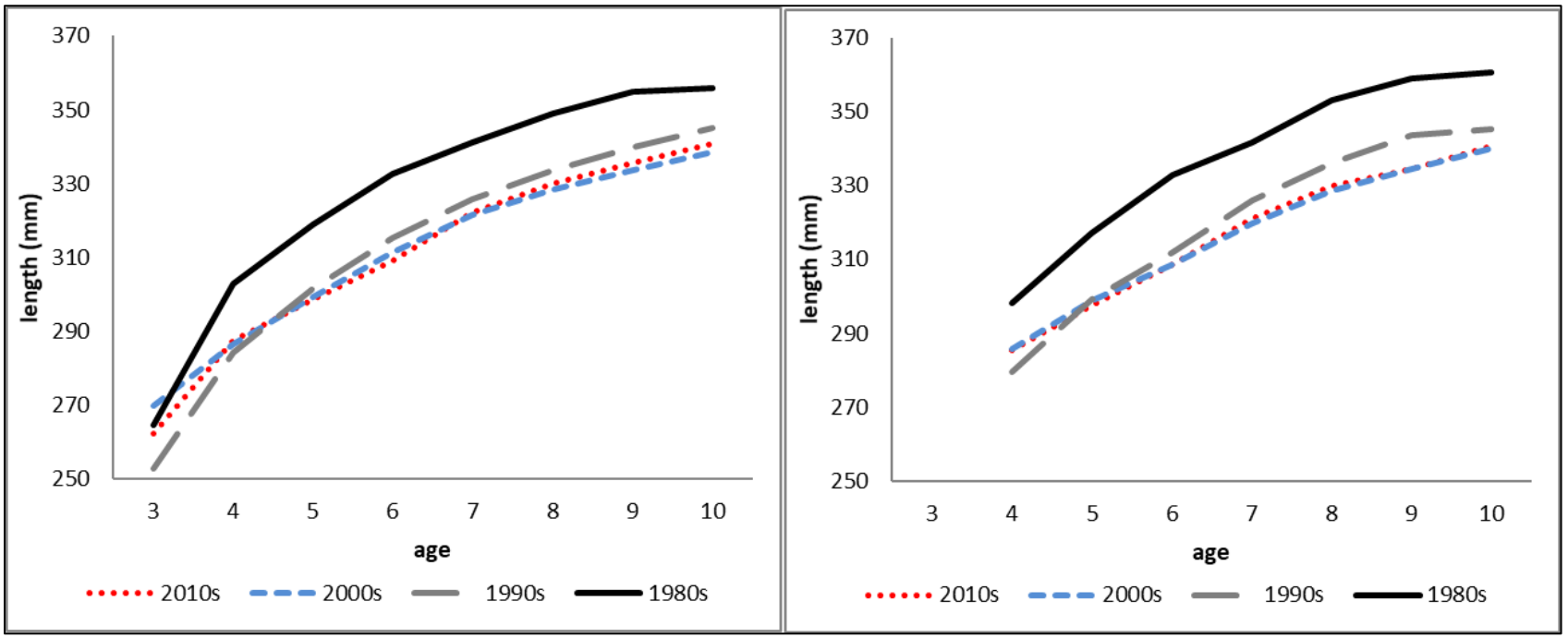

Figure 15. Mean length age (mm) of spring spawning (left panel) and fall spawning (right panel) herring by decade.

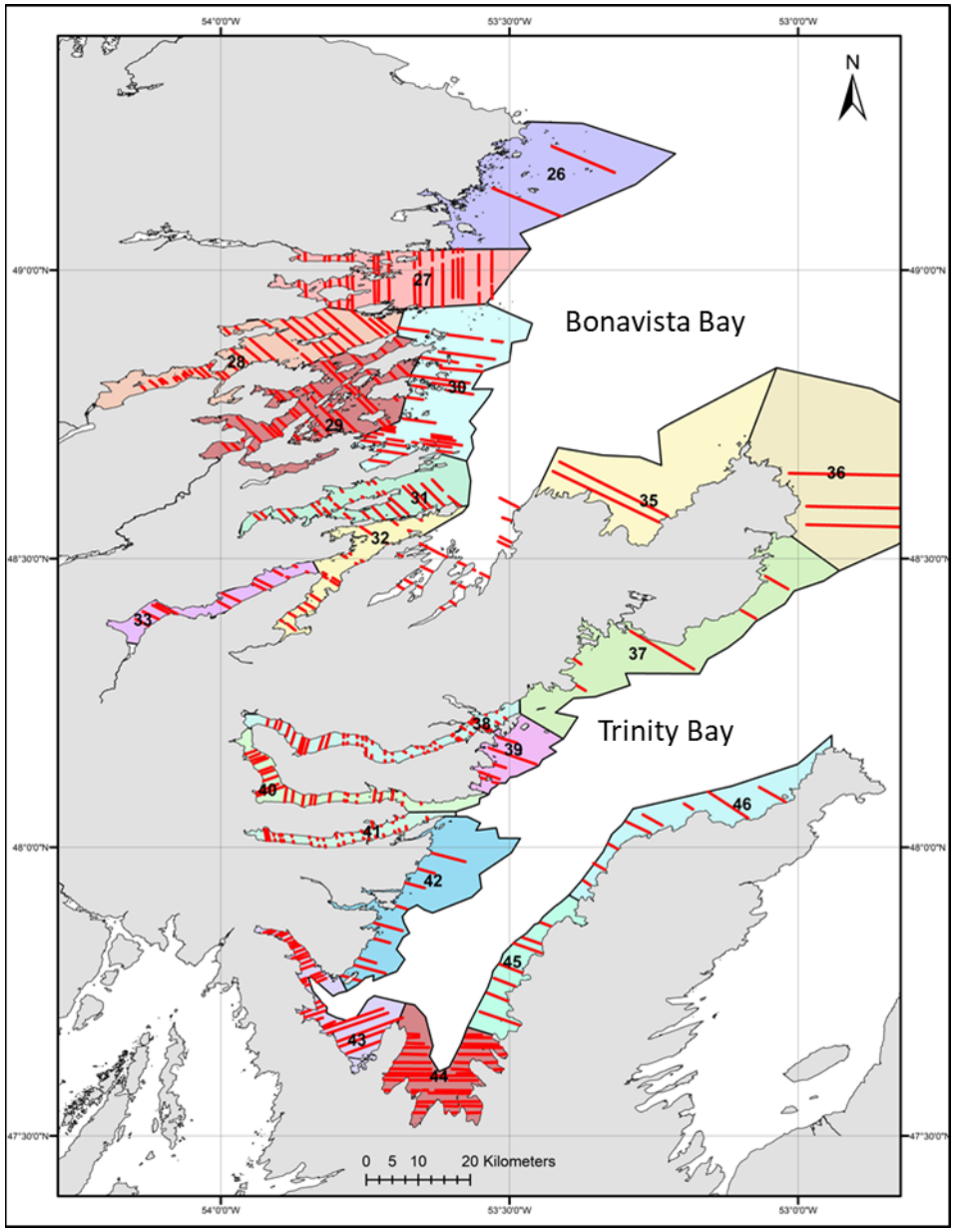

Figure 16. Strata and completed transects (red lines) in the fall 2019 Bonavista Bay-Trinity Bay herring acoustic survey.

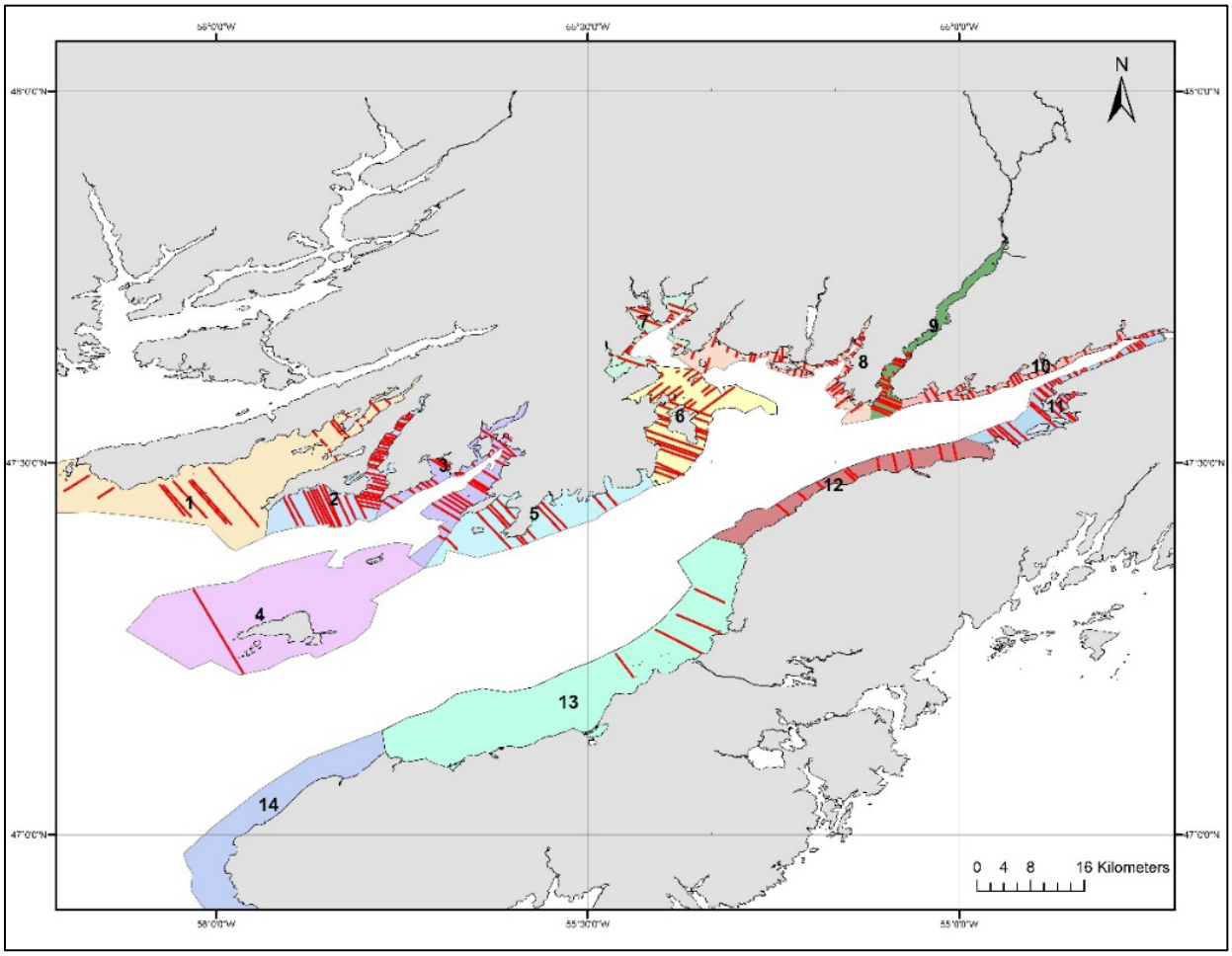

Figure 17. Strata and completed transects (red lines) in the winter 2020 Fortune Bay herring acoustic survey.

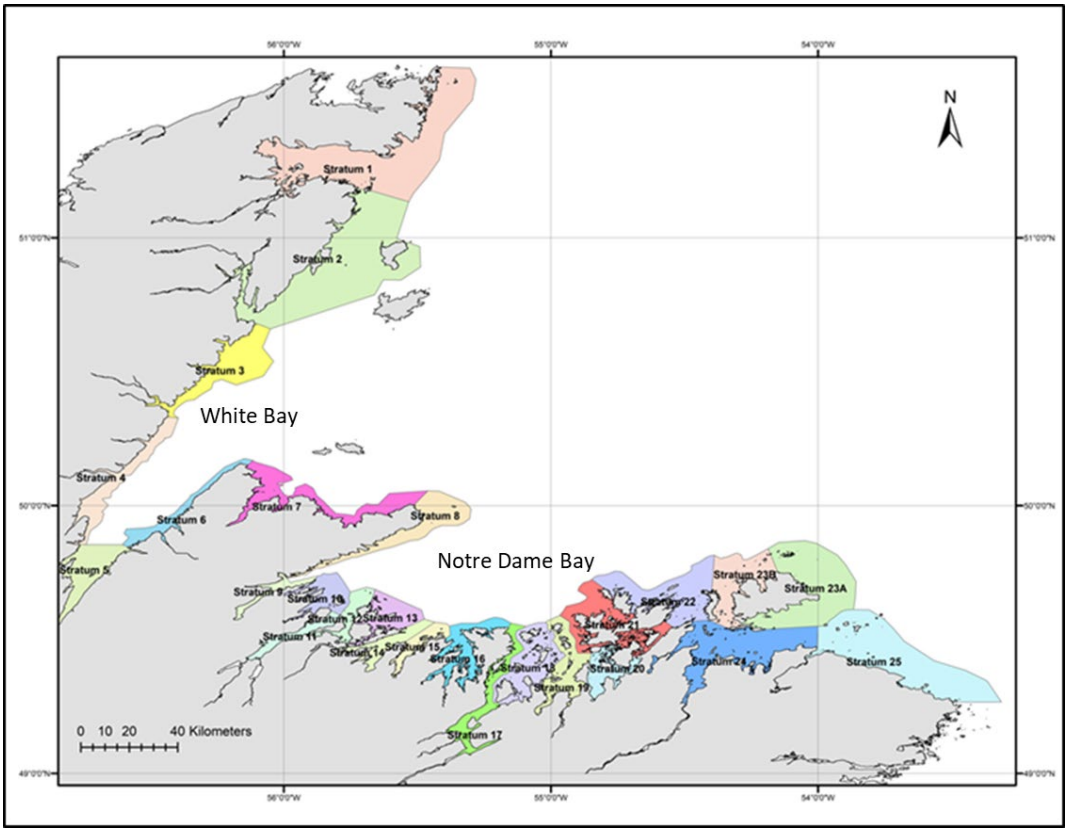

Figure 18. Strata surveyed in fall 2020 White Bay-Notre Dame Bay herring acoustic survey.

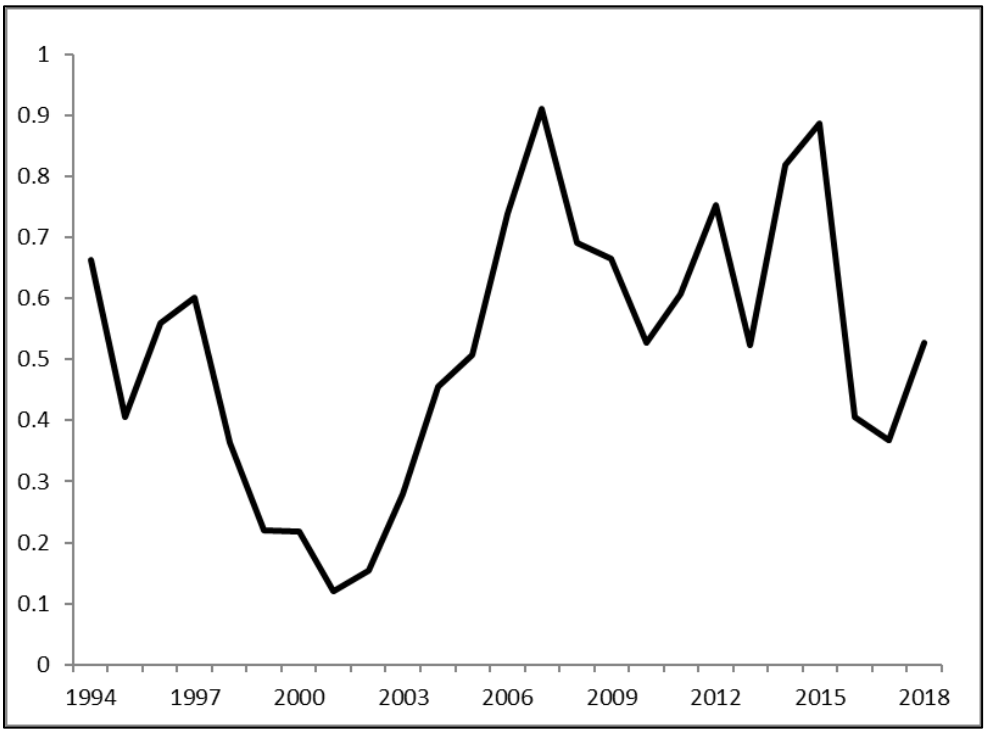

Figure 19. Stock status index of Bonavista-Trinity Bay stock complex.

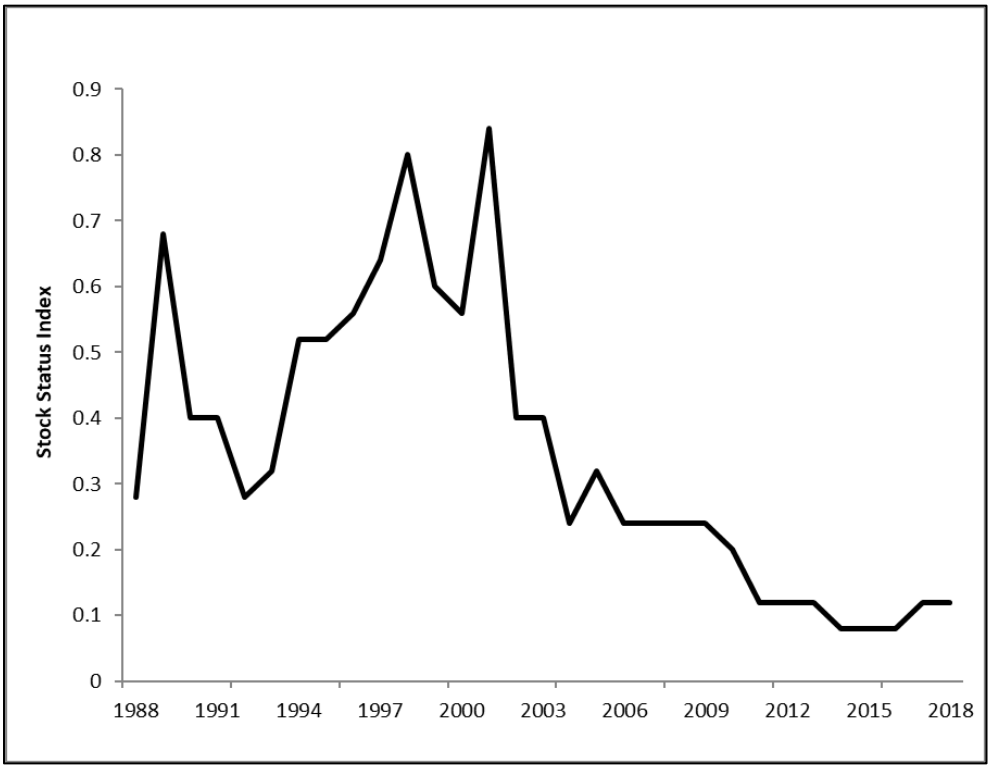

Figure 20. Stock status index of Fortune Bay stock complex.

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