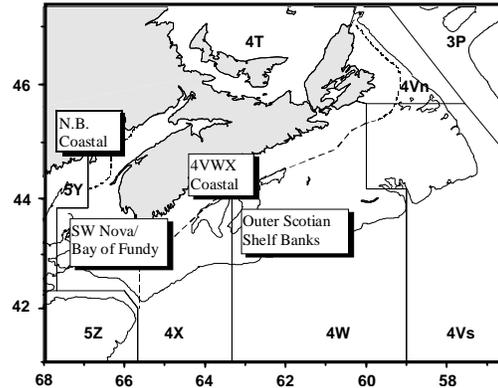


P. Buerschaper
Scott & Scott 1988

4VWX and 5Z Herring



Background

Atlantic herring is a pelagic species found on both sides of the North Atlantic. Herring aggregate to 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 is known to contain a number of spawning areas separated to various degrees in space and time. Spawning units in close proximity, with similar spawning times, and which share a larval distribution area (e.g. Trinity Ledge and German Bank in SW Nova Scotia) are considered part of the same complex - and undoubtedly have much closer affinity than spawning units which 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 localised, sometimes very near shore or in small embayments. The situation is complicated further by the fact that herring tend to migrate long distances, and to mix outside of the spawning period 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.

Recognizing that each component has several spawning areas, and that there is mixing of fish from more than one component, 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, trap, and midwater trawl.

The Georges Bank herring stock (5Z) is one of three major stocks occurring in the Gulf of Maine. Between 1961 and 1977 this stock supported the largest commercial fishery on the western Atlantic. High levels of exploitation combined with poor recruitment during the early seventies resulted in the stock's collapse in 1977.

The first sign of a recovery occurred in 1984 when a large number of age 1 juveniles were collected on the Bank. However, it was not until 1986 that both Canadian and U.S.A. research surveys began to detect reproductively active herring on the Bank and larvae in ichthyoplankton samples.

Assessment approaches for this transboundary stock differ between Canada and the U.S.A. In the U.S.A., Georges Bank forms one component of the "Coastal Zone Complex" which includes all herring stocks in NAFO areas 5Y and 5Z. Canada takes the more historical approach and assesses Georges Bank as a separate stock unit based on the spawning area in 5Z.

In 1998, the herring stock assessment and related research was enhanced by a number of projects undertaken with the assistance of the fishing industry, particularly purse seine and gillnet organizations working through the **Pelagics Research Council (PRC)**. The PRC is an organization created by the herring and mackerel fishing industry to sponsor and promote research to improve the biological basis for management. In conjunction with DFO, the PRC undertook a variety of projects including:

1. Technical training of vessel crew members and captains so that they have an appreciation of biological methods and rationale and are competent in sampling and tagging.
2. Enhanced biological sampling in fisheries throughout the Scotia-Fundy area.
3. An acoustic survey of the offshore Scotian Shelf banks at expected spawning time using industry vessels.
4. An ichthyoplankton survey of the offshore Scotian Shelf banks to document spawning.
5. Initiation of a new tagging program to resolve issues of stock structure and movement of herring and mackerel.
6. A questionnaire survey of coastal herring and mackerel fishers from Cape Breton to Yarmouth to document spawning areas, and to improve knowledge of trends and activity in this relatively undocumented part of the fishery.
7. Improved acoustic survey methods, including improved editing and advancement in the area of quantitative sonar (in collaboration with Univ. of New Brunswick Ocean Mapping Dept.).
8. In cooperation with purse seine and gillnet associations, organization and conduct of acoustic surveys of spawning areas and major aggregations of herring.
9. Initiation of a genetic study of herring population structure using advanced DNA analysis methods (in collaboration with Dalhousie University).
10. Documentation of incidental catch in the purse seine fishery.
11. Analysis of information on several aspects of herring and mackerel ecology, including fluctuations in fat content, relationship between distribution and hydrographic conditions.

Summary

SW Nova Scotia/Bay of Fundy Spawning Component

- Spawning stock biomass (SSB) of the SW Nova Scotia spawning component was estimated from acoustic surveys of spawning grounds to be at least 520,000t.
- Age composition continues to improve, but the population contains a small fraction of fish older than the 1992 year-class.
- Large amounts of spawning fish were documented on German Bank and in Scots Bay, but spawning was again absent from the Seal Island grounds, and the Trinity Ledge spawning group

remains below the level of the early 1980's.

- The 1999 catch should not exceed 105,000t.

Offshore Scotian Shelf Banks

- The 1998 fishery for herring on the Scotian Shelf Banks landed 5,579t, substantially less than in the previous two years. This reduction in catch is attributed to herring behavior and distribution (herring remained close to bottom).
- Age composition from both the fishery and research survey showed a dominant 1992 year-class.
- There is little quantitative information on which to evaluate the status of this stock. The second year of a larval herring survey indicated spawning on the Western/Sable Island Bank area, and greater herring abundance in 1998 than in 1997. The July bottom trawl survey indicated a general increase in abundance and distribution.

Coastal Nova Scotia Spawning Component

- With a few exceptions, the fisheries and stock status of spawning groups along the coast of Nova Scotia remain undocumented.
- A questionnaire survey has improved documentation of these coastal spawning areas and fisheries, but further information is required to evaluate stock status.
- No coastal spawning group should have a large effort increase until information is available on the state of that spawning group.
- There is continued concern for the status of the Bras D'Or Lakes spawning herring, and it is again recommended

that from a biological perspective it is preferable that there be no fishery.

Georges Bank (5Z)

- In 1996 Canada recommended that a combined Canada/US catch of 20,000t for Georges Bank would not exceed reference points commonly used for herring.
- The 1998 US assessment reported a record high spawning stock biomass (1.8 million tonnes, NMFS, 1998) for the Coastal Stock Complex which includes Georges Bank.
- Continuation of the 20,000t cap may be unduly restrictive to the Canadian herring industry.
- Effort should be made to undertake a joint Canada/US assessment of this stock through the Transboundary Resources Assessment Committee (TRAC).
- Catches should be monitored closely and data gathered which will permit separate evaluation of components of the US coastal stock complex.

Objectives and Management

The 1998 Scotia-Fundy Herring Integrated Fisheries Management Plan (DFO 1998) set out principles, conditions, and management measures for the 4VWX and 5Z herring fisheries. The main principle stated in the plan was “the conservation of the ... stock and the preservation of all of its spawning components”.

Specific conservation objectives were reviewed and developed further during 1997 (Sinclair 1997). Three objectives and a number of targets within these objectives were defined:

- 1) To maintain the reproductive capacity of herring in each management unit:
 - 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: maintain fishing mortality at or below $F_{0.1}$
- 3) To maintain ecosystem integrity/ecological relationships (“ecosystem balance”).

An “in-season” management process, first implemented in the southwest Nova Scotia fishery during 1995 continued to be used widely, and was extended to other areas and fisheries within the 4VWX management area. The approach encouraged surveying using the commercial fleet under scientific direction prior to fishing 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. It 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. The 1998 management plan extended the Dockside Monitoring Program (DMP) further to improve documentation of landings by the fixed gear sector.

Landings (thousands of tonnes)

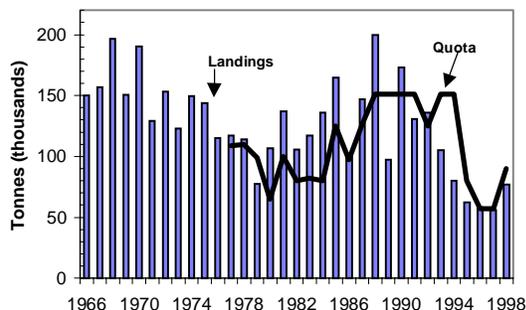
Year	1970- 1979 Avg.	1980- 1989 Avg.	1990- 1995 Avg.	1996	1997	1998
4WX SW NS TAC	106	106	135	57	57	90
4WX SW NS	131	131	115	58	56	78
4VWX Coastal NS	<1	<1	1	2	3	4
Scotian S. Banks	30*	<0.1	<0.1	12	20	6
SW NB	26	24	28	16	21	20
Total Landings	172	155	142	88	100	108

*average 1970-73

SW NOVA SCOTIA/BAY OF FUNDY SPAWNING COMPONENT

The Fishery

The TAC in 1998 for this component was set at 90,000t (an increase from 57,000t allocated the previous two years), with 71,280t (80%) allocated to the mobile gear sector and 17,820t (20%) to the fixed gear sector.



Total landings from this component in 1998 were 78,139t. Landings by the purse seine sector (71,444t which included some quota reallocated from the fixed gear sector) were higher than in 1997, reflecting the higher quota. Landings by Nova Scotia weirs (4,464t) were similar to 1997, but gillnet landings (2,231t) were lower, primarily reflecting poor market conditions.

Continuation of the in-season management approach resulted in improved sampling and in ongoing discussion and review of the

fishery. Again, fishing on spawning aggregations operated under a “survey, assess then fish” protocol, in which spawning aggregations were surveyed and predefined conditions had to be met before that part of the fishery was allowed to take place.

The distribution of herring as reflected by the fishery was similar to time periods when the biomass was at moderate to high levels. Herring occurred on the usual summer feeding and prespawning areas, and with the exception of an absence of fishing on Seal Island and limited spawning at Spectacle Buoy, at all major spawning locations at the expected times. As has been the case for several years, there was only a limited abundance of herring during the winter months in Chedabucto Bay, where during the 1970’s and 1980’s a fishery took place on large overwintering aggregations.

Resource Status

Acoustic surveys were undertaken on major spawning areas and some of the major fishing areas using the acoustic equipment on commercial vessels. Sonars and sounders of the purse seine fleet, and sounders of the gillnet fleet were used to document the number, location and approximate size of herring schools. Five acoustic recording devices (four permanently aboard purse seiners, and one mobile unit used on purse seiners and gillnet vessels) allowed the logging of quantitative records for later analysis from “structured surveys” and during many fishing trips in 1998. Biomass estimates were made using standard target strength relationships.

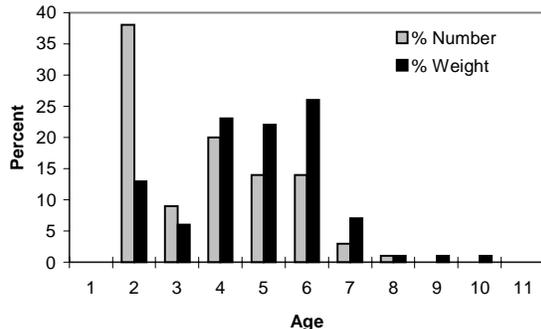
Due to the increased number of quantitative acoustic recording systems, mapping records collected from vessels without quantitative recording gear made up a smaller fraction of available information in 1998. Mapping

information was used to define school size in acoustic surveys, and was quantified using the area and a relative density category (light, medium, or heavy) as in recent years.

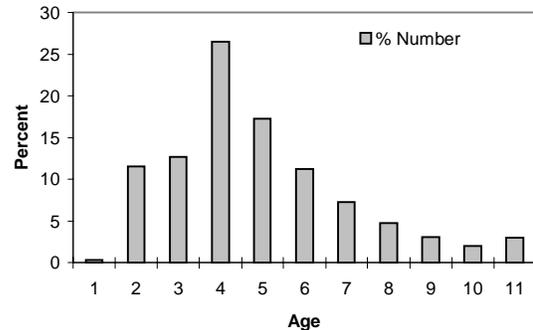
There was a deterioration in 1998 (compared with 1996 and 1997) in the number of “structured survey” estimates made by the purse seine and gillnet fleets, but there was better surveying of school size in association with fishing operations. Acoustic estimates from the spawning grounds documented 520,000t of spawning herring. As these surveys were separated by at least 10 day periods, double counting was thought to have been avoided.

Location	1998 Estimate
Scots Bay	72,008
Trinity Ledge	6,762
German Bank	440,460
Spectacle Bouy	1,329
Total	520,559

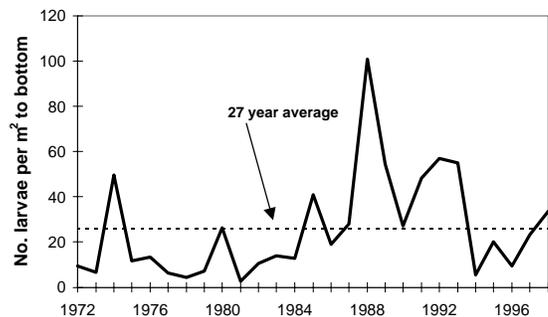
The 1992 (age 6), followed by 1994 (age 4) and 1993 (age 5) year-classes dominated the 1998 landings from this fishery in weight, but the 1996 year-class (age 2) was most prevalent in number. The contribution of the strong 1992 year-class improved the fraction of fish age 6+ in the population, but the very low numbers older than the 1992 year-class remains a negative aspect of the **age composition** of this stock.



The expected distribution at age under $F_{0.1}$ fishing strategy and average recruitment would include a greater fraction of herring ages 7+.



The 1998 **larval abundance** index (33.6 larvae m^{-2}) was higher than it has been in the previous four years, and above the average of the 27 year time series. The larval abundance series indicates a progressive recovery from a low in 1994, although the sudden, large drop in larval abundance index in 1994 remains difficult to explain.



Large aggregations which included substantial amounts of pre-spawning and juvenile herring were present in the traditional summer feeding areas. Although there continues to be fewer herring in Chedabucto Bay, which had been a major overwintering area for this component in the 1980’s, there was a very large aggregation of young herring (>400,000t) off Chebucto Head in January 1999. The stock affinity of the herring in that aggregation is not known.

Sources of Uncertainty

The acoustic estimation process used in this evaluation is still in the developmental stage. There has been continued positive evolution of acoustic biomass estimates using recording devices on industry vessels, but there is need for improved survey coverage (spatial and temporal), as well as further investigation of the duration of the spawning stages, and investigation of target strength.

Ecosystem Considerations

Herring is a prominent species in the diets of many other fish, birds and marine mammals, and should be managed with these interactions in mind. At present, a natural mortality rate of 0.2 and maintenance of SSB at moderate to high levels is assumed to account for these interactions. Recent management initiatives to protect spawning components are intended to maintain biodiversity.

Since 1994, when low fat content and poor condition of herring were observed, there has been increased interest in the condition and behavior of herring as it relates to environmental conditions. Fat content information from 1987 to 1998 gathered from three processing plants, indicates that the fat content of herring in 1998 was below average, but not as low as 1994.

Preliminary analysis of the distribution of humpback and finback whales (predators of herring) in the month of August indicated that there have been fewer animals near the Long Island shore of Nova Scotia since 1995 than in the early 1990's. Some of these animals are known to have been in the vicinity of German Bank in 1998.

Outlook

Acoustic surveys documented 520,000t of herring on spawning grounds. As there was incomplete coverage, especially of Scots Bay, this is considered to be a minimum estimate of SSB.

Surveys and fishing confirmed the presence of large amounts of herring on German Bank. Scots Bay spawning was documented to have taken place over a long time period, but lack of surveys for about a month during the peak period of spawning resulted in lower observed spawning biomass than in 1997. Observed spawning stock biomass at Trinity Ledge was lower than in 1997, and although this was considered to be an underestimate because of insufficient survey coverage, it is concluded that the Trinity Ledge spawning area has not fully recovered, and remains below historical levels. There remains concern that there was no spawning observed in the traditional Seal Island area and limited spawning at Spectacle Buoy.

Substantial aggregations of herring were documented outside the spawning areas. The geographical distribution of herring during the summer feeding period was as expected from observations in previous years when the stock was at moderate to high abundance.

The 1998 TAC was not caught, but this is attributed primarily to allocations and market conditions, rather than resource status.

The age composition has improved, with age 6+ making a greater than average contribution to the catch (18% by number, 36% by weight), but there were very few fish older than the 1992 year-class. The prevalence of the 1996 year-class in the catch and in a very large aggregation of

young overwintering herring documented off Chebucto Head, may indicate the presence of a strong recruiting year-class.

The 1998 larval herring abundance index from the Bay of Fundy survey which is considered to represent spawning stock biomass near the end of the fishery has increased over the past four years, indicating growth of the spawning biomass to above the average of the past 25 years.

The substantial reductions in TAC and landings implemented in the past four years have had a positive impact on the rebuilding of this component. The spawning stock biomass appears to have increased from the low experienced about 1994 to above 520,000t in 1998.

The previous assessment of this 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 improve age composition. These improvements in stock status will take time, and it would be prudent to continue to fish below $F_{0.1}$. The long-term $F_{0.1}$ yield for this component, assuming average recruitment, is estimated to be about 110,000t. Assuming that the 520,000t observed SSB is a minimum, fishing at 105,000t in 1999 should generate an F less than $F_{0.1}$ which will allow continued growth of SSB and further improvement of age composition.

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 objectives related to maintaining spawning potential.

The “survey, assess, then fish (20%)” decision rule was implemented as an experimental approach, in addition to the TAC, to spread the fishing effort among spawning components in proportion to their relative size. The 1998 assessment suggested that the portion of surveyed spawning biomass taken on the spawning grounds should be reduced below 20% to account for the amount that might be taken in fisheries outside of the spawning season. If all the spawning fish were being surveyed, and if the 20% of each surveyed portion of the spawning component were taken, the protocol could allow disproportionate catch from some spawning areas. At present however, survey coverage is incomplete, and suballocations based on the 20% protocol have not usually been taken. While the protocol would be improved by using a percentage less than 20%, this is seen as a minor refinement of a management decision-making procedure which is very valuable as currently used.

Acoustic surveys have become critical to stock status evaluation. It is important that there be continued improvement in coverage and survey design, and attention to developing year-to-year consistency in these surveys. A plan for “structured surveys” has been proposed (Melvin and Power 1999).

OFFSHORE SCOTIAN SHELF BANKS SPAWNING COMPONENT

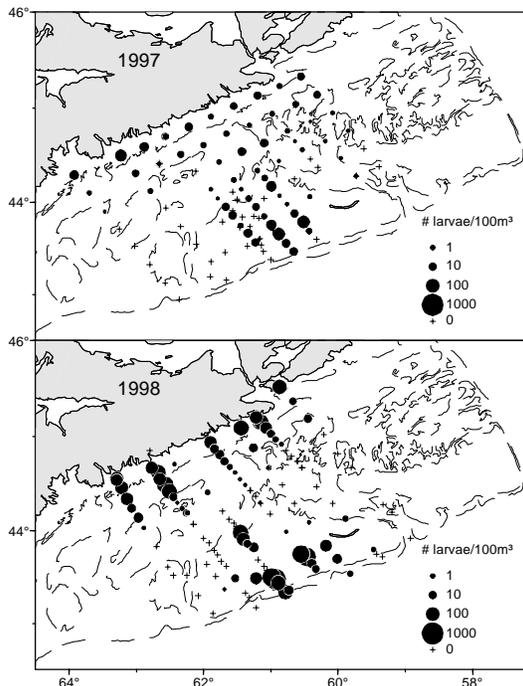
Stock Structure and Management Unit

Evidence of increasing presence of herring (e.g. in research vessel surveys) and of spawning offshore from research surveys and occasional fishing excursions within the past decade have suggested that there is a discrete offshore spawning component. The presence

of ripe herring in catches in 1986, of spawning herring in research surveys in 1997, of larvae in scientific surveys (1991-93, 1997-98), and the consistent presence of large herring on the Scotian Shelf in summer trawl surveys are all consistent with the treatment of the offshore banks as a separate management unit.

An analysis of ichthyoplankton data and records of spawning herring from a compilation of all available information from the Scotian Shelf indicates that spawning takes place on central Sable Island Bank during the second half of October, although the precise location and extent of egg beds have not been determined.

A larval herring survey was conducted in November 1997 and again in November 1998 in collaboration with the PRC and Dalhousie University.



This was the second broad scale directed larval survey for herring on the offshore Scotian Shelf since the Scotian Shelf Ichthyoplankton (SSIP) surveys ended in

1982. These surveys confirm the presence of small herring larvae offshore, presumed to originate from spawning on the offshore banks in addition to small larvae near-shore from coastal spawning. Fall ichthyoplankton surveys in both 1997 and 1998 showed a high concentration of recently hatched larvae in the Western/Sable Island Bank area. Maximum densities in 1998 (713 larvae/100 m³) were an order of magnitude greater than those in 1997 (69 larvae/100 m³).

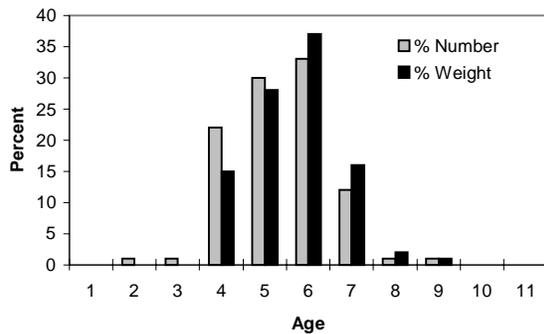
The Fishery

A foreign fishery during the period 1963-1973 is estimated to have removed as much as 60,000t in a year from the offshore Scotian Shelf banks. There had been little effort or herring catch after the extension of jurisdiction until 1996 when a fishery was initiated by the 4WX purse seine fleet and 11,745t was taken.

The 1998 fishing activities offshore occurred from May 7 to June 26. There were many reports of unusual herring behavior making the fish difficult or impossible to catch. Several commercial fishers found that, in certain areas, herring were staying very close to bottom and not exhibiting the characteristic vertical movement toward the surface. Others stated that herring were rising to the surface very quickly then dispersing making them impossible to catch by purse seine. Many of the fishers felt that these changes in behavior were due to changes in the environment, particularly ocean temperatures. Catches were focused on and around Emerald Basin, The Patch and Mackenzie Spot. The 1998 fishery for herring on the Scotian Shelf landed 5,579t, substantially less than the two previous years (11,745t in 1996 and 20,261t in 1997). The reduction in catch is attributed to changes in herring behavior and distribution.

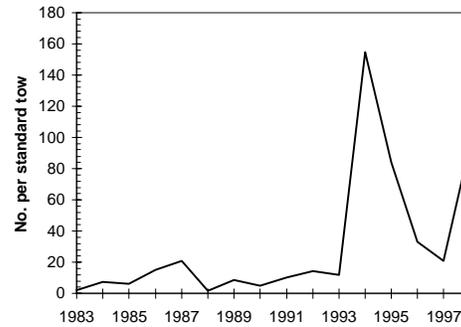
Resource Status

The 1998 offshore banks fishery was dominated both in number and weight by the 1992 year-class (age 6; 37% by weight, 33% by number), followed in importance by 1993 and 1994 year-classes. Age 6+ made up 56% of the catch by weight. The age structure in the fishery has varied over the last three years, and is not helpful in determining stock status.



The age distribution from the 1998 July bottom-trawl survey was also dominated by the 1992 to 1994 year-classes.

Results from the summer bottom trawl survey showed few herring on the Scotian Shelf during the 1970's, but increasing amounts during the 1980's and a relatively widespread distribution recently. Offshore herring catches during the 1998 July bottom trawl survey were second highest in the 29 year time series at 96 fish per standard tow. Herring were widely distributed on banks west of Sable Island. The 1998 bottom trawl survey herring catches were widely distributed and the second highest in the past 16 years during which the same vessel and gear have been used.



There is little quantitative information on which to evaluate the status of this stock. The second year of the larval herring survey indicated spawning on the central portion of Sable Island Bank, and greater herring abundance in 1998 than in 1997. The July bottom trawl survey indicated a general increase in abundance and distribution.

Outlook

The foreign fisheries between 1969 and 1973 did not appear to be sustainable. Landings from this time period ranged from 13,000t to 60,000t.

The initial catch level for 1999 should not exceed the 12,000t reference value used in the 1998 fishing plan. There continues to be the need for increased industry surveys to estimate abundance.

Management Considerations

There is insufficient documentation of the stock size, distribution, and spawning behavior of this component. Industry, science and management are encouraged to continue to work together to develop a medium term strategy (i.e. over the next few years) for assessment and exploitation of the herring on the Scotian Shelf outer banks.

The need for decision rules for management of this fishery has been identified. A

proposal that the fishery be restricted to 10% of surveyed biomass outside the spawning areas, and to 5% of surveyed biomass on spawning areas was considered by some to be overly restrictive.

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

The Fishery

There has been a considerable increase in the number of active gillnet licenses in recent years. This was the third year of the fishery on spawning fish east of Halifax and the second year of a gillnet roe fishery off Little Hope. There has been a marked increase in the gillnet roe fishery off Glace Bay.

Recorded landings by gillnet along the coast of Nova Scotia totalled 4,192t in 1998, an increase of 41% from the recorded landings of 1997 (2,965t). Landings in major fisheries were as follows:

Landings (t)			
Year	1996	1997	1998
East of Halifax	1,280	1,520	1,100
Little Hope	0	490	1,170
Glace Bay	0	170	1,730
Bras d'Or	170	160	120

Resource Status

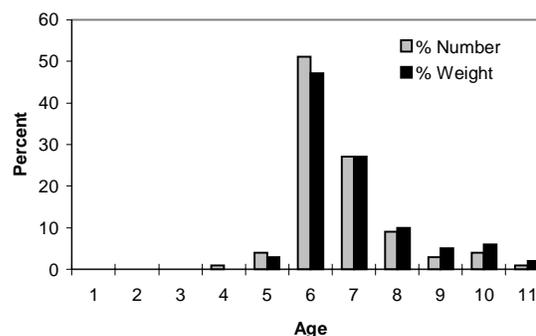
Several aspects of this component and its fishery have been documented in a recent questionnaire survey of fishers conducted by DFO Science and the Pelagics Research Council (PRC). With the implementation of mandatory log records, the landings in the inshore fishery are being documented with

improved accuracy, however, apart from a few areas, there remains insufficient information to evaluate stock status. The major fisheries of this component are discussed below.

East of Halifax

The October roe fishery lasted from September 27, 1998 to October 24, 1998 and landed 1,100t. Recorded landings were lower than in 1997, due largely to bad weather that prevented the boats from fishing.

One acoustic survey involving 15 vessels was held in the Eastern Passage area on October 22, 1998. The overall estimate of the amount of herring seen was approximately 8,000t.



The fishery was dominated by age 6 (1992 year-class) followed by age 7 (1991 year-class) in both number and weight.

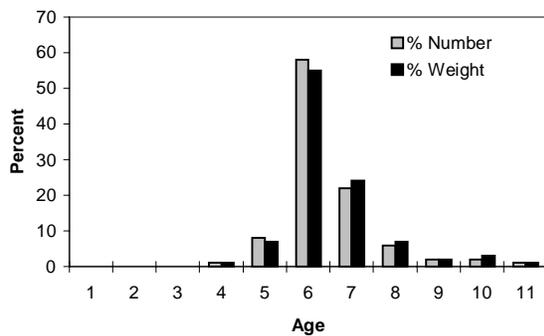
Little Hope

The fishery occurred in the Little Hope area, southwest of Liverpool, N.S., from September 30 to October 20, 1998. A total of 1,170t was landed by gillnet fishers, an increase of 117% over the recorded landings from 1997.

Two surveys of the area were undertaken in 1998. A mapping and acoustic survey, undertaken October 6, 1998, documented

7,000t while another mapping survey on October 17 documented a further 7,100t, for a total of approximately 14,000t.

The Little Hope fishery was sampled extensively during the 1998 fishing season with 25 length frequency samples collected. The majority of fish were ripe and running (maturity stage 6). Landings were dominated by the 1992 year-class (age 6), followed in importance by the 1991 and 1990 year-classes.



From the questionnaire survey it appears that there has been little coastal herring fishing in Shelburne County in recent years, apart from the Little Hope roe fishery. The Scotia-Fundy Inshore Fishermen’s Association stated that this is due to reduced abundance of herring.

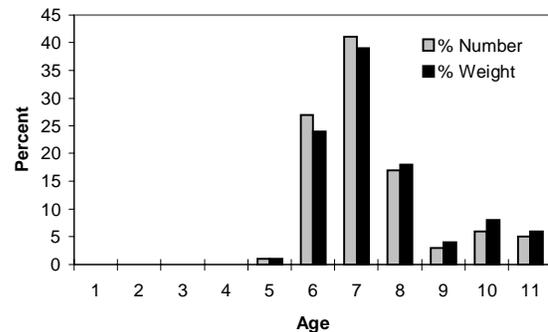
Glance Bay

A new fishery has developed off Glance Bay, Cape Breton in the past two years. The 1998 fishery occurred from the Red Grounds off Sydney Mines to Scaterie Island. A total of 1,730t were landed by gillnet fishers from August to October 1998, an order of magnitude more than 1997.

No surveys were conducted in this area.

Seven samples were obtained from the fishery. The majority of the fish (92%) were ripe and running (maturity stage 5 and 6).

The 1991 year-class (age 7) was dominant in numbers and weight, followed in importance by the 1992 and 1990 year-classes.



Bras d’Or Lakes

The gillnet fishery occurred in the Bras d’Or Lakes from March 30 to May 18, with the majority of fishing activity taking place between April 20 and May 1. The duration of the fishery was similar to previous years, with the exception of the unusually short season in 1997.

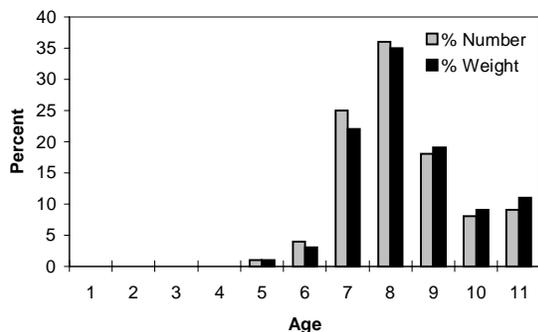
A number of management measures were put into place in 1998 in an attempt to reduce landings by 50%. However, overall recorded landings for 1998 were 122t, down 26% from 164t in 1997.

In 1998, there was very little ice on the Lakes allowing an early start to the season as well as the setting of nets in St. Andrew’s Channel, an area that is usually covered in ice. This led to a concentration of effort in the Groves Point area in addition to the usual locations such as Baddeck Bay and the Barra Strait. Landings from the Marble Mountain to McKinnon’s Point area were low in 1998, since part of the traditional fishing area was closed.

The results of egg bed surveys conducted on a continual basis were combined with information received from other sources to identify spawning sites in 1998. Spawning was reported in seven areas in 1998, an

increase over three areas identified in 1997. Spawning was observed in several locations in the Northwest part of Bras d'Or Lake at Benacadie, Eskasoni Harbour and Christmas Pond, Lime Hill, Baddeck and Groves Point.

The Bras d'Or Lakes were sampled extensively during the 1998 fishing season. The majority of the fish (46%) were spent and recovering (stage 7 and 8) with 38% ripe or ripe and running (maturity stage 5 and 6). In 1998 16% of the fish were autumn spawners, a marked increase from 1997. This verified the information provided by fishers which indicated that there were a greater proportion of fall spawners in 1998 than in previous years. The 1990 year-class (age 8), 1991 and 1989 year-classes were most prevalent. The absence of recruiting herring, noted last year, is again apparent in the very small fraction of age 4-6 herring in the catch.



Outlook

There is increasing pressure to develop fisheries (especially for roe). These new fisheries are being proposed in the absence of knowledge of the current level of fishing pressure or estimates of spawning group status.

The fixed gear herring fishery in the coastal Nova Scotia spawning component has been largely unrestricted and undocumented. Recent changes to management and the recent questionnaire survey have improved

knowledge, but few of the spawning areas have been studied. Age composition is known for a couple of areas, but for the most part, sampling has been inadequate. The lack of knowledge of specifics of stock structure, lack of documentation of the historical fishery, and limited survey information preclude evaluation of current fishing mortality. However, individual spawning groups within this component are vulnerable to fishing because of their relative small size and proximity to shore.

As in the past two years, it is recommended that *“no coastal spawning area should have 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.”*

It was noted in 1997 and 1998 that the status of herring in the Bras d'Or Lakes was cause for concern. This year, there have been some positive signs but negative signs have persisted. Faced with continued negative signals from the herring fishery in the Bras d'Or Lakes and the failure of the 1998 management plan to reduce the overall landings by half, it is appropriate to reiterate the advice given in 1998: *“Given continued deterioration in signals from the Bras d'Or Lakes fishery it is preferable, from a biological perspective, that no fishing take place on this spawning component”* (Anon, 1998).

Management Considerations

There was a review of the “survey, assess, then fish” protocol. In coastal Nova Scotia there is no overall quota, and the size and historical performance of various spawning groups are poorly documented. In addition to traditional fisheries for bait and personal use there have been new directed fisheries

on the spawning grounds for a roe market. The following guidelines are proposed to assist decision making in the range of situations encountered in the coastal Nova Scotia spawning component:

Spawning Areas with a Known History

In the case of spawning components where there has been at least 5 years of biomass estimates, where the approximate size of the fishery outside of the spawning area is known, and where the spawning components are considered to be healthy and of sufficient size, up to 10% of the surveyed biomass would be appropriate under the survey/assess/fish protocol.

Spawning Areas without a Known History and New Fisheries

For spawning components for which there are less than 5 years of biomass estimates or for new roe fisheries, the allocations should be less to reflect the greater uncertainty of the situation. It is suggested that an appropriate allocation would be a maximum of 5% of surveyed biomass if a large body of fish (greater than SSB threshold defined under objectives) has been documented, but that the allocation should be lower if only a moderate body of fish (less than threshold) is documented. These thresholds need to be defined.

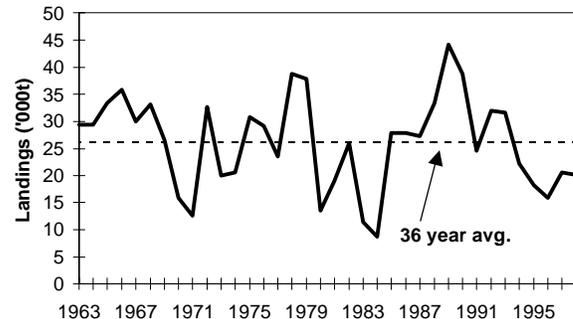
Spawning Areas for which there is Concern

For spawning components for which there is concern (i.e. evidence of poor recruitment, decrease in spawning locations, low larval abundance, poor catches, narrow age distributions in the catch), surveys should be conducted, but no fishing should be undertaken.

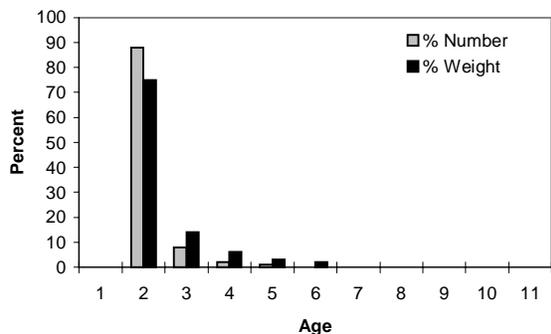
SW NEW BRUNSWICK MIGRANT JUVENILES

The southwest New Brunswick weir and shutoff fishery has relied, for over a century, on the aggregation of large numbers of juvenile (ages 1-3) herring near shore at the mouth of the Bay of Fundy. These have traditionally been considered to be a mixture of juveniles, dominated by fish originating from 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 of active weirs and distribution of weirs has decreased over the past decade, due in part to the conversion of sites to aquaculture. The 1998 catch (20,091t) was very close to that of the previous year, but below the 36 year average of about 26,000t.



Sampling of this fishery has been extensive. The 1998 catch was, as usual, dominated by age 2 (88% by number; 75% by weight), followed by age 3. Only a small proportion (3% by nos., 11% by weight) were ages 4+.



The recent US management plan assumes that all of the juvenile herring from this fishery originate from the US “coastal complex” which is considered to be at high abundance. The assumptions of stock affinity should be studied as part of the new tagging program.

GEORGES BANK (5Z)

The last Canadian review of the Georges Bank herring stock was conducted in 1996. At that time comparison of the larval abundance index and historical VPA biomass estimates indicated a SSB of 100,000 - 200,000t for the bank proper. The Canadian advice for 1996 was that a combined Canada/US catch of 20,000t would not exceed reference points commonly used for herring. It was also noted that catches exceeding 100,000t, combined with poor recruitment led to a rapid collapse of the stock. This advice was continued for 1997 and 1998. No Canadian landings were reported from Georges Bank in 1998.

In the spring of 1998 the US Stock Assessment Review Committee (SARC) estimated the 1997 herring Coastal Stock Complex biomass, which includes Georges Bank/Nantucket Shoals and the Gulf of Maine, to be 2.9 million tonnes with a spawning stock biomass of 1.8 million tonnes (NMFS, 1998). This represents a factor of three increase since 1994.

Retrospective analysis showed a strong positive bias for SSB (50%) and negative bias for fishing mortality (40-50%). Stock biomass projections for the period 1998-2000 were made using the 1997 catch of 119,000t and the MSY of 317,000t. In both cases the SSB was expected to increase steadily.

Given the revised US assessment of the Coastal Stock Complex, of which Georges Bank is a part, and the reported increase in stock size, continuation of status quo (i.e. 20,000t cap) may be restrictive to the Canadian herring industry. In recent years, considerable progress has been made in industry documentation of fishery data and Canada has assumed that fleet activity will lead to enhanced information upon which to evaluate stock status. It is thus proposed that landings by both countries be monitored closely and that data be gathered which will permit separate evaluation of components of the US herring complex. Effort should also be made to undertake a joint assessment of this stock through the Transboundary Resources Assessment Committee (TRAC).

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