ASSESSMENT OF NEWFOUNDLAND EAST AND SOUTH COAST HERRING IN 2017 AND 2018

Image. Atlantic Herring (Clupea harengus).
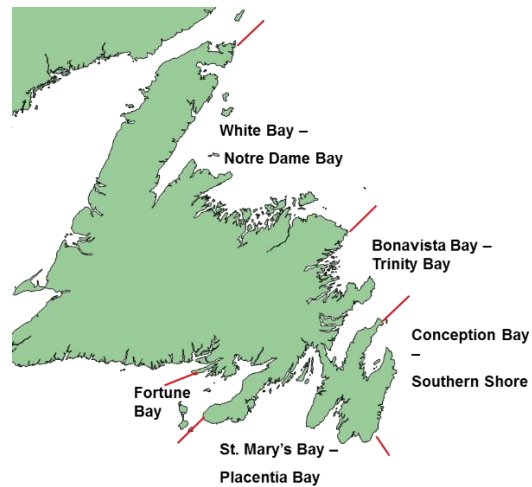
Figure 1. Map of Newfoundland east and south coast Atlantic Herring stock complexes.

Context:

Atlantic Herring (Clupea harengus) occurring in the Northwest Atlantic Fisheries Organization (NAFO) Divisions 2J3KL and Subdivision 3Ps are managed by stock complexes (Fig. 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 and are fished in southern Labrador – the stock affinity of these fish is currently unknown. Herring are fished both commercially and for bait; in 2017 and 2018 the combined Total Allowable Catch (TAC) for all stock areas was 12,842 t, approximately 46% of which was landed in both years. Total estimated bait removals were 1,192 t in 2017 and 675 t in 2018, based on DFO Science telephone surveys.

Spring spawning Herring historically comprised over 90% of all Newfoundland stock complexes. However with an increase in fall spawner recruitment through the 2000s in all areas except Fortune Bay, stock composition shifted, with fall spawning Herring comprising as much as 80% of the catch during the 2010s. At the time of this assessment, a decline in fall spawner recruitment and the presence of stronger spring year classes entering the fishery led to an increase in the percentage of spring spawners; most stock complexes are now comprised of a somewhat equal mix of spring and fall spawners, with the exception of Fortune Bay where spring spawners still dominate. These changes in spawning stock composition are correlated with ocean temperature and are thought to be driven by plankton dynamics.

This Science Advisory Report is from the Assessment of Divisions 2J+ 3KL and Subdivision 3Ps Herring meeting, held March 18, 2019 in St. John's, NL. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada (DFO) Science Advisory Schedule](#) as they become available.

SUMMARY

Overview

- The spring research gillnet program was used to update the stock status in Bonavista Bay-Trinity Bay and Fortune Bay. A similar gillnet research program conducted through the Coastal Baseline Program was used to update stock status for Placentia Bay.

- Given the absence of a quantitative indicator to evaluate stock trajectory, the group was unable to provide advice on stock status for White Bay-Notre Dame Bay or Conception Bay-Southern Shore.

- In all areas except Fortune Bay, spawning stock composition changed in the early 2000s from spring spawner to fall spawner dominance. Although strong recruitment of several spring spawner year classes increased the percentage of spring spawners in 2016-2017, the proportion remains below those observed prior to the 2000s.

Labrador

- Preliminary data indicate that Labrador landings were 18 t in 2017 (4% of the 500 t TAC) and 412 t in 2018 (82% of the TAC), the highest landings since the fishery began in 2013. The stock affinity of these fish is currently unknown.

White Bay – Notre Dame Bay

- Preliminary data indicate that White Bay – Notre Dame Bay landings reached the highest levels since the early 1990s in 2017 at 2367 t (92% of the TAC) and 2179 t in 2018 (85% of the TAC).

Bonavista Bay – Trinity Bay

- Preliminary data indicate that Bonavista Bay-Trinity Bay landings decreased from recent highs in 2015, with 729 t landed in 2017 (26% of TAC) with a further decrease in 2018 with 608 t (20% of TAC) landed.

- The stock status index derived from the research gillnet program decreased significantly in 2016 and again slightly in 2017. Future prospects for the stock are positive, with mean catch rates of age 4-6 Herring of both spawning components increasing from 2016 to 2017, and recent year class recruitment above average. Given the diverging trends in these indices, the stock status evaluation is uncertain.

Conception Bay – Southern Shore

- Preliminary data indicate that Conception Bay-Southern Shore landings increased to 610 t in 2017 (68% of the TAC), the highest level since the 1990s, but decreased to 114 t in 2018 (14% of the TAC). All commercial landings were from Conception Bay.

St. Mary's Bay – Placentia Bay

- Preliminary data indicate that St. Mary's Bay-Placentia Bay landings increased to the highest levels since the 1990s with 1,295 t landed in 2017 (62% of the TAC) and 1,397 t (62% of the TAC) landed in 2018.

- Combined catch rates in the Placentia Bay gillnet research program in 2018 were above the reference period mean and higher than the catch rate derived from the 2016 Placentia Bay acoustic survey; however, the catch was dominated by a single year class and recruitment was at or below average, giving an overall stock status of uncertain.

Fortune Bay

- Preliminary data for Fortune Bay indicate that landings remained low in 2017 at 175 t (15% of the TAC), but increased for the first time in recent years to 830 t (70% of the TAC) in 2018.

- The stock status index derived from the spring research gillnet program had a declining trend through the 2000s, with a slight increase in 2017. Mean catch rates of age 4-6 Herring increased from 2016 to 2017; however, this was due to the recruitment of the strong 2012 year class. Given these indices, the stock status evaluation is negative.

BACKGROUND

Stock Structure

Atlantic Herring (*Clupea harengus*) in NAFO Divisions 2J3KL and Subdivision 3Ps are divided into five stock complexes: 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 and are fished in southern Labrador; however, the stock affinity of these fish is currently unknown. The five stock complexes were determined through tagging experiments in the early-1980s, based on the spawning locations to which Herring returned annually (Wheeler and Winters 1984a; Wheeler and Winters 1984b). All five stock complexes are composed of both spring and fall spawners which remain mixed to some extent at all times.

Historically, all Newfoundland Herring stocks were dominated (90% or more) by spring spawners; however, fall spawner recruitment increased throughout the northwest Atlantic during the early-2000s, causing a shift in spawning stock composition (Melvin et al. 2009). In south and east coast Herring stocks, fall spawners comprised an increasing proportion of the catch through the 2000s (Fig. 2) – up to 80% in most areas except Fortune Bay, where fall spawner recruitment did not increase and spring spawners remained dominant (DFO 2017). With this shift in spawning stock composition, it was recommended at the 2013 2J3KLPs Herring framework assessment meeting that both spring and fall spawning components should be assessed for all stock areas where both were prevalent (Bourne et al. 2015). This change was implemented as of the 2015 assessment (DFO 2015). Since the last assessment (DFO 2017), fall spawner recruitment has declined and several potentially strong spring spawner year classes have entered the fishery, resulting in an approximately equal mix of spring and fall spawners in most stock areas as of 2017 (Fig. 2).
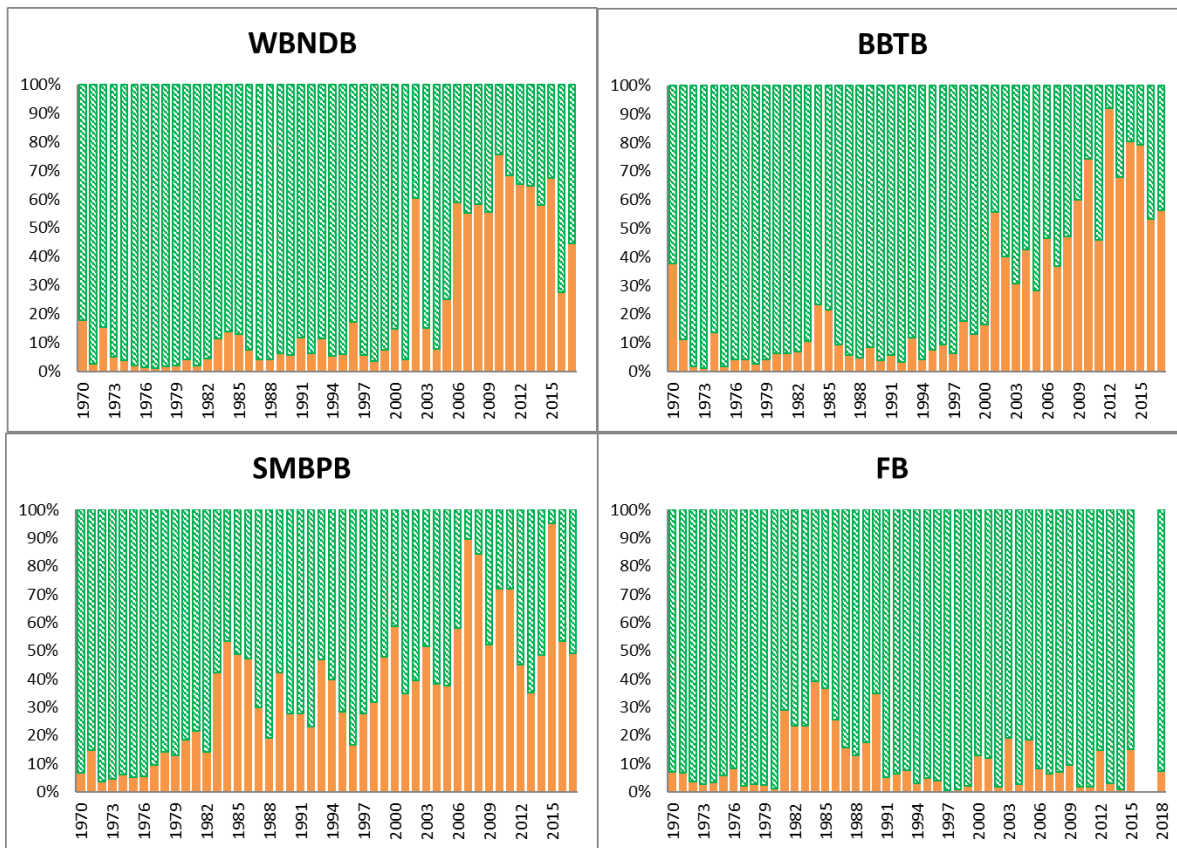
Figure 2. Percentage of spring (green/top bars) and fall (orange/bottom bars) spawning Herring in commercial fishery in White Bay-Notre Dame Bay (top left), Bonavista Bay-Trinity Bay (top right), St. Mary's Bay-Placentia Bay (bottom left) and Fortune Bay (bottom right) stock areas.

Commercial Fishery

The combined TAC for all areas in 2017-18 was 12,842 t, approximately 46% of which was landed in both years – landings data for 2017-18 were considered preliminary at the time of this assessment (Fig. 3). The commercial fishery is largely carried out by purse and tuck seines, with bar seines, gillnets and traps comprising a smaller percentage of total landings. The fishery takes place entirely during spring in FB, and during spring, fall and early winter in other stock areas.
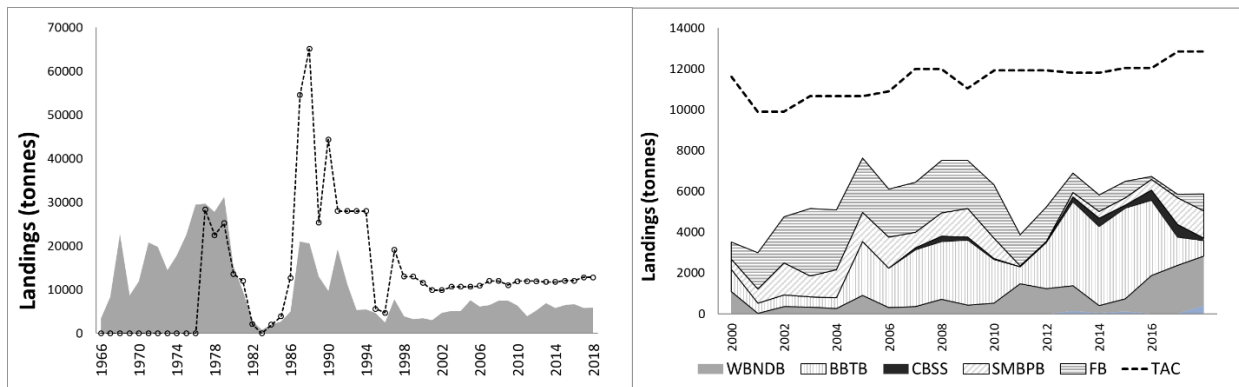
Figure 3. Total TAC (dashed line), total commercial landings 1966-2018 (left panel) and landings by stock area 2000-18 (right panel). Note: 2017 and 2018 landings data considered preliminary.

There has been a commercial Herring fishery in Labrador since 2013 with a 500 t fixed gear TAC. In 2017, only 4% of the TAC was landed, but landings increased to 80% in 2018. No catch composition data was available for 2017 in this area as no commercial samples were collected. In WBNDB, approximately 92% and 95% of the 2568 t TAC was landed in 2017 and 2018, respectively. These represent some of the highest landings since the late 1990s (Fig. 3). The age distribution in the 2017 catch in WBNDB was broad, with incoming age 2, 3 and 4 spring spawners comprising a large proportion of the catch, and fall spawners dominating all older (age 5+) age classes (Fig. 4). In BBTB, landings decreased, with approximately 23% and 13% of the 5,990 t TAC landed in 2017 and 2018 respectively (Fig. 3). Industry reported that these decreases were largely due to high percentages of undersized fish. The age distribution of the 2017 catch in BBTB was largely dominated by the 2012 year class (age 5's) with a mix of spring and fall spawners (Fig. 4). Commercial landings in CBSS increased through the 2010s and remained relatively high in 2017 with 68% of the 895 t TAC landed; however, landings decreased in 2018 to just 13% of the TAC (Fig. 3). As with BBTB, these lower landings were attributed to the presence of high percentages of undersized fish. The age distribution in CBSS in 2017 was similar to that of BBTB, with the strong 2012 year class dominating the catch (Fig. 4). Commercial landings increased in SMBPB in 2017 and 2018, with approximately 63% of the 2100 t TAC landed in both years (Fig. 3). As with other stock areas, the strong 2012 year class dominated the commercial catch in this area in 2017 (Fig. 4). Landings in FB remained low in 2017 with 22% of the 789 t TAC landed, but increased in 2018 to 100% of the TAC (Fig. 3). No commercial samples were obtained in 2017 but the 2018 catch at age showed that the stock is dominated by the 2012 year class, with very few Herring of any other age class (Fig. 4). This is similar to the skewed age distribution observed in this area during the 2010s when the 2002 year class comprised almost all of the catch for a number of years (DFO 2017).
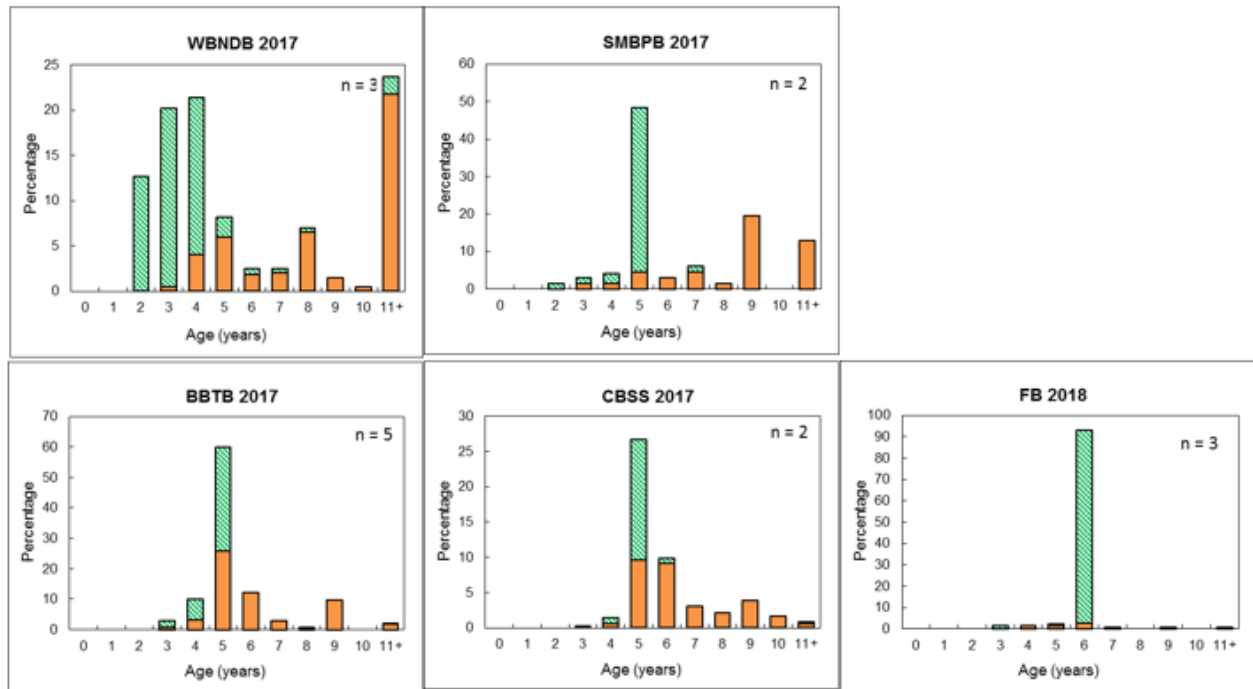
Figure 4. Commercial catch at age by stock area and spawning stock component (spring spawners=green/top bars; fall spawners=orange/solid bars) based on commercial samples (n=number of samples) in 2017 for WBNDB (top left), BBTB (bottom left), SMBPB (top center), CBSS (bottom centre) and 2018 for FB (bottom right).

Bait Fishery

Herring are also fished for bait, with the gillnet bait fishery largely occurring during the spring prior to the lobster fishery. Because bait removals are not required to be reported, an annual telephone survey of bait fishers has been conducted by DFO Science since 2008. The phone survey is used to estimate total active fishers and bait removals by area (CBSS was added to the survey in 2016). Throughout the time series approximately 25-35% of bait license holders have been active each year, though the number of license holders has consistently declined. In 2017, an estimated 529 fishers were fishing Herring for bait, this number decreased to 363 fishers in 2018. Based on survey results, approximately 1,192 t of Herring was landed as bait in 2017, and 675 t in 2018. Estimated bait removals have been at or below the total bait allocation of 1,400 t since the phone survey began (Fig. 5).

From 1996 to 2016, voluntary logbooks were also sent to all bait license holders to estimate removals, but return rates were extremely poor and the telephone survey is used as the primary method to estimate bait removals. In 2017 logbooks became mandatory, with approximately 13% of active 2J3KLPs bait fishers returning them that year. Follow up calls were completed in the winter of 2018 to increase compliance and return rates in the following year were 15% at the time of this assessment, though that is likely an underestimate as logbooks were still being returned at the time of the assessment.
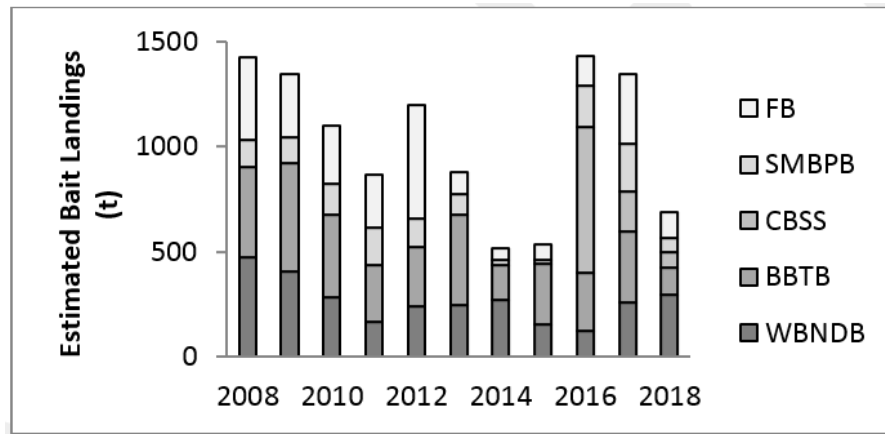
Figure 5. Herring bait removal estimates (t) by stock area based on the annual DFO Science telephone survey (note CBSS was added to survey in 2016).

ASSESSMENT

Stock status is evaluated using data collected from the DFO Science Herring research gillnet program, which provides a fishery-independent index of abundance. In areas where the program operates, four fishers per bay set a standardized fleet of five gillnets of varying mesh size (ranging from two to three inches) for a 45 day period each spring in a set location. During the fishing period, fishers keep detailed logbooks and collect samples of Herring caught in their nets. These samples are then used to calculate mesh-disaggregated catch rates at age by spawning type, calculate year class strength, and to derive a recruitment index based on catch rates of age 4 fish. The program currently operates in BBTB and FB only; however, in 2018 a similar program ran in Placentia Bay as a part of the Coastal Environmental Baseline Program, under DFO's Oceans Protection Program.

A stock status index is calculated based on three metrics from the research gillnet program: the overall catch rate (scored as a percentage of the reference period mean); catch rates of mature year classes (scored as a percentage of the reference period mean); and the number of mature year classes that are of above average strength. A fixed reference period of 1990-2005 was decided during the 2017 stock assessment meeting (DFO 2017) as it captures recent variation in the stocks. In stock areas where both spring and fall spawners are prevalent, the stock status index is derived for each spawning component and combined as a weighted mean based on the percentage of each spawning component in the catch. The status for future prospects is evaluated by assessing the strength of two ages classes (age 4 [recruiting] and age 5).

Bonavista Bay – Trinity Bay

In BBTB, combined catch rates in the research gillnet program decreased sharply in 2016 after reaching a time series high in the previous year. Catch rates declined further in 2017 and increased slightly in 2018, but still remain well below the reference period mean (Fig. 6). For the first time in a decade, the percentage of fall spawners in the catch fell below 50% in 2017, comprising 48% of the catch. The percentage of fall spawners increased slightly in 2018 to 52% but is still relatively low compared to previous years.
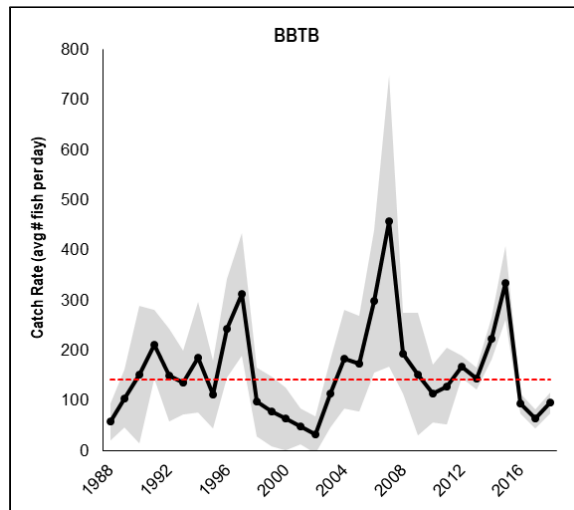
Figure 6. Combined mean catch rate of spring and fall spawning Herring 1988-2018 (dashed/red line = reference period mean) in the Bonavista Bay-Trinity Bay spring research gillnet program.

The age structure of Herring sampled during the research gillnet program was broadly distributed in 2017. Spring spawners comprised 100% of the age 3 and 4 year classes. In 2017, for the first time since the late-1990s, recruitment of age 4 fall spawning Herring fell well below the reference period (1990-2005) mean, while spring spawner recruitment was above average for the third consecutive year (Fig. 7). Relative year class strength (mean catch rates at age 4, 5 and 6) has been above average for fall spawners since the late-1990s. Spring spawner year class strength has been more variable, but the mean catch rates for the 2012 year class at ages 4 and 5 indicate that 2012 is a potentially strong year class for spring spawners (Fig. 8). The stock status index (Fig. 9), based on spring and fall spawning components, decreased significantly in 2016 and decreased again slightly in 2017 (the index could not be updated to 2018 as Herring age data was not available for this assessment). Future prospects are positive as spring spawner recruitment has been above average in recent years and the 2012 year class was of above average strength (Figs. 7 and 8).
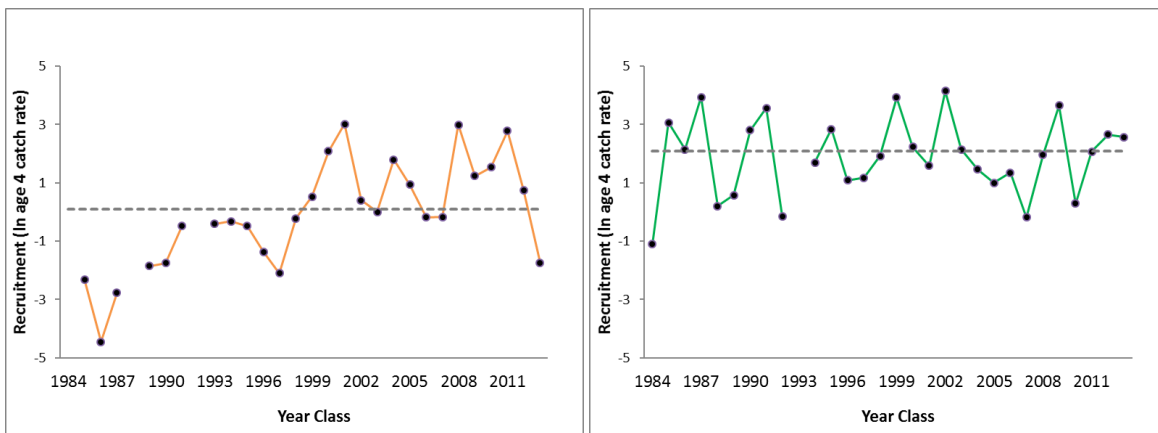

Figure 7. Recruitment of age 4 fall spawning (left) and spring spawning (right) Herring and reference period (1990-2005) mean (dashed line) in the Bonavista Bay-Trinity Bay stock area based on catch rates in the spring research gillnet program.
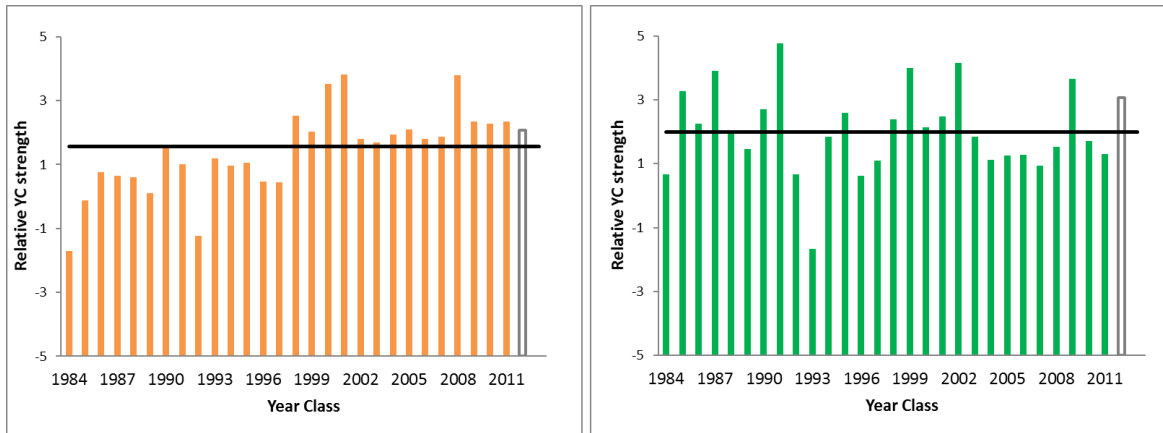
Figure 8. Relative year class strength (mean catch rate at age 4, 5 and 6; solid bars) and initial year class strength (mean catch rate at age 4 and 5; unfilled bars), and reference period (1990-2005) mean year class strength (solid line) of fall spawning (left) and spring spawning (right) Herring in the Bonavista Bay-Trinity Bay stock area in the spring research gillnet program.
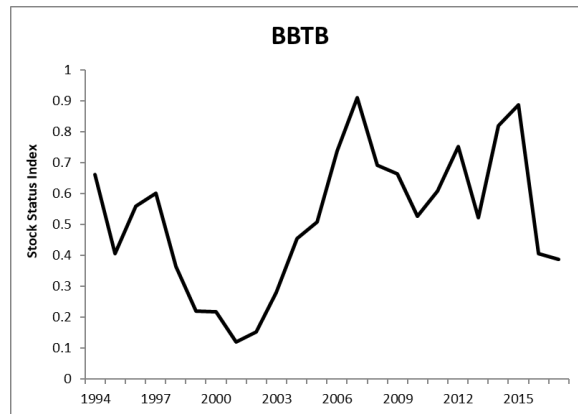

Figure 9. Stock status index for Bonavista Bay-Trinity Bay (1994-2017) derived from the catch at age and catch rates of spring and fall spawners from the annual spring research gillnet program.

St. Mary's Bay – Placentia Bay

Though there is no longer a research gillnet program in SMBPB, the stock status for this stock area was evaluated based on the results of the 2018 Placentia Bay Coastal Baseline research gillnet program which followed the same protocols as the original program, allowing the time series to continue. As this program operated in Placentia Bay only, previous SMBPB combined catch rates (1982-2012) were revised to include only the PB portion of the stock area. The results of an opportunistic acoustic survey in 2016 were used to extrapolate a catch rate estimate for that year, which was just below average (DFO 2017). The 2018 catch rate was slightly higher than 2016 – just above the reference period mean (Fig. 10). The catch was dominated by the strong 2012 year class and composed of 64% spring spawners. Recruitment of fall spawners was about average while recruitment of spring spawners was below average (Fig. 11). Year class strength and the stock status index could not be calculated for this area given the large gaps in the time series.
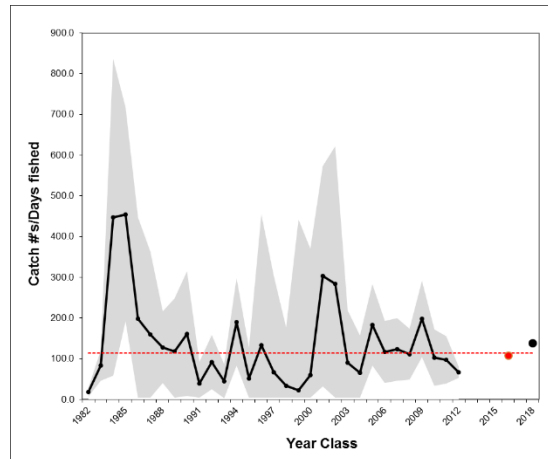
Figure 10. Combined mean catch rate of spring and fall spawning Herring 1982-2012 (black/solid line), estimated 2016 catch rate (red point) and 2018 catch rate (black point) and reference period mean (dashed/red line = reference period mean) in the Placentia Bay research gillnet program.
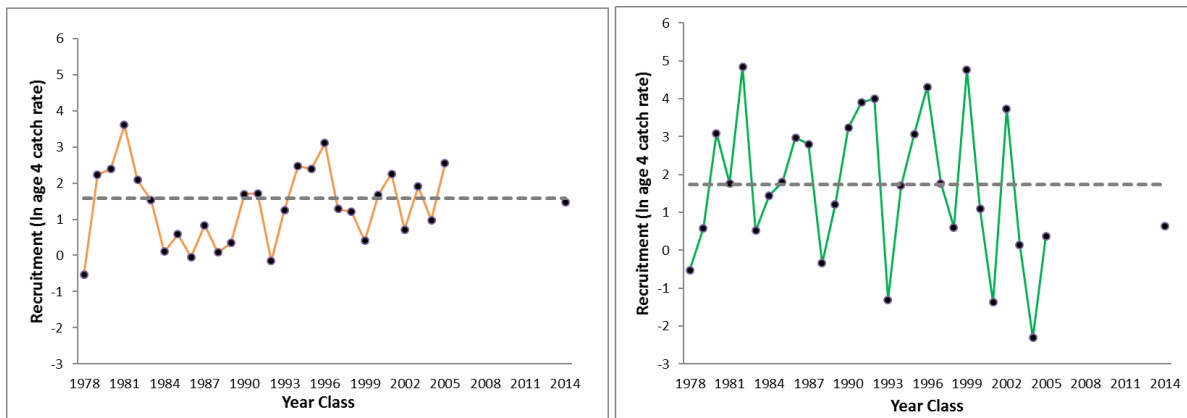

Figure 11. Recruitment of age 4 fall spawning (left) and spring spawning (right) Herring and reference period (1990-2005) mean (dashed line) in Placentia Bay based on catch rates in the spring research gillnet program.

Fortune Bay

In FB, combined catch rates in the research gillnet program have been well below the reference period mean throughout the 2000s, decreasing sharply in 2002 and again to a lesser extent in 2011(Fig. 12). The percentage of spring spawners remains high in this stock area, at 90% in 2017 – the fall spawner portion of this stock is not assessed as it is not well tracked by the spring research gillnet program (DFO 2017).
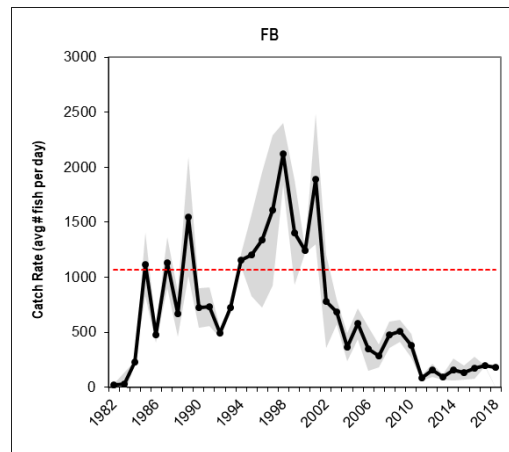
Figure 12. Combined mean catch rate of spring and fall spawning Herring 1988-2018 (dashed/red line = reference period mean) in the Fortune Bay spring research gillnet program.

The age structure of Herring sampled during the research gillnet program was dominated by age 5's, which comprised over 75% of the catch. This 2012 year class is the first to be of above average strength since 2002 (Fig. 13); previous to the recruitment of the 2012 year class, the 2002 year class had accounted for over 90% of the catch (DFO 2017). Recruitment of the 2013 year class is well below the reference period mean (Fig. 13). The stock status index decreased throughout the 2010s but increased slightly in 2017 (Fig. 14).
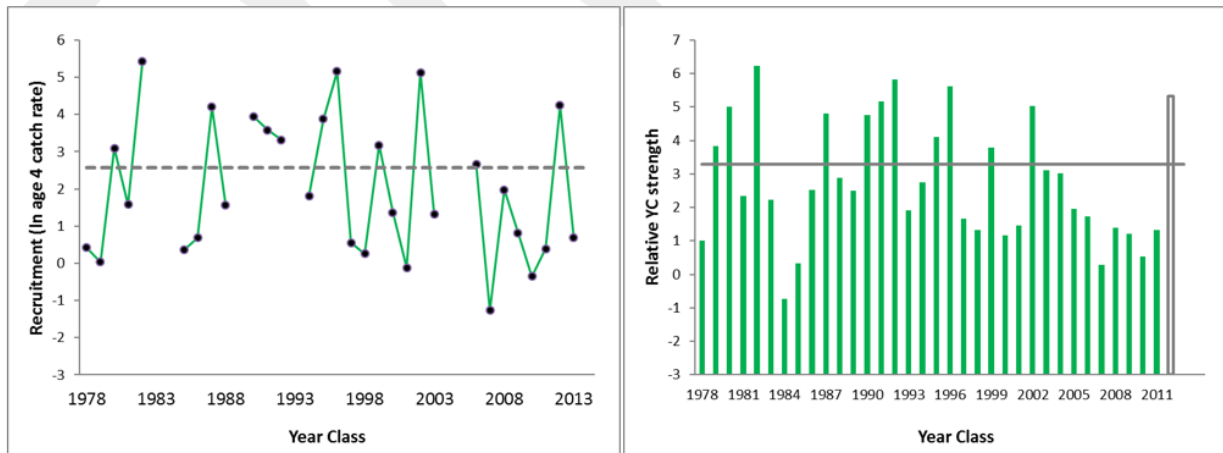

Figure 13. Recruitment of age 4 spring spawning Herring (left) and reference period (1990-2005) mean (dashed line), and relative year class strength (mean catch rate at age 4, 5 and 6; solid bars) and initial year class strength (mean catch rate at age 4 and 5; unfilled bars) of spring spawning Herring (right) in the Fortune Bay stock area in the spring research gillnet program.
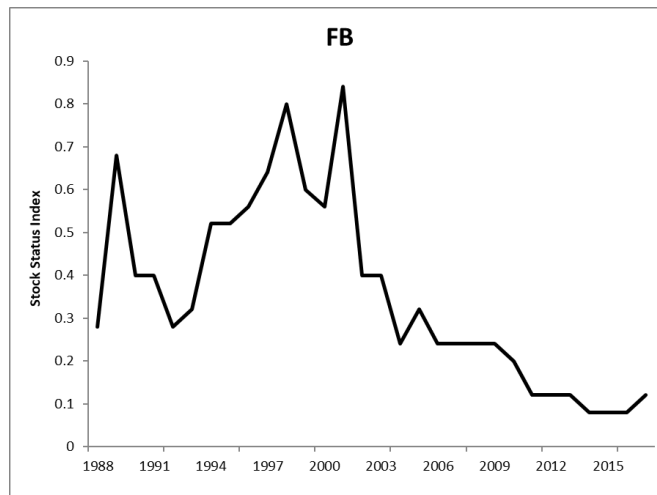
Figure 14. Stock status index for Fortune Bay (1988-2017) derived from the catch at age and catch rates of spring spawners from the annual spring research gillnet program.

Sources of Uncertainty

The inability to estimate spawning stock biomass and exploitation rates continues to be a major source of uncertainty for this stock assessment.

The lack of a fishery-independent abundance index in two of five stock areas makes it impossible to update the standardized stock status index. Only biological updates could be provided for these two stock areas based on limited sample data from the commercial fishery.

Distribution of Herring has likely changed since stock complexes were delineated in the 1980s; it is currently unknown how migration patterns may have changed and what impact this may have on stock structure.

The inability to estimate population sizes has precluded the calculation of stock status zones and reference points. This severely limits the implementation of the precautionary approach in fisheries management decisions.

CONCLUSIONS AND ADVICE

White Bay – Notre Dame Bay

Without a fishery-independent index the status of this stock could not be assessed. Commercial landings have increased over the last number of years and the age structure of the catch is stable.

Bonavista Bay – Trinity Bay

The stock status index derived from the research gillnet program decreased significantly in 2016 and decreased again slightly in 2017. However, future prospects for the stock are positive, with mean catch rates of age 4-6 Herring of both spawning components increasing from 2016 to 2017, and recent age 4 recruitment above average. Given the diverging trends in these indices, the stock status evaluation is uncertain.

Conception Bay – Southern Shore

Without a fishery-independent index the status of this stock could not be assessed. Commercial landings decreased in this area in 2018 due to a high percentage of undersized fish. The catch was dominated in 2017 by the strong 2012 year class, however this year class was not a significant portion of the catch in 2018.

St. Mary's Bay – Placentia Bay

Combined catch rates for both spawning components in the Placentia Bay research gillnet program in 2018 were above the reference period mean and higher than the biomass estimate derived from the 2016 Placentia Bay acoustic survey; however, the catch was dominated by a single year class and recruitment was at or below average. The stock status is uncertain for SMBPB.

Fortune Bay

The stock status index derived from the spring research gillnet program had a declining trend through the 2000s, with a slight increase in 2017. Mean catch rates of age 4-6 spring spawning Herring increased from 2016 to 2017; however, this was due to the recruitment of a single strong year class (2012). Given these indices, the stock status evaluation is negative.

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SOURCES OF INFORMATION

This Science Advisory Report is from the March 18, 2019 Assessment of Divisions 2J+3KL and Subdivision 3Ps Herring. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada (DFO) Science Advisory Schedule](#) as they become available.

Bourne, C.B., Mowbray, F., Squires, B. and Croft, C. 2015. An assessment framework meeting and review of Newfoundland east and south cost Herring stocks to the spring of 2013. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/029.

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Melvin, G.D., Stephenson, R.L. and Power, M.J. 2009. Oscillating reproductive strategies of Herring in the western Atlantic in response to changing environmental conditions. ICES Journal of Marine Science. 66:1784-1792.

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Wheeler, J.P, and Winters, G.H. 1984. Migrations and stock relationships of east and southeast Newfoundland Herring (*Clupea harengus*) as shown by tagging studies. J. Northw. Atl. Fish. 5:121-129.

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Correct Citation for this Publication:

DFO. 2019. Assessment of Newfoundland east and south coast Herring in 2017 and 2018. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/049.

Aussi disponible en français :

MPO. 2019. Évaluation des stocks de hareng des côtes est et sud de Terre-Neuve en 2017 et 2018. Secr. can. de consult. sci. du MPO, Avis sci. 2019/049.