



2018 ASSESSMENT OF 4VWX HERRING

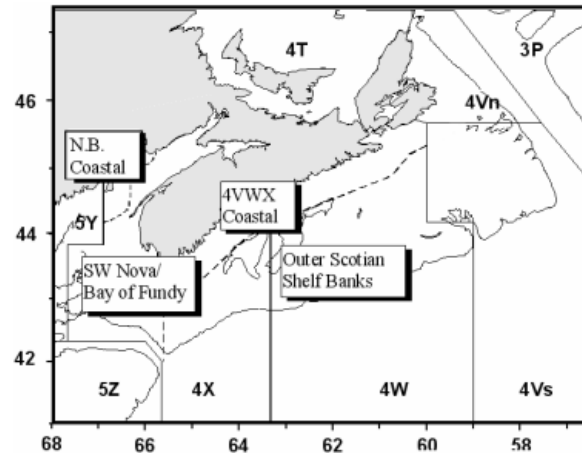
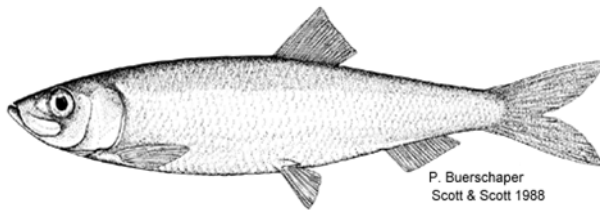


Figure 1. 4VWX Herring management area and stock component locations.

Context:

In support of scientific advice for the 2017-18 and 2018-19 fisheries, the 2018 assessment of the 4VWX Herring stock complex was reviewed through a Science Advisory Process. A meeting was held to review and evaluate biological and fishery information on 4VWX Herring status as a basis for establishing quota for the 2017-18 fisheries, as required in the Integrated Fisheries Management Plan. The terms of reference included evaluation of the Southwest Nova Scotia/Bay of Fundy (SWNS/BoF) spawning component, evaluation of the use of the turnover biomass estimates as the main index in assessing the SWNS/BoF spawning component, evaluation of the status of the fishery with respect to the Limit Reference Point (LRP), compilation and review of information regarding the Offshore Scotian Shelf and the Coastal Nova Scotia spawning components, an update on southwest New Brunswick migrant juvenile fishery component, and recommendations to management on stock status. Participants included scientists, fishery managers, and representatives of the industry, provincial governments, and other stakeholders. The last assessment of this resource was in 2015 (DFO 2015).

The 2003 (Evergreen) Scotia-Fundy Herring Integrated Fisheries Management Plan (IFMP) set out principles, conditions, and management measures for the 4VWX Herring fisheries (DFO 2003). The main principle stated in the plan is “the conservation of the Herring resource and the preservation of all of its spawning components”. The background for the conservation objectives was first developed and reviewed by Sinclair (1997). Three conservation objectives appear in the plan:

1. To maintain the reproductive capacity of Herring in each management unit through:
 - persistence of all spawning components in the management unit;
 - maintaining biomass of each spawning component above a minimum threshold;
 - maintaining a broad age composition for each spawning component; and
 - maintaining a long spawning period for each spawning component.
2. To prevent growth overfishing:
 - continue to strive for fishing mortality at or below $F_{0.1}$.
3. To maintain ecosystem integrity/ecological relationships (“ecosystem balance”): Herring is prominent in the

diet of many fish, birds and marine mammals and should be managed with these interactions in mind.
Specific targets include:

- maintaining spatial and temporal diversity of spawning; and
- maintaining Herring biomass at moderate to high levels.

Progress against these objectives was evaluated at this meeting. Since 1995, the Herring stock assessment and related research has been increasingly dependent on a number of projects undertaken with the assistance of the fishing industry. These include industry sampling for biological characteristics of the landings, as well as acoustic surveys using industry vessels and tagging. A major review of the assessment framework was conducted in 2006-07 (DFO 2007) followed by a framework meeting in 2011. No model was chosen but recommendations for the assessment were provided in the report (DFO 2011). In 2012, an LRP was set for spawning biomass in Scots Bay and German Bank to be evaluated based on the three-year moving average (Clark et al. 2012). The next framework meeting is being planned.

This Science Advisory Report is from the April 11-12, 2018, Assessment of Herring in NAFO Divisions 4VWX. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

SUMMARY

SW Nova Scotia/Bay of Fundy

- Landings for the 2014-2015 and 2015-2016 quota years were 49,204t and 50,012t against a Total Allowable Catch (TAC) of 50,000t each year for the SW Nova Scotia/Bay of Fundy component. In the 2016-2017 quota year, landings were 39,430t against a TAC of 42,500t. The quota was reduced in 2017 due to concerns related to the lack of stock rebuilding and decreased acoustic biomass estimates from the main spawning grounds.
- Although there is uncertainty associated with the biomass estimates, longer term trends in biomass appear to be evident for the Southwest Nova Scotia/Bay of Fundy (SWNS/BoF) spawning component: a decreasing trend in the German Bank area from 1999 to present, and an increasing trend in the Scots Bay area since 2005. The last three years on German Bank have been the lowest in the history of the surveys.
- At the March 2013 Assessment Meeting, it was noted that fish abundance could be overestimated (double-counting) or underestimated (missing fish) using the acoustic survey approach employed. Methodology was presented in Melvin et al. (2014) to account for double-counting. These results were used to revise the acoustic Spawning Stock Biomass (SSB¹) estimates for the entire time series, including the Limit Reference Point (LRP). Consensus was reached on using these revised estimates as the basis of the assessment and the advice.
- In 2012, an LRP for the SWNS/BoF Herring spawning component (German Bank and Scots Bay) was identified as the 2005-2010 average acoustic survey biomass (371,067t), below which the risk of serious harm is unacceptable (Clark et al. 2012). Revisions to the method for estimating the SSB adopted at this assessment resulted in a change in the LRP from 371,067t to 316,313t.
- The three-year moving average decreased by about 8% in 2017 to be at the LRP for the first time since 2011. Stock biomass and the TAC have been relatively stable at a low level in recent years from (2011 to 2016). The consensus of the meeting was that further management measures that reduce exploitation are required to support stock rebuilding.

¹ Throughout this document, Spawning Stock Biomass (SSB) refers to the spawning stock biomass recorded at the time of the acoustic surveys.

- The biomass of spawning fish estimated to be on Trinity Ledge from 2015 to 2016 is low relative to values observed in the early 2000s; however, there was a substantial increase in the SSB in 2017. This is a good sign and may indicate a return of spawning to the area. Additionally, spawning biomass was also recorded in the fall in the Spectacle Buoy area for the first time since 2006. Until there is a sustained increase in the biomass estimate over several years, fishing during the spawning season on Trinity Ledge has the potential to jeopardize the persistence of this spawning unit.
- The broad range of ages observed in the commercial catch indicates that the conservation objective to maintain a broad range of ages is generally being met. Industry-developed management measures that limit exploitation on juvenile fish and spawning grounds are important for sustainability and should be continued and strengthened.
- There has been a trend of declining mean weight at age. Declining trends in commercial mean weight at age since the 1970s have reduced productivity of the stock.
- Given that the stock is at the LRP, the importance of a new framework assessment for this stock to address sources of uncertainty and make improvements to the assessment was emphasized.

Offshore Scotian Shelf Banks

- Since 1996, a fishery has occurred on feeding aggregations on the offshore banks, primarily in May and June, with catches ranging from 20,261t in 1997 to 58t in 2014. Landings have been low, less than 10,000t since 2012, averaging less than 2,000t but increased to 4,000t in 2017. Landings from the offshore are subject to market, weather and fish availability.
- No industry surveys were conducted on the Offshore Scotian Shelf during the years 2015-2017.
- In the absence of recent information about stock status there is no basis for evaluating the current 12,000t catch allocation. The industry is encouraged to explore and undertake structured surveys of the offshore area.

Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia

- From 2009 to 2017, landings in the Little Hope/Port Mouton area have ranged between 2,150t and 5,943t, and have been near or above the allocation in some years (from -1,246t to +1,559t).
- From 2009 to 2017, landings in the Eastern Shore area have ranged between 771t and 6,045t, and are generally within the allocation.
- Landings were minimal for Glace Bay with 4t reported in 2016 and none in 2015 and 2017.
- The Bras d'Or Lakes area remained closed to herring fishing. It has been noted since 1997 that the status of Herring in the Bras d'Or Lakes is cause for concern. In the absence of current abundance information the Bras d'Or Lakes should remain closed.
- Individual spawning groups within the Coastal component are considered vulnerable to fishing because of their relatively small size (biomass) and proximity to shore. For this reason, a large effort increase in new areas has a potential to markedly reduce abundance in the absence of information about the status of the specific spawning group.
- With the exception of the four main areas, the size of various additional spawning groups and landings from these groups are poorly documented. In addition to the traditional bait and personal-use fisheries, directed roe fisheries have occurred on several spawning grounds since 1996.

Southwest New Brunswick Migrant Juvenile

- The southwest New Brunswick weir and shutoff fisheries have relied, for over a century, on the aggregation of juvenile Herring (Ages 1-3) near shore at the mouth of the Bay of Fundy.
- The landings in this fishery are usually juveniles (Age 1 or 2); however, in 2017 older fish were present the catch. This is a departure from what was being caught during the last decade.
- For the time series presented, current landings are at or near the lowest observed. In 2015 and 2017, the number of weirs with landings was the second lowest recorded (11), but 26 weir reported landings in 2016.
- Abundance of Herring available to the weirs is unknown and there is no research being conducted to investigate local Herring abundance.
- The primary sources of information for assessing this component are the landings, which have declined markedly from the 1980s to present. The landings time series for this fishery may not be indicative of abundance because catches are extremely susceptible to many factors in addition to abundance, including effort.

Upper Stock Reference

- An Upper Stock Reference (USR) of 632,626t for the combined observed acoustic biomass on the spawning grounds of German Bank and Scots Bay was proposed. As no consensus could be reached, it was agreed that no USR recommendation would be put forward from this meeting. This discussion will be revisited at the next stock framework.

BACKGROUND

Species Biology

Atlantic Herring (*Clupea harengus*) is a pelagic species found on both sides of the North Atlantic. Herring spawn in discrete locations to which they have a strong affinity. The majority of Herring in the 4VWX area are fall spawners. These Herring mature in 4VWX and first spawn at three or four years of age, then begin an annual pattern of spawning, over-wintering, and summer feeding. This often involves considerable migration and mixing with members of other spawning components and stocks. Fishing takes place on dense summer feeding, over-wintering, and spawning aggregations.

The 4VWX management unit contains a number of spawning areas, separated to various degrees in space and time. Spawning areas in close proximity with similar spawning times, and which share a larval distribution area, are considered part of the same component. These undoubtedly have much closer affinity than spawning areas that are widely separated in space or time and do not share a common larval distribution. Some spawning areas are large and offshore, whereas others are small and more localized, sometimes very near shore or in small embayments. The stock structure is complicated further as Herring migrate long distances and mix outside of the spawning period both with members considered part of the same component and with members of other components. For the purposes of evaluation and management, the 4VWX Herring fisheries are divided into four components (Figure 1):

1. SW Nova Scotia/Bay of Fundy spawning component (referred to as the “stock component”).
2. Offshore Scotian Shelf banks spawning component.
3. Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia spawning component.
4. SW New Brunswick migrant juveniles.

Each component except southwest (SW) New Brunswick migrant juveniles has several spawning areas, and there is mixing of fish among spawning components outside of the spawning period.

Fishery

Fisheries in 4VWX have been dominated by purse seine (80-90%), followed by gillnet, weir, shutoff and trap.

Landings for the 2014-2015 and 2015-2016 quota years were 49,204t and 50,012t against a Total Allowable Catch (TAC) of 50,000t each year for the SW Nova Scotia/Bay of Fundy (SWNS/BoF) component (Table 1). In the 2016-2017 quota year, landings were 39,430t against a TAC of 42,500t (Figure 2). Landings have tracked the TAC since 2002, with most of the quota (and on occasion slightly more) being taken each year since 2002. The quota was reduced in 2017 due to concerns related to the lack of stock rebuilding and decreased acoustic biomass estimates from the main spawning grounds.

Table 1. Reported landings (thousands of tonnes) and TAC for the 4VWX Herring management unit by component from 2010 to 2017 with averages for recent and prior decades.

Year	Average 1970-79	Average 1980-89	Average 1990-99	Average 2000-09	2010	2011	2012	2013	2014	2015	2016	2017
4VWX SW Nova Scotia TAC ¹	106	106	112	69	55	50	50	50	50	50	50	42.5
4VWX SW Nova Scotia ¹	131	131	96	66	46	50	48	47	50	49	50	39
4VWX Coastal NS ²	<1	<1	4	7	6	4	3	4	5	5	8	8
Scotian Shelf Banks ²	38	<0.1	13	6	12	10	1	2	<0.1	2	1	4
SW New Brunswick ²	26	24	24	15	11	4	1	6	2	<0.2	4	2
Total Landings	172	155	137	93	74	68	52	58	57	56	63	53

¹ Quota year from October 15th of the preceding year to October 14th of the current year.

² Calendar year from January 1st to December 31st.

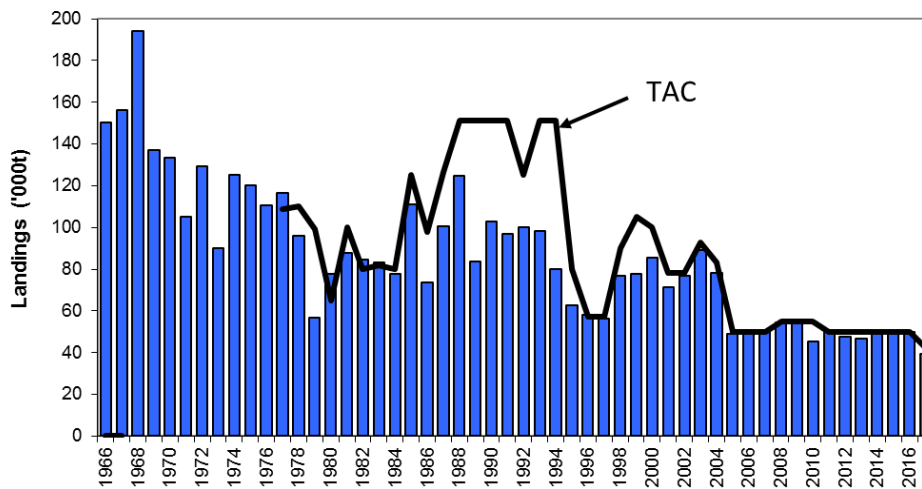


Figure 2. Landings (thousands of tonnes) and TAC for the SW Nova Scotia/Bay of Fundy spawning component.

Additional landings of 7,115t were taken in the non-stock components (outside the SWNS/BoF spawning component) in 2015 for a total of 56,139t, with an increase in landings from the Scotian Shelf Banks and Coastal Nova Scotia components and a decrease to a historic low in the New Brunswick weirs and shutoffs. In 2016, non-stock landings were 12,900t resulting in a total of 62,912t, with increased landings from the New Brunswick weirs and shutoffs and Coastal Nova Scotia and a decrease in the Scotian Shelf Banks component. In 2017, non-stock landings were 13,885t resulting in

a total of 53,315t, with an increase in landings from the Scotian Shelf Banks and Coastal Nova Scotia components and a decrease in the New Brunswick weirs and shutoffs component.

The largest proportions of landings came from fishing grounds in the German Bank (40% in 2015, 41% in 2016, 35% in 2017), Gannet Dry Ledge (24% in 2015; 24% in 2016, 19% in 2017) and Scots Bay (16% in 2015; 16% in 2016, 15% in 2017) areas. There was a decrease in percentages of landings from Grand Manan compared to recent previous years. Scots Bay landings increased from 9% (2014) to 16% (2015), 16% (2016), and 15% in 2017.

Industry and management have explored means of managing the complexity within each component (such as distributing fishing effort among spawning areas according to their relative size) and taking account of the interaction among components (such as fishing restrictions on some areas of mixing). Since the fall of 2010, there have been self-imposed measures by industry to monitor and restrict catches of juvenile fish.

ASSESSMENT

SW Nova Scotia/Bay of Fundy (SWNS/BoF)

The 2014-2015 landings had a catch composition of 40% Age 2 and 15% Age 3 fish. The 2015-2016 landings were primarily Age 2 and Age 3 fish, 65% of the catch by number. In the 2016-2017 landings Age 2 and Age 3 fish made up 48% of the catch by number, while 30% were Age 4 (Figure 3). Based on the catch at age, the 2013 year-class appears stronger than adjacent ones resulting in an increase in the number of Age 4 fish in the landings in 2017. This is an improvement over the previous five years. The fishery catch at age also shows a decreased in the proportion of Age 5+ fish since 2013 (Figure 4); however, Age 5+ fish are still contributing a fair portion of the landings (31%, 25%, and 21% of the catch in 2015, 2016 and 2017 by number, respectively).

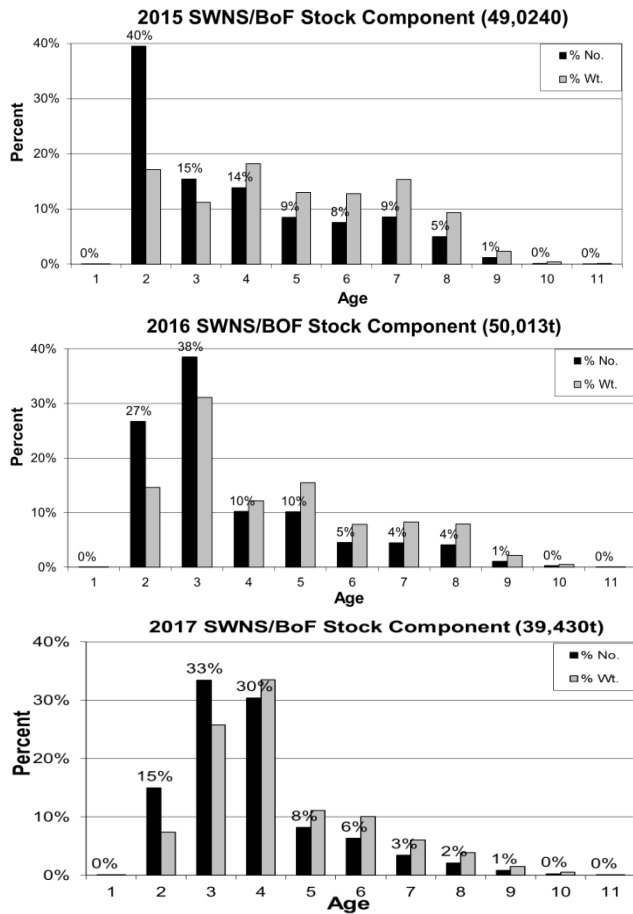


Figure 3. Fishery catch at age (% numbers and % weight) for SWNS/BoF spawning component (2014-15, 2015-16, 2016-17 quota years).

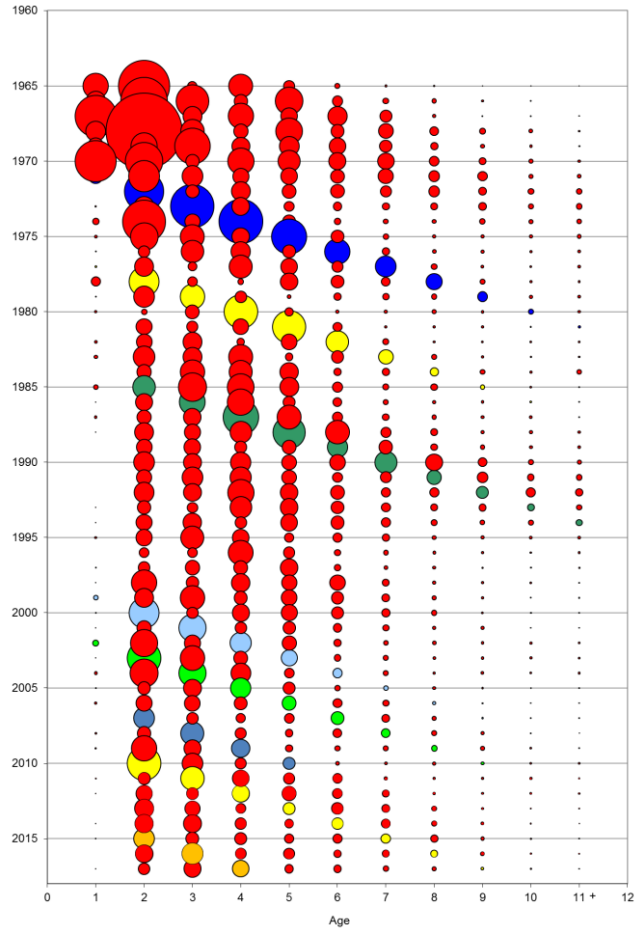


Figure 4. Historical relative numbers at age (denoted by circle size) for SWNS/BoF spawning component from 1965-2017. Selected year-classes are indicated by colours.

The total number of fish calculated to be removed by the fishery was 448 million in 2014, 443 million in 2015, 475 million in 2016 and 376 million in 2017, suggesting relatively similar landings in the three years prior to the cut in the TAC in 2017.

Acoustic Surveys

The acoustic age composition is assumed to be representative of the overall spawning biomass at these ages at the time the areas are surveyed and may include non-spawning juveniles. Acoustic survey catch at age had a broad age distribution of fish from Ages 2-11, but all 2-year olds and approximately 50% of 3-year olds are non-spawners. Similarly, the commercial catch at age had a broad age distribution of fish from Ages 2-10. The proportion of fish at Age 6 and older was 41% (2015), 40% (2016) and 36% (2017) in the acoustic survey catch at age compared with 23% (2015), 14% (2016) and 13% (2017) in the fishery (Figure 5). The mean age of the acoustic survey catch at age decreased from 5.3 years (2015), to 5.2 (2016) and then to 5.0 (2017).

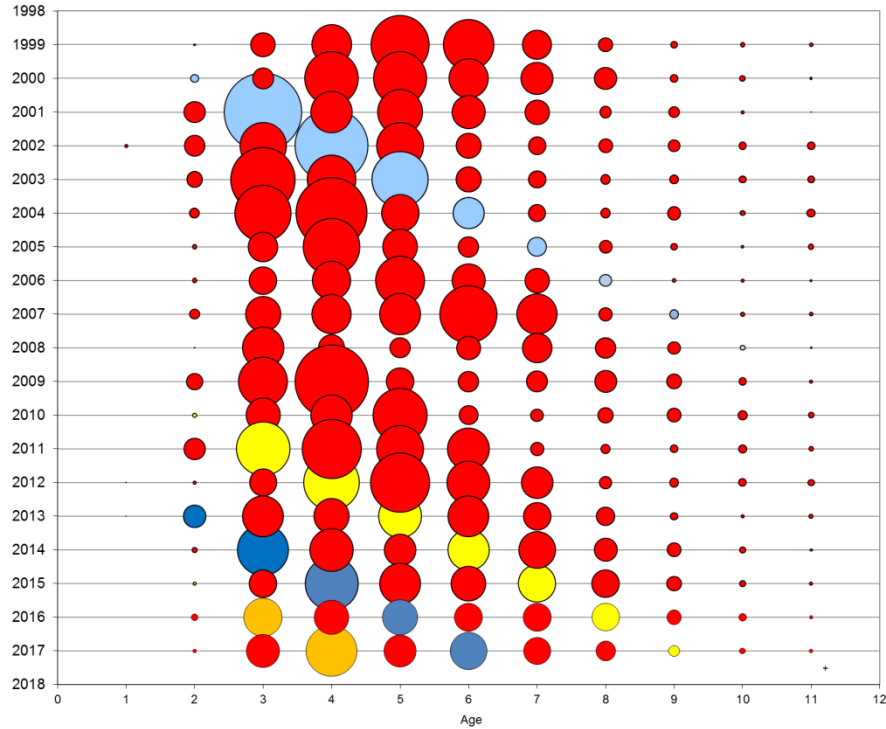


Figure 5. Acoustic survey relative numbers at age (denoted by circle size) for the overall SWNS/BoF spawning component. Selected year-classes are indicated by colours

Industry-led surveys with automated acoustic recording systems deployed on commercial fishing vessels were used to document the distribution and abundance of mainly spawning Herring aggregations. Scheduled surveys were conducted approximately every two weeks (between late June and mid-October) on the main spawning grounds, and an index of Spawning Stock Biomass (SSB) for each component was estimated by summing these results (Table 2; Figure 6).

Table 2. Acoustic survey biomass index for SWNS/BoF spawning component for 2010 to 2017 (thousands of tonnes) with averages for 1999-2004 and 2005-2010. A dash (-) indicates no data or no survey.

Location/Year	Average 1999-2004	Average 2005-2010	2010	2011	2012	2013	2014	2015	2016	2017	Average 1999-2017
Scots Bay (inbox)	120	37	36	89	121	55	184	224	98	128	97
Scots Bay (outbox)	-	4	10	32	38	7	4	21	3	8	12
Scots Bay Total	120	40	46	121	158	62	188	245	100	136	104
German Bank (inbox)	304	272	192	249	221	201	191	140	163	167	252
German Bank (outbox)	-	6	16	9	7	9	2	0	0	0	6
German Bank Total	304	276	208	258	228	210	193	140	163	167	255
Trinity Ledge	9	6	2	7	3	1	5	1	1	14	6
Spec Buoy (spring)	1	1	2	0	-	-	-	-	-	-	1
Spec Buoy (fall)	88	0	-	-	-	-	-	-	-	9	32
Overall Stock Area	522	323	258	386	389	273	386	386	264	326	370
Seal Island	6	10	-	1	-	-	-	-	-	-	6
Browns Bank	45	8	-	-	-	-	-	-	-	-	26
Total All Areas	572	325	258	388	389	273	386	386	264	326	374

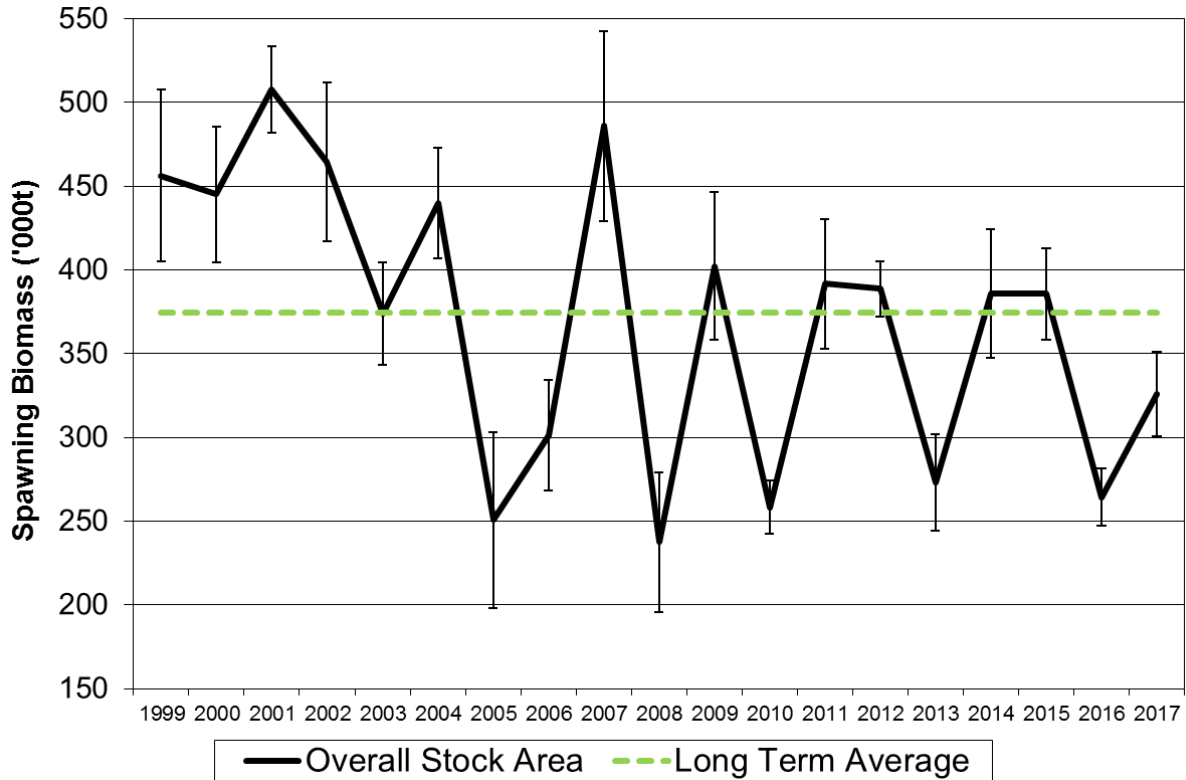


Figure 6. Spawning Stock Biomass index with 95% Confidence Interval (C.I.) from acoustic surveys for the overall SWNS/BoF spawning component along with the long-term average.

At the March 2013 Assessment meeting, it was noted that fish abundance could be overestimated (double-counting) or underestimated (missing fish) using the acoustic survey approach employed. Methodology was presented in Melvin et al. (2014) to account for double-counting. Mark-recapture methods were used to estimate the proportion of fish remaining on the spawning grounds relative to the elapsed time between surveys. These results were used to revise the acoustic SSB estimates for the entire time series, including the Limit Reference Point (LRP). This resulted in a change in the LRP from 371,067t to 316,313t. Consensus was reached on using these revised estimates as the basis of the assessment and the advice. There was agreement to retain the current survey protocol of 10-14 days between surveys.

Six surveys were conducted in Scots Bay in 2015, six in 2016 and eight in 2017. Five usable structured surveys were conducted on the German Bank in both 2015 and 2016, and five acceptable surveys were completed in 2017. These surveys were used to estimate the SSB. Individual survey area coverage was good and consistent with established protocols.

The biomass of spawning fish estimated on Trinity Ledge from 2012 to 2016 is low relative to values observed in the early 2000s. In 2015, only one acceptable survey was completed while in 2016, three acoustic surveys were completed; however, several additional trips to search for fish were conducted, although no schools of significant amounts were found. In 2017, there was a substantial improvement in the biomass to about 14,000t. Additionally, the acoustic catch at age indicated that a high proportion (52%) of the fish surveyed on Trinity were 4-year olds. No surveys were completed around the Spectacle Buoy area in the fall since 2006; however, in 2017 three surveys were completed with a biomass of about 9,000t of which 80% were 3- and 4-year olds. There were no surveys around Seal Island or Browns Bank during 2015-2017.

The overall SWNS/BoF (Scots Bay, German Bank and Trinity Ledge) surveyed biomass for all the spawning grounds, however, decreased slightly in 2015 (385,564t, 95% Confidence Interval (C.I.): +/- 27,572t), decreased again in 2016 (264,087t +/- 17,150t) and increased in 2017 to 325,900t (+/- 25,140t). The 2017 biomass estimate is below the long-term average of 374,780t (Figures 6 and 7).

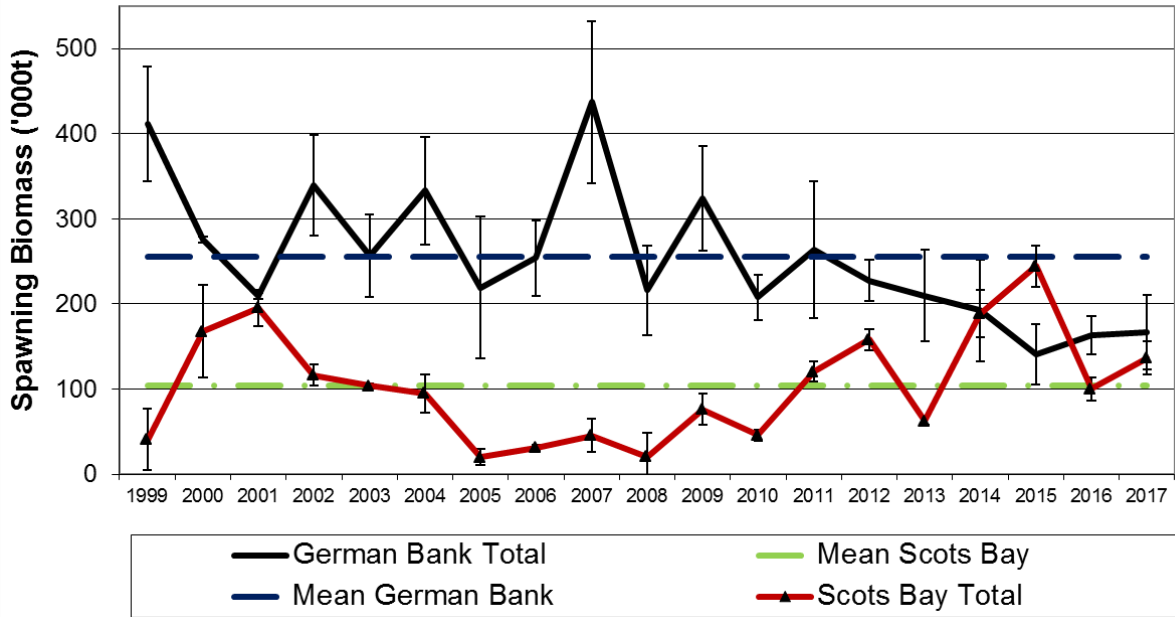


Figure 7. Spawning Stock Biomass index with 95% C.I. from acoustic surveys for German Bank and Scots Bay.

While some fluctuations in the biomass estimates for the SWNS/BoF spawning complex occurred in both Scots Bay and German Bank, the last three years on German Bank have been the lowest in the history of the surveys. In Scots Bay, biomass estimates from 2015 to 2017 were 244,609t (+/- 24,249t), 100,221t (+/- 13,636t), and 136,275t (+/- 19,496t), respectively.

The total German Bank biomass was estimated to be 140,248t (+/- 35,425t) in 2015, 163,361t (+/- 22,669t) in 2016, and 167,033t (+/- 43,915t) in 2017.

Longer-term trends in biomass appear to be evident for the SWNS/BoF spawning component: a decreasing trend in the German Bank area from 2009 to present and an increasing trend in the Scots Bay area since 2005. The fluctuations in the estimates, however, warrant caution in both German Bank and Scots Bay.

In 2012, an LRP for the SWNS/BoF Herring spawning component (German Bank and Scots Bay) was identified as the 2005-2010 average acoustic survey biomass (371,067t), below which the risk of serious harm is considered unacceptable (Clark et al. 2012). Biomass estimates have fluctuated about this limit since 2010. Revisions to the method for estimating SSB adopted at this assessment resulted in a change in the LRP from 371,067t to 316,313t. Since 2010, the confidence intervals have included the LRP (Figure 8).

The three-year moving average increased above the LRP in 2011 and has been basically flat from 2012 to 2016. The average decreased by about 8% in 2017 to be at the LRP for the first time since 2011 (Figure 8).

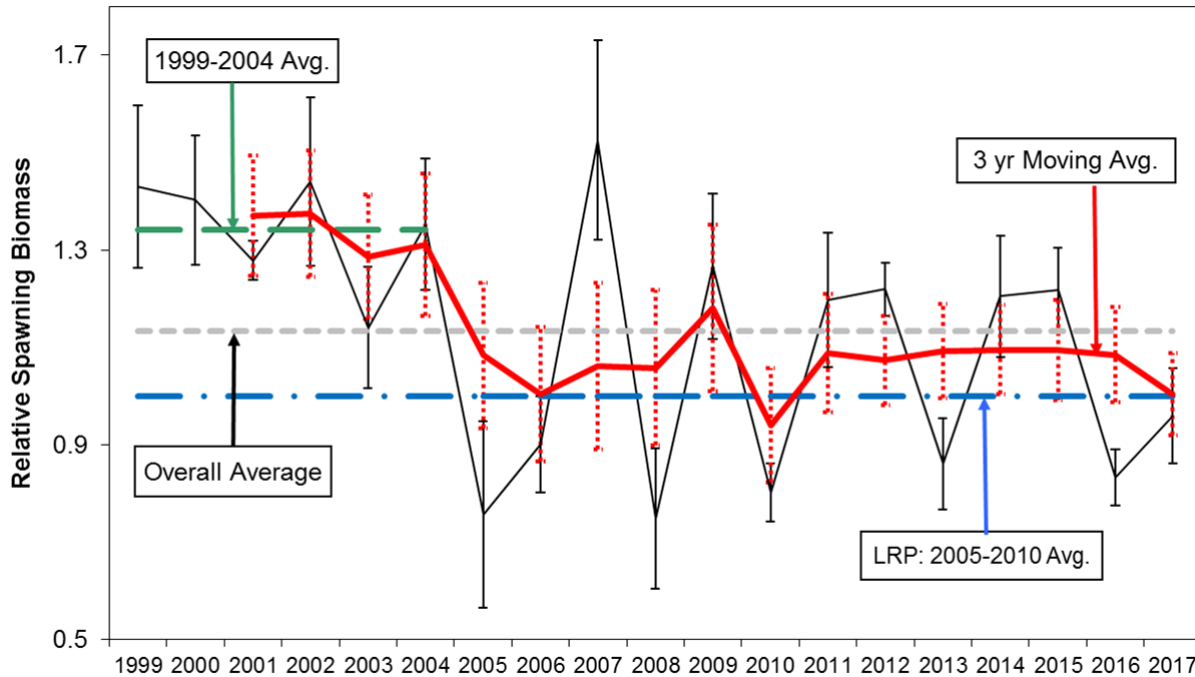


Figure 8. Relative spawning stock biomass index (with 95% C.I.), the calculated three-year moving average, the long-term average and the Limit Reference Point for the SWNS/BoF spawning component (German Bank and Scots Bay).

Stock Trends and Current Status

Stock status and scientific advice for 4VWX Herring is based on methods and recommendations from the January 2011 framework (DFO 2011) and the 2012 Limit Reference Point meeting (Clark et al. 2012), and updated at this meeting.

The advice for the SWNS/BoF spawning component is based on the observations and conclusions of the conservation objectives identified in the Integrated Fisheries Management Plan (IFMP) (Table 3; DFO 2003).

Table 3. Observations and conclusions on conservation objective elements from the IFMP for SWNS/BoF spawning component in 2015, 2016 and 2017.

Objective	2015, 2016 and 2017: Observations
Persistence of all spawning components	Spawning continues to be observed in Scots Bay and German Bank. Spawning activity could not be determined on Seal Island or Browns Bank due to a lack of fishing or survey effort. In 2017, there was an improvement in the amount of documented spawning biomass on Trinity Ledge and in the Spectacle Buoy area in the fall. Minor spawning components have not been assessed in recent years.
Maintain biomass of each component	The average SSB on German Bank for the last three years (156,897t) is the lowest in the 1999-2017 time series. The Scots Bay average SSB for the last three years (160,368t) is above the 1999-2017 average (103,362t). In 2017, there was a substantial improvement in the SSB on Trinity Ledge and in the Spectacle Buoy area in the fall.
Maintain broad age composition	Currently broad ranges of ages are in the commercial landings (2-10), as well as in the acoustic surveys catch at age (2-11). During the last three years, there was a reduction in the number of 2-year olds caught in the fishery and

Objective	2015, 2016 and 2017: Observations
	there are indications of a stronger 2013 year class.
Maintain long spawning period	Scots Bay showed an increase in the length of spawning period in comparison to recent years (as a result of an earlier start date and later end date, also seen in the maturity samples collected during surveys), while German Bank showed a similar length of spawning period in the last three years. While there was little spawning on Trinity Ledge in 2015 and 2016, there was a substantial improvement in 2017 with spawning occurring mid-August to early September.
Fishing mortality at or below $F_{0.1}$	Fishing mortality could not be determined. In comparison to the relative exploitation rate in 2014 (11%), the relative exploitation rate remained at 11% in 2015, increased to 15% in 2016 and decreased to 12% in 2017.
Maintain spatial and temporal diversity of spawning	This objective seems to be met with the spatial distribution of spawning aggregations as well as catches in Scots Bay appearing to be similar during 2015 to 2017. On German Bank, the spawning distribution during 2015-2017 was generally spread within the 'strata box', with localized groups seen in both the northern and southern portions. Therefore, spawning periods are being maintained both temporally and spatially on the two major spawning grounds. There was an improvement in 2017 in the Trinity Ledge and Spectacle Buoy spawning areas.
Maintain biomass at moderate to high levels	Overall, the biomass estimates in the last two years are the lowest since 2010 and this objective is not being met. In 2015, the SSB estimates in the main areas of German Bank and Scots Bay increased slightly (over 2014), decreased 31% in 2016 and an increase of 15% in 2017.
Maintain three-year moving average above the LRP	The three-year moving average has decreased relative to the LRP and in 2017 is at the LRP.

Observations on Mean Weight

There has been a trend of declining mean weight at age for the SWNS/BoF component of the 4WX Herring fishery (Figure 9). Declining trends in commercial mean weight at age since the 1970s have reduced productivity of the stock.

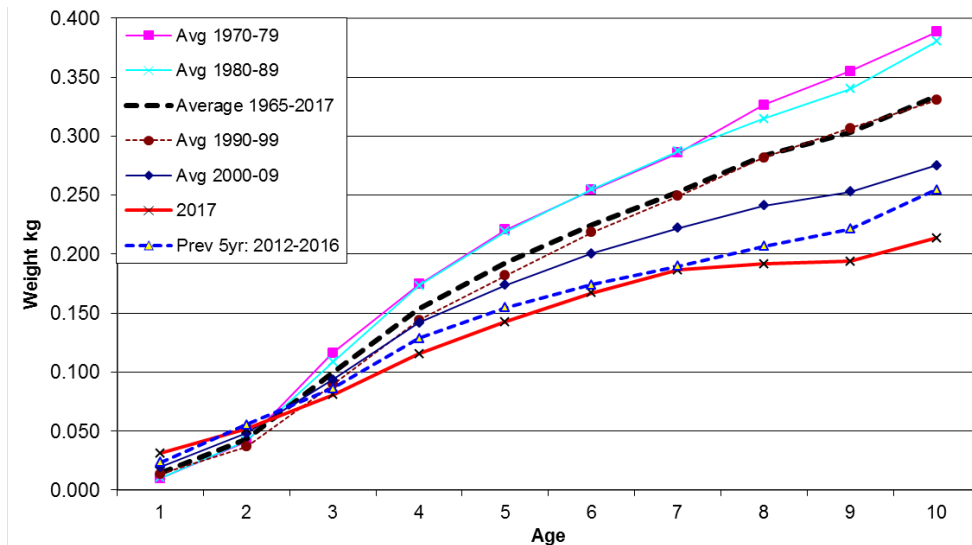


Figure 9. Fishery mean weights at age for the SWNS/BoF component for 2017 season compared with the decadal averages, overall time series for 1965-2017, and the previous five-year average (2012 to 2016).

Offshore Scotian Shelf Banks

Since 1996, a fishery has occurred on feeding aggregations on the offshore banks, primarily in May and June, with landings ranging from 20,261t in 1997 to a historic low of 58t in 2014 (Figure 10). Landings have been low, less than 10,000t since 2012, averaging less than 2,000t but increased to 4,000t in 2017. Landings from 2012 to 2016 were amongst the lowest in the time series. Landings from the offshore are subject to market, weather and fish availability. In 2015, 2016 and 2017, the age composition of the catch was primarily adult Herring (Age 3+). In 2015, substantial proportions of the catch were at Age 5 (26%), Age 6 (21%) and Age 7 (17%) by number. In 2016, the catch consisted of 33% Age 4, 21% Age 5 and 19% Age 6. In 2017, the catch consisted of Ages 3-8 ranging from 11% to 23% by number (Figure 11).

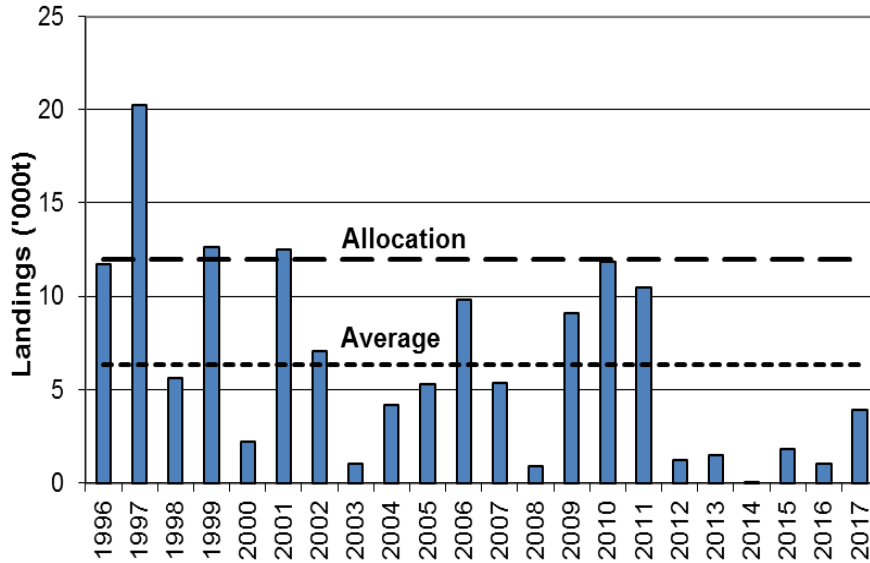


Figure 10. Offshore Scotian Shelf Herring landings (includes bycatch in other fisheries) since 1996 with overall average for the period.

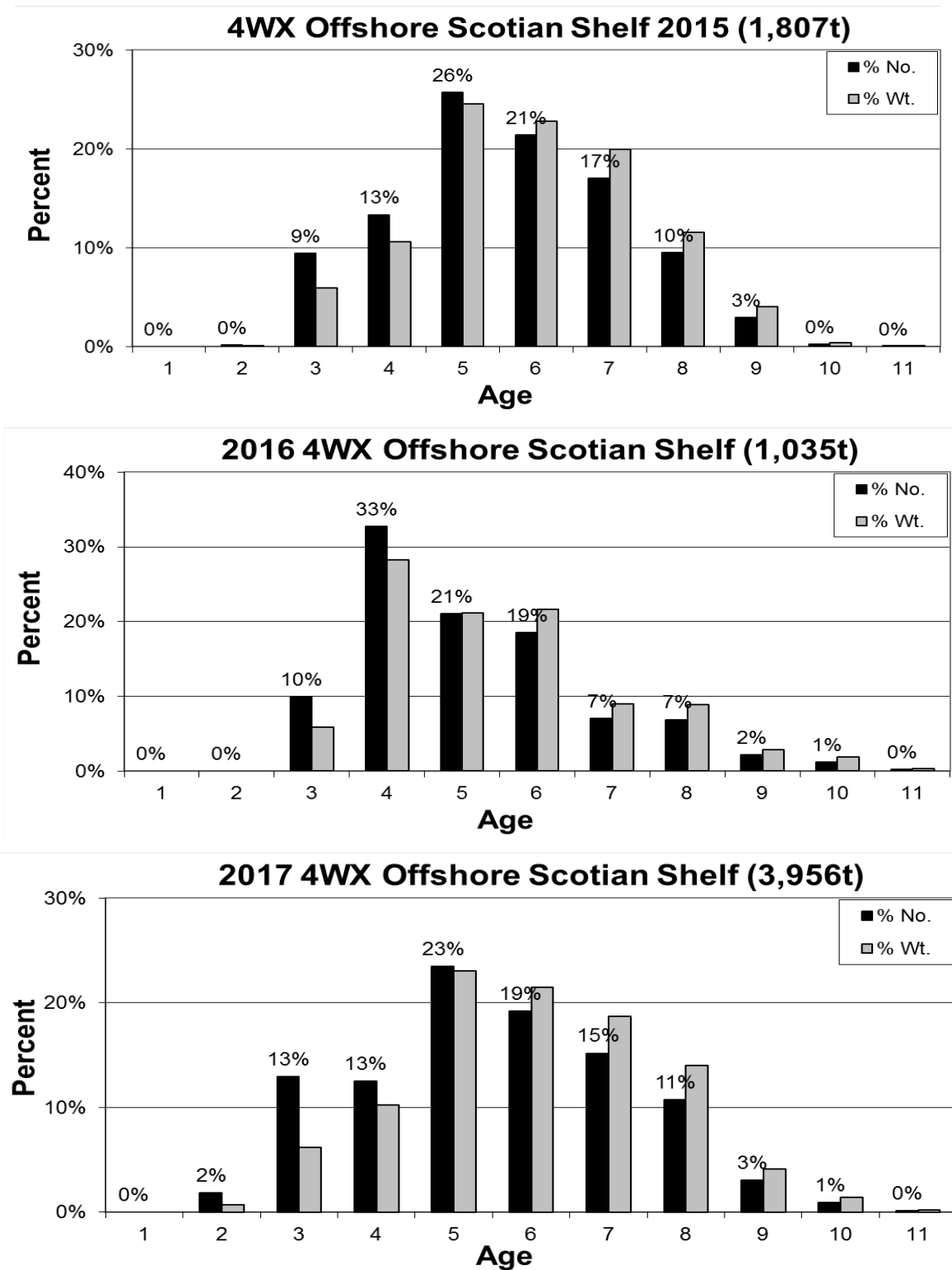


Figure 11. Fishery catch at age (% numbers and % weight) for the 2015, 2016 and 2017 Offshore Scotian Shelf Herring component.

No industry surveys were conducted on the Offshore Scotian Shelf during 2015-2017. In recent years, summer research bottom trawl surveys have indicated a relatively widespread Herring distribution on the Scotian Shelf (Power et al. 2013; Singh et al. 2014, 2016). The bottom trawl data, while useful for documenting size, maturity, and distribution, are not considered indicative of overall Herring abundance (Power et al. 2013).

In the absence of recent information about stock status, there is no basis for evaluating the current 12,000t catch allocation. The industry is encouraged to explore and undertake structured surveys of the offshore area.

Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia

There is no quota for the Coastal Nova Scotia spawning component. Harvest levels from these areas use 10% of the recent five-year average of survey biomass to set allocations.

Apart from the four areas indicated in Table 4, the size and historical performance of various spawning groups are poorly documented. In addition to the traditional bait and personal-use fisheries, directed roe fisheries have occurred on several spawning grounds since 1996.

Table 4. Recorded landings and allocations (tonnes) of Herring from major gillnet fisheries on the Coastal Nova Scotia spawning component for 2010 to 2017 with average for 2000-2009.

Landings (t)		Average 2000-2009	2010	2011	2012	2013	2014	2015	2016	2017	Average Catch Last 5 Years	Average Catch all Years
Little Hope/Port Mouton	Catch	2,645	3,106	2,576	2,150	2,499	3,596	4,160	5,943	5,557	4,351	2,886
	Allocation	2,559	2,454	2,094	2,188	2,787	3,577	3,772	6,151	6,803	-	-
Halifax/Eastern Shore	Catch	3,223	2,302	908	771	1,390	1,163	1,001	1,837	2,259	1,530	2,245
	Allocation	3,218	4,373	4,188	2,920	2,427	1,959	1,066	1,884	2,856	-	-
Glace Bay	Catch	927	11	0	7	2	1	0	4	0	1	582
Bras d'Or Lakes	Catch	6	0	0	0	0	0	0	0	0	0	25
Total landings		6,801	5,419	3,484	2,928	3,891	4,760	5,161	7,784	7,816	5,882	5,738

Note. In 2013, the original allocation of 2,387t for little Hope was increased by 400t.

Landings and allocations in the Little Hope/Port Mouton area decreased from 2009 to 2012, and have increased each year since then except for the landings in 2017 (Table 4). In 2015, 4,160t were landed against an allocation of 3,772t. In 2016, 5,943t were landed against an allocation of 6,151t, and, in 2017, 5,557t were landed against an allocation of 6,803t. In the Eastern Shore area, landings increased from 771t in 2012 to 1,390t in 2013 and then decreased to 1,001t in 2015. Landings then increased to 1,884t (2016) and to 2,259t (2017). For the period, 2004 to 2015 allocations for the Eastern Shore area was lowest in 2015 (1,066t) and increased in 2016 (1,884t) and 2017 (2,856t). Allocations in both Little Hope and Eastern Shore are based on the recent five-year average of observed acoustic biomass. Landings were minimal for Glace Bay with only 4t being reported in 2016 and none in 2015 or 2017. The Bras d'Or Lakes area remained closed to Herring fishing. In 2015, the age composition of the landings for the Coastal component was primarily adult Herring from the size selective gillnet fishery with a substantial proportion of the catch (97%) Age 4 and older. In 2016, the catch at age was made up of 99% Age 4 and older, while in 2017, 98% the fish were Age 4 and older (Figure 12).

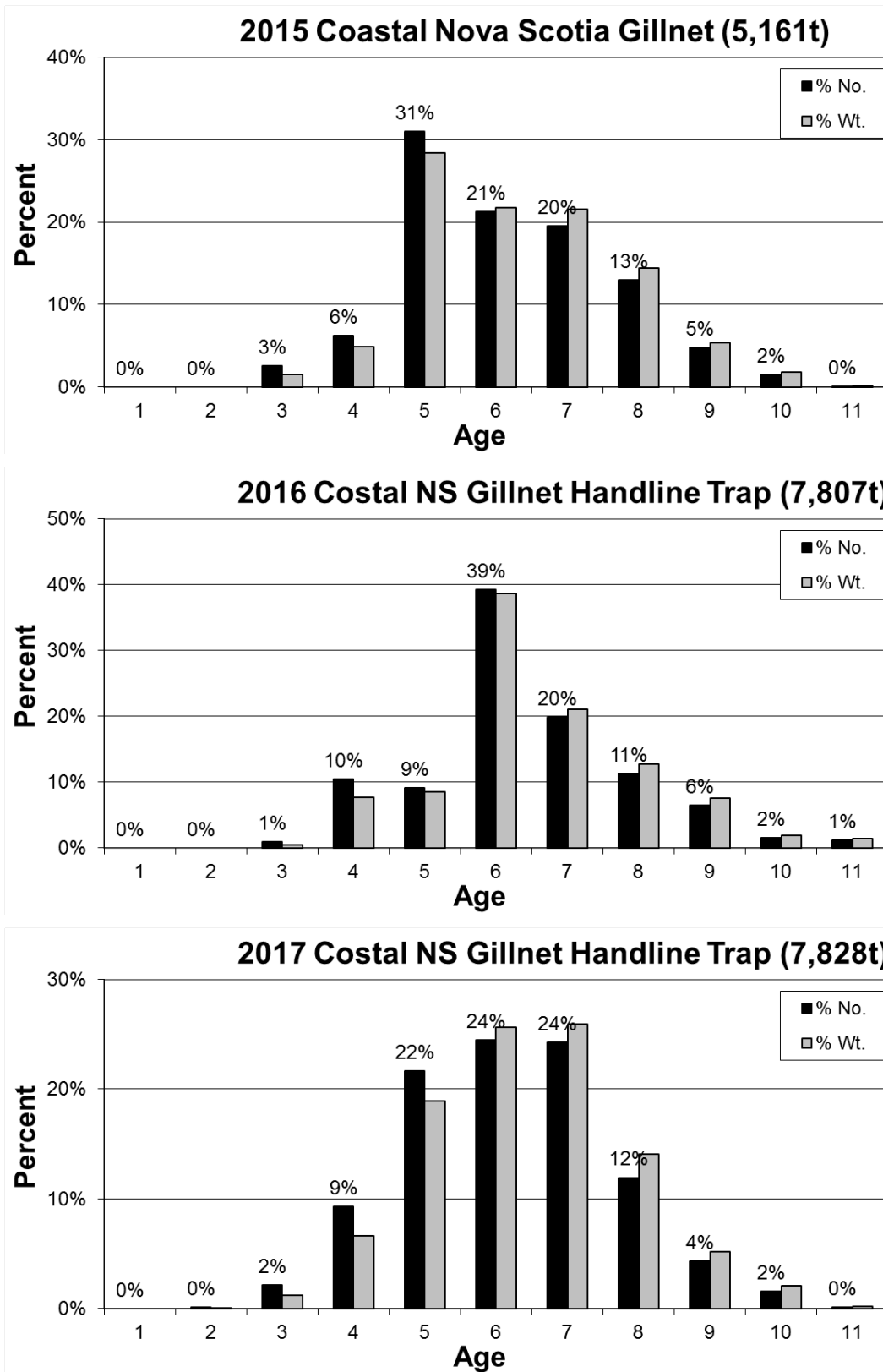


Figure 12. Fishery catch at age (% numbers and % weight) for the 2015, 2016 and 2017 Coastal Nova Scotia (gillnet and trap) Herring component.

As the inshore roe gillnet fisheries off Glace Bay, East of Halifax, and Little Hope developed (since 1996), participants have contributed to sampling and surveying. In 2015, the total spawning biomass estimate for the Little Hope area was 145,396t. This represented a substantial increase in the spawning biomass estimate over the 2014 estimate (46,077t) and a historical high for the area. The total spawning biomass estimate for the Little Hope area decreased to 61,408t in 2016 and increased slightly in 2017 to 66,815t but below the five-year average of 78,845t (Table 5, Figure 13). The total spawning biomass estimate in the Halifax/Eastern shore area was 68,562t in 2015, which represents an increase of about seven times the 9,586t estimate in 2014. The estimated total spawning biomass decreased by 14% to 54,312t in 2016 and increased again by about 1% to 58,681t in 2017. This estimate is above both the five-year average of 39,602t and the long-term average from 1998 to 2017 of 33,606t (Figure 14). There was no acoustic survey and no fishery in the Glace Bay area during the years 2015-2017 (Figures 15A and 15B). No Herring surveys have been conducted in the Bras d'Or Lakes since 2000.

Table 5. Estimated Herring acoustic Spawning Stock Biomass (thousands of tonnes) from 2010 to 2017 with average for 1999-2009 recent five-year average for the Coastal Nova Scotia spawning component areas. n/s denotes no survey.

Location	Average 1999-2009	2010	2011	2012	2013	2014	2015	2016	2017	Average Last 5 Years	Average All Years
Little Hope/Port Mouton	25.9	26.7	28.8	12.8	74.0	46.1	145.4	61.4	66.8	78.8	38.7
Halifax/ Eastern Shore	36.4	27.7	5.5	3.7	6.9	9.6	68.6	54.3	58.7	39.6	33.6
Glace Bay	8.3	0.0	0.0	n/s	0.0	n/s	n/s	n/s	n/s	0.0	6.0
Bras d'Or Lakes	0.3	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	0.3

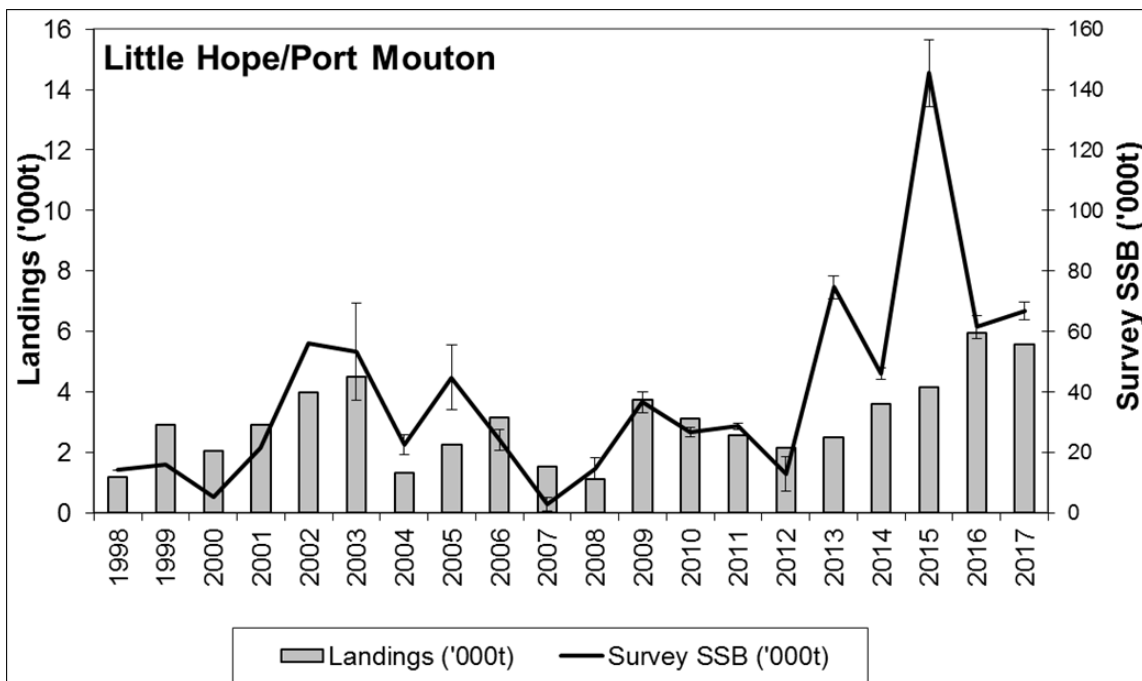


Figure 13. Landings and acoustic survey Spawning Stock Biomass with 95% C.I. ('000t) for the Little Hope/Port Mouton gillnet fishery for 1997-2017. No C.I. could be calculated for years prior to 2003.

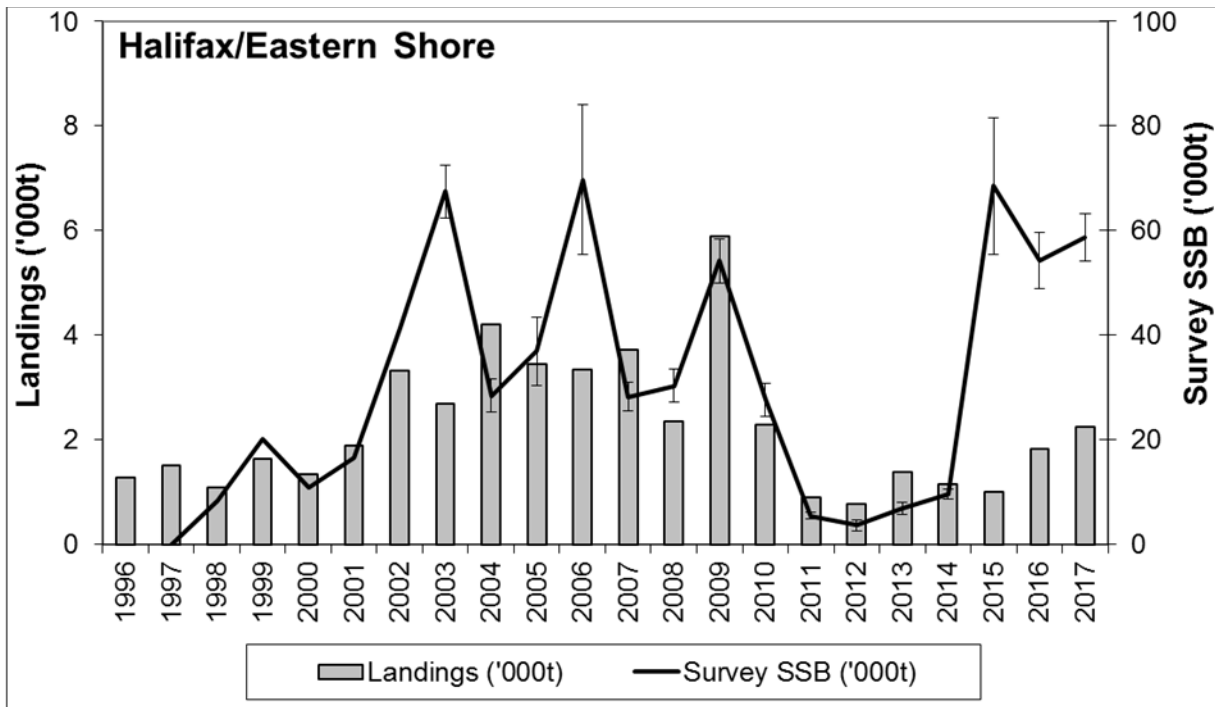


Figure 14. Landings and acoustic survey Spawning Stock Biomass with 95% C.I. ('000t) for the Halifax/Eastern Shore gillnet fishery for 1996-2017. No C.I. could be calculated for years prior to 2003.

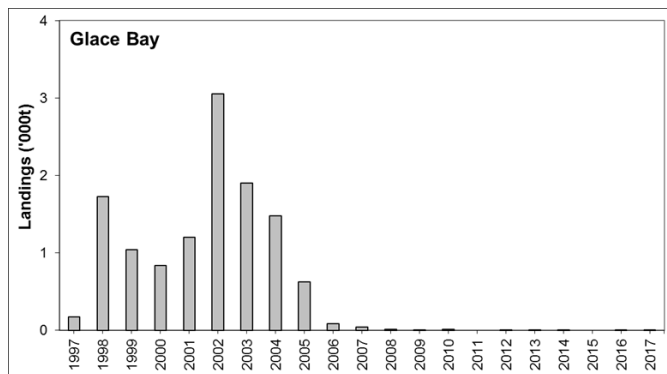


Figure 15(A). Landings ('000t) for the Glace Bay gillnet fishery for 1997-2017.

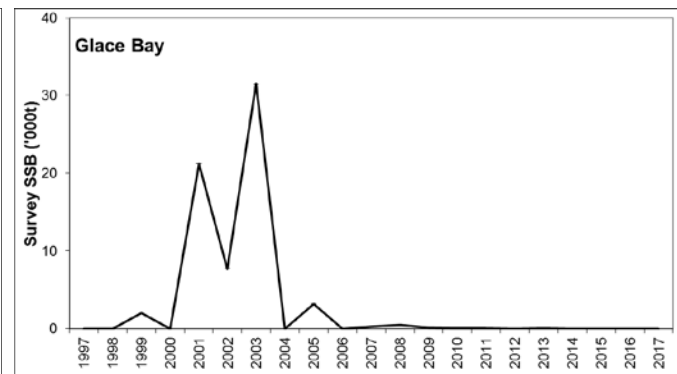


Figure 15(B). Acoustic survey Spawning Stock Biomass ('000t) for the Glace Bay for 1997-2017. No C.I. could be calculated due to limited number of surveys.

Collaborative surveys with industry have improved our knowledge of two areas (Little Hope/Port Mouton, Halifax/Eastern Shore), but there has been no increase in information from other areas. The Glace Bay area was last surveyed in 2013. Individual spawning groups within the Coastal component are considered vulnerable to fishing because of their relatively small size (biomass) and proximity to shore. It is recommended that no Coastal spawning group experience a large effort increase in new areas until information on abundance and movement is available to evaluate the state of that spawning group.

It has been noted since 1997 that the status of Herring in the Bras d'Or Lakes is cause for concern. In the absence of current abundance information, the Bras d'Or Lakes should remain closed.

Southwest New Brunswick Migrant Juveniles

The southwest New Brunswick weir and shutoff fisheries have relied, for over a century, on the aggregation of juvenile Herring (Ages 1-3) near shore at the mouth of the Bay of Fundy. These fish are considered to be a mixture of juveniles, dominated by those originating from Northwest Atlantic Fisheries Organization (NAFO) Subarea 5 spawning components and have, therefore, been excluded from the SWNS/BoF quota.

Landings in the New Brunswick weir and shut-off fishery decreased to a historic low in 2015 of 146t from 2,149t in 2014. In 2016, the landings increased to 4,060t and then decreased to 2,102t in 2017. It is notable that in 2007 landings were 30,944t, the highest in nearly 20 years and higher than the long-term average of 20,680t (Figure 16). For the times series presented, current landings are at or near the lowest observed. The age distribution of fish caught in the New Brunswick weir and shutoff fishery were mostly juveniles Ages 1 or 2, making up 99% in 2015, 84% in 2016 and 58% in 2017 (Figure 17). There were older fish caught in the weirs in 2017, which is a departure from what was being caught during the last decade. The number of weirs with landings increased from 11 in 2015 to 26 in 2016, and decreased to 11 in 2017.

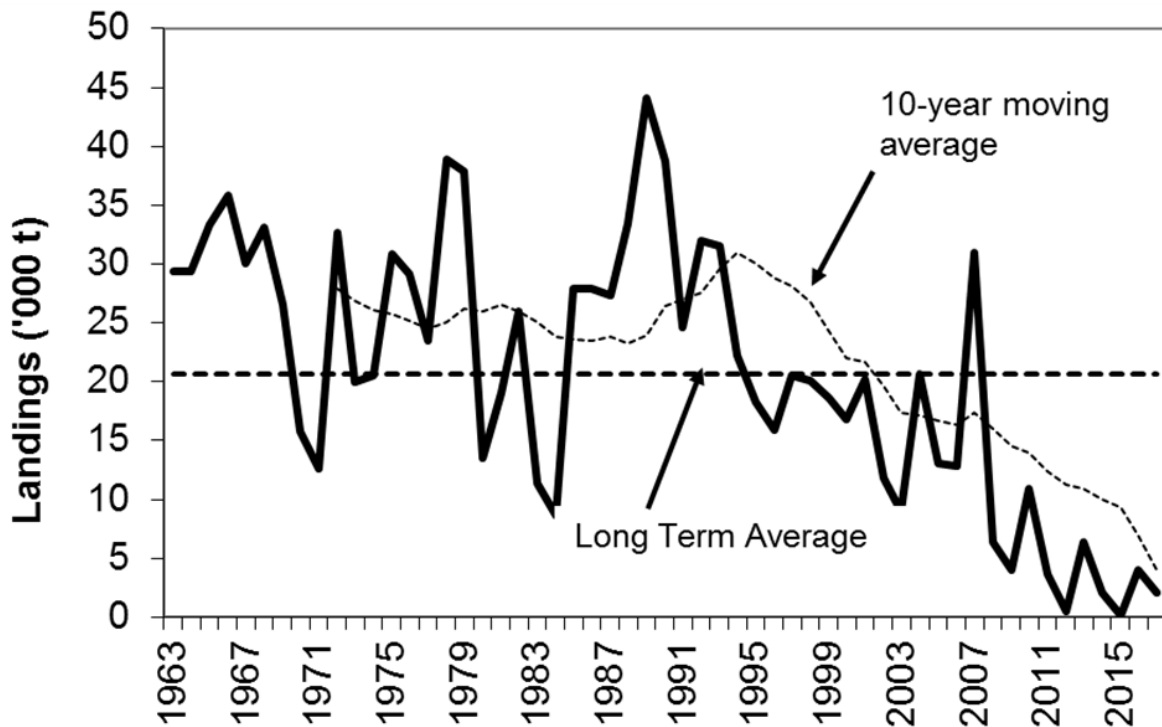


Figure 16. Herring landings from New Brunswick weir and shutoff fishery for 1963-2017 with long-term average and 10-year moving average.

The landings time series for this fishery may not be indicative of abundance because catches are extremely susceptible to many factors in addition to abundance, including effort.

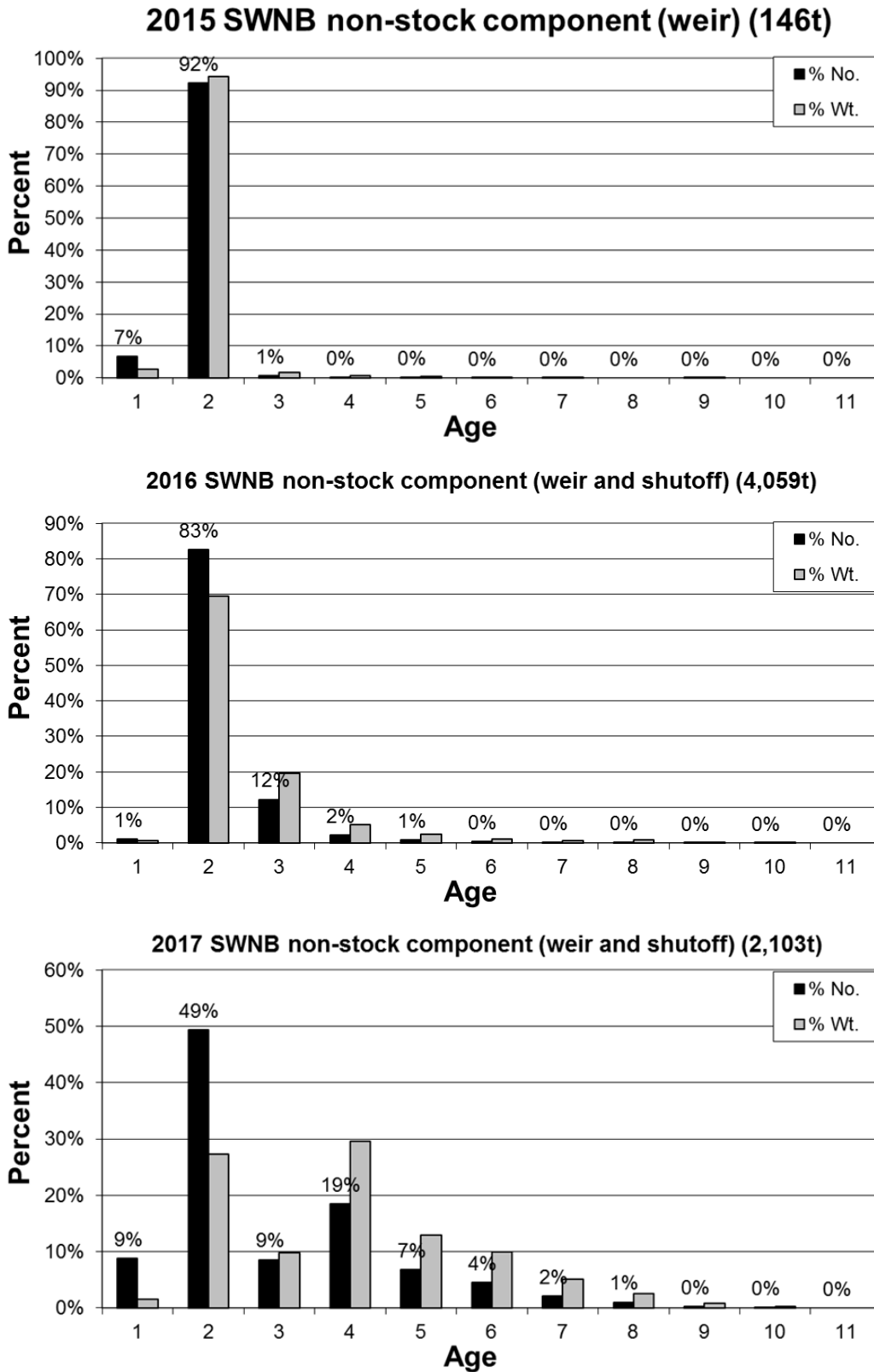


Figure 17. Fishery catch at age (% numbers and % weight) for the 2015, 2016 and 2017 SW New Brunswick migrant juvenile Herring component.

Sources of Uncertainty

SW Nova Scotia/Bay of Fundy

Acoustic surveys are a valuable tool for the assessment of this fishery and methods continue to be improved. Uncertainty remains for several factors including estimation of biomass in the acoustic dead/blind zones at the surface and close to bottom, the assumption that the surveys are additive, and residence time on the spawning grounds. An update on the tagging study by Melvin et al. (2014) on German Bank presented at this assessment meeting may help to reduce double counting. The error associated with the conversion of acoustic energy into biomass is also a source of uncertainty that should be reviewed at an upcoming framework assessment.

Recruitment into this fishery by year class has been highly variable and, as is the case with most fisheries, the size of recruiting year class is unknown, leading to uncertainty in future abundance changes.

The mechanisms causing changes in fish weight at age are not understood.

Advice on stock status uses relative trends in SSB and exploitation rate because there is no accepted analytical assessment model. This creates a difficulty in putting current SSB in a historical context as acoustic data only exist for 1999-2017.

Offshore Scotian Shelf Banks

Age distribution data are often interpreted as a proxy for survival. However, variability in cohort size or the targeting of different age classes will also influence the age distribution in a given year. As such, there is uncertainty whether the more evenly distributed age classes observed for the offshore in all three years (2015-2017) is a result of changes in survival or recruitment.

In the absence of recent information on stock status, there is no basis for evaluating the current 12,000t catch allocation. Industry is encouraged to explore and undertake structured surveys of the offshore area.

Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia

The age distribution data is often interpreted as a proxy for survival. However, variability in cohort size or the targeting of different age classes will also influence the age distribution in a given year. As such, interpretation of changes in the age distribution from 2015 to 2017 is unclear.

The survey method used to estimate abundance in this component differed from that used in SWNS/BoF. One difference is the way in which surveys were included, excluded, or combined, which may overestimate abundance.

With the exception of the four main areas, the size of various additional spawning groups and landings from these groups are poorly documented. In addition to the traditional bait and personal-use fisheries, directed roe fisheries have occurred on several spawning grounds since 1996.

The Glace Bay area has not been surveyed since 2013.

No Herring surveys have been conducted in the Bras d'Or Lakes since 2000.

Southwest New Brunswick Migrant Juveniles

The primary sources of information for assessing this component are the landings, which have declined markedly from the 1980s to present. The landings time series for this fishery may not be indicative of abundance because catches are extremely susceptible to many factors in addition to abundance, including effort.

The relative contribution of various spawning components to this fishery is unknown (e.g., Subarea 5, SWNS/BoF, etc.).

Upper Stock Reference

An Upper Stock Reference (USR) of 632,626t for the combined observed acoustic biomass on the spawning grounds of German Bank and Scots Bay was proposed for the SWNS/BoF stock component. This value is twice the current LRP of 316,313t, which is commonly used for setting USR values when no model is available. Some meeting participants felt that this was an appropriate USR and should be adopted as an interim reference point until the next stock framework could be completed. Other meeting participants proposed that the short-term rebuilding target based on the average survey value from the early part of the acoustic time series (1999-2004) should be used as the proxy USR (424,000t), with a goal of rebuilding the stock to a Target Reference Point (559,000t) over the long term. As no consensus could be reached, it was agreed that no USR recommendation would be put forward from this meeting. This discussion will be revisited at the next stock framework.

Assessment Frequency and Interim Updates

It was proposed and agreed upon that 4VWX Herring would be assessed every two years, with interim Science Response reports conducted annually.

The Science Response Report will include updates for the SWNS/BoF, Offshore Scotian Shelf, Coastal Nova Scotia spawning components and Southwest New Brunswick migrant juveniles. For each component, key information including the fishery information (landings and fishery catch at age) and survey information will be presented. The status of the SWNS/BoF spawning component with respect to the LRP will be evaluated. Observations and conclusions on conservation objectives from the management plan for SWNS/BoF spawning component will also be reviewed. Bycatch from the fishery will be reviewed at stock assessments.

In an interim year, if the SSB index for German Bank and Scots Bay is found to be below the LRP, this is considered to be an appropriate trigger for an early assessment. Other unexpected changes such as significant contraction in the age structure could also trigger an earlier than expected stock assessment. A new framework will be triggered when there is significant new information that would change the assessment approach, e.g., new survey information or detailed habitat information.

CONCLUSIONS AND ADVICE

SW Nova Scotia/Bay of Fundy

Although there is uncertainty associated with the biomass estimates, longer term trends in biomass appear to be evident for the SWNS/BoF spawning component: a decreasing trend in the German Bank area from 1999 to present, and an increasing trend in the Scots Bay area since 2005. The three-year moving average was basically flat from 2012 to 2016 and decreased by about 8% in 2017 to be at the LRP for the first time since 2011. This decrease is a cause for concern and current management measures may not be adequate to meet the rebuilding plan objectives. Biomass estimates have fluctuated about the LRP since 2010 with the confidence intervals overlapping with the LRP every year. Stock biomass and the TAC have been relatively stable at a low level in recent years from (2011 to 2016). The consensus of the meeting was that further management measures that reduce exploitation are required to support stock rebuilding.

The biomass of spawning fish estimated to be on Trinity Ledge from 2015 to 2016 is low relative to values observed in the early 2000s; however, there was a substantial increase in the SSB in 2017. This is a good sign and may indicate a return of spawning to the area. Additionally, spawning biomass was also recorded in the fall in the Spectacle Buoy area for the first time since 2006. Until there is a sustained increase in the biomass estimate over several years, fishing during the spawning season on Trinity Ledge has the potential to jeopardize the persistence of this spawning unit.

The broad range of ages observed in the commercial catch indicates that the conservation objective to maintain a broad range of ages is generally being met. Industry-developed management measures that limit exploitation on juvenile fish and spawning grounds are important for sustainability and should be continued and strengthened.

Given that the stock is at the LRP, the importance of a new framework assessment for this stock to address sources of uncertainty and make improvements to the assessment was emphasized.

Offshore Scotian Shelf Banks

Since 1996, a fishery has occurred on feeding aggregations on the Offshore Scotian Shelf, primarily in May and June, with catches ranging from 20,261t in 1997 to 58t in 2014. Landings have been low, less than 10,000t since 2012, averaging less than 2,000t but increased to 4,000t in 2017. The lowest landings in the time series occurred between 2012 and 2016.

No industry surveys were conducted on the Offshore Scotian Shelf during years 2015-2017.

Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia

From 2009 to 2017, landings in the Little Hope/Port Mouton area have ranged between 2,150t and 5,943t, and have been near or above the allocation in some years (from -1,246t to +1,559t).

From 2009 to 2017, landings in the Eastern Shore area have ranged between 771t and 6,045t, and are generally within the allocation.

Landings were minimal for Glace Bay with 4t reported in 2016 and none in 2015 and 2017.

The Bras d'Or Lakes area remained closed to Herring fishing. It has been noted since 1997 that the status of Herring in the Bras d'Or Lakes is cause for concern. In the absence of current abundance information the Bras d'Or Lakes should remain closed.

Individual spawning groups within the Coastal component are considered vulnerable to fishing because of their relatively small size (biomass) and proximity to shore. For this reason, a large effort increase in new areas has a potential to markedly reduce abundance in the absence of information about the status of the specific spawning group.

Southwest New Brunswick Migrant Juveniles

Landings in the New Brunswick weir and shut-off fishery decreased to a historic low in 2015 of 146t, increased to 4,060t in 2016, and decreased to 2,102t in 2017. It is notable that in 2007 landings were 30,944t, the highest in nearly 20 years and higher than the long term average of 20,680t.

For the time series presented, current landings are at or near the lowest observed. In 2015 and 2017, the number of weirs with landings was the second lowest recorded (11), but 26 weir reported landings in 2016. The landings in this fishery are usually juveniles (Age 1 or 2); however, in 2017 older fish were present the catch. This is a departure from what was being caught during the last decade.

Abundance of Herring available to the weirs is unknown and there is no research being conducted to investigate local Herring abundance.

OTHER CONSIDERATIONS

Observer reports continue to indicate low numbers of bycatch of non-Herring species in the purse seine sets. In 2015, 2016 and 2017, bycatch consisted of small amounts of Silver Hake, Mackerel (Atlantic), Short-fin Squid, Shrimp, Mako Shark, Blue Shark, Thresher Shark, Porbeagle Shark, Spiny Dogfish, Winter Flounder, Jellyfishes, Monkfish and American Lobster, and a single Bluefin Tuna. All bycatch

was released with the exception of very small quantities of Silver Hake, Shortfin Squid, Shrimp, Mackerel (Atlantic), and Spiny Dogfish.

LIST OF MEETING PARTICIPANTS

Name	Affiliation
Anderson, Sam	Fisher-Newfoundland - NAFO Div. 4R
Andrushchenko, Irene	DFO Science, Maritimes Region
Baker, Lori	Eastern Shore Fisherman's Protective Association.
Bennett, Lottie	DFO Science, Maritimes Region
Boyce, Daniel	Fisheries and Oceans Canada
Bundy, Alida	DFO Science, Maritimes Region
Chandler, Alan	Nova Scotia Department of Fisheries & Aquaculture
Clark, Kirsten	DFO Science, Maritimes Region
Clay, Allen	Femto Electronics Limited
Cook, Adam	DFO Science, Maritimes Region
Debertin, Allan	DFO Science, Maritimes Region
d'Entremont, Kim	Comeau's Sea Foods Limited
d'Eon, Glen	Southwest Seiners Co.
d'Eon, Sherman	Cape Breeze Seafoods Ltd.
Ford, Jennifer	DFO Science, Maritimes Region
Fry-Buchanan, Joy	Atlantic Herring Co-op / Full Bay Scallop Association.
Fuentes-Pardo, Angela	Dalhousie University
Grant, Heather	Ecology Action Centre
Hooper, Tony	Connors Bros. Clover Leaf
Hubley, Brad	DFO Science. Maritimes Region
Jayawardane, Aruna	Maliseet Nation Conservation Council
Kaiser, Tim	Scotia Garden Seafood Inc.
Kavanagh, Sana	Confederacy of Mainland Mi'kmaq
Kent, Donald	Eastern Shore Group
Kerr, Quentin	Dalhousie University
Kho, James	Dalhousie University
Landriault, Marc	Comeau Seafoods
Martin, Ryan	DFO Science, Maritimes Region
McDermid, Jenni	DFO Science, Gulf Region
Melvin, Gary	DFO Science, Maritimes Region
Mitchell, Vanessa	Maritime Aboriginal Peoples Council
Munden, Jenna	Herring Science Council
Murphy, Chris	William R. Murphy Fisheries Ltd.
Partington, Peter	Little Hope Fishermens Association
Perrier, Erika	Atlantic Policy Congress of First Nations Chiefs Secretariat
Robicheau, Lloyd	Eastern Shore Fisherman's Protective Assn.
Ruzzante, Daniel	Dalhousie University
Saulnier, Billy	Comeau's Sea Foods Limited
Saulnier, Brian	SeaCrest Fisheries
Saunders, Jennifer	DFO Resource Management, Maritimes Region
Singh, Rabindra	DFO Science, Maritimes Region
Soomai, Suzuette	DFO Fisheries Management, Maritimes Region
Stirling, Roger	Seafood Producers Assn of Nova Scotia

Name	Affiliation
Surette, Dwayne	DFO Conservation & Protection, Maritimes Region
Waters, Christa	DFO Fisheries Management, Maritimes Region

SOURCES OF INFORMATION

This Science Advisory Report is from the April 11-12, 2018, Assessment of 4VWX Herring. Additional publications from this process will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

Clark, D.S., Clark, K.J., Claytor, R., Leslie, S., Melvin, G.D., Porter, J.M., Power, M.J., Stone, H.H., and Waters, C. 2012. [Limit Reference Point for Southwest Nova Scotia / Bay of Fundy spawning component of Atlantic Herring, *Clupea harengus* \(German Bank and Scots Bay\)](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2012/025. iii + 14 p.

DFO. 2003. 2003-2006 Scotia-Fundy Fisheries Integrated Herring Management Plan, NAFO subdivisions 4WX, 4Vn and 5Z. Department of Fisheries and Oceans.

DFO. 2007. [Proceedings of the Maritimes Provinces Regional Advisory Process on the assessment framework for 4VWX Herring stocks; 31 October–1 November 2006 and 9–11 January 2007](#). DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/002: 52 p.

DFO. 2011. [Proceedings of the Maritimes Provinces Regional Advisory Process on the Assessment Framework for Southwest Nova Scotia/Bay of Fundy Herring; 24 – 28 January 2011](#). DFO Can. Sci. Advis. Sec. Proceed. Ser. 2011/031.

DFO. 2015. [2015 Assessment of 4VWX Herring](#). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/040.

Melvin, G.D., Martin, R., and Power, M.J. 2014. [Estimating German Bank and Scots Bay Herring Spawning Ground Turnover Rates from Tag Returns](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2014/068: iv + 22 p.

Power, M.J., Knox, D., MacIntyre, A., Melvin, G.D., and Singh, R. 2013. [2011 Evaluation of 4VWX Herring](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2012/085: iv + 85 p.

Sinclair, M. (Chair). 1997. [Report of the Maritimes Region Herring Workshop, 18-19 February 1997](#). Can. Stock Assess. Proceed. Ser. 97/12: 58 p.

Singh, R., Melvin, G.D., Clay, A., and Power, M.J. 2014. [Summary of 2011 and 2012 Herring Acoustic Surveys in Northwest Atlantic Fisheries Organization \(NAFO\) Divisions 4VWX](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2014/067. v + 147 p.

Singh, R., Dalton, A., Knox, D., MacIntyre, A., and Melvin, G.D. 2016. [2015 Evaluation of Northwest Atlantic Fisheries Organization \(NAFO\) Divisions 4VWX Herring](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2016/073. vi + 125 p.

THIS REPORT IS AVAILABLE FROM THE

Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive, PO Box 1006
Dartmouth, Nova Scotia B2Y 4A2

Telephone: 902-426-7070

E-Mail: XMARMRAP@mar.dfo-mpo.gc.ca

Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-5087

© Her Majesty the Queen in Right of Canada, 2017



Correct Citation for this Publication:

DFO. 2018. 2018 Assessment of 4VWX Herring. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/052.

Aussi disponible en français :

MPO. 2018. Évaluation du hareng de 4VWX de 2018. Secr. can. de consult. sci. du MPO, Avis sci. 2018/052.