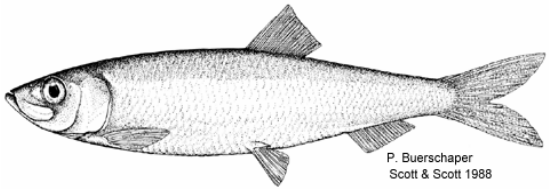
Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Maritimes Region
Canadian Science Advisory Secretariat
Science Advisory Report 2009/035

2009 ASSESSMENT OF 4VWX HERRING



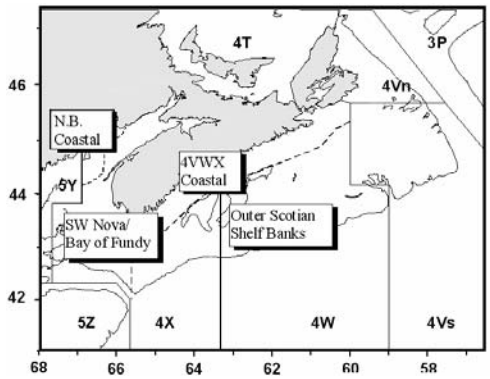


Figure 1. 4VWX herring management area and stock component locations.

Context :

In support of scientific advice for the 2008/09 fishery, the 2009 assessment of the 4VWX herring stock complex (Figure 1) was undertaken by the Science Advisory Process. The meeting was held April 7-8, 2009, in Dartmouth, N.S. to review and evaluate biological and fishery information on 4VWX herring status as a basis for establishing quota for the 2008/2009 fisheries, as required in the Integrated Fisheries Management Plan. The terms of reference included an evaluation of the SW Nova Scotia / Bay of Fundy spawning component, 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, an update of progress of target strength studies, analysis of impacts of harvesting on size and age and the long-term effects on biomass 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 2008.

The 2003-2008 Scotia-Fundy Herring Integrated Fisheries Management Plan (rolling evergreen) (DFO 2003) set out principles, conditions, and management measures for the 4VWX herring fisheries. The main principle stated in the plan is "the conservation of the herring resource and the preservation of all of its spawning components". 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;*
   - *maintenance of biomass of each spawning component above a minimum threshold;*
   - *maintenance of a broad age composition for each spawning component; and*
   - *maintenance of 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"):*
   - *maintain spatial and temporal diversity of spawning*
   - *maintain 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 dependant on a number of projects undertaken with the assistance of the fishing industry. These include industry sampling of biological characteristics of the catch, as well as acoustic surveys using industry vessels and tagging. A major review of the assessment framework including aspects of stock structure, sampling and tagging results, acoustic surveys and design was completed in the fall and winter of 2006-07 (DFO 2007). A final Framework meeting is planned to evaluate and review assessment formulations and alternative models/approaches.

SUMMARY

SW Nova Scotia / Bay of Fundy

- Landings in 2007/08 were 54,560t against a Total Allowable Catch (TAC) of 55,000t for the SW Nova Scotia / Bay of Fundy component. Landings have tracked the TAC in recent years with most of the quota being taken each year since 2002.
- Overall length composition in the catch has improved. Proportion of larger (30cm+) sizes continues to increase. There has been an increase in medium sized (23-30cm) fish, but the strength of the incoming year-class is unknown.
- Acoustic biomass estimates decreased and are near the lowest in the time series for each of the major survey areas. Taking into consideration confidence intervals, overall spawning stock biomass (SSB) for the past 4 years has been steady, at a lower level than in the 1999-2004 period. SSB in 2008 is the lowest in the time series.
- Fishing mortality could not be determined. Relative exploitation rates based on acoustic surveys increased in 2008.
- This assessment indicates little improvement from the low level of the resource noted in recent assessments.
- A harvest strategy that exercises continued caution to facilitate further rebuilding is strongly recommended. Catch levels should remain near the current status quo due to uncertainties in estimating SSB, recruitment and the exploitation rate for this stock.

Offshore Scotian Shelf Banks

- Since 1996, a fishery has taken place on feeding aggregations on the offshore banks, primarily in May and June, with catches ranging from 1,000 to 20,000t. Total landings were 920t in 2008, down from 5,400t in 2007 and 9,800t in 2006.
- There is little new information to add and no reason to change the previous recommendation that the initial catch allocation should not exceed the 12,000t as described in the DFO Management Plan.
- The industry has been encouraged to explore and undertake structured surveys of the offshore area, but this has not occurred since 2001.

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

- In 2008 there was an increase in surveyed acoustic biomass in the Little Hope/Port Mouton area from the low of the previous year but biomass is still below average. The surveyed biomass in the Halifax/Eastern shore area saw a slight increase and is close to the long term average SSB observed for this area.
- Collaborative research with industry has improved our knowledge in three areas (Little Hope/Port Mouton, Halifax/Eastern Shore and Glace Bay), but there has been no increase in knowledge in other areas. It is again recommended that no coastal spawning areas experience a large effort increase in new areas until enough information is available to evaluate the state of that spawning group.
- Harvest levels from these areas use a five-year average of recent catches and/or surveyed acoustic biomass with the Calibration Integration Factor (CIF) to set annual removals. It is recommended that given the current situation of reduced or below average biomass in all areas, the “survey, assess, then fish” protocol should be applied.

SW New Brunswick Migrant Juvenile

- These fish have been considered to be a mixture of juveniles, dominated by those originating from NAFO Subarea 5 spawning components, and have therefore been excluded from the 4WX quota.
- Landings in the 2008 New Brunswick weir and shut-off fishery were 6,400t, the lowest catch since 1963 and well below the long term average. The previous year's fishery landed 30,900t which was higher than the long term average of 24,000t.
- The success of this passive fishery is historically unpredictable, and catches are inherently susceptible to many natural variables in addition to abundance.

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. Herring mature and first spawn at three or four years of age (23 to 28cm or 9 to 11in), then begin an annual pattern of spawning, over-wintering, and summer feeding, which often involves considerable migration and mixing with members of other spawning groups. Fishing takes place on dense summer feeding, over-wintering, and spawning aggregations. The majority of herring in the 4VWX stock are fall spawners.

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 situation 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:

1. SW Nova Scotia / Bay of Fundy spawning 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 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 the 4VWX area in recent years have been dominated by purse seine (90%), followed by weir, gillnet, shutoff, and trap.

Landings in 2007/08 were 54,560t against a Total Allowable Catch (TAC) of 55,000t for the SW Nova Scotia / Bay of Fundy component (Table 1). Landings have tracked the TAC in recent years with most of the quota being taken each year since 2002 (Figure 2). There were additional landings of 11,060t in the non-stock components for an area total of 65,630t with a decreased

proportion of catches from the New Brunswick weirs and shutoffs in 2008. Catches by fishing grounds were similar to recent years with the largest proportions from the German Bank (43%), Gannet/Dry Ledge (19%) and Grand Manan (20%) areas. There was an increase in catches from German Bank and below average catches from Scots Bay and the Long Island shore area. The duration of the spawning fishery on German Bank was similar to previous years but there were gaps in daily landings from the spawning grounds due to the abundance of salps (*Thalia democratica*) which restricted fishing operations.

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 appropriate account of the interaction among components (such as fishing restrictions on some areas of mixing). Prior to 2005, there was targeting of young fish and the high proportion of juveniles in the catch resulted in lost potential yield. Since 2005/2006 industry made a concerted effort to avoid small fish (<23cm). The result was a decrease in the proportion of fish less than 23cm in the catch since 2003. This, combined with the reduced TAC, has allowed the proportion of adult fish from 23 to 30cm to increase (Figure 3). The total removals of fish by number have also been reduced by close to 50% from 2005 to 2008 relative to 2004.

Table 1. Reported landings (thousands of tonnes) and TAC for the 4WX herring management unit by component from 2000 to 2008 with averages for prior decades.

Year	Average 1970-79	Average 1980-89	Average 1990-99	2000	2001	2002	2003	2004	2005	2006	2007	2008
4WX SW Nova Scotia TAC*	106	106	112	100	78	78	93	83	50	50	50	55
4WX SW Nova Scotia*	131	131	96	85	72	77	89	78	49	50	50	55
4VWX Coastal NS^	<1	<1	4	4	6	10	9	7	7	7	5	4
Scotian Shelf Banks^	38	<0.1	13	2	12	7	1	4	5	10	5	1
SW New Brunswick^	26	24	24	17	20	12	9	21	13	13	31	6
Total Landings	172	155	137	108	110	106	108	110	74	79	92	66

* Quota year from Oct. 15 of the preceeding year to Oct 14 of the current year

^ Calendar year from Jan. 1 to Dec. 31

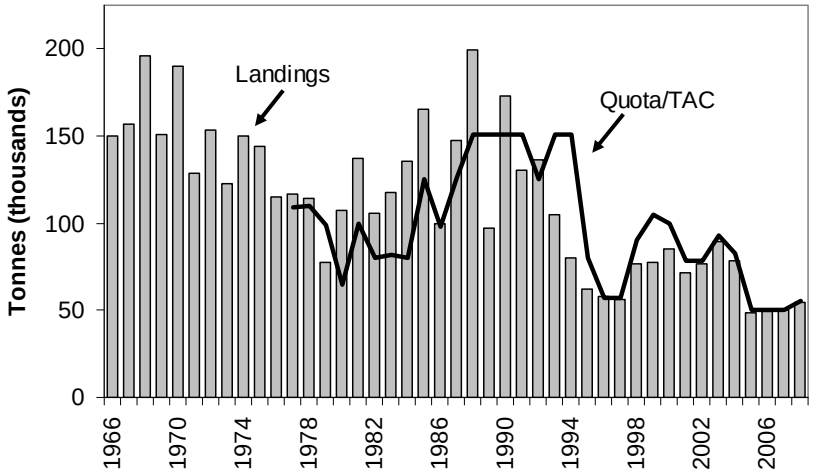


Figure 2. Landings (thousands of tonnes) and TAC for the SW Nova Scotia / Bay of Fundy spawning component.

ASSESSMENT FOR THE SOUTHWEST NOVA SCOTIA / BAY OF FUNDY SPAWNING COMPONENT

In 2008 the catch at length size composition was comprised of 37% fish less than 23cm (23cm = length at which 50% are mature), 57% fish 23 to 30cm, and 6% sizes larger than 30cm representing a broad size distribution (Figure 3, 4). There continues to be an increase of older/larger fish in the catch but the percentage is well below pre-1999 levels. The number of smaller fish in the catch (less than 23cm) was similar to years since 2005; however, the number of mid-sized fish increased in 2008. This increase is associated with improved recruitment but not necessarily a strong 2005 year-class recruiting to the Spawning Stock Biomass (SSB), as previously expected (DFO 2008). The proportion of the catch greater than 30cm increased in 2008 to 6% from a low of 2% in 2006 (Figure 3). The reduced TAC and redirection of effort since 2005 has resulted in a reduction in the catch in numbers. The total number of fish removed by the fishery was estimated to be 454 million or 55% of the 2004 removals (821 million).

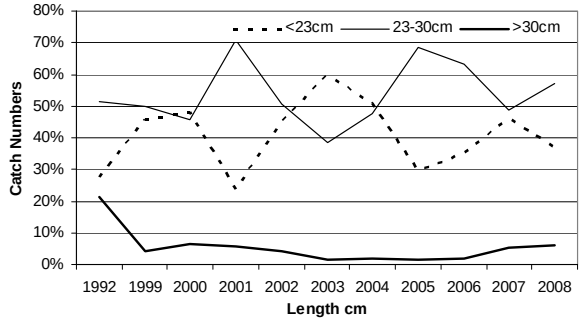


Figure 3. Proportions of size groups (% number) <23cm, 23-30cm and >30cm herring in the catch from the SW Nova Scotia / Bay of Fundy spawning component.

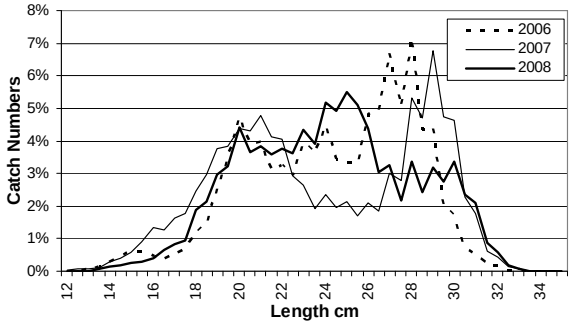


Figure 4. Catch at length (% number) for the 2006, 2007 and 2008 overall SW Nova Scotia / Bay of Fundy herring spawning component.

Acoustic Surveys

Industry led surveys with automated acoustic recording systems deployed on commercial fishing vessels were used to document the distribution and abundance of herring. Scheduled surveys were conducted every 2 weeks on the main spawning components and an index of SSB for each component was estimated by summing these results (Table 2).

Four surveys were conducted in Scots Bay in 2008. The survey effort in Scots Bay was reduced in part due to increased operational costs (i.e. fuel costs). Five usable surveys were completed on German Bank. Additional acoustic data from fishing nights on German Bank were examined but not included in the overall biomass estimate. Individual survey area coverage was good and consistent with established protocols. Inclusion of the Calibration Integration Factor (CIF) is deemed to provide a more accurate estimate of biomass and re-analysis for earlier years was begun in 2008. Until the revision including the CIF for 1999 to 2002 is completed only results without this factor are shown when comparing years.

The amount of spawning fish documented on Trinity Ledge in 2008 was extremely low but survey coverage was limited. There were no surveys and no reports of spawning herring around Seal Island and Browns Bank grounds. A small spawning fishery occurred on Spectacle Buoy in June with limited survey effort.

Table 2. Acoustic survey biomass index for SW Nova Scotia / Bay of Fundy spawning component for 1999 to 2008 ('000's t). Blanks indicate that no survey was undertaken. Estimates are calculated without the use of the CIF.

Location/Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average 1999-2007
Scots Bay	41	106	164	141	134	108	17	29	46	19	87
German Bank	461	356	191	393	344	368	211	246	337	203	323
Trinity Ledge	4	1	15	8	15	7	5	9	1	0	7
Spectacle Buoy (spring)			1		1		0.3		0	0	1
Spectacle Buoy (fall)			88								88
Subtotal	506	463	458	542	493	482	233	283	384	222	427
German (outside box)								4		2	4
Seal Island			3	1	12			8			6
Browns Bank			46					6			26
Overall SSB	506	463	507	543	506	482	233	301	384	224	436
Overall SE % *	19	14	10	9	17	15	28	16	25	27	17

* Overall SE% is the percentage of the standard error of the estimate to the mean.

Biomass estimates in the traditional survey areas for Scots Bay, Trinity Ledge and German Bank were 223,900t, which is a decrease of approximately 162,000t from 2007. While the overall acoustic biomass is less than in 2007, due to variability around the survey estimates, it is not statistically different from the previous 3 years which were at a lower level than from 1999-2004 (Figure 5). The overall biomass estimate in 2008 is the lowest in the time series.

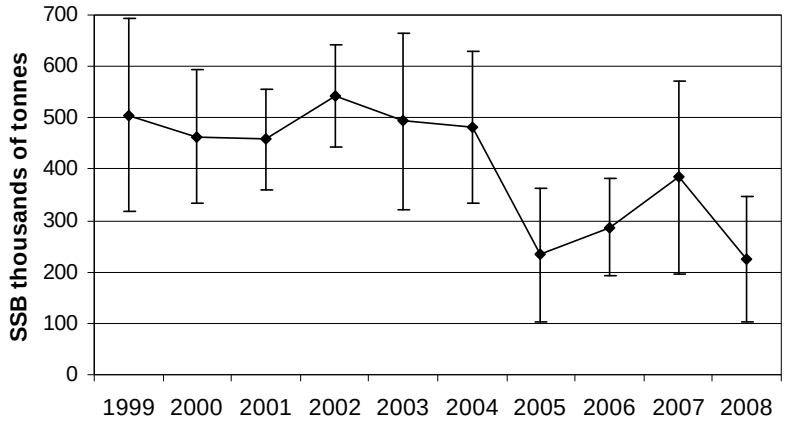


Figure 5. SSB index from acoustic surveys for the SW Nova Scotia / Bay of Fundy spawning component, and for Scots Bay and German Bank areas.

Stock Trends and Current Status

The 2008 framework review concluded that while the current acoustic survey can only provide a relative index of abundance, efforts should continue towards developing an absolute estimator.

The result of ageing studies indicate that under ageing leads to an over-estimate of fishing mortality and an under estimate of biomass; the amount dependent upon the severity of the under-ageing (Melvin and Power, 2007). As a result, an age based analytical assessment with estimates of fishing mortality cannot be undertaken until the ageing issues are resolved. It is anticipated that ageing will be completed by the end of 2009.

There are mixed signals for this component. While the overall acoustic biomass is less than in 2007, due to variability around the survey estimates, it is not statistically different from the previous 3 years which were at a lower level than from 1999-2004. Fishing mortality was not determined. However, relative exploitation appears to have increased in 2008 based on the acoustic surveys and catch (Figure 6), keeping in mind the variability in acoustic survey estimates.

The number of smaller fish in the catch (less than 23cm) was similar to years since 2005, however the number of mid-sized fish increased in 2008. This increase is associated with improved recruitment but not necessarily a strong 2005 year-class recruiting to the SSB, as previously expected (DFO 2008).

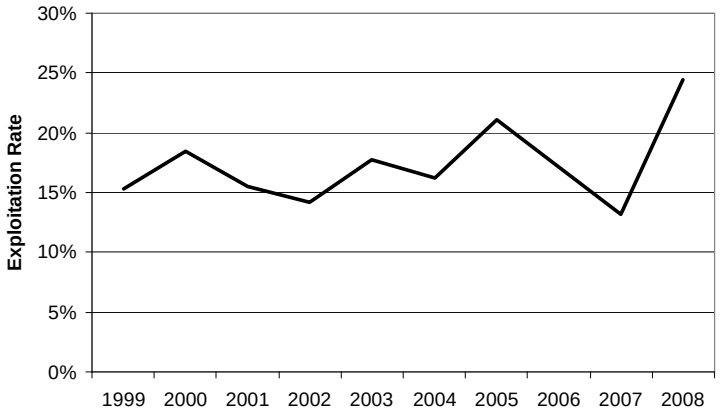


Figure 6. Relative exploitation rate for the SW Nova Scotia / Bay of Fundy spawning component using overall catch as a proportion of the overall acoustic SSB.

Sources of Uncertainty

- There is uncertainty with determination of Age 4+ herring for this stock which is under review.
- There is no independent index of recruitment.
- The actual size of 2005 recruiting year-class is unknown.
- A major source of uncertainty continues to be the assumption that the surveys are simply additive. If herring do not move on to and off of the spawning grounds in waves, the estimate of total SSB will be biased; upward due to double counting or downward due to the missing of waves.
- As well, herring have been observed close to bottom or near the surface (dead/blind zone), which can lead to an under-estimation of biomass from acoustic surveys.
- Other significant issues relate to the completeness of coverage of the survey area, inter-annual turn-over processes on each area, and factors that influence the target strength and acoustic backscatter (DFO 2007).

CONCLUSIONS AND ADVICE

The objectives for this stock from the management plan and the current observations are summarized below.

Objective	2008: Observations
Persistence of all spawning components	Spawning observed in Scots Bay and German Bank. Spawning activity could not be determined on Seal Island or Browns due to a lack of fishing or survey effort. Trinity Ledge with minimal spawning.
Maintain biomass of each component	Acoustic biomass estimates decreased and are near the lowest in the time series for each of the major survey areas. Taking into consideration confidence intervals, overall SSB for the past 4 years has been steady, at a lower level than in the 1999-2004 period. SSB in 2008 is the lowest in the time series.
Maintain broad age composition	Overall length composition in the catch has improved. Proportion of larger (30cm+) sizes continues to increase. There has been an increase in medium sized (23-30cm) fish but the strength of the incoming year-class is unknown. Without a population model catch is the best available proxy of the population.
Maintain long spawning period	Start of spawning in 2008 for German Bank and Scots Bay was typical. Virtually no spawning on Trinity Ledge. The duration appeared shorter for Scots Bay.
Fishing mortality at or below $F_{0.1}$	Fishing mortality could not be determined. Relative exploitation rates based on acoustic surveys increased in 2008.
Maintain spatial and temporal diversity of spawning	Insufficient spawning in all areas except for German Bank. Scots Bay area appeared less diverse.
Maintain biomass at moderate to high levels	Herring are a key component in the ecosystem. SSB continues to be at a low level. Recently observed changes in environment may have an impact on spawning type prevalence and abundance.

This assessment indicates little improvement from the low level of the resource noted in recent assessments. A harvest strategy that exercises continued caution to facilitate further rebuilding is strongly recommended. Catch levels should remain near the current status quo due to uncertainties in estimating SSB, recruitment and the exploitation rate for this stock.

OTHER CONSIDERATIONS

The high price of fuel had a major impact on the distance travelled and the search behaviour in 2008 resulting in reduced survey effort.

Pooling or sharing of catches amongst vessels to minimize sets and discards has reduced the actual effort and minimized occurrence of discards.

Due to the presence of a significant bloom of salps (‘eyeballs’), herring behaviour and catch success was impacted in 2008.

Increases in grey seal abundance and changes in distribution raise concern about changes in herring behaviour and abundance.

Observer reports of by-catch in purse seine sets have previously reported small amounts of mackerel, squid and dogfish.

A number of issues and research recommendations were identified at the herring framework in 2007 and are being addressed as funds become available.

ASSESSMENT, CONCLUSIONS AND ADVICE FOR OTHER COMPONENTS

Offshore Scotian Shelf

Since 1996, a fishery has taken place on feeding aggregations on the offshore banks, primarily in May and June, with catches ranging from 1,000 to 20,000t (Figure 7). Total landings were 920t in 2008, down from 5,400t in 2007 and 9,800t in 2006 with most landings by purse seine in May and June, in the vicinity of the Patch, Emerald and Western banks.

In 2008, the size composition of the catch was mostly adult herring with a substantial proportion (36%) larger than 30cm (see highlighted bars Figure 8).

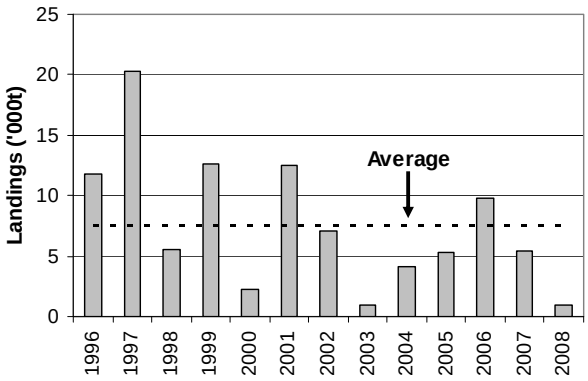


Figure 7. Offshore Scotian Shelf herring landings since 1996 with overall average for the period.

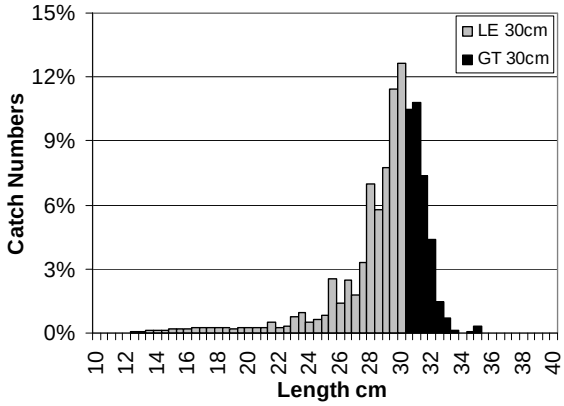


Figure 8. Catch at length (% numbers) for the 2008 Offshore Scotian Shelf herring component.

There have been no industry surveys of the offshore Scotian Shelf area since 2001. The DFO summer ecosystem trawl survey index which previously demonstrated considerable abundance of herring widely spread over the Scotian Shelf has declined substantially from the high of 2004. The bottom trawl data are not considered indicative of overall herring abundance.

There is little new information to add and no reason to change the previous recommendation that the initial catch allocation should not exceed the 12,000t as described in the DFO Management Plan. The industry has been encouraged to explore and undertake structured surveys of the offshore area but this has not occurred since 2001.

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

There is no quota for the coastal Nova Scotia spawning component. Apart from the four areas, the size and historical performance of various spawning groups are poorly documented (Table 3). In addition to the traditional bait and personal-use fisheries, directed roe fisheries have occurred on several spawning grounds since 1996.

Table 3. Recorded landings (thousands of tonnes) of herring from major gillnet fisheries on the Coastal Nova Scotia spawning component for 1996 to 2008.

.

Landings (000's t)

Landings	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Little Hope/Port Mouton		0.5	1.2	2.9	2.0	2.9	4.0	4.5	1.3	2.2	3.1	1.5	1.1
Halifax/Eastern Shore	1.3	1.5	1.1	1.6	1.4	1.9	3.3	2.7	4.2	3.4	3.3	3.7	2.4
Glace Bay		0.2	1.7	1.0	0.8	1.2	3.1	1.9	1.5	0.6	0.1	0.0	0.0
Bras d'Or Lakes	0.2	0.2	0.1	0.0	0.1								
Total	1.5	2.3	4.1	5.6	4.3	6.0	10.4	9.1	7.0	6.3	6.6	5.3	3.5

The landings of 3,500t in 2008 in the gillnet fisheries along the coast of Nova Scotia declined from 2007. Landings were slightly lower for Little Hope/Port Mouton area, had a large decrease for the Eastern Shore area, and were minimal for Glace Bay. The Bras d'Or Lakes area remained closed. There was an additional 200t landed from trap nets located in Cape Breton and St. Margaret's Bay.

As the inshore roe fisheries off Glace Bay, East of Halifax and Little Hope developed (since 1996), participants have contributed to sampling and surveying. In the previous assessment (for 2007 fishing year) there was a reduction in surveyed acoustic biomass in the Halifax/Eastern Shore area of about 50%, while the Little Hope area saw an even larger decline of almost 90%. In 2008, there was an increase in surveyed acoustic biomass in the Little Hope/Port Mouton area from the low of the previous year, but biomass is still below average (Table 4, Figure 9). The surveyed biomass in the Halifax/Eastern shore area saw a slight increase and is close to the long term average SSB observed for this area (Figure 10). Surveys were also completed near Glace Bay but there were very little spawning herring documented or catch reported (Figure 11). No herring surveys have been conducted in the Bras d'Or Lakes since 2000.

Table 4. Estimated herring acoustic SSB (thousands of tonnes) and recent 5 year average for the Coastal Nova Scotia spawning component areas as calculated with the CIF.

Survey Area	2003	2004	2005	2006	2007	2008	Average 2004-2008
Little Hope/Port Mouton	53.1	22.5	44.7	24.1	2.8	14.5	21.7
Halifax/Eastern Shore	92.6	28.4	37.0	68.9	28.3	30.3	38.6
Glace Bay	31.5	0.0	3.2	n/s	0.2	0.5	1.0
Bras d'Or Lakes	n/s	n/s	n/s	n/s	n/s	n/s	no surveys

As indicated for the SW Nova Scotia / Bay of Fundy component, summing of multiple surveys may result in overestimates of SSB due to double counting. However, the majority of surveys of the Coastal Nova Scotia spawning component were undertaken on spatially separated aggregations of fish.

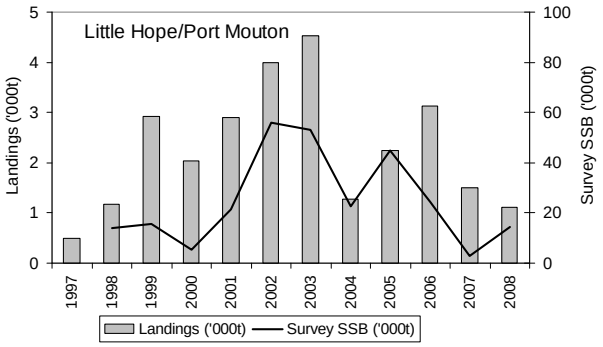


Figure 9. Landings and acoustic survey SSB ('000t) for the Little Hope/Port Mouton gillnet fishery for 1997-2008.

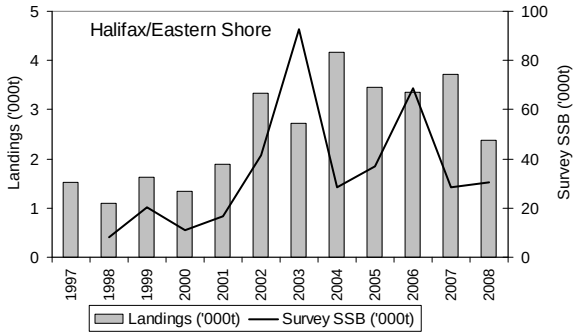


Figure 10. Landings and acoustic survey SSB ('000t) for the Halifax/Eastern Shore gillnet fishery for 1997-2008.

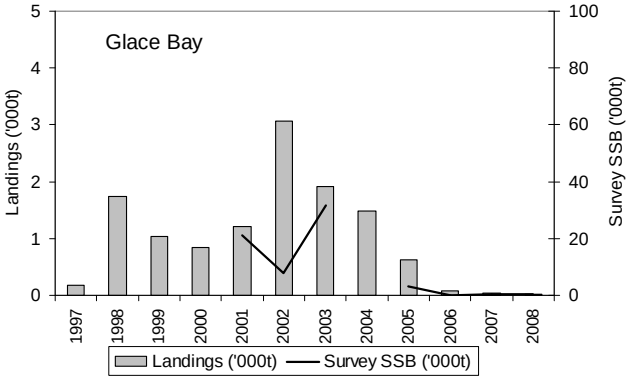


Figure 11. Landings and acoustic survey SSB ('000t) for the Glace Bay gillnet fishery for 1997-2008.

Collaborative research with industry has improved our knowledge in three areas (Little Hope/Port Mouton, Halifax/Eastern Shore and Glace Bay), but there has been no increase in knowledge in other areas. Individual spawning groups within this component are considered vulnerable to fishing because of their relatively small size and proximity to shore. It is again recommended that no coastal spawning areas experience a large effort increase in new areas until enough information 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, but there has been no research or surveys in recent years. It is therefore again appropriate to reiterate that no fishing should take place on this spawning component.

Harvest levels from these areas use a five-year average of recent catches and/or surveyed acoustic biomass with the CIF to set annual removals. The provision to document sufficient quantities of fish each year before the fishery begins had been waived recently due to substantial abundances. It is recommended that given the current situation of reduced or below average biomass in all areas, the "survey, assess, then fish" protocol should be applied.

SW New Brunswick Migrant Juveniles

The southwest New Brunswick weir and shutoff fisheries have relied, for over a century, on the aggregation of large numbers of juvenile herring (ages 1-3) near shore at the mouth of the Bay of Fundy. These fish have been considered to be a mixture of juveniles, dominated by those originating from NAFO Subarea 5 spawning components, and have therefore been excluded from the 4WX quota.

Landings in the 2008 New Brunswick weir and shut-off fishery were 6,400t, the lowest catch since 1963 and well below the long term average. The previous year's fishery landed 30,900t which was higher than the long term average of 24,000t (Figure 12).

The size distribution of fish caught in the 2008 New Brunswick weir and shutoff fishery was mostly juvenile size fish well suited to the sardine market with 98.7% less than 23cm (Figure 13). The number of active weirs with catch decreased in the 2008 season although there were more weirs reported as constructed.

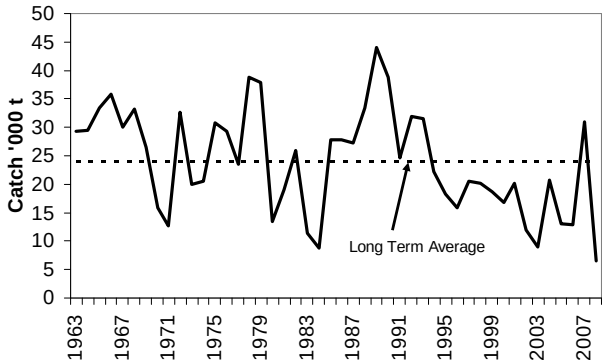


Figure 12. Herring landings from New Brunswick weir and shutoff fishery for 1963-2008 with long term average catch.

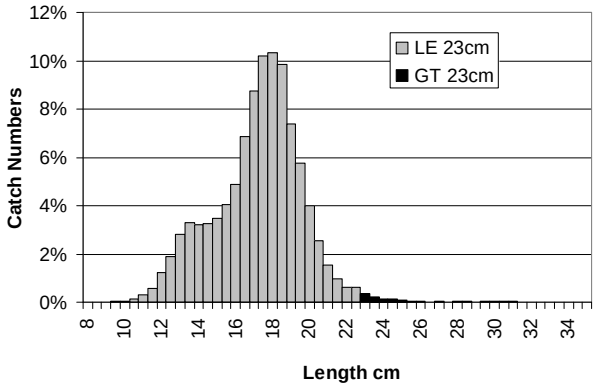


Figure 13. Catch at length (% numbers) for the 2008 SW New Brunswick migrant juvenile herring component.

The success of this passive fishery is historically unpredictable, and catches are inherently susceptible to many natural variables in addition to abundance. In 2008, weir fishermen in most areas reported good abundance close to their weirs, but catches remained low throughout the season.

SOURCES OF INFORMATION

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 2007 and 9 – 11 January 2007. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/002.

DFO. 2008. 2008 Assessment of 4VWX Herring. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/023.

Melvin, G.D., and M.J. Power. 2007. Ageing Inconsistencies and Sensitivity Analysis for 4WX Herring. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/071.

FOR MORE INFORMATION

Contact: Michael Power
St. Andrews Biological Station
531 Brandy Cove Road
St. Andrews, New Brunswick
E5B 2L9

Tel: (506) 529-5881
Fax: (506) 529-5862
E-Mail: Michael.Power@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Box 1006, Stn. B203
Dartmouth, Nova Scotia
Canada B2Y 4A2

Telephone: 902-426-7070
Fax: 902-426-5435
E-Mail: XMARMRAP@mar.dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1919-5079 (Printed)
ISSN 1919-5087 (Online)

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2009. 2009 Assessment of 4VWX Herring. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/035.