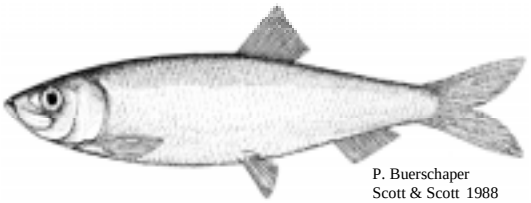
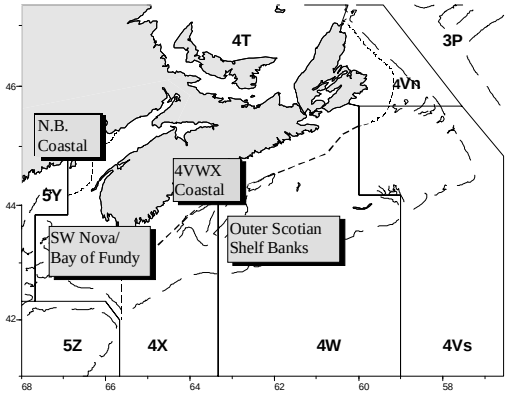
Fisheries and Oceans / Pêches et Océans
Maritimes Region

DFO Science
Stock Status Report B3-03



P. Buerschaper
Scott & Scott 1988

4VWX 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, over wintering, and summer feeding which often involves considerable migration and mixing with members of other spawning groups.

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 Seal Island 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 localized, 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 with members of other spawning groups. Some spawning areas, are known from fishery sampling, tagging, etc. to have formed the basis for major historical fisheries, while others have not. For the purposes of evaluation and management the 4VWX herring fisheries are divided into four components described in the first section of this status report.

Recognizing that each component has several spawning areas, and that, at times, 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 restrictions on some areas of mixing).

Fisheries in the 4WX areas in recent years have been dominated by purse seine, weir and gillnet, with relatively minor landings by midwater trawl, shutoff, and trap.

Assessment/Management Units

A) <u>SW Nova Scotia/Bay of Fundy spawning component</u>:

Herring from major spawning areas off SW Nova Scotia and in the Bay of Fundy have formed the basis for the large "stock" fishery, managed under TAC for many years. Fishing has taken place on these fish on the spawning grounds, in pre-spawning and feeding aggregations, and historically on the same fish (demonstrated by tagging) in overwintering areas in eastern Nova Scotia. Current fishery segments:

4Xqr (Bay of Fundy/SW Nova) summer purse seine
4Xs fall and winter (Bay of Fundy) purse seine
4Xs (Bay of Fundy) midwater trawl
4X (SW Nova) summer gillnet
4X (Nova Scotia) summer weir
4W (Chedabucto Bay) winter purse seine
4X (Halifax) winter purse seine (may include Coastal N.S. component)
4X (N.B.) weir and shutoff (adult only)

Canada

B) Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia spawning component:

Many spawning locations (both spring and fall) are known to have existed historically along the coast of Nova Scotia. They have been fished traditionally by inshore geartypes (gillnet, trap) for bait, subsistence use, and sale but are poorly documented. These are presumed not to have contributed to the traditional SW Nova Scotia fishery, and traditionally have been excluded from the management plan. Current fishery segments:

4VWX South Shore, Eastern Shore and Cape Breton Nova Scotia trap and gillnet
4X (Halifax) winter purse seine (may include overwintering SW Nova component)

C) Offshore (>25 mi) Scotian Shelf banks spawning component:

Herring were taken on the offshore Scotian Shelf by foreign fisheries prior to the extension of jurisdiction, when these fish were presumed to be part of an overall 4WX stock. Evidence of increasing presence of herring (e.g. in research vessel surveys) and of spawning offshore within the past decade has suggested that there is a discrete offshore spawning component.

The presence of spawning herring in catches in 1986 and of larvae in scientific surveys (1991-93), the consistent presence of large herring on the Scotian Shelf in summer trawl surveys, and broad age distribution of the catch are all consistent with the separate management treatment of the offshore banks. Current fishery segments:

4WX (offshore) purse seine

D) SW New Brunswick migrant juveniles:

The SW New Brunswick weir and shutoff fishery has relied, for over a century, on the aggregation of large numbers of juveniles near shore at the mouth of the Bay of Fundy. These have traditionally been considered to be a mixture dominated by fish originating from Subarea 5 spawning components. Current fisheries:

4X (NB) weir and shutoff (juveniles only)

Landings (thousands of tonnes)

Year	70-79 Avg.	80-89 Avg.	1990	1991	1992	1993	1994	1995	1996
4WX SW NS TAC	106	106	151	151	125	151	151	80	57
4WX SW NS	131	131	173	131	136	105	80	63	58
4VWX coastal NS	<1	<1	0.5	0.5	0.6	0.5	0.4	0.4	1.5
Scotian S. Banks	30[1]	<0.1	0.4	1.1	0.2	0.1	<0.1	<0.1	12
SW NB	26	24	39	25	32	32	22	18	16
Total	188	156	213	158	169	138	102	81	88

[1] average 1970-73

SW NOVA SCOTIA/BAY OF FUNDY SPAWNING COMPONENT **(traditional 4WX "stock")**

The Fishery

The TAC for this component was reduced from 80,000 t in 1995 to 50,000 t in 1996. Although 57,000 t was allocated, it was still the lowest quota ever for this fishery. An "in-season" management scheme first implemented in the 4WX herring fishery during 1995 encouraged survey and evaluation prior to fishing to ensure that fishing was distributed appropriately among various components of the stock (particularly among spawning components) according to the relative size and current state of each component. This was continued, and extended in 1996, so as to be able to react quickly to signals from the fishery.

As a result of the low quota, landings from the SW Nova Scotia component (58,068 t) were the lowest in three decades. The amount taken by purse seine and a single midwater trawl (48,252 t) was the lowest since 1979. For the first time in several years, a substantial quantity (6340 t) was taken by gillnet. Nova Scotia weirs took 3,476 t, continuing an increase since 1991.

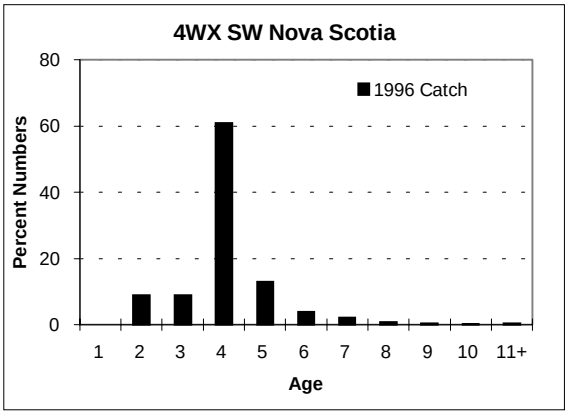
In-season management has resulted in an increase in the quantity, quality, and availability of information from the fishery. Surveys have been implemented, sampling has increased, and data handling procedures have been changed to allow more rapid summary of results. Several segments of the fishery have operated under a "survey, assess, then fish" protocol, in which predefined conditions had to be met before that part of the fishery was allowed to take place.

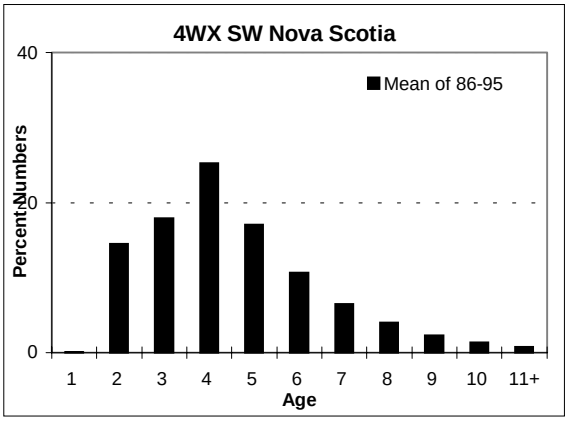
The distribution of herring as reflected by the fishery during summer feeding and pre-spawning period seemed normal. Surveys and fishing showed good abundance of herring on Scots Bay, and German Bank spawning grounds, and the return of spawners to Trinity Ledge and Lurcher Shoal. There was an absence of spawning, however, at Seal Island, and low abundance in the overwintering area of Chedabucto Bay, where only 2,000 t was taken.

Resource Status

The 1992 year-class (age 4) dominated all fisheries on the SW Nova Scotia spawning component except for midwater trawl. The 1992 year-class made up a disproportionately large portion of the catch by number (61%) and weight (60%). It was followed in relative importance by the 1991 year-class (age 5) at 13% by number and 16% by weight. These same year-classes had also dominated the 1995 fishery. The dominance of a single year-class in this fishery is quite different from the usual more balanced age distribution (as shown in the average of 1986-95) and from lightly fished areas nearby (offshore Scotian Shelf banks, coastal Nova Scotia), and is considered an undesirable situation.

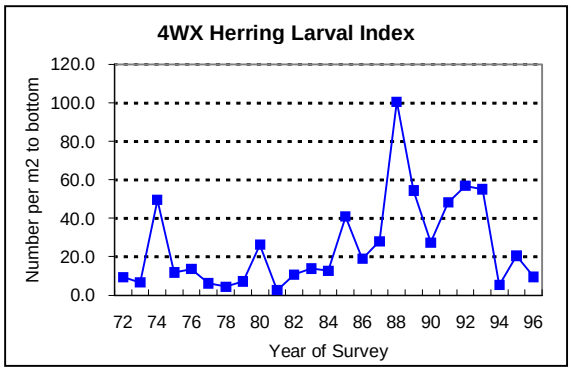
Although there was fleet avoidance of younger fish (because of the low quota), the 1993 year-class was poorly represented in the catch, and may be weak. The relatively low proportion at age 2 in the catch may indicate that the 1994 year-class, which originated in the year of the warm water temperature anomaly and extremely low larval herring abundance, is also relatively weak.





Larval Abundance

The larval abundance index, as traditionally calculated, was lower than that of 1995, but above that of 1994 which was the lowest observed since 1981. An initial attempt to improve the use of the larval abundance index by partitioning the index by the age composition of the spawning population warrants further investigation.



In-Season Surveys

Building on trials undertaken in 1995, an expanded series of surveys was undertaken of major spawning areas and some other major fishing areas using commercial vessels. Sonars and sounders were used by both the purse seine and later the gillnet fleet to document number, location and approximate size of herring schools. In the most successful of these surveys, many vessels worked together to provide comprehensive coverage of the target areas. During 1996 almost 800 hours of surveying was undertaken by industry vessels: 610 hours by the purse seine sector, and 180 hours by the gillnet sector. The 13 surveys undertaken on spawning grounds of the SW Nova component documented 190,000 t of spawning herring. Survey methods are still under development, and more quantitative rigor is required in several aspects of these surveys, however they were considered to represent a minimum biomass estimate. Surveys did not cover the entire spawning season or all spawning locations, and conservative density values were used in contouring.

Spawning Area	Survey Date	Estimated Biomass
Scots Bay	24-Jul-96	1,000
	31-Jul-96	43,000
Trinity Ledge	14-Aug-96	3,300
	27-Aug-96	10,400
	5-Sep-96	10,500
	11-Sep-96	5,000
Lurcher Shoal	24-Sep-96	18,000
German Bank	28-Aug-96	8,000
	11-Sep-96	12,800
	30-Sep-96	74,000
Seal Island	11-Sep-96	2,500
Spectacle Grounds	11-Sep-96	6,500
Total biomass		195,000

An analytical assessment, similar in structure to that used in the previous two assessments was attempted. Larval abundance was related to spawning stock biomass (SSB) from which the larvae were derived. Although the analysis suggests a SSB of about 300,000 t, there is large uncertainty in parameter estimates due to weak fit to the tuning index, especially in the last three years, and the predicted population estimate was considered to be too high. The analytical assessment (considered to be an overestimate), and the 190,000 t documented in survey (considered a minimum) were thought to bracket the actual SSB.

Major Sources Of Uncertainty

At present, there is a lack of a reliable indicator of abundance for this stock. There have been difficulties using the larval abundance index, and there is no other time

series. The sudden drop in larval abundance index in 1994, and relatively low values of the last three years compared to the previous three years is difficult to explain. Acoustics, although promising, are under development. There is need for improved quantification and objectivity in industry acoustic (sonar/sounder) surveys.

Outlook

The fishery continues to rely primarily upon a single year-class (1992). Recruiting year-classes (1993 and 1994) may be relatively weak. There is a need to rebuild spawning stock biomass and to broaden age structure in the population; therefore, it is appropriate to fish below F0.1 level for several years. A fishery at the status quo catch (57,000 t) is considered unlikely to exceed F0.1 reference levels, but may result in a decrease in SSB if recruitment is poor.

The in-season management approach should help protect individual spawning areas.

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 is assumed to account for these interactions. Low fat content and poor condition in herring observed in 1994, thought to be related to an environmental anomaly, have not been observed since.

Management Considerations

In 1996, 20% of surveyed biomass was used as the target percentage in the "survey, assess, then fish" protocol. Target harvest percentage on spawning grounds should be reviewed, to take into consideration the harvest of those spawners taken on other grounds outside of the spawning season.

4VWX COASTAL SPAWNING COMPONENT

The Fishery

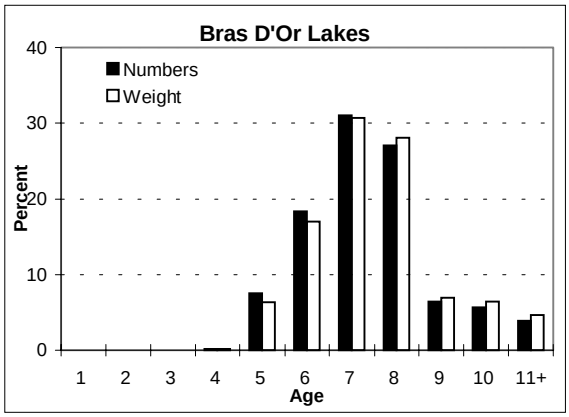
Although the fishery operates throughout coastal waters of 4VWX, very limited information is available except in two areas. Landings by gillnet and trap along the coast of Nova Scotia included a new fishery on spawning fish east of Halifax (1300t, October) and a well documented fishery in the Bras D'Or Lakes (spring, 170t). The relatively small amount of additional landings recorded from the remainder of the coast (190t) is thought to be the result of poor catch reporting, for a considerable amount of herring is known to have been landed for bait and local use. There is a large latent effort in the gillnet sector. The 2000 licenses on record for 1996 allow almost 1000 miles of gillnet to be set. Records indicate that fewer than 200 licenses were active in 1996; however, this is a substantial increase from the 30-40 which were active in the past seven years.

The winter purse seine catches off Halifax in the past two years contained mostly small, overwintering fish, which may have included fish from this coastal spawning component.

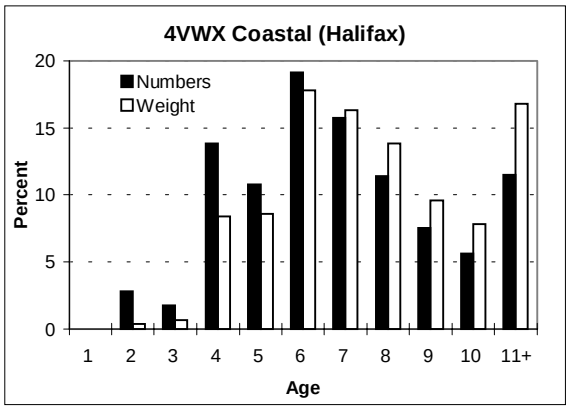
Resource Status and Outlook

A specific study of herring, and the herring fishery, in the Bras D'Or Lakes began in 1996. The fishery of approximately 170 t was dominated by the 1989 (age 7) and 1988 (age 8) year-classes. The 1990 and 1991 year-classes were poorly represented in the catch, and may be relatively weak. A survey of fishers indicated that there had been a decrease in abundance of herring in the lakes

in recent years, that spawning in 1996 was restricted to only a few of the traditional spawning grounds, and that fishing effort had increased and become more concentrated.



The new gillnet fishery east of Halifax took fish with a broad age distribution. The catch was dominated by 1990 and 1989 year-classes (ages 6 and 7), but had high proportion of age 11+. An industry survey of the area in October estimated almost 40,000t.



Aside from the two areas mentioned above, there is little information, and no basis for evaluation of these stocks.

Management Considerations

There is concern that the winter purse seine fisheries near the coast may take an unknown proportion of fish from this component, along with overwintering fish from other areas, at some times and places. This issue is discussed in more detail in a 1997 Fishery Status Report entitled "Decision rules for management of overwintering fisheries."

The reduction in spawning areas, and increase in effort in the Bras D'Or Lakes are cause for concern. Effort in the Bras D'Or Lakes commercial and bait fisheries should be reduced, so as to reduce landings of this spawning group.

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.

There is urgent need for improvement the monitoring of existing fisheries and documentation of spawning groups

OFFSHORE SCOTIAN SHELF BANKS SPAWNING COMPONENT

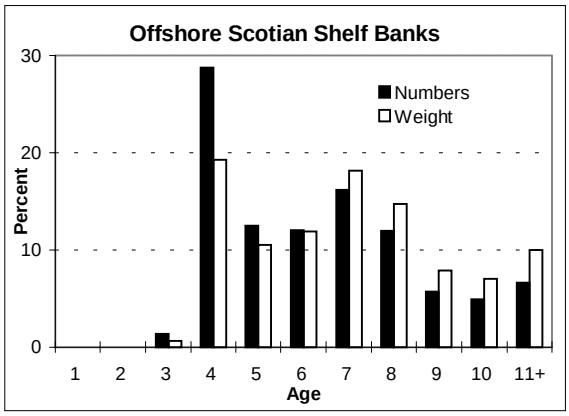
The Fishery

A foreign fishery during the period 1963-1974, took as much as 60,000 t in a single year from the offshore Scotian Shelf banks. Since the extension of jurisdiction, there has been little herring catch or effort. The 1996 fishery began May 22, and continued to June 24. Landings of 11,750 t were primarily from "The Patch" located approximately 50 mi southeast of Halifax, with some catch from other banks.

Resource Status and Outlook

The 1996 landings from the offshore banks had a broad age distribution, dominated by the 1992 year-class (age 4), followed by the

1989 year-class (age 7). A single industry sonar/sounder survey in June 1996 covered a large area, but documented only a moderate amount of herring on Emerald/Western banks and a dense aggregation on French Bank (located about 30 mi south of Country Harbour).



Although insufficient information is available to evaluate stock size, there have been several encouraging signs regarding the state of herring on offshore banks. The July research bottom trawl survey showed little herring on the Scotian Shelf during the late 1970's and early 1980's, increasing amounts during the late 1980's and relatively widespread distribution in recent years. Spawning was documented in industry samples from Western Bank in 1986, and larvae have been present in occasional ichthyoplankton surveys.

Management Considerations

Foreign fisheries took relatively large amounts (as much as 60,000 t in a year) from the offshore Scotian Shelf banks during the period 1963-1973. These fisheries did not sustain large catches over a number of years and the average recorded catch for the 1970-73 period was 30,000 t. Industry, science and management are encouraged to work together to develop a medium term strategy for assessment and exploitation of the herring on the Scotian Shelf outer banks.

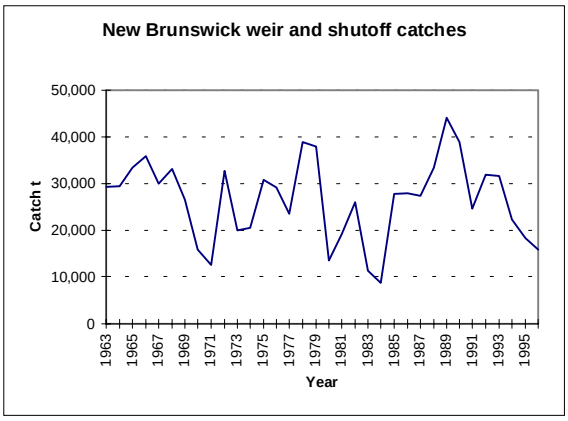
SW NEW BRUNSWICK MIGRANT JUVENILES

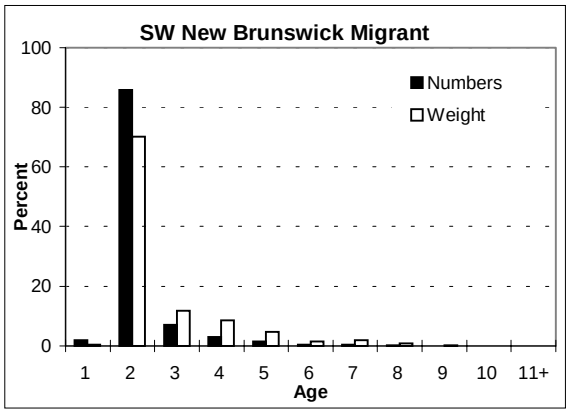
The Fishery

The 1996 catch (15,900 t) in weir and shutoff fisheries was below average and the lowest on record since 1984 (8,700 t). The decline in catch is thought to be the product of a decrease in the number of active weirs and a lack of fish available to the gear. Purse seiners fishing in the Grand Manan area in 1996 observed substantial amounts of juvenile (ages 2 and 3) herring. Landings from this fishery are included in the U.S. coastal Maine complex (Subarea 5) which is considered to be at high abundance.

Resource Status and Outlook

There has been a 50% decline in total catch in the past 3 years which may be cause for concern. Catch at age has been dominated, as in previous years, by age 2 (86% number; 70% weight) with some age one, three, and a few older ages (4+).





No separate evaluation of this fishery was made.

For more Information

Contact: Rob Stephenson
St. Andrews Biological Station
St. Andrews, New Brunswick
E0G 2X0

Tel: (506) 529-8854
Fax: (506) 529-5862
E-Mail: robs@sta.dfo.ca

References

Stephenson, R.L., M.J. Power, F.J. Fife, G.D. Melvin and S. Paul. 1997. Evaluation of the stock status of 4WX herring. DFO Canadian Stock Assessment Secretariat Res. Doc. 97/61.

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Maritimes Regional Advisory Process
Department of Fisheries and Oceans
P.O. Box 1006, Stn. B105
Dartmouth, Nova Scotia
Canada B2Y 4A2
Phone number: 902-426-7070
e-mail address: v_myra@bionet.bio.dfo.ca

Internet address: http://csas.meds.dfo.ca

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