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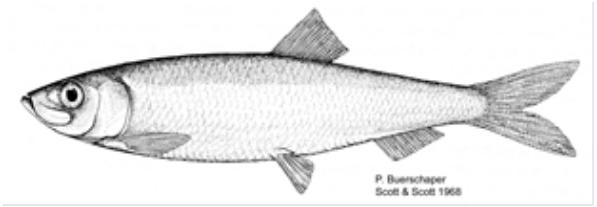
Canadian Science Advisory Secretariat
Newfoundland and Labrador Region **Science Advisory Report 2015/028**

ASSESSMENT OF NEWFOUNDLAND EAST AND SOUTH COAST HERRING STOCKS TO THE SPRING OF 2014



Atlantic herring (Clupea harengus)

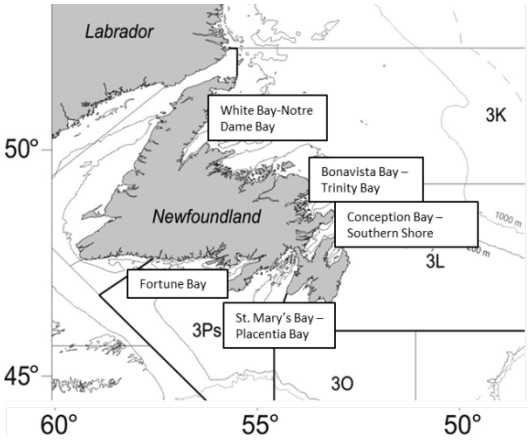


Figure 1. Map of NAFO divisions 3KL and subdivision 3Ps herring stock complexes

Context:

Atlantic herring (Clupea harengus) are managed by five stock complexes distributed along the east and south coasts of Newfoundland: 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). In addition, herring occur along the southwest coast of Newfoundland and southern Labrador; the affinities of these herring are uncertain. Herring mature between ages 2 and 4 and are fully recruited to the fishery by age 4. All stock complexes have both spring and fall spawning components, which remain mixed throughout the year and are not fished separately. Fishing seasons are dependent on area and gear, with total annual landings in the past five years (to 2013) averaging 5939 t. Principal gears used in the fishery include: purse seines, tuck seines, bar seines, traps, and gill nets.

A Regional Peer Review meeting for the assessment of Atlantic herring stock complexes on the east and south coasts of Newfoundland (NAFO divisions 3KL and subdivision 3Ps) was held February 3-5, 2015 in St. John's, NL. Participants included DFO scientists and technicians, fisheries managers, representatives from the Fish Food and Allied Workers Union, the provincial government, Memorial University of Newfoundland and the commercial fishery. The terms of reference included updates on the 2013 and 2014 commercial fisheries, the annual herring research gillnet program, telephone and logbook surveys, biological and ecological data, distribution and trends in spawning stock composition and spawning type designation. The last assessment of these stocks took place in 2011 and an assessment framework meeting was held in 2013.

Since 2002, performance reports, including evaluation of abundance indices and biological characteristics, have been used to assess the current status and future prospects. During this assessment a stock status index was updated for the BBTB and FB stock complexes, and overall stock status for WBNDB and SMBPB was evaluated without the use of an index, based on available information.

SUMMARY

Biological and Ecological Information

- Spawning stock composition changed in the 2000s on the northeast coast (White Bay-Notre Dame Bay [WBNDB] and Bonavista Bay-Trinity Bay [BBTB]) as fall spawners accounted for an increasing proportion of the catch, this is likely attributable to a change in environmental conditions.
- Lengths and weights at age of spring and fall spawning herring decreased in the 1990s in all areas; there were further decreases in the 2000s on the south coast (St. Mary's Bay-Placentia Bay [SMBPB] and Fortune Bay [FB]).
- The L50 of spring spawning cohorts decreased through the late 1980s and 1990s, but showed an increasing trend from 1996 to 2009. The average L50 of spring spawners in the commercial fishery from 2010 to 2013 was 248 mm and for fall spawners was 254 mm (fork length).
- An increase in the frequency of occurrence of herring in spring multispecies offshore trawl surveys has indicated a change in distribution. Year class composition in the 2011-13 surveys was similar to that of the commercial and research gillnet fisheries, but it is unknown to which stock complexes herring found offshore belong.
- The peak of spring spawning shifted from May-June to July during the 2000s, coinciding with declines in spring spawner catch rates and rising ocean temperatures.

White Bay – Notre Dame Bay

- Due to poor market conditions, reported landings were 1238 t in 2013, 47% of the TAC, similar to 2011 and 2012. An estimated 282 t were caught in the 2013 bait fishery and purse seine fishers estimated 460 t of discards, largely due to small herring.
- The 2008 fall year class and 2009 spring year class continued to account for a large proportion of the commercial landings. The percentage of fall spawners in the commercial fishery remained high in 2013 at 65%.
- Fixed gear and purse seine fishers indicated an increasing perception of abundance from 2012 to 2013.
- The age structure of the commercial fishery was similar to that of the BBTB research gillnet catch at age where stock status improved in 2013.
- A standardized performance index indicated that stock status declined from 2009 to 2011 and improved in 2012; this index was not updated in 2013 due to the discontinuation of the research gillnet program.
- There are no indications of a decline in abundance and several strong year classes are present in the commercial catch at age, indicating that current stock status is positive.

Bonavista Bay – Trinity Bay

- Reported landings were at their highest in 2013 since 1992 at 4112 t, nearly twice as high as 2012 (83% of the TAC, mobile gear and tuck seine allocations were taken in most areas). An estimated 509 t were taken as bait in 2013 and purse seine fishers estimated 58 t of discards.
- The 2008 fall year class and 2009 spring year class continued to account for a large proportion of the commercial landings. The percentage of autumn spawners in the commercial fishery remained high in 2013 at 65%.

- Fixed gear and purse seine fishers indicated an increasing perception of abundance from 2012 to 2013.
- Combined catch rates in the spring research gillnet program were just below average in 2013, and at their highest in 7 years in 2014. Fall spawners continued to account for the majority of the catch at 66% in 2013. The 2008 fall year class and 2009 spring year class each accounted for over 20% of the catch in 2013, with spring and fall age 11+ fish accounting for a further 20%.
- Recruitment of age 4 fish in the research gillnet program was high for spring spawners in 2013 compared to the time series mean (1988-2013). Fall spawner recruitment was high in 2012 and average in 2013. Three mature spring year classes and 8 fall year classes were above average in 2013.
- There are no indications of declines in abundance and several strong year classes are present in the stock complex; a standardized index indicated that stock status has remained stable for the last 3 years, giving an overall positive evaluation for current stock status.
- Short term prospects for the stock are positive, with mean catch rates of age 4-6 herring of both spawning components in the research gillnet program increasing over the past several years.

St. Mary's Bay – Placentia Bay

- Reported landings were 212 t in 2013, 9% of the TAC, higher than 2011 and 2012 when there were no purse seine landings. An estimated 112 t were caught in the 2013 bait fishery and purse seine fishers estimated 60 t of discards.
- The age distribution in the commercial fishery was uncertain in 2013 due to small sample sizes. Preliminary results from commercial samples show a higher proportion of younger fish in 2014.
- Purse seine fishers indicated increasing abundance in 2013, whereas fixed gear fishers indicated a decrease.
- A standardized performance index indicated that stock status remained fairly stable from 2008-10, increased in 2011 and decreased in 2012; this index was not updated in 2013 due to the discontinuation of the research gillnet program.
- Due to low activity in the commercial fishery few samples were available for the calculation of catch at age in this area and there is a high level of uncertainty in reporting age structure, therefore current stock status is uncertain.

Fortune Bay

- The TAC was reduced by 25% to 2260 t in 2013 as a result of concerns about poor recruitment in the area; reported landings for that year were 986 t, 43% of the reduced TAC. In 2014 landings were 797 t, 35% of the reduced TAC. An estimated 58 t were caught as bait in 2014, the lowest value in the time series (2006-14).
- The commercial catch age distribution continued to be highly skewed toward older fish, with over 80% of the catch consisting of age 11+ spring spawners in 2013. Unlike other stock areas the proportion of fall spawners has not increased significantly in FB, with spring spawners accounting for 97% of landings.
- Fixed gear fishers indicated declining abundance, as has been the case since 2001.
- Combined catch rates in the spring research gillnet program have been below the long term average during the 2000s and below the decadal average from 2011-14. The age distribution in 2013, like that of the commercial fishery, was highly skewed toward age 11+ spring spawners.
- There has been extremely poor recruitment of both spring and fall spawners since 2002.

- A standardized performance index indicated that stock status was at its lowest point in the time series in 2013, giving an evaluation of negative current stock status.
- Short term prospects for the stock are negative, with mean catch rates of age 4-6 herring of both spawning components in the research gillnet program decreasing in 2011 and remaining at historical low levels in 2013.

BACKGROUND

Species Biology

Atlantic herring (*Clupea harengus*) are distributed along the North American coast south to Cape Hatteras and north to southern Labrador. The five stock complexes along the south and east coasts of Newfoundland were delineated through tagging experiments in the late 1970s and early 1980s, based on spring spawning locations. These stock complexes are: WBNDB, BBTB, Conception Bay-Southern Shore (CBSS), SMBPB and FB.

It is not known whether these stocks still exhibit the same distribution and migration patterns, as biomass, stock composition and environmental conditions have changed significantly since they were defined. An increase in the frequency of occurrence of herring in spring multispecies offshore trawl surveys has indicated a potential change in distribution during the 2000s. Year class composition of herring collected during these surveys between 2011 and 2013 has been similar to that of the inshore research gillnet program and commercial fishery in most stock areas, however it is currently not known to which stock complexes offshore herring belong.

All five stock complexes have historically been composed primarily of spring spawning herring, with a small (>10%) fall spawning component; however spawning stock composition changed in the 2000s as spring spawners declined and fall spawners concurrently increased in most stock areas. Fall spawners now account for over 50% of the catch in most areas. The exact cause of this shift is not known but it is likely attributable to a change in environmental conditions, as the decline of spring spawners and subsequent increase in fall spawner recruitment coincided with warming ocean temperatures in the late 1990s.

During the 2000s the peak of spring spawning in most areas shifted from May-June to July, coinciding with declines in spring spawner catch rates and rising ocean temperatures. This led to a larger proportion of summer spawning herring in research samples. Because there were no clear decision rules for spawning stock designation of July-spawning herring, an exploratory analysis was conducted during this assessment to examine the impact of re-designating summer-caught herring based on maturity stage (vs. otolith). This resulted in minimal changes to the overall time series, but a gonaodsomatic index will be developed prior to the next assessment to more accurately designate spawning groups of herring caught during the summer.

Lengths and weights at age of spring and fall spawning herring decreased through the 1990s in all areas, there were further decreases in the 2000s on the south coast (SMBPB and FB). Length at 50% maturity (L50) of spring spawner cohorts showed an increasing trend from 1996 to 2004, a decrease in 2005 and a sharp increase in 2009 (Fig. 2); a similar analysis of fall spawners could not be done due to small sample sizes. The average L50 (fork length) of spring spawners in the commercial fishery from 2010-13 was 246 mm (Fig. 2) and 251 mm for fall spawners, an increase from the 2000s.

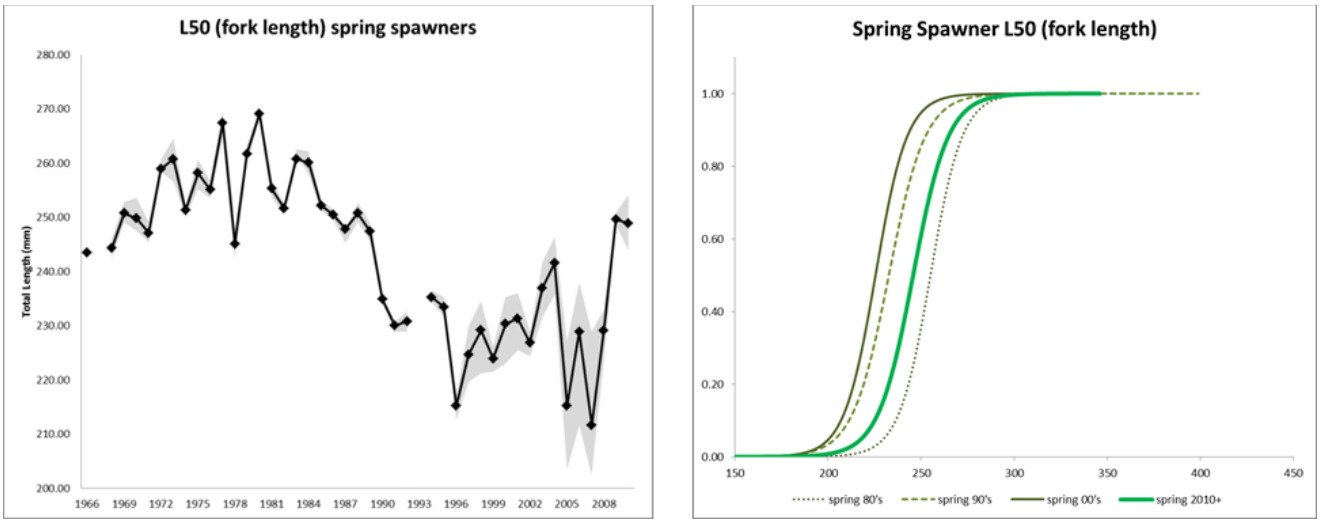


Figure 2. Length at 50% maturity (total length) of spring spawners by cohort (left) and by decade (right).

Fishery

The current combined TAC for all stock areas is 12,700 t, 53% (6749 t) of which was landed in 2013 (Fig. 3). The commercial fishery is carried out largely by purse and bar seines, with smaller proportions of the landings taken by tuck seines, traps and gillnets (Fig. 3). The fishery takes place in both the spring and the fall in all areas except FB, where there is only a spring fixed gear fishery. Landings for 2014 are presented but were not finalized at the time of this assessment.

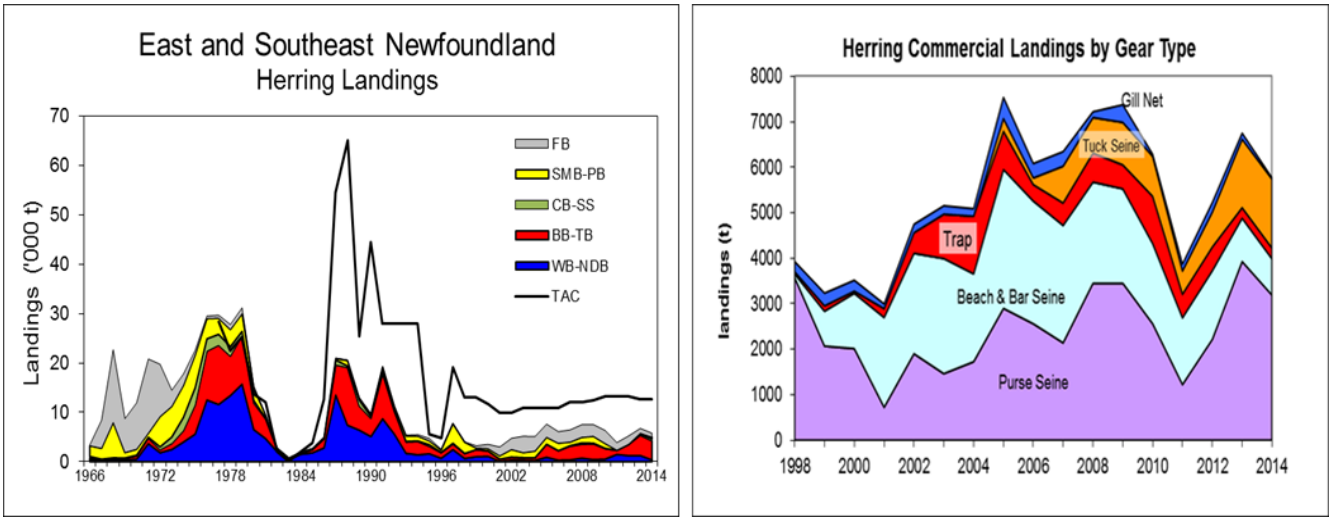


Figure 3. Commercial landings by stock area and total TAC (left) and by gear type since 1998 (right); (note 2014 landings are preliminary).

A gillnet bait fishery occurs each summer; these landings are not reported and an annual telephone survey is used to estimate bait removals for each stock area which is included in commercial catch at age matrices. Voluntary logbooks are also distributed to fixed gear fishers to help obtain data on the bait fishery; return rates of these logbooks have been poor.

An additional telephone survey of purse seine fishers is conducted each spring and fall to obtain estimates of unreported discards. In recent years these estimates have been high due to a large proportion of undersized fish in many areas. In 2013 a pilot project was implemented where the

minimum size of herring was lowered from 265 mm (fork length) to 240 mm to both reduce discarding and allow for the collection of small herring, which were used to re-examine the L50 of the stocks. The data from these samples was still being processed at the time of this assessment.

Due to poor market conditions, reported landings in WBNDB in 2013 were 1238 t, 47% of the TAC; the 2008 fall and 2009 spring year classes continued to account for a large proportion of the commercial landings, with fall spawners composing 65% of the catch (Fig. 4). Most landings in recent years have been by purse seines and traps during both a spring and fall fishery. An additional estimated 282 t were caught in the 2013 bait fishery and purse seine fishers estimated 460 t of discards, largely due to small herring. Both fixed gear and purse seine fishers indicated an increasing perception of abundance from 2012 to 2013.

Reported landings in BBTB in 2013 were the highest since 1992 at 4112 t, 83% of the TAC (mobile gear and tuck seine allocations were taken in most areas). The fall 2008 and spring 2009 year classes also accounted for a large proportion of landings in this stock area, with fall spawners composing 65% of the 2013 catch (Fig. 4). An estimated 509 t of bait were removed in 2013 and purse seine fishers estimated 58 t of discards. Both fixed gear and purse seine fishers indicated an increasing perception of abundance from 2012 to 2013.

In 2013 commercial landings in CBSS were the highest in over a decade, at 408 t, representing 68% of the 600 t TAC. All landings in this area in recent years have been in CB and most are attributable to purse and tuck seines. Catch at age was not available for this area at the time of this assessment.

Effort and commercial landings in SMBPB have been low for the past several years, with 212 t landed in 2013 (9% of the TAC); the commercial catch at age in 2013 was composed largely of age 11+ fish (Fig. 4) but this is highly uncertain due to small sample sizes. Preliminary results from commercial samples in 2014 showed a high proportion of younger fish. An estimated 112 t of bait were removed in 2013 and purse seine fishers estimated 50 t of discards. Fixed gear fishers indicated a decreasing perception of abundance from 2012 to 2013, whereas purse seine fishers reported an increase.

Reported landings in FB have declined overall since 2009. The TAC was reduced by 25% in 2013 due to concerns from Science about poor recruitment; reported landings for that year were 986 t, 43% of the reduced TAC. In 2014 landings were 797 t, 35% of the reduced TAC. An estimated 58 t were caught as bait in 2014, the lowest value in the time series (2006-2014). The commercial catch age distribution continued to be highly skewed toward older fish, with over 80% of the catch consisting of age 11+ spring spawners in 2013 (Fig. 4). Unlike other stock areas the proportion of fall spawners has not increased significantly in FB, with spring spawners accounting for 97% of landings. Fixed gear fishers indicated a declining perception of abundance, as has been the trend since 2001.

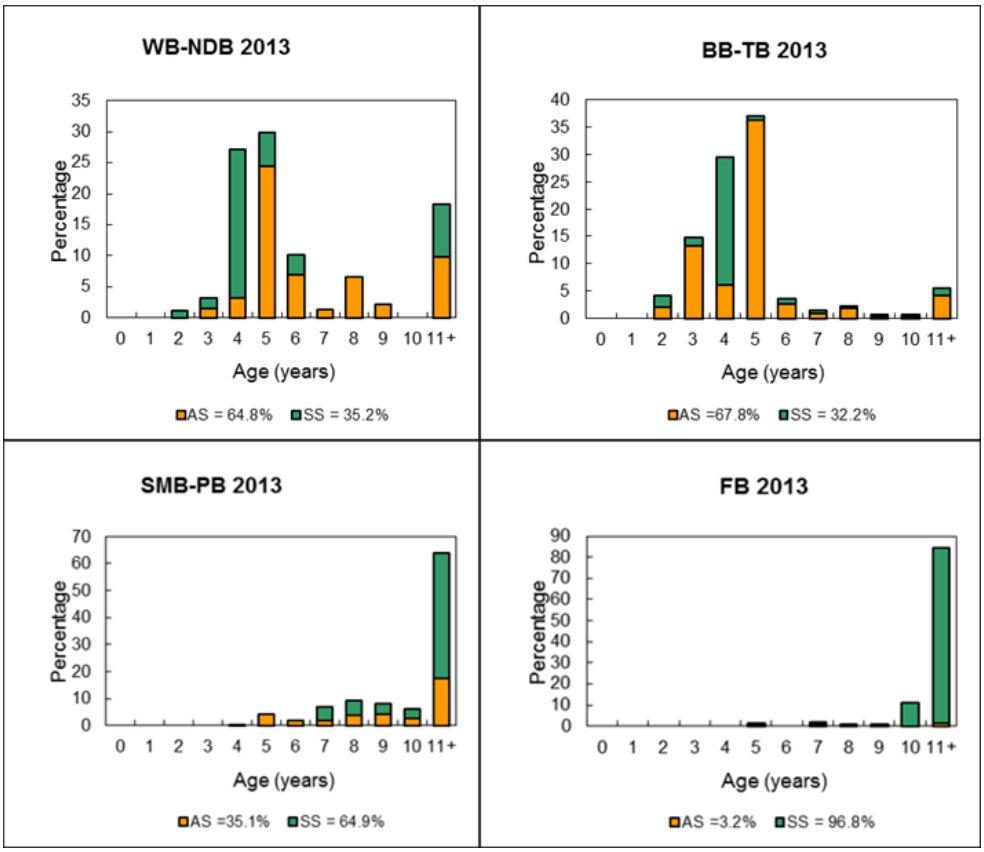


Figure 4. 2013 commercial age distribution by spawning type and stock area.

ASSESSMENT

White Bay – Notre Dame Bay

Until its discontinuation in 2012, catch rates in the WBNDB research gillnet program had increased during the 2000s after a sharp decline in the late 1990s, with fall spawners comprising an increasing proportion of the catch (Fig. 5). Catch rates were at their lowest in 2011 but improved again in 2012. The age distribution of fish caught in 2012 showed a range of year classes, with strong 2008 and 2009 (age 3 and 4) spring spawner cohorts. The 2008 spring year class was also prevalent in the 2013 commercial fishery in this area (Fig. 4) suggesting that it continues to be a strong cohort in the stock area. The catch at age time series for this stock area shows few strong spring year classes during the 2000s where fall spawners have improved (Fig. 5). There is no current recruitment index for this area.

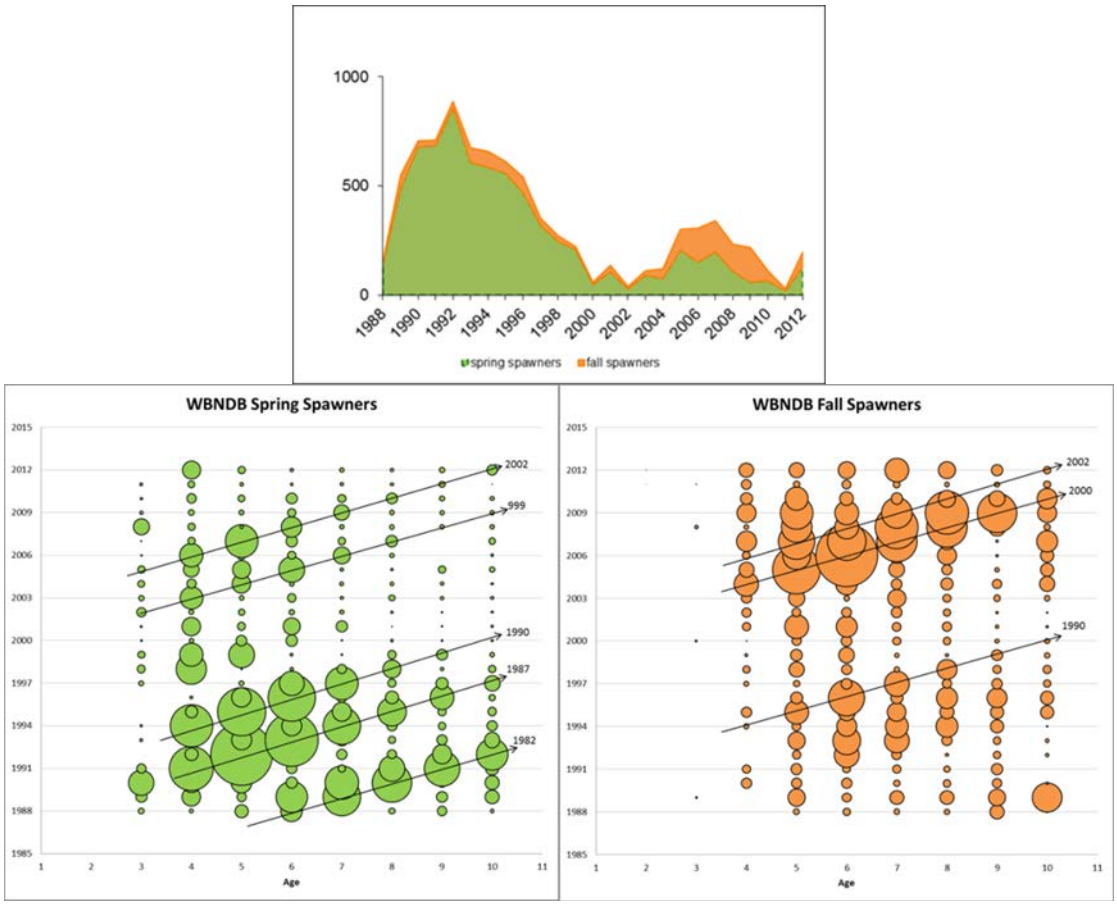


Figure 5. Catch rates by spawning type (above) and catch rate at age in the WBNDB research gillnet program to 2012.

Current stock status is calculated using average scored values of research gillnet catch rates, number of cohorts above average and the mean catch rate of older fish. In WBNDB this index declined from 2009 to 2011, and then increased in 2012. Given that this area no longer has a research gillnet program this index cannot be updated further, information from the commercial fishery and the adjacent BBTB stock area has been used to evaluate the stock for 2013/2014. The results of this evaluation are summarized in the following performance table (Table 1).

Table 1a. White Bay-Notre Dame Bay performance table to the spring of 2013 – summary of fishery.

The Fishery	***Observation***
Reported Landings: 2013	Reported landings in 2013 were 1,238, 47% of the TAC, similar to 2011 and 2012.
Total Removals: 2013	In addition to reported landings, 282 t were estimated to have been taken for bait in 2013. Purse seine fishers estimated fishers estimated 460 t of discards in 2013 with 56% survival.
Effort: 2013	Documented purse seine effort (total sets) in 2013 was 84, the highest since 1997; 28% of fishers contacted in the fixed gear phone survey were active, the lowest percentage in the time series.

Table 1b. White Bay-Notre Dame Bay performance table to the spring of 2013 – indices and interpretations.

Cumulative Indices and Biological Characteristics	***Observation***	***Interpretation***
Fixed Gear Fisher Observations 1996-2014 from telephone surveys and logbooks	Fixed gear fishers reported decreasing abundance from 2009-11 and increasing abundance since that time.	Increasing trend in abundance.
Purse Seine Fisher Observations 1996-2013	Abundance has been increasing through the 2000s.	Increasing trend in abundance.
Commercial Catch at Age	Age 4 spring spawners and age 5 fall spawners in 2013 accounted for over 50% of the catch; fall spawners comprised 65% of landings.	Population age structure stable
Length and Weight at Age	Have not changed significantly since the 1990s.	-

Table 1c. White Bay-Notre Dame Bay performance table to the spring of 2013 – stock status evaluation.

Stock Status Interpretation	***Evaluation***
There are no indications of a decline in abundance, and several strong year classes are present in the commercial catch at age.	**+**

+ = Positive Evaluation

Bonavista Bay – Trinity Bay

Catch rates in the research gillnet program in BBTB decreased through the late 1990s but increased again during the 2000s, with a higher proportion of fall spawners (Fig. 6). The age distribution in 2013 reflected that of the commercial fishery (Fig. 4) with strong 2009 spring and 2008 fall year classes accounting for a large proportion of the catch, which was composed of 66% fall spawners. The catch rate at age time series for this stock area shows few strong spring year classes through the 1990s, one in 2002 and potentially another in 2009; the 2000s had the strongest fall year classes in the time series, with the most recent being 2008 (Fig. 6).

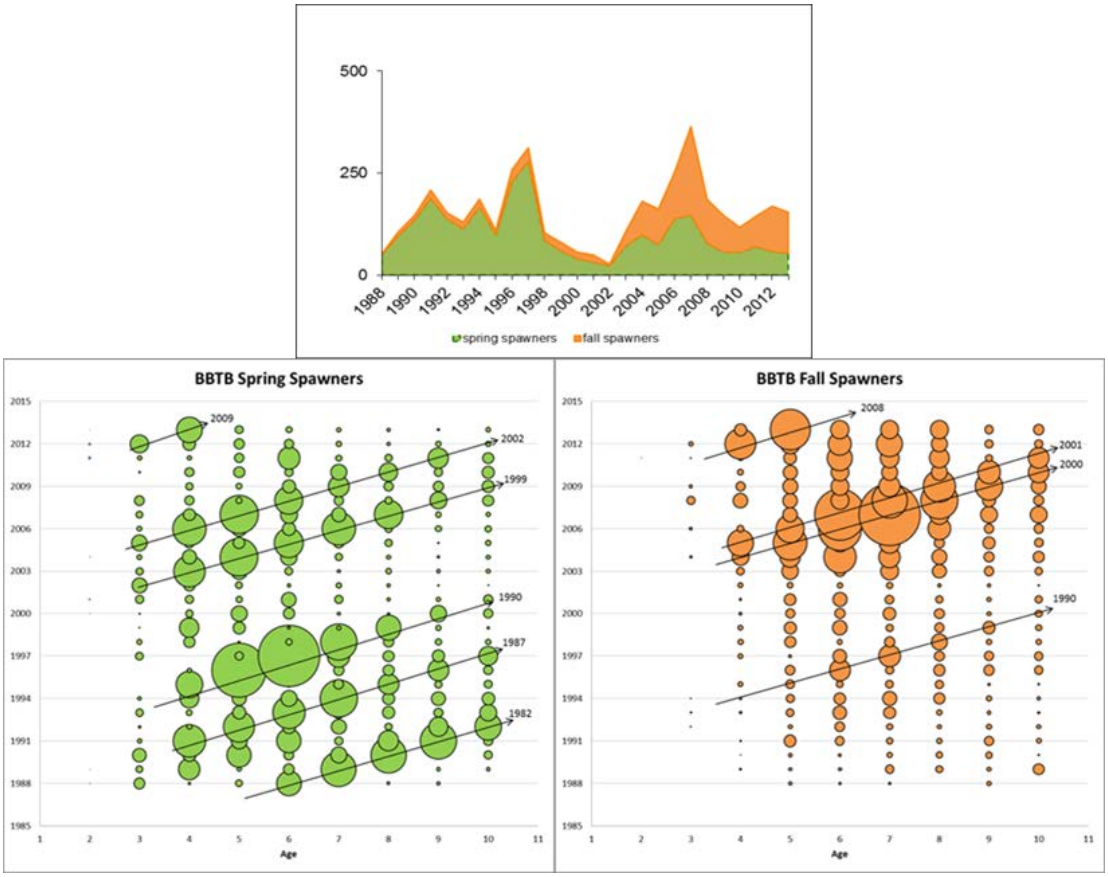


Figure 6. Catch rates to 2014 (above) and catch rate at age to 2013 (below) by spawning type in the BBTB research gillnet program.

Recruitment of age 4 fish in the research gillnet program was high for spring spawners in 2013 compared to the time series mean (1988-2013); fall spawner recruitment was high in 2012 and average in 2013. Three mature spring year classes and 8 fall year classes were above average in 2013 (Fig. 7). There are no indications of declines and several strong year classes are present in the stock complex; the standardized stock status index (derived from the research gillnet program) has remained stable for the last 3 years (Fig. 7), giving an overall positive evaluation for current stock status. Short term prospects are positive, with mean catch rates of age 4-6 herring of both spawning components increasing over the past several years. The results of this evaluation are summarized in the stock area performance table (Table 2).

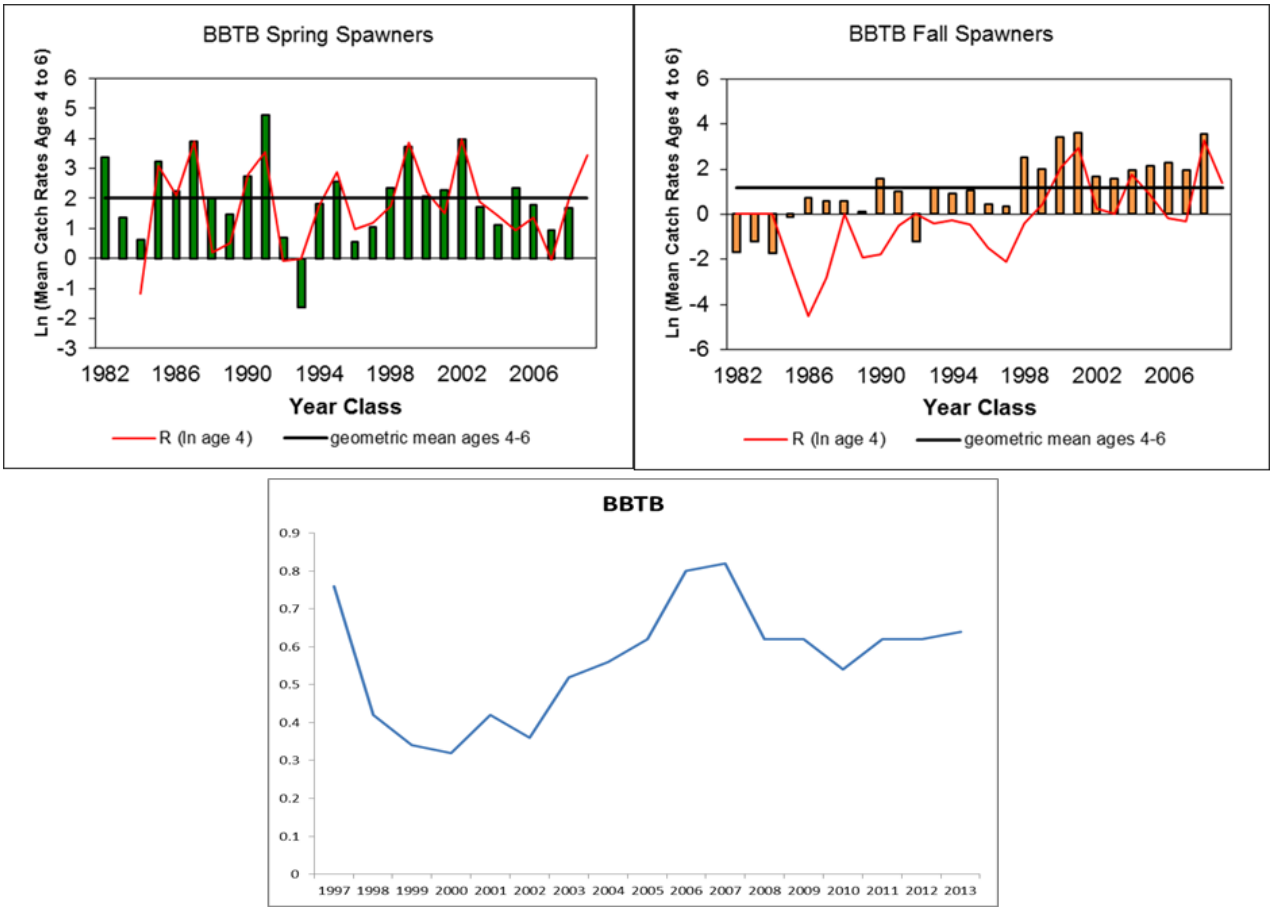


Figure 7. Year class strength and recruitment by spawning type (above) and current stock status index (below) for BBTB.

Table 2a. Bonavista Bay-Trinity Bay performance table to the spring of 2013 – summary of fishery.

The Fishery	***Observation***
Reported Landings: 2013	Reported landings in 2013 were 4,112, 83% of the TAC, the highest landings since 1992.
Total Removals: 2013	In addition to reported landings, 509 t were estimated to have been taken for bait in 2013. Purse seine fishers estimated fishers estimated 58 t of discards in 2013 with 75% survival.
Effort: 2013	Documented purse seine effort (total sets) in 2013 was 77; 39% of fishers contacted in the fixed gear phone survey were active, the lowest percentage in the time series.

Table 2b. Bonavista Bay-Trinity Bay performance table to the spring of 2013 – indices and interpretations.

Cumulative Indices and Biological Characteristics	***Observation***	***Interpretation***
Fixed Gear Fisher Observations 1996-2014 from telephone surveys and logbooks	Fixed gear fishers reported decreasing abundance since 2011.	Increasing trend in abundance.
Purse Seine Fisher Observations 1996-2013	Abundance has been increasing since 2011.	Increasing trend in abundance.
Commercial Catch at Age	Age 4 spring spawners and age 5 fall spawners in 2013 accounted for over 50% of the catch; fall spawners comprised 65% of landings.	Population age structure stable.
Length and Weight at Age	Have not changed significantly since the 1990s.	-

Table 2c. Bonavista Bay-Trinity Bay performance table to the spring of 2013 – research gillnet program.

Research Gillnet Program	***Observation***	***Interpretation***
Research gillnet catch rates	Average in recent years, above average in 2014.	Increasing trend in abundance.
Research gillnet age composition and Recruitment	Recruitment of age 4 fish was high for spring spawners in 2013; high for fall spawners in 2012 and average in 2013. Age distribution well distributed with strong 2008 and 2009 year classes.	Population age structure stable, good recruitment.

Table 2d. Bonavista Bay-Trinity Bay performance table to the spring of 2013 – stock status evaluation.

Stock Status Interpretation	***Evaluation***
There are no indications of a decline in abundance, and several strong year classes are present in the commercial catch at age and recruitment is average or above average.	**+**

+ = Positive Evaluation

St. Mary's Bay – Placentia Bay

Prior to its discontinuation in 2012, catch rates in the SMBPB research gillnet program had declined during the 2000s, with a larger proportion of fall spawners than in the past (Fig. 8). The age distribution of fish caught in 2012 showed a range of year classes, with age 3 spring spawners (2009 year class) and age 11+ fish comprising a large proportion. The 2013 commercial catch at age was largely age 11+ fish (Fig. 4) but is considered highly uncertain due to small sample sizes. The catch at age time series for this stock area shows the last strong spring year class in 2002 and no clearly strong fall year classes in recent years (Fig. 8). There is no current recruitment index for this area, but preliminary results from 2014 commercial samples indicate the presence of young fish in the area.

Figure 8. Catch rates (above) and catch rate at age (below) by spawning type in the SMBPB research gillnet program to 2012.

The current stock status index for this area remained fairly stable from 2008-10, increased in 2011 and decreased in 2012; it was not updated for this assessment. Due to the low activity in the commercial fishery few samples were available for the calculation of catch at age in this area and there is a high level of uncertainty in reporting age structure, therefore current stock status is uncertain. The results of this evaluation are summarized in the following performance table (Table 3).

Table 3a. St. Mary's Bay- Placentia Bay performance table to the spring of 2013.

The Fishery	***Observation***
Reported Landings: 2013	Reported landings in 2013 were 212 t, 9% of the TAC, up from just 1 and 2% in 2011 and 2012.
Total Removals: 2013	In addition to reported landings, 112 t were estimated to have been taken for bait in 2013. Purse seine fishers estimated fishers estimated 60 t of discards in 2013 with 90% survival.
Effort: 2013	Documented purse seine effort (total sets) in 2013 was 16; 15% of fishers contacted in the fixed gear phone survey were active, the lowest percentage in the time series.

Table 3b. St. Mary's Bay- Placentia Bay performance table to the spring of 2013 – indices and interpretations.

Cumulative Indices and Biological Characteristics	***Observation***	***Interpretation***
Fixed Gear Fisher Observations 1996-2014 from telephone surveys and logbooks	Fixed gear fishers reported decreasing from 2011 to 2014.	Decreasing trend in abundance.
Purse Seine Fisher Observations 1996-2013	Abundance has been increasing through the 2000s.	Increasing trend in abundance.
Commercial Catch at Age	The 2013 age distribution was largely composed of age 11+ herring, but sample sizes were small so uncertainty in these estimates are high.	Population age structure is uncertain.
Length and Weight at Age	Declined in the 1990s and again during the 2000s.	-

Table 3c. St. Mary's Bay- Placentia Bay performance table to the spring of 2013 – stock status evaluation.

Stock Status Interpretation	***Evaluation***
Due to low activity in the commercial fishery and no current research gillnet program, few samples were available for the calculation of catch at age in this area and there is a high level of uncertainty in reporting age structure; therefore current stock status is uncertain.	**?**

? = Uncertainty of Interpretation

Fortune Bay

Catch rates in the research gillnet program in FB have declined through the 2000s, remaining below the series mean and dropping below the decadal mean from 2011-14; spring spawners continue to constitute the majority of the catch in this area (Fig. 9). The age distribution in 2013 reflected that of the commercial fishery (Fig. 4) with age 11+ spring spawners comprising more than 75% of the total catch. The catch rate at age time series shows that the only strong spring year class during the 2000s was in 2002 and this cohort is now exiting the fishery, there have been no clear trends in fall year class strength in this area due to low sample sizes (Fig. 9).

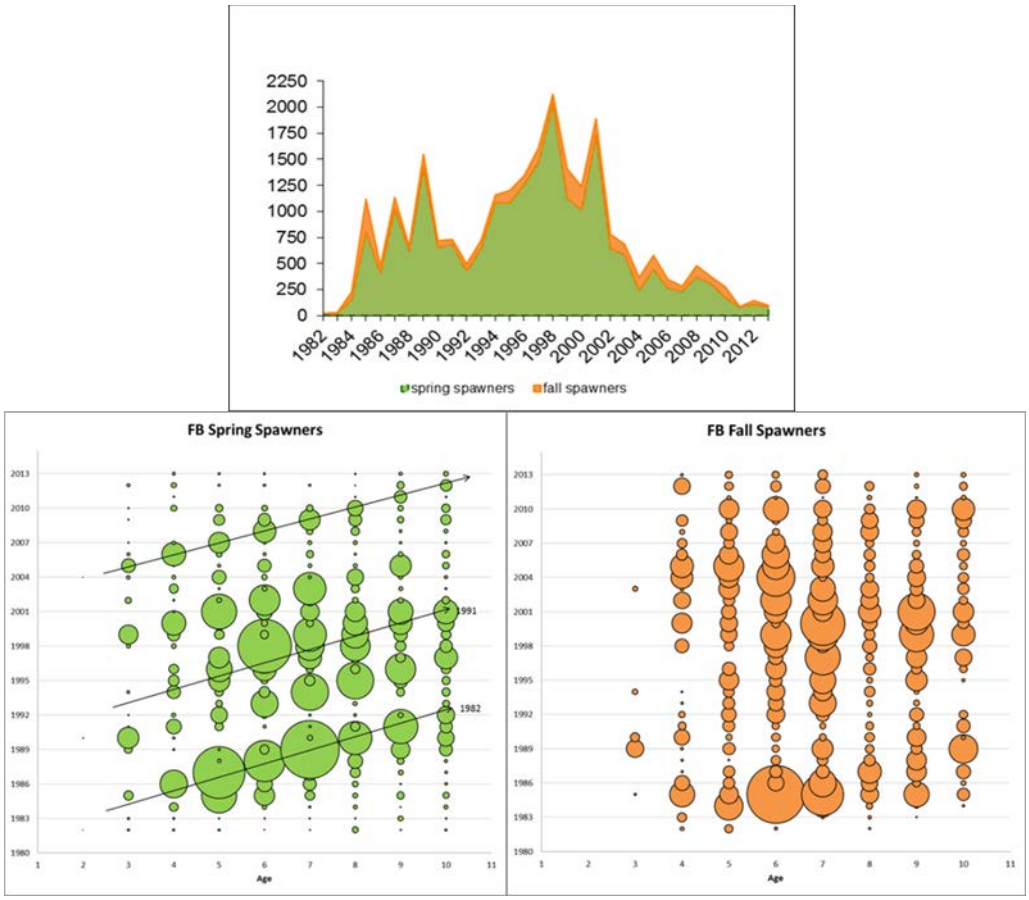


Figure 9. Catch rates to 2014 (above) and catch rate at age to 2013 (below) by spawning type in the BBTB research gillnet program.

Recruitment of age 4 fish in the research gillnet program has been poor through the 2000s; recruitment of the 2008 fall year class was slightly above average but catch rates of this cohort remain low. Only one mature spring year class was above average (now age 11+) and 4 mature fall year classes were average (Fig. 10). The standardized performance index for this area was at its lowest point in the time series in 2013, giving an evaluation of negative current stock status. Short term prospects are also negative, with mean catch rates of age 4-6 herring of both spawning components in the research gillnet program decreasing in 2011 and remaining at historical low levels in 2013 (Fig. 10). The results of this evaluation are summarized in the stock area performance table (Table 4).

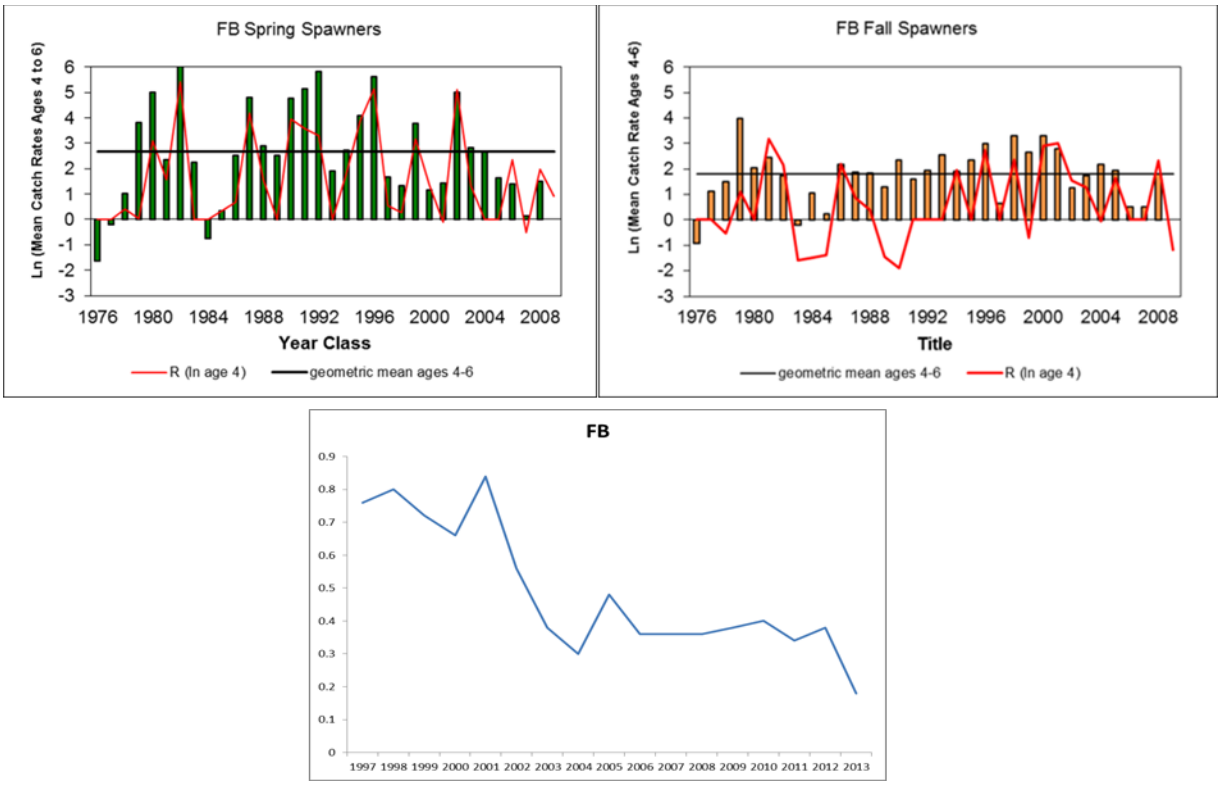


Figure 10. Year class strength and recruitment by spawning type (above) and current stock status index (below) for Fortune Bay.

Table 4a. Fortune Bay performance table to the spring of 2013 – summary of fishery.

The Fishery	***Observation***
Reported Landings: 2013	Reported landings in 2013 were 968, 43% of the TAC, which was reduced by 25% from previous levels in response to concerns about the stock's age distribution.
Total Removals: 2013	In addition to reported landings, 118 t were estimated to have been taken for bait in 2013.
Effort: 2013	47% of fishers contacted in the fixed gear phone survey were active, the lowest percentage in the time series.

Table 4b. Fortune Bay performance table to the spring of 2013 – indices and interpretations.

Cumulative Indices and Biological Characteristics	***Observation***	***Interpretation***
Fixed Gear Fisher Observations 1996-2014 from telephone surveys and logbooks	Fixed gear fishers reported continual decreasing abundance through the 2000s.	Decreasing trend in abundance.
Commercial Catch at Age	Age 11+ fish comprised more than 80% of the catch, spring spawners accounted for 97% of landings.	Population age structure is highly skewed toward older fish
Length and Weight at Age	Declined in the 1990s and again in the 2000s.	-

Table 4c. Fortune Bay performance table to the spring of 2013 - research gillnet program.

Research Gillnet Program	***Observation***	***Interpretation***
Research gillnet catch rates	Below the long term average through the 2000s, below the decadal average for the past several years.	Decreasing trend in abundance.
Research gillnet age composition and Recruitment	Recruitment has been poor for both spawning components through the 2000s, there has been no indication of a strong year class since.	Population age structure is skewed toward older fish, recruitment is very poor.

Table 4d. Fortune Bay performance table to the spring of 2013 – stock status evaluation.

Stock Status Interpretation	***Evaluation***
Recruitment is extremely poor, the standardized recruitment index is at its lowest point in the time series and mean catch rates of age 4-6 herring of both spawning components are at historical low levels. Current and short term prospects are negative.	-

- = Negative Evaluation

Sources of Uncertainty

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

The lack of a fishery-independent abundance index in several areas makes it impossible to update the standardized current stock status index; instead stock status is derived using information from the commercial fishery which may not accurately reflect population dynamics.

There has been an apparent change in spawning behavior, with an increase in summer spawning. This may impact the validity of the spring research gillnet program results and the designation of spring and fall spawners using the historical method based largely on otolith structure.

The proportion of fall spawning herring has increased in most stock areas but there is no fall research gillnet program to provide a comparable index to the current spring program which runs in the BBTB and FB stock areas, which would provide a better indication of fall spawner abundance trends.

Distribution of herring has likely changed since stock complexes were delineated in the late 1970s and early 1980s, but it is unknown how migration patterns have changed and what impact this may have had on stock complex structure.

The evaluation of trends within abundance indices is dependent, among other things, upon the uncertainties associated with each index. Due to the limited fishery and research data, sample sizes for most indices in these assessments, with the exception of the gill net fisher index from telephone surveys, are generally small resulting in higher uncertainties.

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

CONCLUSION

White Bay – Notre Dame Bay

A standardized performance index indicated that stock status declined from 2009 to 2011 and improved in 2012; this index was not updated in 2013 due to the discontinuation of the research gillnet program.

The age structure of the commercial fishery was similar to that of the BBTB research gillnet catch at age where stock status improved in 2013. There are no indications of a decline in abundance and

several strong year classes are present in the commercial catch at age, indicating that current stock status is positive.

Bonavista Bay – Trinity Bay

There are no indications of declines in abundance and several strong year classes are present in the stock complex; a standardized index indicated that stock status has remained stable for the last 3 years, giving an overall positive evaluation for current stock status. Short term prospects for the stock are positive, with mean catch rates of age 4-6 herring of both spawning components in the research gillnet program increasing over the past several years.

St. Mary's Bay – Placentia Bay

A standardized performance index indicated that stock status remained fairly stable from 2008-10, increased in 2011 and decreased in 2012; this index was not updated in 2013 due to the discontinuation of the research gillnet program. Due to low activity in the commercial fishery few samples were available for the calculation of catch at age in this area and there is a high level of uncertainty in reporting age structure, therefore current stock status is uncertain.

Fortune Bay

There has been extremely poor recruitment of both spring and fall spawners since 2002.

A standardized performance index indicated that stock status was at its lowest point in the time series in 2013, giving an evaluation of negative current stock status. Short term prospects for the stock are negative, with mean catch rates of age 4-6 herring of both spawning components in the research gillnet program decreasing in 2011 and remaining at historical low levels in 2013.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 3-5, 2015 Status of Division 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.

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