

**REPORT ON THE STATUS OF SOME PELAGIC STOCKS  
IN THE CANADIAN NORTHWEST ATLANTIC**

**Atlantic Stock Assessment Secretariat  
Science Branch  
Department of Fisheries and Oceans  
P.O. Box 1006, Stn. B 215  
Dartmouth, Nova Scotia  
Canada B2Y 4A2**

*Original*

---

**August 1994**

## Table of Contents

Overview .....	3
Herring in Division 4R .....	4
Herring in the Southern Gulf of St. Lawrence .....	10
Herring in Subdivision 4Vn .....	16
Herring in divisions 4WX .....	17
Georges Bank Herring (Division 5Z) .....	20
Mackerel in subareas 2-6 .....	23

---

### Overview

In contrast to groundfish stocks, pelagic fish stocks are generally abundant on the Canadian Atlantic coast. Spring spawning herring in the northeastern Gulf of St. Lawrence (NAFO Division 4R) are an exception because of intensive targeted exploitation on that spawning component. Landings for pelagic stocks remain below the TACs, mostly because markets are poor, but also because of by-catch problems in the developing mackerel fishery.

Herring stocks appear to have reached peak abundance in the late 1980s-early 1990s. They are expected to decline in the next few years until such time as strong year-classes are produced. Future prospects for mackerel depend on the size of the 1988 year-class which is not precisely estimated at this time.

---

**Summary  
Stock Assessment  
Northeast Gulf of St. Lawrence Herring  
(NAFO Division 4R)**

**Summary**

Herring stocks are characterized by regularly recurring years of high recruitment, every 6 to 8 years. However, the strength of these good year-classes is rather unpredictable. Nonetheless, the fishery must be carried by these regular year-classes until the arrival of the next year-class. The fishery has been sustained since 1984 by the 1980 and 1982 year-classes, as well as the 1979 year-class for spring and fall stocks respectively. The strength of the 1986 and 1988 year-classes of fall spawners and the 1987 year-class of spring spawners will therefore be the critical factor in the herring fishery in Division 4R in the near future.

The present analyses indicate a spring stock biomass of 44,000 t in 1994, which is the lowest since 1973. This situation can be explained by two key factors. First, although total catches have remained below the advised catch of 22,000 t, catches were not evenly distributed between the two spawning groups due primarily to the concentration of the fishing effort on spring spawners in St. Georges Bay since 1988. Second, recruitment of the 1987 year-class among spring spawners was not as high as anticipated and therefore was unable to rebuild the stock. Unfortunately, this year-class is not strong enough to replace the 1980 and 1982 year-classes.

With respect to fall spawners, the 1986 year-class appears to be very strong, and although we are unable to provide a precise estimate, we can say that it can support increased fishing effort.

**Analysis**

In the past decade, total landings of herring on the west coast of Newfoundland increased from 10,500 t in 1984 to reach a maximum of 21,400 t in 1986. In the past seven years, landings have remained between 15,100 t and 19,400 t.

Since 1984, abundance indices have been estimated for spring and fall spawners from detailed logs of daily gillnet catches and effort compiled by index fishermen. The catch rates reveal that the 1986 cohort of fall spawners is well above average, whereas the 1987 cohort of spring spawners appears much lower, as if it had already begun to decline at age five in gillnet catches.

Data on geographic distribution were gathered on the basis of three research surveys in the summer (August-September), fall (November) and winter (January). The preliminary biomass estimates of the 1993 fall acoustic survey revealed the presence of roughly 71,000 t of spring and fall spawners in the southern regions, half of which were spring spawners.

**Assessment**

According to the projections, if current catches of spring spawners (11,000 t) are maintained in 1994, the spawning biomass (four-year-old fish and over) will continue to decline, and will reach a historical low of 27,000 t in 1995. However, by reducing fishing mortality to  $F_{0.1}$ , catches of spring spawners will be 5,400 t in 1994 and should slow the decline in the biomass of the stock.

The status of the spring stock indicates that fishing mortality is high and we do not anticipate the rebuilding of the stock in the medium term. We have serious concerns about the short-term health of this stock. There are several indications that spawning activities have already been affected by the reduction in the size of the stock. As a result, the fishing effort on this component must be reduced as much as possible by eliminating all directed fishing.

The results of the cohort analyses indicate that fall spawners have not been as heavily harvested as spring

---

spawners in recent years. The catch rate, taken from the index of the index fishermen, indicates that the 1986 year-class is significant since the 1992 abundance estimate was the highest in the series. Redirecting the fishing effort to the fall stock could be supported, at least in the short term, by this component.

---

Year	1987	1988	1989	1990	1991	1992	1993	1994	Min. <sup>1</sup>	Med. <sup>1</sup>	Max. <sup>1</sup>
Reference level ( $F_{0.1}$ )	30.6	51.4	37.0	20.5							
Advised catch	30.6	30.0 <sup>3</sup>	30.0 <sup>3</sup>	20.5	22.0 <sup>4</sup>	22.0 <sup>4</sup>	22.0 <sup>4</sup>	17.0 <sup>5</sup>	10.0	17.0	30.6
TAC	30.6	30.6	37.0	35.0	35.0	35.0	35.0	35.0	10.0	17.0	37.0
Reported catches	16.6	18.1	17.4	16.9	19.4 <sup>2</sup>	15.3 <sup>2</sup>	15.1 <sup>2</sup>		8.1	15.3	21.4
Unreported catches	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	4.0	8.3
Estimated discards	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total catches	16.6	18.1	17.4	16.9	19.4 <sup>2</sup>	15.3 <sup>2</sup>	15.1 <sup>2</sup>		10.5	15.3	21.4
Total biomass											
- Spring stock	139.3	109.8	113.6	95.0	75.8	61.0	51.9	43.9	51.9	109.5	147.6
- Fall stock											
Spawning biomass (4+)											
- Spring stock	125.5	101.9	87.3	67.5	68.2	55.1	41.1	33.3	38.7	80.9	126.2
- Fall stock											
F - Average (5+)	0.122	0.266	0.230	0.300	0.284	0.293	0.393		0.102	0.216	0.393

All catch and biomass figures are in '000 of tonnes (t).

<sup>1</sup> for 1977-1993. <sup>2</sup> Preliminary statistics. <sup>3</sup> Status quo. <sup>4</sup> Maximum recorded catches. <sup>5</sup> Average catches of the past 6 years.

**Catches:** Since 1986, landings have remained between 15,100 t and 19,400 t. The proportion of total catches taken by purse seine vessels compared to fixed gear increased from 80% in 1985 to 98% in 1993.

**Data and Assessment:** The cohort analyses were calibrated by ADAPT using gillnet catch-at-age rates (by number) from the index fishermen's logbooks. The analysis indicates a spring stock biomass in 1993 of mid-year 2+ of 52,000 t, which is the lowest estimate since 1973. The results of the analyses for the fall stock indicate that this component has not been as heavily harvested in recent years as spring spawners.

**Fishing Mortality:** Fishing mortality of the spring stock in 1993 was estimated at 0.27. However, among older fish, F has been above 0.3 since 1990. The analysis for the fall stock do not converge, with F at full recruitment being much lower than 0.1 since 1985.

**Recruitment:** The abundance of the 1987 year-class of the spring stock is approximately half that of the 1980 and 1982 year-classes. The 1986 year-class of the fall stock has been apparent in the late fall fishery since 1990, and its predominance since 1991 indicates strong recruitment for this stock.

**Environmental Factors:** Several observations reveal a lack of adequate food in the region of Bonne Bay in the fall, likely due to environmental factors, and premature movement of the herring to deeper waters, sometimes even outside the Gulf.

#### Multispecies Factors:

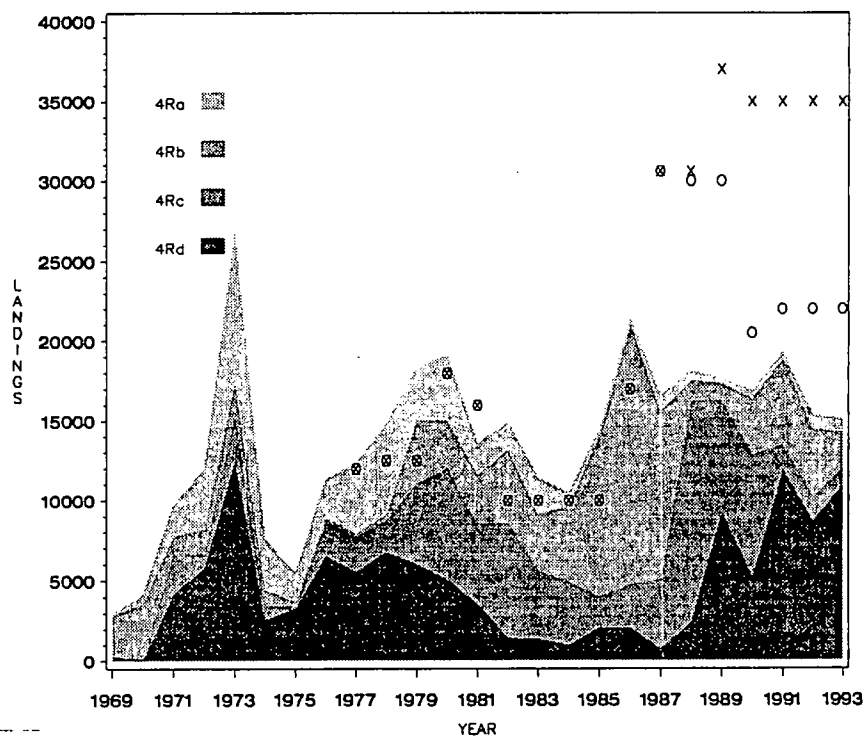
**State of the Stock:** Our current perception of the status of the spring stock is that fishing mortality is high and we do not anticipate rebuilding in the medium term. The fall stock appears to be rebuilding.

**Forecast for 1994 and 1995:** If the current harvesting pattern is maintained, which consists in targeting the spring component, the short-term future of the stock will be threatened. There are a number of indications that spawning activities have already been affected by the reduction in the size of the stock. The fishing effort on this component must therefore be reduced as much as possible by eliminating all directed fishing. Redirecting the fishing effort to the fall stock may be supported, at least in the short term, by this component.

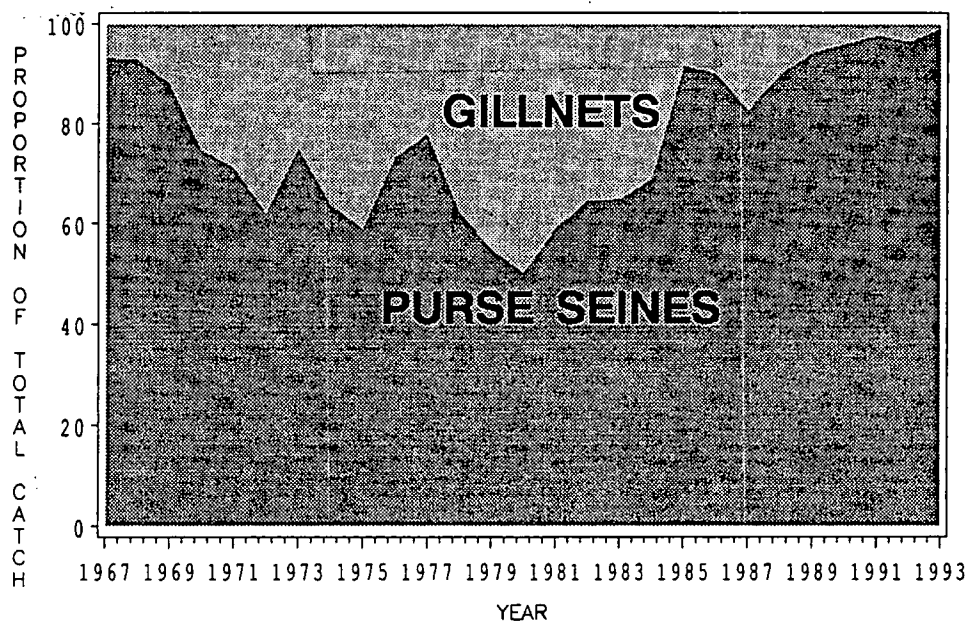
#### Long-term Prospects:

**Comments:** If we hope to maintain total 4R herring catches, the fishing effort must be directed to the fall stock in the areas where the two components are separate in space, or where the fall stock is predominant. These areas appear to be near the mouth of St-Georges Bay in the spring (April to June) and north of Pointe Riche in the fall (after July).

## Commercial Herring Landings

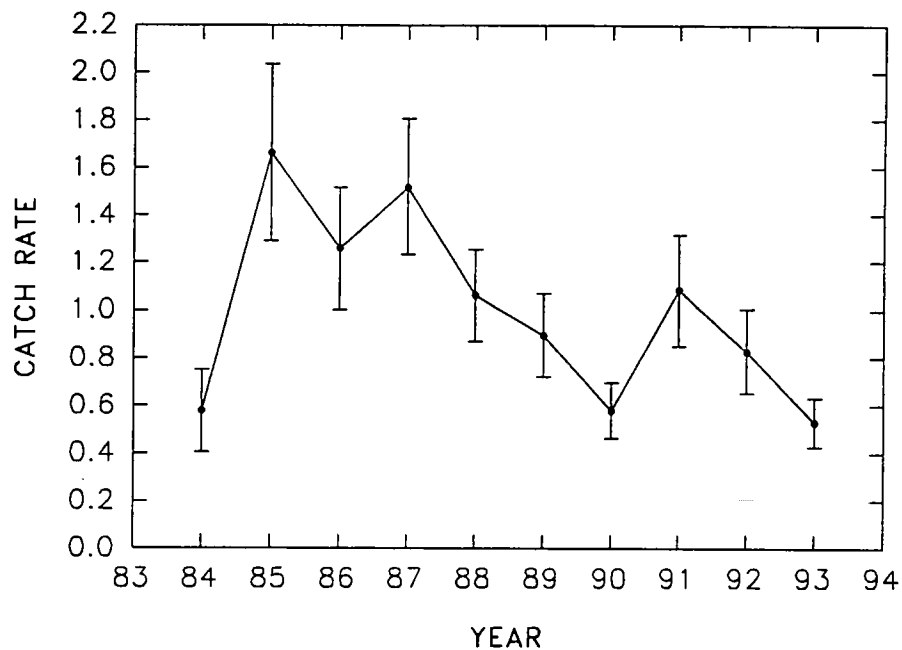


Cumulative commercial herring landings (t) by fishing area in NAFO Division 4R from 1969 to 1993. "X" indicates annual TAC; "O" indicates scientific advice.

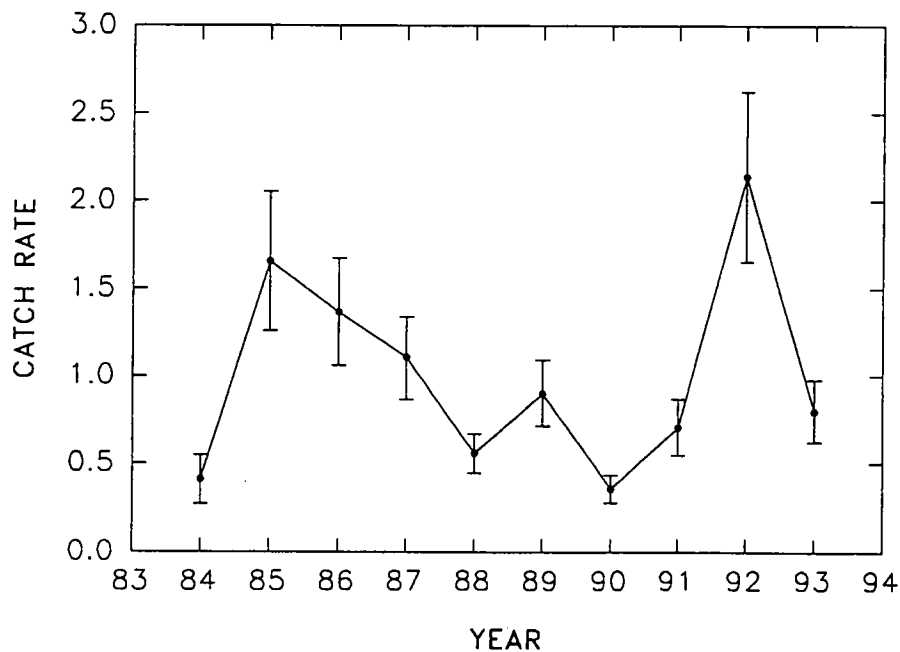


Proportion of total herring landings taken by gillnets and purse seines in NAFO Division 4R from 1967 to 1993.

## A) Spring Spawners

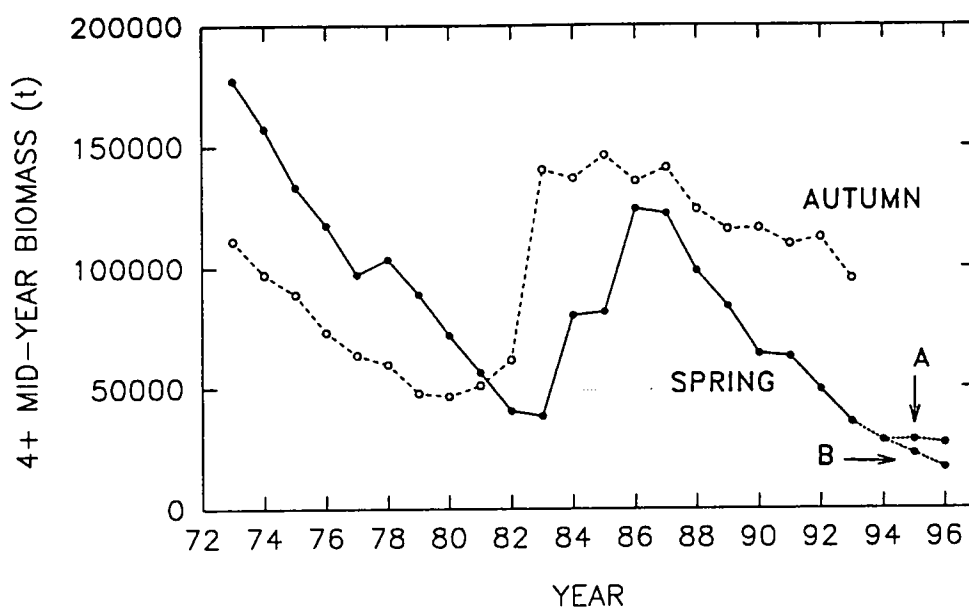


## B) Autumn Spawners

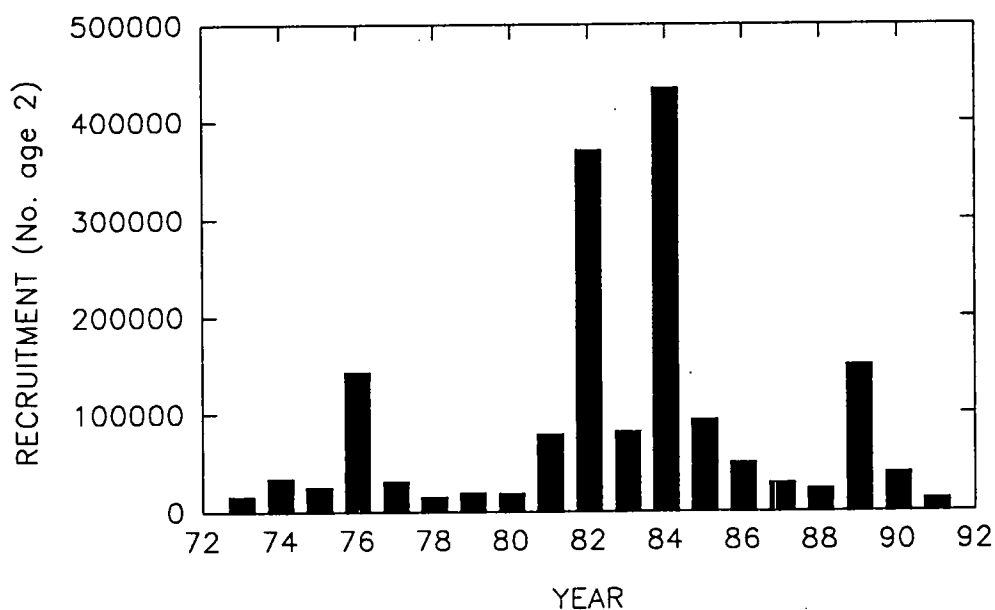


Standardized gillnet catch per unit effort ( $\pm$  two standard error) for (A) spring-spawning and (B) autumn-spawning herring in NAFO Division 4R as calculated from index-fishermen's logbook data.





Mid-year population biomass (4+) for 4R spring and autumn spawning herring from 1973 to 1993 with projection scenarios assuming (A)  $F=0.3$  and (B) constant catches at 11,000 t in 1994 and 1995.



Year-class size at age 2 (recruitment) as estimated by cohort analysis for 4R spring-spawning herring from 1973 to 1991.

### Summary of Status of Southern Gulf of St. Lawrence Herring

#### SUMMARY

The fall spawning stock has been at two levels since 1978. Years of low stock size were from 1978 to 1983 with high stock sizes from 1985 to 1993. Stock size in 1993 is slightly lower than 1992. Fishing pressure has been lower than management targets since 1991 and current fishing practices are within conservation guidelines. The fall stock is now dominated by a single year-class, those spawned in 1987, which will be seven year-olds in the 1994 fishery.

The spring spawning stock has also been at two levels since 1978. Years of low stock size were from 1978 to 1985 and a higher level from 1986 to 1993. There is no estimate of fishery exploitation rates for this stock but abundance index levels since 1991 indicate that current fishing practices are within conservation guidelines. The spring stock is now dominated by a single year-class, herring spawned in 1988, which will be six year-olds in the 1994 fishery.

#### ANALYSIS

Landings of fall spawners were 28,000 t in 1993 and landings of spring spawners were 19,000 t in 1993. An additional 3,700 t of fall spawners and 200 t of spring spawners were landed in 4Vn. The total of 51,000 t was less than half the combined southern Gulf of St. Lawrence herring quota of 105,400t (101,200 t in 4T and 4,200 t in 4Vn). These landings were similar to average values for 1973 to 1993 of 46,000 t. Since 1981, over 80% of the landings have been from fixed gear on spawning beds which primarily harvest fish from the spawning stock associated with the fishing season.

Industry input from a phone survey, index gillnetter programs, and meetings indicate that in most areas there was no change in fishing success in 1993 compared to 1992 and to the last ten years. Exceptions in the fall fishery were improved abundance in the Magdalen Islands and Escuminac and a decline in abundance in the Acadian Peninsula. The exception in the spring fishery was improved abundance in Nova Scotia. Poor market conditions were expressed as the reason for low catches and effort in 1993 compared to previous years.

In both spawning stocks the mean weight of the catch in all gears has declined in the last three years. These declines were observed in all gears and are the result of fewer older ages and declines in mean weights at all ages.

Gillnet catch rates are the principal abundance indices used to determine trends in stock size for southern Gulf of St. Lawrence herring. These show slightly lower levels in 1993 compared to 1992 but similar levels to those observed since 1986 in both stocks. These conclusions were supported by similar levels of abundance observed in acoustic surveys in October since 1991, a fall spawning bed survey at Fisherman's Bank, PEI since 1985, and as by-catch in September groundfish surveys.

#### ASSESSMENT

Biomass estimates of fall herring age 5 and older were 375,000 t in 1993 compared to 200,000 t in 1991 and 50,000 t in 1980. This increase is largely due to the 1987 year-class which accounts for about 40% of the population by number. There are no indications of new strong year-classes entering either the spring or fall stock in 1994. The outlook for fall spawners in 1995 is that if catches equal the TAC in 1994 (85,000 t) then a catch of about 100,000 t would be within conservation limits in 1995. There is no quantitative forecast for spring spawners but current fishing levels do not seem detrimental to stock size.

---

## Herring in 4TVn Fall Spawners

Year	1987	1988	1989	1990	1991	1992	1993	1994	Min <sup>1</sup>	Med <sup>1</sup>	Max <sup>1</sup>
Advised Catch	31.3	59.7	53.7	53.7	53.7	60	81.3	81.3			
4Vn Advised Catch	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2			
4T TAC	64.6	66.1	70.1	65.9	65.9	65.9	80.8	80.8			
4Vn TAC	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2			
Tot. TAC	68.8	70.3	74.3	70.1	70.1	70.1	85	85			
4T Gillnet Catches	50.7	39.3	32.9	56.2	27.9	32.9	22.8 <sup>2</sup>		5.5	24.5	56.2
4T P.S. Catches	9.3	10.9	10.1	6.4	5.7	5.4	5.3 <sup>2</sup>		1.9	8.7	25.5
4Vn P.S. Catches	2.0	2.3	1.9	4.0	4.0	3.9	3.7 <sup>2</sup>		1.5	2.6	4.0
Total Catches	62.0	52.5	44.9	66.6	37.5	42.2	31.8 <sup>2</sup>		15.4	33.2	66.6
5+ Biomass	239	292	290	269	226	393	377		28	187	393
7+ Biomass	122	117	111	155	136	122	111		6	71	155
Mean F (5-9)	0.30	0.22	0.18	0.29	0.13	0.12	0.09		0.09	0.30	1.08

All catch and biomass numbers are in '000 of tonnes. Advised catch levels are provided for spawning group but TACs are set by fishing season. All catches are by spawning group. <sup>1</sup>Min, med, and max values are from 1978 to 1993. <sup>2</sup>Preliminary statistics.

**Catches:** Fall spawners are harvested by gillnets and purse seines. During the fall spawning season 90% of the gillnet catch is fall spawners. The spring purse seine fishery harvests primarily fall spawners during June. The fall purse seine fishery in 4T harvest about 70% fall spawners, and the winter 4Vn fishery harvests 85-95% fall spawners. Catches have generally been below TACs in recent years because of poor markets and reduced effort.

**Data and Assessment:** The assessment is based on an ADAPT-VPA using gillnet catch rates as the abundance index. Index gillnetters, acoustic surveys, spawning surveys at Fisherman's Bank, and by-catch in September groundfish surveys support the conclusions from stock size estimates.

**Fishing Mortality:** Fishing mortality has been below target F of 0.20 since 1991.

**Recruitment:** The 1987 year-class is the largest seen since 1978 and comprises about 40% of the catch by number in fixed and mobile gear. No new strong year-classes are evident in the population.

**Environmental Factors:** In 1993, catches on spawning beds occurred during average peak weeks in Chaleur Bay fisheries, one week earlier than average in Escuminac-West PEI, and two weeks earlier than average in the Northumberland Strait.

**Multispecies Factors:** It was estimated that about 60,000 t of fall and spring herring were consumed by cod in 1992 and 1993.

**Forecast for 1995:** The 1993 to 1995 quotas for the 4TVn fall spawning stock have been set at 85,000 t. If the TAC were taken in 1994 then  $F_{0.1}$  in 1995 would be about 100,000 t.

**State of the Stock:** Biomass increased during the 1980s from very low levels in the late 1970s. 5+ biomass peaked at 393,000 t in 1992. 7+ biomass peaked in 1990 at 155,000 t. These peak levels correspond to the entry of large year-classes into the populations in those years. This pattern emphasizes the importance of year-class strength in evaluating the effect of fishing levels on this stock.

**Long-term Prospects:** The 1987 year-class is large and recruitment from new year-classes does not appear to be strong. The fishery will be carried by the 1987 year-class for the next few years.

## Herring in 4TVn Spring Spawners

Year	1987	1988	1989	1990	1991	1992	1993	1994	Min <sup>1</sup>	Med <sup>1</sup>	Max <sup>1</sup>
4T Advised Catch	12.9	12.8	21	16	16	16.8	16.8	16.8			
4T TAC	8.2	12.8	16.8	21	21	21	21	21			
4T Gillnet Catches	13.2	14.8	12	9.9	11.4	12.7	15.5 <sup>2</sup>		5.5	10.1	15.5
4T P.S. Catches	4.4	6.6	4.4	3.8	2.8	2.9	3.6 <sup>2</sup>		0.4	4.7	14.3
4Vn P.S. Catches	0.3	0.3	0.2	0.7	1	0.3	0.2 <sup>2</sup>		0.2	0.9	1.5
Total Catches	17.9	21.7	16.4	14.4	15.2	15.8	19.3 <sup>2</sup>		7.0	14.4	23.7
Tot. Biomass											
Sp. Biomass											
Mean F											

All catch and biomass numbers are in '000 of tonnes. Reference levels are provided for spawning group but TACs are set by fishing season. All catches are by spawning group. <sup>1</sup>Min, med, and max values are from 1978 to 1992. <sup>2</sup>Preliminary statistics.

**Catches:** Spring spawners are harvested by gillnets and purse seines. During the spring fishing season, catches in the spring gillnet fishery are 99% to 100% spring spawners. The spring purse seine fishery catches few spring spawners in June. About 30% of the fall purse seine fishery catch is spring spawners. The winter 4Vn fishery harvests about 5-15% spring spawners. Catches have generally been below the TAC in recent years because of poor markets.

**Data and Assessment:** Changes in advice are based on gillnet catch rate trends in the spring fishery. Conclusions based on these data are supported by the annual acoustic survey and the proportion of spring spawners sampled during that survey.

**Fishing Mortality:** Because of reduced effort due to poor markets, fishing mortality has probably been low in recent years.

**Recruitment:** The 1988 year-class was most numerous in fixed and purse seine fisheries (about 45% by number). Previous high year-classes were 1979 and 1982.

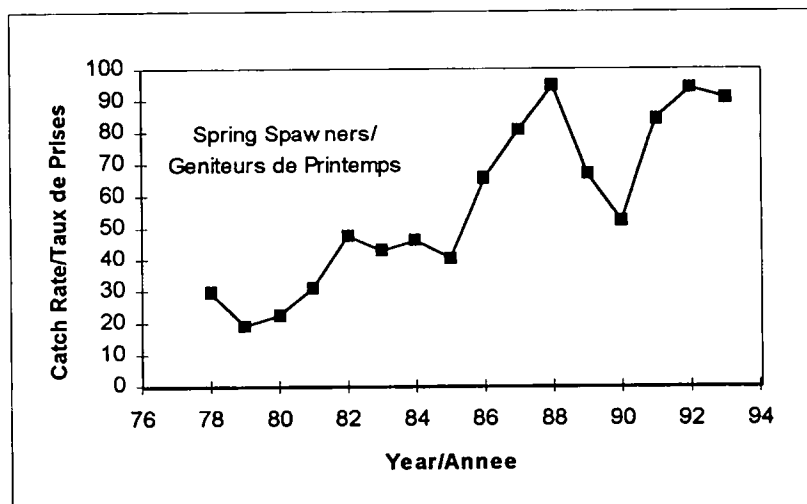
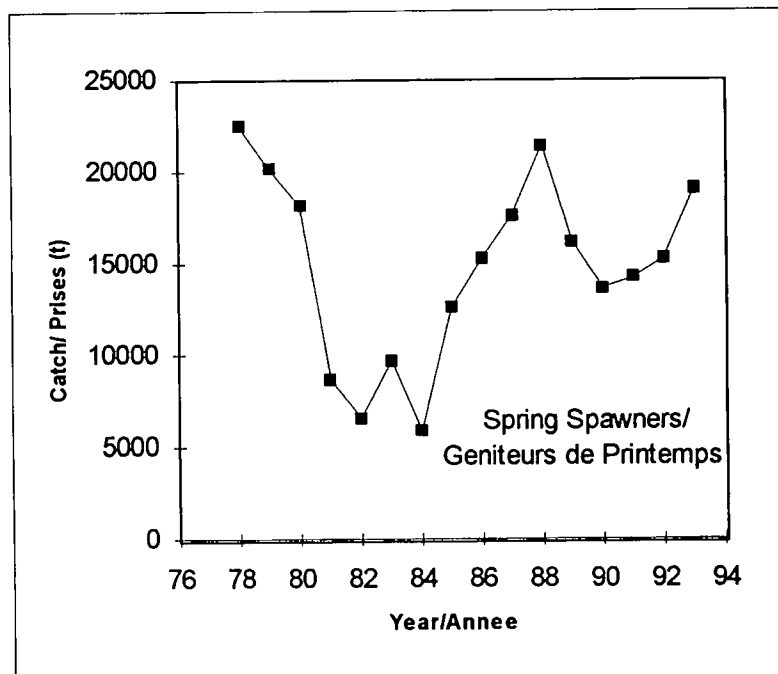
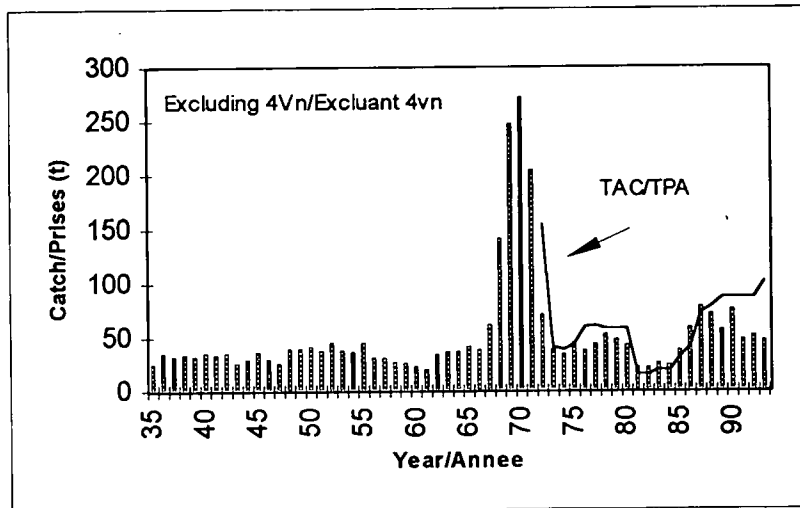
**Environmental Factors:** In 1993, catches on spawning beds occurred during the average peak week in Chaleur Bay, were one week later than normal in Escuminac-West PEI, and were one week earlier than expected in Northumberland Strait.

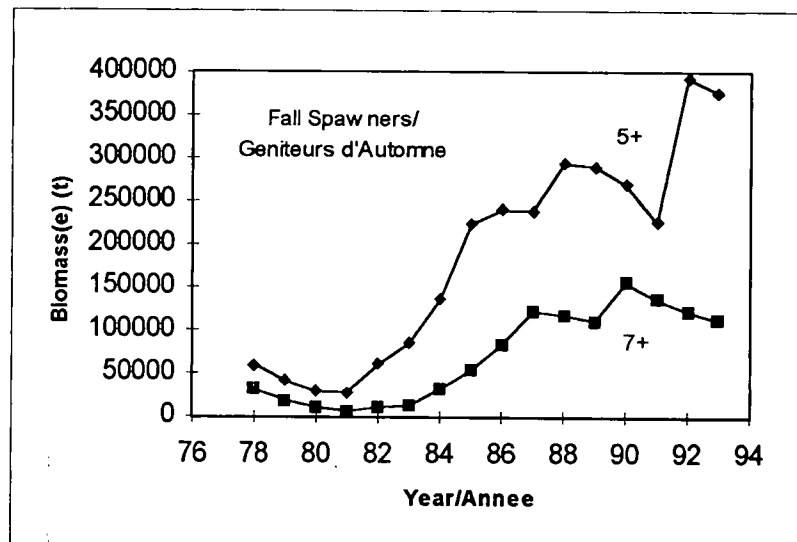
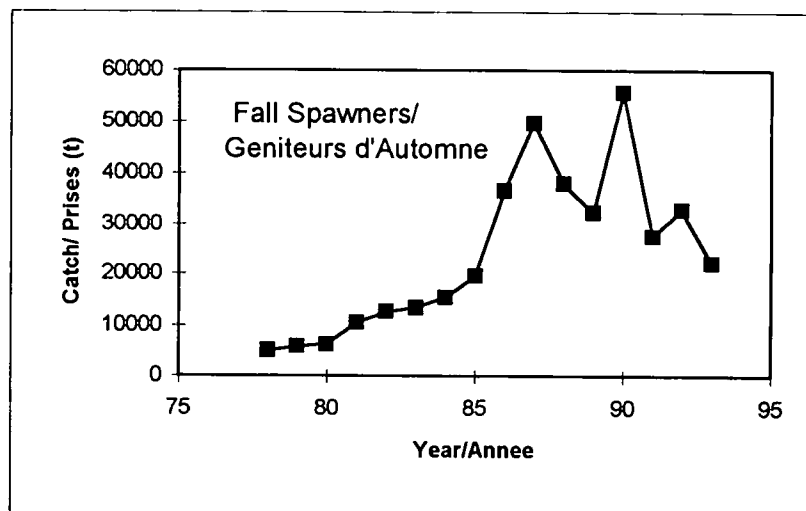
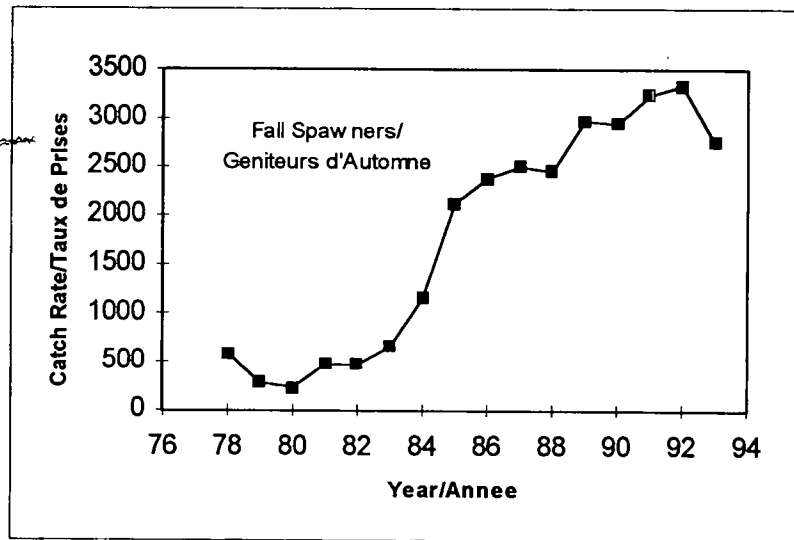
**Multispecies Factors:** It was estimated that about 60,000 t of fall and spring herring were consumed by cod in 1992 and 1993.

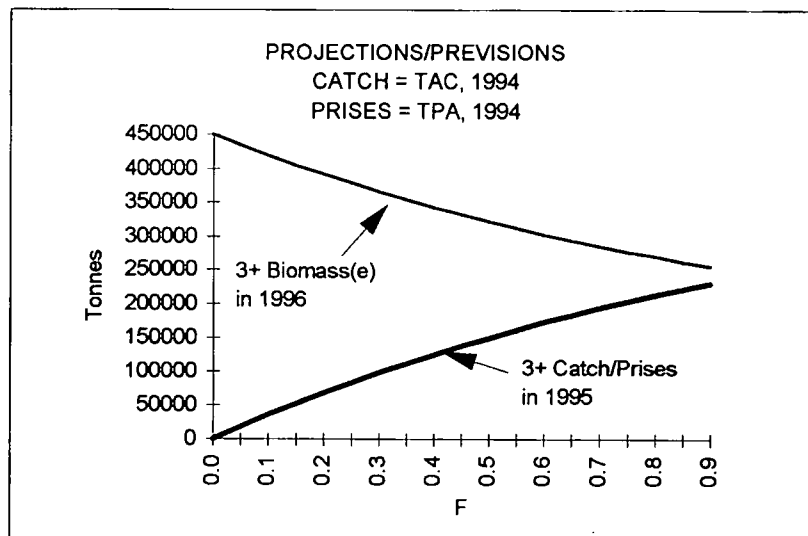
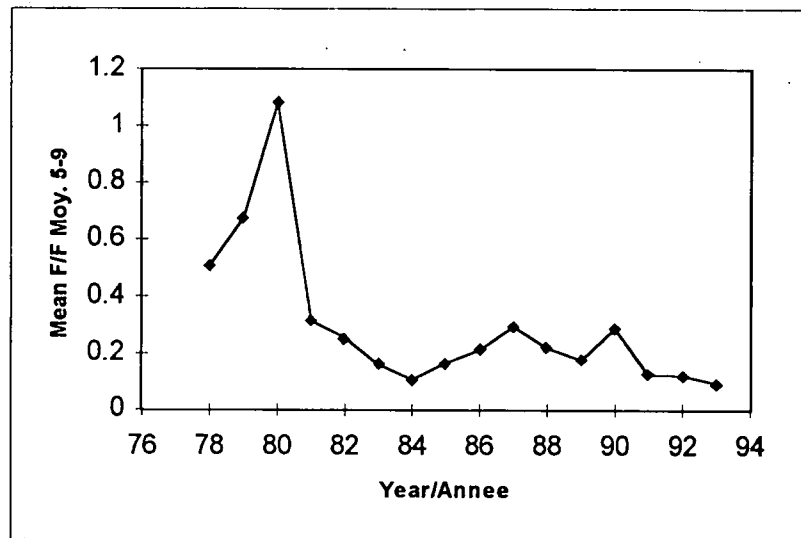
**State of the Stock:** Catch rates indicate that the abundance of spring herring in 1993 was similar to 1992.

**Forecast for 1995:** An analytical assessment was not possible for spring spawners. Catch rates indicate abundance of spring spawners in 1993 was similar to 1992. Spring spawners comprise on average about 30% of the 4T catch and acoustic survey samples. If this is indicative of relative population sizes then a catch of 20,000 t would translate to an F that would be below  $F_{0.1}$  conservation levels.

**Long-term Prospects:** The spring spawning stock is likely to be dependent on the 1988 year-class in the coming years.







### Summary of Status of Sydney Bight Herring

- \* Landings in the 4Vn winter (Nov/Dec) purse seine fishery were 4228t in 1992 and 3956t in 1993. Recorded landings by inshore (gillnet, traps and misc.) gear in 1993 amounted to 273t, but this is considered to be an underestimate.
  - \* Location and composition of the catch has changed over the history of the 4Vn fishery. The historical fishery and tagging results indicated that the area contained a mixture of fish in the winter. The restriction of the purse seine fishery to the northern portion of 4Vn in recent years was intended to increase the proportion of 4T fish taken in the catch, and reduce the catch of fish of 4WX or local 4Vn stocks. Recent sampling indicates that this has been successful, and purse seine landings from the winter fishery in the northern portion of 4Vn are to be included in the 4T herring assessment. The 4T assessment/management unit, however, should not be referred to as 4TVn, because of the presence of a resident/local spawning population of herring in 4Vn.
  - \* A study of the biology of Bras d'Or Lake herring spawners has been proposed by Aboriginal Fisheries Services (Eskasoni, Cape Breton), in collaboration with DFO. If conducted, it would provide useful information on several aspects of the resident population, including the degree of movement out of the Bras d'Or Lake, and degree of involvement in the winter fishery.
-



**Summary of Status of Scotian Shelf - Bay of Fundy Herring**

- \* The 1993 landings were 105,000t. The 1993 TAC was 151,000t. Since at least 1987, the reported landings have not been restricted by the TAC (although landings that have been corrected for misreporting have exceeded the TAC in four of seven years). The 1993 landings are below average for recent years. The shortfall in landings was due to a new dockside monitoring program, market limitations and unusual distribution of the resource.
  - \* The new dockside monitoring program is estimated to have considerably reduced under-reporting of landings.
  - \* The geographic patterns of landings in 1992 and 1993 were unusual compared to the past decade. The "over-wintering" fishery in the Chedabucto Bay area was small, and a large portion of the winter fishery catch was taken off Halifax. In addition, fishing success at several traditional spawning areas has declined in recent years (Trinity Ledge, German Bank), and large catches were taken in areas not usually fished (off Liverpool and on the Southwest Grounds).
  - \* The larval herring survey abundance estimates are an index of spawning stock size. There has been an increase in larval abundance during the late 1980s, with the 1993 estimate being high.
  - \* The summer groundfish research vessel survey catches herring as by-catch. The 1993 survey by-catch was high.
  - \* Due to under reporting of catches, an SPA-based analytical assessment has not been carried out for this management unit for several years. Thus, there are no estimates of fishing mortality or stock size.
  - \* The two indices of abundance (research vessel surveys and larval herring) suggest that spawning stock size is relatively high. There are no indicators of the relative size of recruiting year-classes.
  - \* The changes in geographic distribution of the population, in particular the relative change in abundance at traditional spawning locations, is a cause for concern.
  - \* Given the mixed signals (i.e., high overall biomass, yet changes in relative contribution to the fishery of various spawning locations), as well as the lack of quantitative assessment to indicate the rate of exploitation, a restriction in landings to the average of recent years would be prudent (about 140,000t).
  - \* Fishing effort should be spread over spawning areas in order to reduce the chance of overfishing individual spawning components.
-

Year	1987	1988	1989	1990	1991	1992	1993	1994	Min. <sup>3</sup>	Med. <sup>3</sup>	Max. <sup>3</sup>
Reference level '000t											
Advised catch '000t											
TAC '000t	127	151	151	151	151	125	151	151	125	151	151
Reported landings '000t	101	125	84	102	97	100 <sup>2</sup>	99 <sup>2</sup>		84	100	125
Unreported catches '000t <sup>1</sup>	56	78	17	81	39	26	7		7	36	75
Total catches '000t <sup>1</sup>	147	200	98	173	131	136	105		98	136	200
Total biomass '000t											
Spawning biomass '000t											
Mean - F ( )											

<sup>1</sup> Using backcalculation from production reports (revision from 1993)

<sup>2</sup> Preliminary statistics.

<sup>3</sup> 1987-1993

**Catches:** Reported 1993 landings were about the same as 1992 and were well estimated with the introduction of mandatory dockside monitoring. Purse seiners accounted for 96% of the total and catch distribution was similar to previous years but with some shifts in Chedabucto Bay after December and in October away from German Bank to the Shelburne - Liverpool area.

**Data and Assessment:** Comparison of monitored landings in 1993 and those back-calculated from product reports, showed close correspondence and were used to modify the catch matrix for recent years. Logbook coverage was much reduced from previous years (<40% landings) but was still useful for determining the distribution and timing of the purse seine fishery.

#### Fishing Mortality:

**Recruitment:** The 1989 year-class now dominates the stock catch in numbers and weight and is similar to the 1988 year-class.

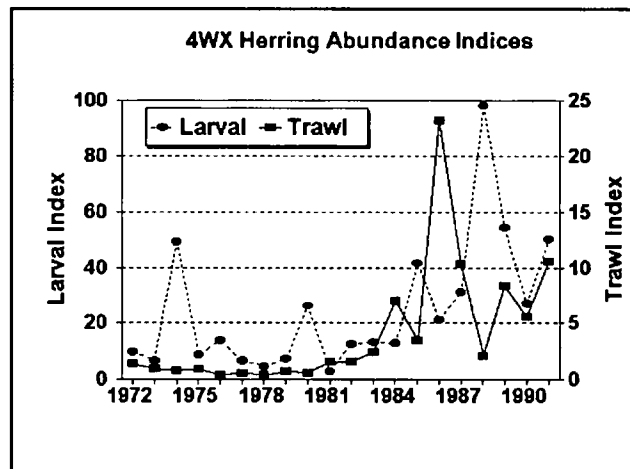
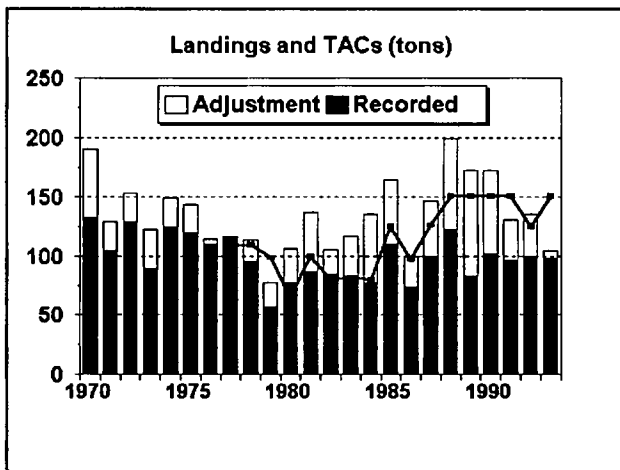
**Environmental Factors:** Recent changes in local availability and distribution may have been the result of changes such as temperature which have been lower than average in areas of relevance to this stock.

#### Multispecies Considerations:

**State of the Stock:** The larval abundance index and research vessel survey by-catch indices remain high with a general increase through the past decade and indicate above average abundance.

**Forecast for 1995:** No projection was completed.

**Long-term Prospects:** There are no strong year-classes recruiting to the fishery but research surveys show a continued high stock abundance.



### Summary of Status of Georges Bank Herring

- \* The Georges Bank herring population (a transboundary resource) was fished to commercial extinction prior to the extension of jurisdiction in 1977. Essentially no herring were observed on the Bank until the late 1980s. Given the evidence of recovery of the stock, an annual experimental fishery with a combined Canada/USA catch of 5,000t has been permitted since 1992.
  - \* Historical annual landings exceeded 200,000 t per year for several years prior to 1976, but at this level of fishing, the resource was not sustainable.
  - \* In 1993, four vessels searched the Bank but no herring were caught. It was reported that the fish were too deep to be caught with a purse seine.
  - \* The bottom trawl survey by-catch index increased from 1985 to 1992. The 1993 point is about half that for 1992. Present by-catch levels in these surveys exceed those observed in the 1960s and 1970s when the stock was commercially exploited.
  - \* Since 1987, the age composition of the by-catch has been dominated by 3 and 4 year old fish. The relative absence of older fish in the samples caused some concern, but is interpreted as being due to a gradual increasing of abundance over time.
  - \* The larval survey index indicates increasing abundance from 1987 to 1993. The larval concentrations are higher than those observed in the 1970s. The geographic distribution of larvae indicates that spawning is occurring at all of the historical spawning sites and early 1980s spawning areas on both sides of the International Court of Justice (ICJ) line.
  - \* Given the high abundance indices and the geographic patterns in herring distributions, the status of the stock is "recovering" or may be "recovered". A commercial fishery with a combined Canada/USA catch of 20,000t could now be developed on the Bank. A small commercial fishery integrated with a research function would provide additional scientific information to improve estimates of stock status and the harvesting potential.
  - \* Given the transboundary nature of this resource, consistent management by Canada and the USA is required in order to meet their respective objectives.
-

Year	1987	1988	1989	1990	1991	1992	1993	1994	Min.	Med.	Max.
Reference level '000t									....		
Advised catch '000t										—	—
Exp Fishery '000t							5	5			
Reported catches '000t							0	0			
Unreported catches											—
Estimated discards '000t									....		
Total catches '000t							0	0	2.2 <sup>1</sup>	148 <sup>1</sup>	374 <sup>1</sup>
Total biomass '000t											
Spawning biomass '000t											
Mean - F ( )									—	—	....
'1961-1977											

**Catches:** Only a single excursion occurred in 1993 with no catch. No results are available for the 1994 fishery.

**Data and Assessment:** Both the US bottom trawl survey and the Canadian larval abundance index are well above the long-term average, with the larval abundance index being the highest since 1987.

**Fishing Mortality:** Fishing mortality is expected to be low in the absence of a fishery.

**Recruitment:** There has been strong representation of 3 and 4 year old fish in the research survey samples since 1987 indicating good recruitment.

**Environmental Factors:** Temperatures in the upper 50m have been predominantly below normal in recent years, whereas in deep waters they have been steady or declining.

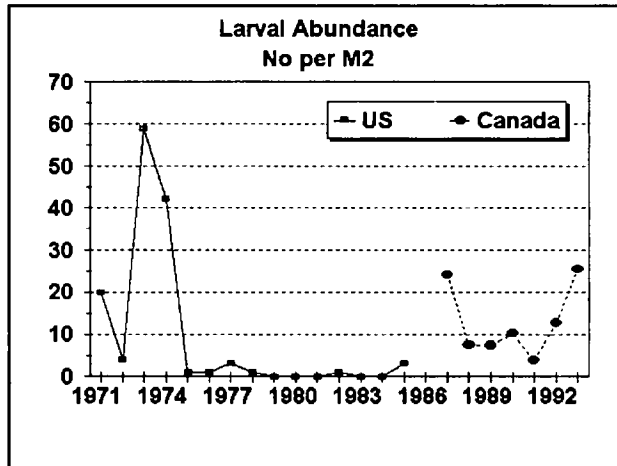
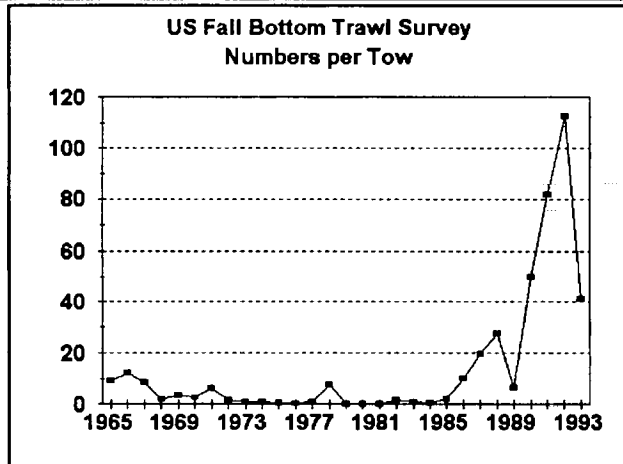
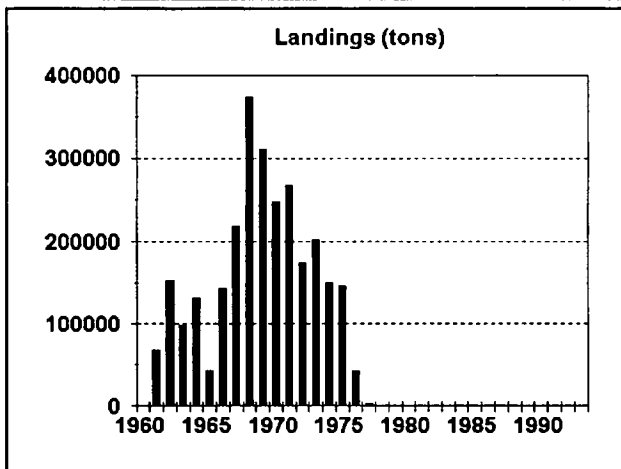
**Multispecies Considerations:** Many species of fish depend on herring for food.

**State of the Stock:** Stock abundance is likely increasing.

**Forecast for 1995:** It is recommended that the combined Canada/US catch be 20,000t.

**Long-term Prospects:** About 100,000t annually.

**Special Comment:** A experimental fishery of 5,000t for 1994 has been approved.



**Summary**  
**Northwest Atlantic Mackerel**  
**(NAFO subareas 2 to 6)**

**Summary**

Mackerel in the northwest Atlantic is a migratory transboundary stock which is shared by Canada and the United States. It has been harvested since the 17th century. In the early 1970s, the fishing effort of foreign fleets was considerable (catches of 430,000 t in 1973). However, since the extension of fisheries jurisdiction to 200 miles by Canada and the United States, catches have fallen to much lower levels. The stock is currently little exploited and it is felt that biomass is high.

In recent years, increased efforts have been made to develop the northwest Atlantic mackerel fishery. Until now, with the exception of the west coast of Newfoundland, very few significant results have been achieved, owing primarily to by-catches of herring and the difficulty of locating mackerel.

**Analysis**

There are two populations of mackerel in the northwest Atlantic with separate spawning grounds. The southern contingent spawns from the coast of New Jersey to Long Island. The northern contingent spawns in the Gulf of St. Lawrence. The two spawning groups overwinter in subareas 5 and 6, but their degree of mixing is not yet known.

Given the lack of a precise abundance index for the stock and the low exploitation rate, it is difficult to use a sequential population analysis to estimate the size of the mackerel population. Catch-at-age data indicate that the 1982 year-class was particularly abundant and that it accounted for the increase in biomass in the 1980s. This year-class is now declining and the biomass of the stock should decrease. A new strong year-class (that of 1988) has appeared, and its presence is significant in commercial catches.

An egg abundance survey in the Gulf of St. Lawrence (which can be used to back-calculate the spawning biomass of the northern component of the stock) is quite variable, but shows that the spawning biomass of this component was about 800,000 t or more between 1985 and 1993. Mackerel abundance was last calculated by SPA in 1991 on the basis of the spring survey for groundfish conducted by the U.S. off the east coast of the United States, and indicated that the biomass increased gradually in the 1980s to peak in 1990.

Data from the Index Fishermen's Program indicate that catches by some coastal fishermen vary significantly from year to year. The most commonly cited reasons for this are extended periods of poor weather, water temperature, currents and winds. A reduction in catches is often viewed by our coastal index fishermen as evidence that the stock is not in as good condition as DFO and the U.S. suggest. It was noted on several occasions that the duration of the presence of large mackerel, which are the first to arrive early in the season, was shorter than usual.

**Assessment**

The biomass of the stock is very high (likely over 800,000 t) and the rate of exploitation is low (fishing mortality of 0.05 or less). The 1982 year-class, which was very large, dominated Canadian catches between 1984 and 1990. However, the abundant 1988 year-class has dominated catches since 1991. Despite the abundance of the stock, the success of the coastal fisheries continues to vary from location to location, or from year to year, due primarily to unpredictable movements of mackerel in a very large area after spawning. These movements depend essentially on weather conditions.

---

Year	1987	1988	1989	1990	1991	1992	1993	1994	Min. <sup>1</sup>	Med. <sup>1</sup>	Max. <sup>1</sup>
Reference level ( $F_{0.1}$ )											
Advised catch	200	200	200	200	200	200	200 <sup>3</sup>				
TAC <sup>4</sup>											
Canadian quota	100	100	100	100	100	105	105	105			
Canadian catches	28	25	21	23	21	25	27		6	18	31
U.S. catches	18	22	16	12	17	13	4		2	8	22
Foreign catches	37	43	37	31	16	0	0		0	23	397
Unreported catches											
Estimated discards											
Total catches	82	90	74	66	54 <sup>2</sup>	38 <sup>2</sup>	31 <sup>2</sup>		12	60	430
Spawning biomass <sup>5</sup>	785	1352	401	1082	1331	792	776		312	792	1556

All catch and biomass figures are in '000 of tonnes (t). <sup>1</sup> For 1962-1993. <sup>2</sup> Preliminary statistics. <sup>3</sup> A TAC of 200 000 t is unilaterally established by Canada, with proposed sharing with the United States on a fifty-fifty basis. <sup>4</sup> Formulated as follows: It is unlikely that catches of 100 000 t by Canada may decrease the stock to below its average abundance. <sup>5</sup> Minimum estimate for the Gulf component derived from egg production estimates taken from the annual egg survey.

**Catches:** Canadian catches have been stable at low levels in the past 10 years. The catches are essentially limited by the lack of lucrative markets. U.S. catches were very low in 1993, with the fishing effort being directed primarily at the squid fishery. Winter fishing is no longer carried out by foreign vessels in subareas 5 and 6.

**Data and Assessment:** Spawning biomass of the Gulf of St. Lawrence component was calculated on the basis of total egg production. According to this method, spawning biomass since 1985 has been above roughly 800,000 t. A sequential population analysis was used to illustrate the probable changes in recruitment, fishing mortality and spawning biomass.

**Fishing Mortality:** Fishing mortality was not precisely quantified, but should be lower than 0.05.

**Recruitment:** The 1988 year-class has been significant in Canadian catches since 1991. Prior to that, the 1982 year-class had dominated since 1984.

**Environmental Factors:** Mackerel is a warm water species and its presence along the coasts depends largely on water temperature. Thermographs will be distributed on a larger scale in 1994 to monitor movements of mackerel on the basis of temperature.

**Multispecies Factors:** It would appear that the development of the purse seine fishery in Baie des Chaleurs has been delayed by the high volume of by-catches of herring.

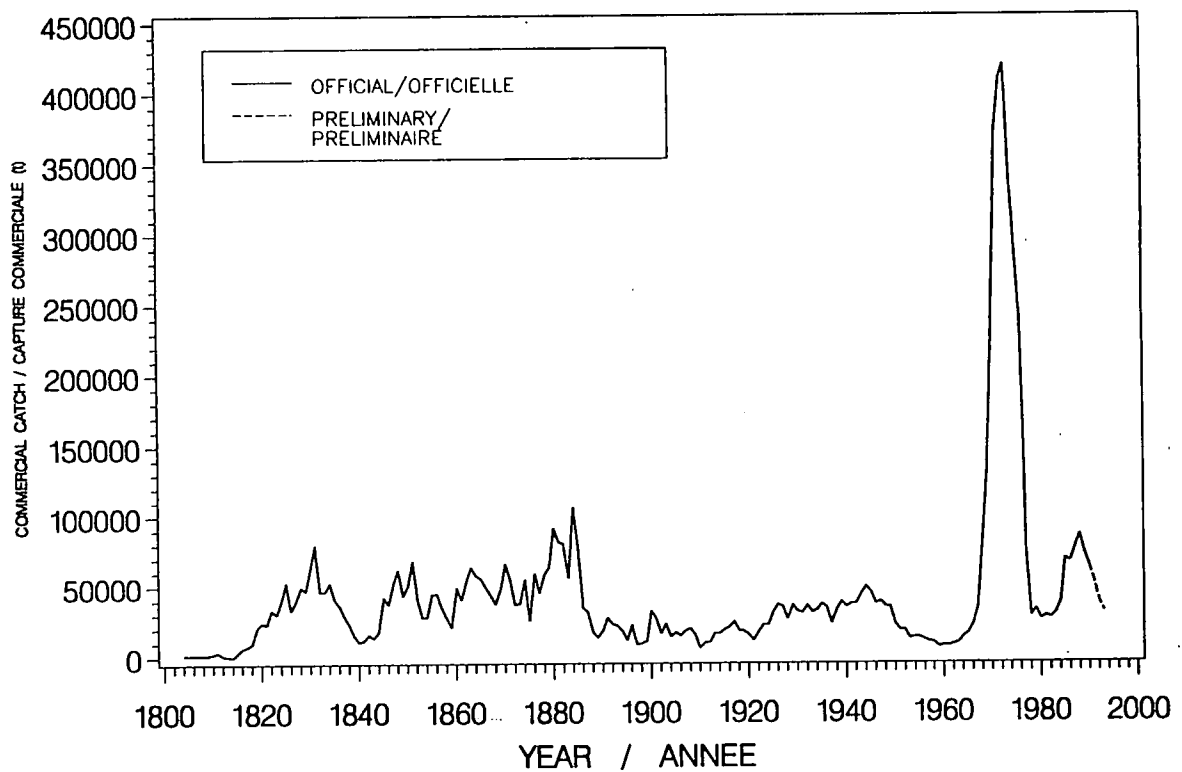
**State of the Stock:** Biomass is high and the abundant 1988 year-class should contribute significantly to the stock in the next few years.

**Forecast for 1995:** No quantitative forecast has been done, but given the low exploitation rate, increased harvesting is possible.

**Long-term Prospects:** Since 1960, average catches have totalled approximately 100,000 t. An increase in Canadian catches can be expected given the problems in the groundfish fishery and the desire to develop the mackerel fishery.

**Comments:** A number of meetings were held with the industry during the winter. The coastal fishermen expressed serious concerns about the possible development of the mackerel fishery. Several fishermen also mentioned the fact that large amounts of mackerel had been caught as bait without being recorded in the Department's statistics.

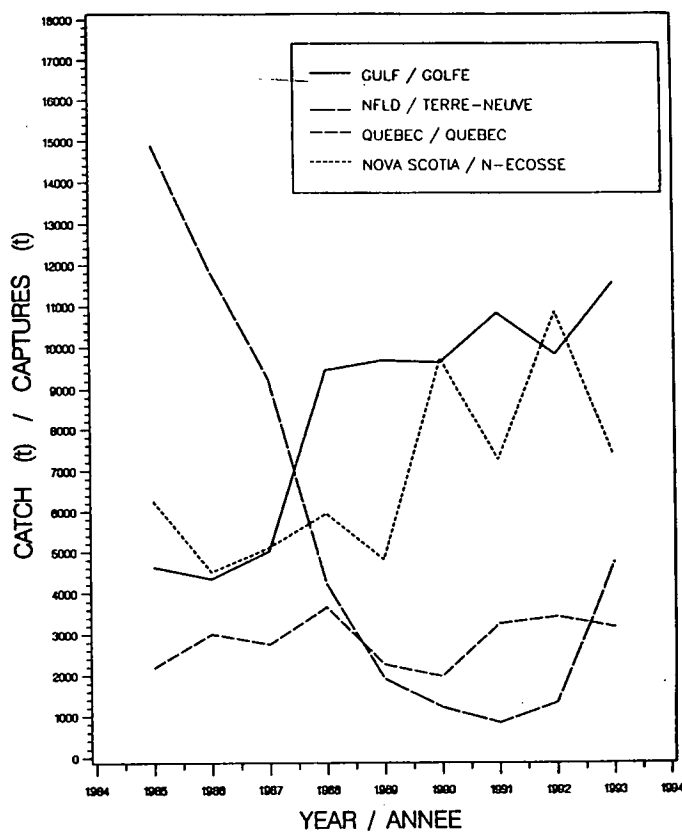




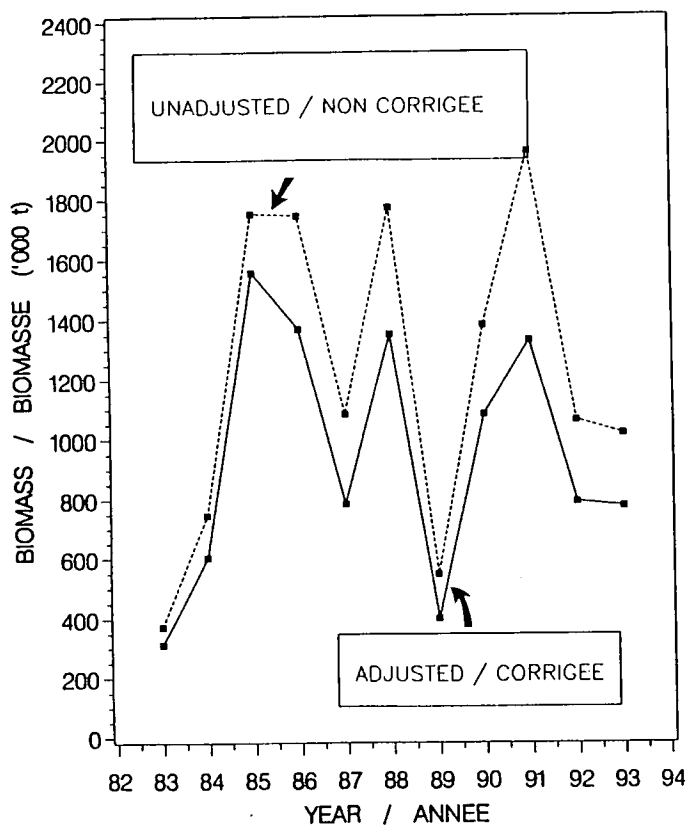
Historical catches (t) of mackerel (early data from Anderson and Paciorkowski, 1980).

#### Reference

Anderson E.D., and A. J. Paciorkowski. 1980. A review of the northwest Atlantic mackerel fishery. ICES. Rapp. P.-V. Réun. Cons. Int. Explor. Mer, 177: 175-211.



Commercial catches (t) of mackerel recorded in each Canadian region since 1985.



Spawning stock biomass of the Gulf of St. Lawrence mackerel based on unadjusted and adjusted egg density.