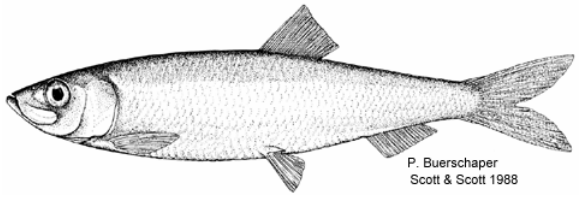


4VWX Herring

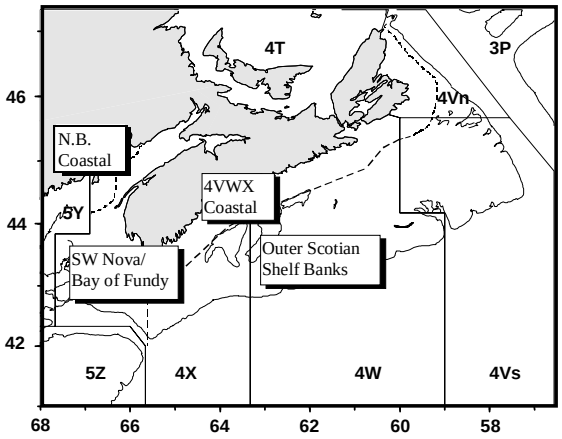
Background

Atlantic herring is a pelagic species found on both sides of the North Atlantic. Herring spawn in discrete locations, to which they are presumed to home. Herring first mature and spawn at three or four years of age (23 to 28 cm or 9 to 11 in), then begin a predictable annual pattern of spawning, overwintering, and summer feeding, which often involves considerable migration and mixing with members of other spawning groups. Most fishing takes place on dense summer feeding, overwintering, 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 complex. 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 complex and with members of other spawning groups. 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; and*
4. *SW New Brunswick migrant juveniles.*

Each component has several spawning areas, and there is mixing of fish among spawning components. 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 of taking appropriate account of interaction among components (such as fishing restrictions on some areas of mixing).



Fisheries in the 4VWX area in recent years have been dominated by purse seine, weir and gillnet, with relatively minor landings by shutoff and trap.

Since 1995, the herring stock assessment and related research have been enhanced by a number of projects undertaken with the assistance of the fishing industry. These include industry sampling of biological characteristics of the catch, acoustic surveys using industry vessels and tagging.

Summary

SW Nova Scotia / Bay of Fundy Spawning Component

- Although acoustic surveys continue to show an SSB of approximately 505,000t, there has been a deterioration in the state of the stock.
- The 2003 catch was dominated by age 2 (by number) and 3 (by weight).
- There is an absence of old fish in the population, and increased targeting of juveniles.
- SSB on both Trinity Ledge and Seal Island spawning areas remain well below historical levels.
- Rapid decline of year-classes indicates high total mortality.
- Although recent catches have been consistent with the survey, assess, fish protocol of less than 20% of surveyed biomass, catch at age indicates that total mortality may be considerably higher.

- Some conservation objectives specified for this fishery are not being met.
- There has been insufficient progress towards conservation objectives in recent years.

Offshore Scotian Shelf Banks Spawning Component

- Landings in 2003 (less than 1,000t) were the smallest since the fishery was reactivated in 1996.
- Survey catches of the past six years have been the highest on record and herring were widely distributed on banks west of Sable Island.
- The initial catch allocation for 2004 should not exceed the 12,000t reference value used in the recent fishing plans.

Coastal Nova Scotia Spawning Component

- Biomass estimates from surveys of the major coastal Nova Scotia spawning components were higher in 2003 with large increases in estimated SSB for the Little Hope (4Xo), Eastern Shore (4Wk) and Glace Bay (4Vn) areas.
- No coastal spawning areas should experience a large effort increase until much more information is available on the state of that spawning group.
- There should be no new fisheries developed when there is uncertainty regarding stock composition and degree of mixing.

SW New Brunswick Migrant Juveniles

- There was a further drop in landings in the traditional New Brunswick weir and shutoff fishery to 9,000t – the lowest since 1983.

Objectives and Management

The 2003-2006 Scotia-Fundy Herring Integrated Fisheries Management Plan (DFO 2003) sets 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 developed and reviewed in 1997 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

An "in-season" management process, first implemented in the southwest Nova Scotia fishery during 1995, continued to be used widely within the 4VWX management area. The approach encouraged surveying using the commercial fleet under scientific direction prior to fishing ("survey, assess, then fish" protocol) to ensure that effort was distributed appropriately among various components of the stock (particularly among spawning components) according to the relative size and current state of each component. The use of this approach in recent years has improved data collection and enabled modifications to management decisions to be made with the involvement of participants and on the basis of up-to-date information.

Landings (thousands of tonnes)

Year	Average 1990-99	2000	2001	2002	2003
4WX SW NS TAC	112	100	78	78	93
4WX SW NS	96	85	72	77	89
4VWX Coastal NS	4	4	6	10	9
Scotian S. Banks	13	2	12	7	1
SW NB	24	17	20	12	9
Total Landings	137	108	110	106	108

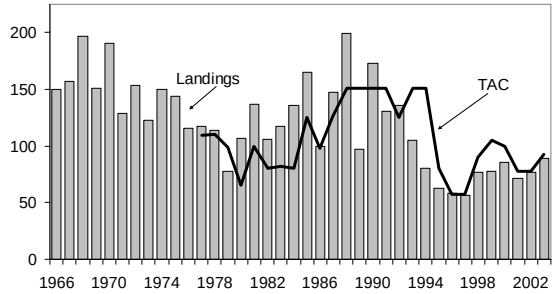
SW NOVA SCOTIA/BAY OF FUNDY SPAWNING COMPONENT

The Fishery

The 2003 catch limit for this component was 93,000t, an increase of 15,000t from the previous year. Eighty percent of the catch limit was initially allocated to the mobile gear sector and 20% to the fixed gear sector, as has been done historically. Transfer of quota to the mobile fleet occurred late in the season.

Total landings from this component in 2003 (89,360t) were 12,000t higher than the previous year, and the highest since 1993. Increased landings by the purse seine sector (88,000t) accounted for the increase, as landings by both the gillnet sector (440t) and the Nova Scotia weirs (920t) were similar to 2002.

Landings and TAC (000's t)



The temporal and spatial distribution of the purse seine fishery was generally as expected. The largest purse seine fisheries occurred on the German Bank and Scots Bay spawning grounds, and on summer-feeding fish off Long Island, N.S. and around Grand Manan. There were substantial increases in landings from Scots Bay and off Long Island, NS.

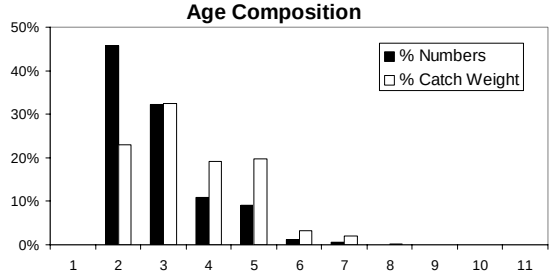
During the 1970's and 1980's, a large fishery took place on over-wintering aggregations in Chedabucto Bay. In recent years however, there has been no fishing effort in this area as traditional vessels have been successfully fishing elsewhere. In some years there has been a small fishery on over-wintering herring in January off Halifax Harbour (Chebucto Head), but the majority of the winter herring landings for the past three years have come from the New Brunswick side of the Bay of Fundy.

A small gillnet fishery that took place in the traditional areas (in June on the Spectacle Buoy area and in Sept. on Trinity Ledge) landed only 440t. Catches in the Nova Scotia weirs, although only a little lower than in 2002, were the third lowest in the 40 year record of landings from this fishery.

The 2000 year-class (at age 3) dominated the catch at age by weight (about 32% of the weight of herring landed), while the 2001 year-class (at age 2) dominated the catch by number (46%). The 1998 year-class, which was dominant by weight in the catch in 2002 was approximately equal in representation to the following (1999) year-class in 2003.

A summary of daily fishery information compiled by the Herring Science Council confirmed that the fishery on this component was largely as expected in location and timing, and that there were substantial amounts of herring in some areas other than spawning grounds. There has been an increase in market for juvenile herring for lobster bait and to offset a shortfall in weir landings.

SW Nova/Bay of Fundy Landings Age Composition



Resource Status

Automated acoustic recording systems deployed on commercial fishing vessels were used to document the distribution and abundance of Atlantic herring in NAFO Division 4VWX from industry vessel surveys and fishing excursions. Scheduled surveys were conducted at approximately 2-week intervals on the main spawning components and the spawning stock biomass for each component was estimated by summing these results.

In 2003, four surveys were conducted in Scots Bay, three on Trinity Ledge and five on German Bank. Survey coverage was good and was consistent with previous years. Additional acoustic data from fishing nights in Scots Bay and German Bank were examined.

Acoustic Survey SSB (000's t)

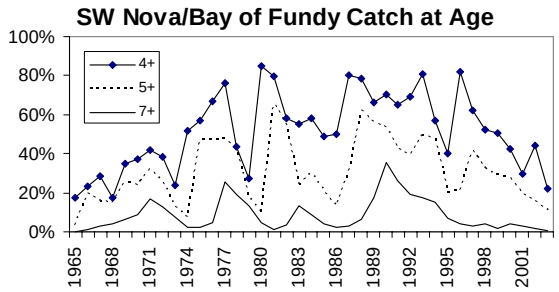
Location	1999	2000	2001	2002	2003
Scots Bay	41	106	164	141	134
Trinity Ledge	4	1	15	8	15
German Bank	461	356	191	393	344
Spec.* (spring)			1		1
Subtotal	**506**	**463**	**370**	**542**	**493**
Spec.* (fall)			88		
Seal Island			3	1	12
Browns Bank			46		
Overall SSB	**506**	**463**	**507**	**543**	**505**
Standard Error (SE)	**19%**	**14%**	**10%**	**9%**	**17%**

* Spec. - Spectacle Buoy

Biomass estimates for Scots Bay, Trinity Ledge and German Bank were approximately 133,900t, 14,500t, and 343,500t for a total surveyed SSB of 493,300t in the traditional survey areas. Recorded biomass on German Bank was less than the previous year, but this is thought to have been due in part to an unusually long period (22 days) between two surveys. A single fishing night survey southeast of Seal Island observed 12,200t and there were 1,400t of spawning fish documented in the spring near Spectacle Buoy. Based on these surveys, the total SSB for the Bay of Fundy/SW Nova Scotia component of the 4WX herring complex in 2002 spawning season was approximately 500,000t. While this represents a slight decrease, it is not considered significantly different from 2002.

There continues to be evidence of reappearance of spawning on the Seal Island grounds, but this area and Trinity Ledge remained well below historical levels.

Age composition in the fishery deteriorated in 2003, and remains a concern. There are few old fish (few age 7+; only 10% age 5+ by number) and the proportion of age 4+ in the catch has declined to about 20%. The rapid decline of year-classes (including the strong 1998 year-class) implies a high total mortality.



An evaluation of progress against biological objectives in the management plan indicates that some objectives are not being met:

	Objective	Met	Not Met
1	**Maintain reproductive capacity**		
1a	Persistence of all spawning components	German Bank and Scots Bay OK; Trinity recovering.	Limited signs of recovery for Seal Island component. Increased fishing on juveniles of mixed origin is inconsistent with this objective.
1b	Maintain biomass of each component	German Bank and Scots Bay	Trinity Ledge and Seal Island
1c	Maintain broad age composition		Few fish older than age 7. Only 20% older than age 3. Rapid decline of year-classes (including strong 1998 year-class).
1d	Maintain long spawning period	German Bank and Scots Bay	Trinity Ledge and Seal Island
2	**Prevent growth over-fishing**		
2a	Fishing mortality at or below $F_{0.1}$	Recent landings less than 20% of survey SSB.	High total mortality and targeting of 2 year olds.
3	**Maintain ecosystem integrity / ecological relationships**		
3a	Maintain spatial and temporal diversity of spawning	German Bank and Scots Bay	Insufficient spawning at Trinity Ledge and Seal Island.
3b	Maintain biomass at moderate to high levels	Acoustic surveys indicate moderate SSB.	

Sources of Uncertainty

The evaluation of stock status in this area relies in large part on the spawning stock biomass estimates derived from industry acoustic surveys. There is considerable variability around individual acoustic survey estimates (standard errors are in the range of 10-60%) although studies of individual weir catches indicate that acoustic biomass estimates are within 15% of the amount of fish harvested. Uncertainty may also arise from assumptions concerning the residence time of herring on spawning grounds, target strength estimates and the coverage of surveys in relation to the extent of spawning.

Ecosystem Considerations

Herring is prominent in the diet of many fish, birds and marine mammals, and should be managed with these interactions in mind. At present, use of a natural mortality rate of 0.2 and maintenance of SSB at moderate to high levels are assumed to account for these interactions.

Recent management initiatives to protect spawning components are intended to maintain the spatial and temporal diversity of herring spawning. Increased fishing on juveniles, which are of mixed or unknown stock affinity, is inconsistent with this objective.

Outlook

Recent assessments of the SWNS/BOF spawning component suggested that fishing mortality should remain below $F_{0.1}$ (about 20% exploitation rate), for a number of years in order to rebuild spawning stock biomass in all spawning areas and to

expand the age composition so as to meet the explicit biological objectives of management.

The 2003 landings were 12,000t higher than in the previous year. Although acoustic surveys continue to show an SSB of approximately 505,000t, there has been a deterioration in the state of the stock and some of the conservation objectives specified for this fishery are not being met. There is an absence of older fish in the population and increased targeting of juveniles. While there is spawning on Trinity Ledge and a small amount of spawning has been observed in recent years near Seal Island, the SSB on both Trinity Ledge and Seal Island spawning areas remain well below historical levels.

The rapid decline in year-classes (failure to reach older ages), even in the strong recent 1998 year-class, indicates high total mortality. It seems that the current catch is substantially higher than what would be consistent with a moderate F. Although these high exploitation rates have not resulted in a reduction of surveyed spawning biomass (presumably due to reasonable recruitment), the rebuilding that these recruits may have represented has been lost.

Recent catches have been consistent with the survey, assess, fish protocol of less than 20% of surveyed biomass. However, the catch at age indicates that total mortality may be considerably higher. The increased trend to catch juveniles could compromise SSB, improvement in age composition and reoccupation of spawning grounds.

Management Considerations

The in-season management approach, which spreads the effort in the fishery spatially and temporally among spawning components, is seen as beneficial in achieving the conservation objectives. The "survey, assess, then fish" protocol is effective in spreading the catch appropriately among spawning components in proportion to their relative size and is considered an important safeguard.

Acoustic surveys have become critical to stock status evaluation. Surveys conducted in 2003 conformed to the proposed survey design. It is important that there be continued attention to coverage and survey design, in order to assure year-to-year consistency in these surveys in all spawning areas.

There has been insufficient progress towards conservation objectives in recent years.

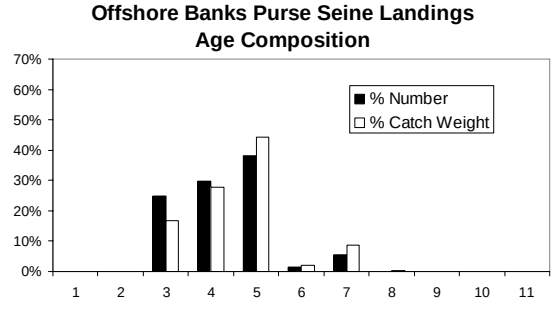
OFFSHORE SCOTIAN SHELF BANKS SPAWNING COMPONENT

The Fishery

A foreign fishery during 1963-1973 is estimated to have removed as much as 60,000t per year from the offshore Scotian Shelf banks. Few herring were caught after the extension of jurisdiction in 1977 until 1996, when a fishery was initiated by the 4WX purse seine fleet and 11,700t was taken.

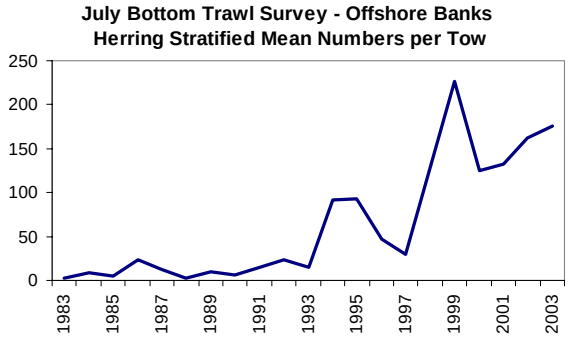
Landings from the 2003 fishery on the Scotian Shelf Banks (less than 1000t) were the smallest since the fishery was reactivated in 1996. Fishing took place primarily in June, in the vicinity of The Patch and Western Hole.

The 1998 year-class (age 5) dominated the age composition of the Scotian Shelf fishery in both number and weight.



Resource Status

Previous results from the DFO July bottom trawl survey showed few herring on the Scotian Shelf during the 1970's, increasing amounts during the 1980's and a relatively widespread distribution in recent years. Offshore herring catches from this survey in 2003 were the second highest in the 34-year time series, with an average of over 170 fish per standard tow. Survey catches of the past six years have been the highest on record (and in the 20 years in which the same vessel and gear have been used). As in recent years, herring were widely distributed on banks west of Sable Island.



Outlook and Management Considerations

The summer bottom trawl research survey demonstrates that there is a considerable abundance of herring widely spread over the offshore banks of the Scotian Shelf. Information from previous assessments indicated the presence of at least some autumn spawning on Western Bank in recent years. There is very little new information to add and no reason to change the previous outlook:

- Recorded landings in the foreign fisheries of 13,000t to 60,000t between 1969 and 1973 did not appear to be sustainable.

- The initial catch allocation for 2004 should not exceed the 12,000t reference value used in the recent fishing plans.

There continues to be insufficient documentation of stock size, distribution and spawning behaviour for this component. Industry, DFO Science and Management are encouraged to continue to work together to improve the biological basis for management. There continues to be the need for industry surveys to estimate abundance.

COASTAL (SOUTH SHORE, EASTERN SHORE AND CAPE BRETON) NOVA SCOTIA SPAWNING COMPONENT

The Fishery and Resource Status

In addition to traditional coastal fixed gear fisheries for subsistence and personal bait, there has been an increase in the number of active gillnet licenses in recent years aimed at spawning herring for the roe market. This was the eighth year for a fishery on spawning fish off Halifax/Eastern Shore and the seventh year of gillnet roe fisheries off Little Hope/Port Mouton and Glace Bay.

Landings (000's t)

	'96	'97	'98	'99	'00	'01	'02	'03
Little Hope		0.5	1.2	2.9	2.0	2.9	4.0	4.5
Eastern Shore	1.3	1.5	1.1	1.6	1.4	1.9	3.3	2.7
Glace Bay		0.2	1.7	1.0	0.8	1.2	3.1	1.9
Bras d'Or	0.2	0.2	0.1	0.0	0.1	0.0	0.0	0.0
Total	1.5	2.3	4.1	5.6	4.3	6.0	10.4	9.1

Recorded landings (9,000t) in 2003 in the four major gillnet fisheries along the coast of Nova Scotia were higher for Little Hope/Port Mouton, but lower in Eastern Shore/Halifax and Glace Bay (Bras d'Or Lakes remained closed).

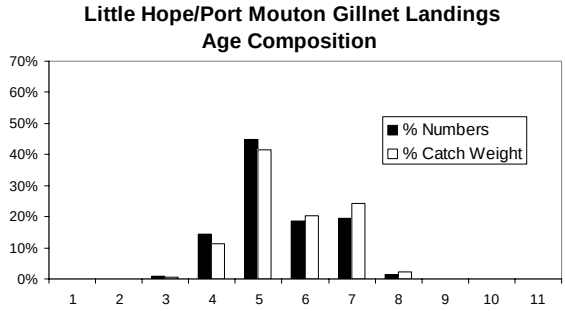
Biomass estimates from surveys of the major coastal Nova Scotia spawning components were higher in 2003 with large increases in estimated SSB for the Little Hope (4Xo), Eastern Shore (4Wk) and Glace Bay (4Vn) areas. There was no acoustic survey effort in the Bras d'Or lakes.

Acoustic Survey SSB (000's t)

	'98	'99	'00	'01	'02	'03
Little Hope	14.1	15.8	5.2	21.3	56.0	62.5
Eastern Shore	8.3	20.2	10.9	16.7	41.5	76.5
Glace Bay		2.0		21.2	7.7	31.5
Bras d'Or		0.5	0.1			

Little Hope/Port Mouton

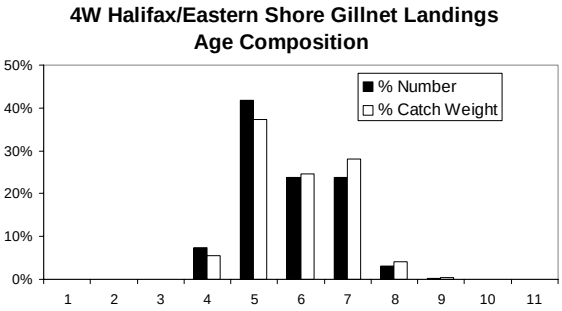
The fishery occurred in the Port Mouton/Little Hope area in September and October. Sampling indicated that the catch was composed primarily of 1996-1998 year-classes (ages 5-7).



A total of 4,500t of herring were landed. An acoustic estimate of 62,500t (56% SE) SSB is the highest for this area to date.

Halifax/Eastern Shore

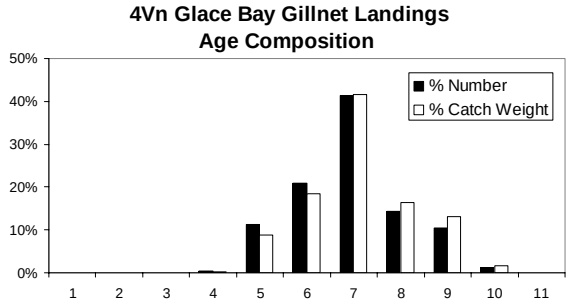
The roe fishery in September and October landed 2,700t. Sampling was limited and indicated that the catch was composed mainly of the 1996 - 1998 year-classes (age 5-7).



Acoustic surveys undertaken by the Eastern Shore Fishermen's Protective Association in October 2003 estimated a SSB of 76,500t (19% SE), the highest for the area to date.

Glace Bay

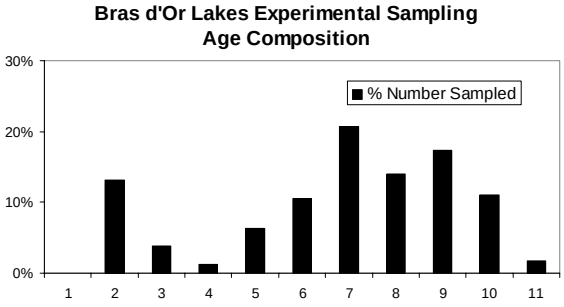
The fishery off Glace Bay, Cape Breton took place in September and October. Landings were 1,900t. Fish aged 7 (1996 year-class) dominated the catch.



Approximately 31,500t of spawning herring was estimated from mapping surveys off Glace Bay.

Bras d'Or Lakes

The fishery was closed. Considerable sampling was undertaken by the Eskasoni Fish and Wildlife Commission in April and May 2003 showed a broad age distribution, dominated by age 7 (1996 year-class).



In 2003 no acoustic surveys were conducted in the Bras d'Or Lakes to document the abundance of spawning herring.

Outlook and Management Considerations

There is no overall quota for the coastal Nova Scotia spawning component and apart from the areas mentioned above, the size and historical performance of various

spawning groups are poorly documented. In addition to traditional fisheries for bait and personal use, the directed roe fisheries on the spawning grounds are increasing.

As the inshore roe fisheries off Glace Bay, East of Halifax and Little Hope have developed, participants have contributed to sampling and surveying and the fisheries have attempted to follow the 'survey, assess, fish' protocol. Surveys and sampling in these areas improved over previous years and should be continued.

Management approaches and recent research efforts have improved knowledge in these three areas, but there has been no increase in knowledge in adjacent areas. Individual spawning groups within this component are considered vulnerable to fishing because of their relatively small size and proximity to shore. As in the past six years, it is recommended that no coastal spawning areas should experience a large effort increase until much more information is available on the state of that spawning group, and there should be no new fisheries developed when there is uncertainty regarding stock composition and degree of mixing.

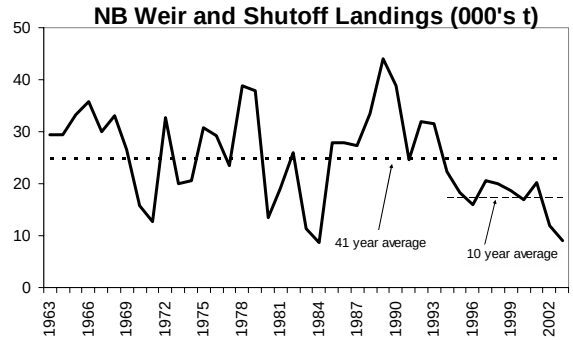
It has been noted since 1997 that the status of herring in the Bras d'Or Lakes is cause for concern. Spawning is still absent from some traditional areas and the observed biomass of spring spawners is very low. Therefore it is appropriate to reiterate that from a biological perspective, there should be no fishing on this spawning component.

The "survey, assess, then fish (<10%)" protocol is considered useful for spawning components that are considered to be healthy and of sufficient size.

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.

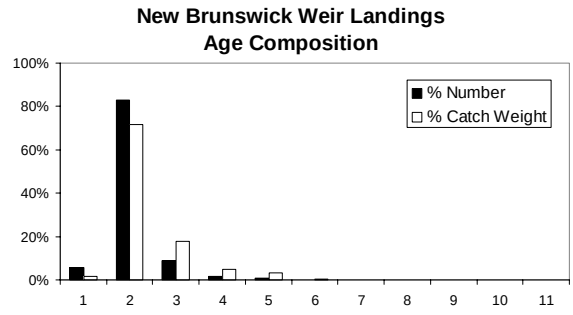
These fish have been considered to be a mixture of juveniles, dominated by those originating from NAFO Subarea 5 spawning components, and have therefore been excluded from the 4WX quota. Mature herring (ages 4+) taken in this fishery are considered to be of 4WX origin.



The number and distribution of active weirs have decreased over the past decade, due in part to the conversion of sites to aquaculture, as well as the reduction in landings over the past decade in the Passamaquoddy Bay area.

There was a further drop in landings in the traditional New Brunswick weir and shutoff fishery to 9,000t - the lowest since 1983 – and there is concern for this fishery.

The 2003 catch was dominated by the 2001 year-class (age 2), which made over 80% of the catch by number and 70% of the catch by weight.



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ISSN 1480-4913 (printed)

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

Correct citation for this publication:

DFO, 2004. 4VWX herring. Can. Science Advis. Sec. Stock Status Rep. 2004/034.