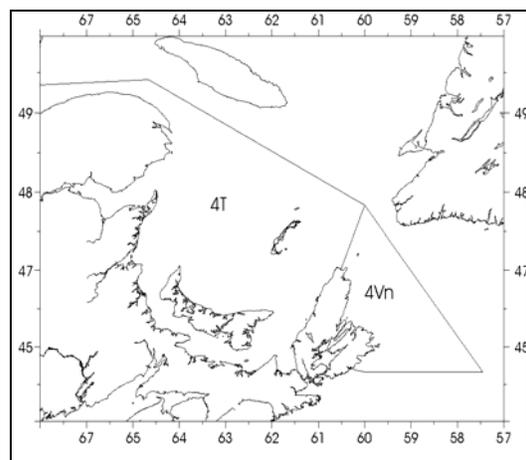


P. Buerschaper  
Scott & Scott 1988

## Southern Gulf of St. Lawrence Herring



### Background

Herring are a pelagic species existing in schools during feeding and spawning periods. Herring in the Southern Gulf of St. Lawrence consist of two components, spring spawners and fall spawners. Spring spawning occurs primarily in May but extends into June at depths <10m. Fall spawning occurs from mid-August to mid-September at depths 5 to 20m. Eggs are attached to the bottom and larger females produce more eggs than small females. First spawning occurs primarily at age four. The largest spring spawning populations are in the Escuminac and Southeast New Brunswick areas and the largest fall spawning population is in Chaleur Bay.

The stock area for Southern Gulf of St. Lawrence herring is the area extending from the north shore of the Gaspé Peninsula to the northern tip of Cape Breton Island and includes the Magdalen Islands. Adults overwinter off the east coast of Cape Breton in NAFO area 4Vn. This area is included in the stock area from mid-October to spring when ice recedes and herring return to the Gulf. Southern Gulf of St. Lawrence herring are harvested by an inshore gillnet fleet on spawning grounds and a purse seine fleet (vessels >65') in deeper water. The inshore fleet harvests >97% spring spawners in the spring and fall spawners in the fall. The purse seine fleet harvests on average about 70% spring spawners during their spring fishery which occurs in the area between Cape Breton Island and the Magdalen Islands. In the fall, the purse seine fleet concentrates in Chaleur Bay and harvests 60-70% fall spawners. TAC management was initiated in 1972. Currently there are approximately 3,500 inshore licenses and 6 large seiner licenses. Large seiner catches are restricted by the requirement that no more than 10% of the catch for any day can exceed 24.5 cm fork length.

### The Fishery

**Management:** The purse seine fleet is allocated 23% of the TAC with the remainder being allocated to the inshore fleet. The purse seine allocation includes a fishery in 4Vn which has been set at 4,200 t since 1986. The major management change in 1995 permitted large seiners to start fishing in Chaleur Bay in mid-August compared to mid-September in 1994 and October 1 in previous years. The TAC for the inshore fleet is divided by area during the spring and fall seasons. In the fall fishery, nightly boat quotas of 20,000 pounds were set for each fishery except for the Magdalen Islands and Quebec small seiners fishing in Chaleur Bay. Nightly quotas for these fisheries were 15,000 pounds.

#### 1995 FALL FISHERY

Area	TAC	Catch (t)
<b>INSHORE</b>		
Isle Verte	400	77
Chaleur Bay	32,500	29,448
Escuminac - West PEI	9,000	9,380
Magdalen	1,600	1,901
Pictou	11,070	10,113
Fisherman's Bank	10,070	3,816
<b>Total Inshore</b>	<b>64,640</b>	<b>54,611</b>
<b>LARGE SEINERS</b>		
All 4T	16,160	15,266
4Vn	4,200	4,143
<b>Total L. Seiners</b>	<b>20,360</b>	<b>19,409</b>
<b>Grand Total</b>	<b>85,000</b>	<b>74,020</b>

**Available from:** Maritimes Regional Advisory Process, Department of Fisheries and Oceans, P.O. Box 1006, Stn B105, Dartmouth, N. S., Canada B2Y 4A2 Telephone: 902-426-8487. E-mail: d\_geddes@bionet.bio.dfo.ca

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April, 1996

## 1995 SPRING FISHERY

Area	TAC	Catch (t)
<b>INSHORE</b>		
Escuminac	5,900	3,169
Remainder of 4T	6,150	5,968
Bait and Roe all 4T	3,550	4,859
Quebec Small Seiners	600	
<b>Total Inshore</b>	<b>16,800</b>	<b>13,996</b>
<b>LARGE SEINERS (All 4T)</b>	<b>4,200</b>	<b>1,825</b>
<b>Grand Total</b>	<b>21,000</b>	<b>15,820</b>

**Landings:** During the fall fishery the inshore fleet catches >97% fall spawners. The purse seiner fleet catches about 30% fall spawners during their spring fishery, 60-70% fall spawners during their fall fishery in Chaleur Bay, and about 90% fall spawners during their 4Vn fishery. As a result, landings during the fall and spring fisheries described above must be separated into the appropriate spring and fall spawning groups to determine if the TAC for each spawning group has been caught.

The table below shows the TACs and landings separated by spawning group and includes 4Vn. The TAC for 4Vn has been included with the fall spawners because 90% of the landings in recent years have been fall spawners. The TAC has been set separately for spring and fall spawners since 1985. The average TAC from 1978 to 1984 for spring and fall spawners combined was 38,000 t with average landings for both groups combined of 37,000 t.

Since 1988, landings of fall spawners have been below the TAC (Fig. 1). In 1995, nearly every area caught 90% or more of their allocation except Fisherman's Bank which caught about 38% of its allocation. Landings were primarily market driven from 1991-1993 when the price for roe herring was 3-4 cents/pound. In 1994, markets improved to 6-8 cents/pound and increased again to 10-12 cents/pound in 1995.

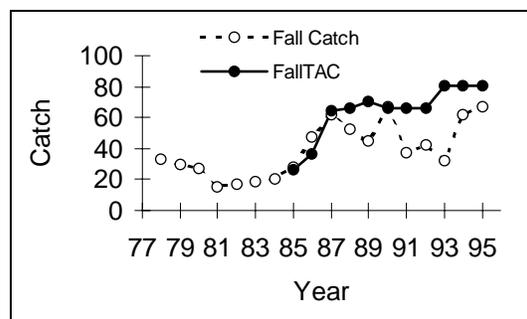
Landings of spring spawners have been close to or above the TAC in the last three years (Fig. 2). Catches in the Chaleur Bay spring inshore fishery have been 1,000 to 1,500 tonnes in 1994 and 1995 compared to an average for 1990 to 1994 of 2,100 tonnes.

**Fall spawner landings (thousands of tonnes)**

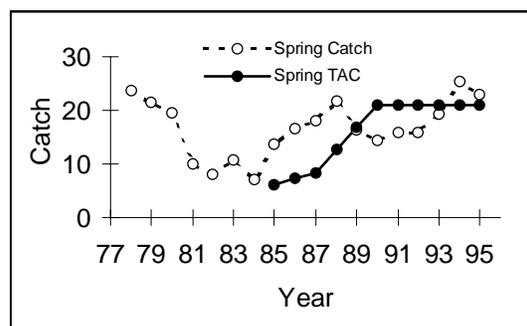
Year	85-91	1992	1993	1994	1995	1996
TAC	61	70	85	85	85	56
Landings	48	42	32	62	66	

**Spring spawner landings (thousands of tonnes)**

Year	85-91	1992	1993	1994	1995	1996
TAC	13	21	21	21	21	17
Landings	17	16	19	25	23	



**Figure 1. Fall spawner TAC and landings (t x 1000)**



**Figure 2. Spring spawner TAC and landings (t x 1000).**

**Biological Data:** The large 1987 year-class was a major contributor to the fall spawner fishery in 1995 for the fifth year. Previous above average year-classes, 1980 and 1983, no longer contribute to the fishery.

The large 1988 year-class was a major contributor to the spring spawner fishery in 1995 for the fourth year. The previous above average year-class, 1982, no longer contributes to the fishery.

Average weights-at-age of spring and fall spawners caught by both inshore and purse seine fleets during the last three or four years are below those observed during the 1980s (Figs. 3,4,5,6). These declines in average weight could be caused by competition during the recent period of high abundance or the result of low productivity in recent years.

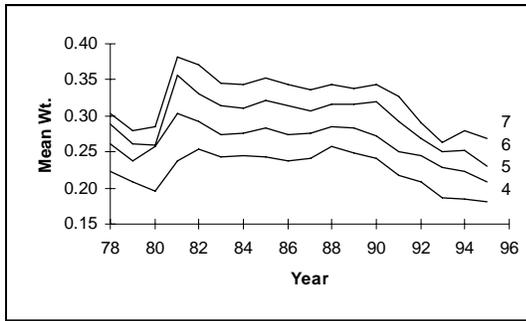


Figure 3. Mean weights for age 4-7 fall spawners.

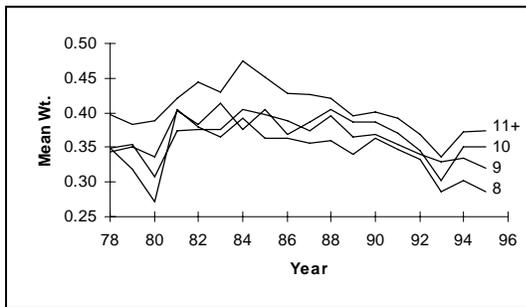


Figure 4. Mean weights at age for age 8-11+ fall spawners.

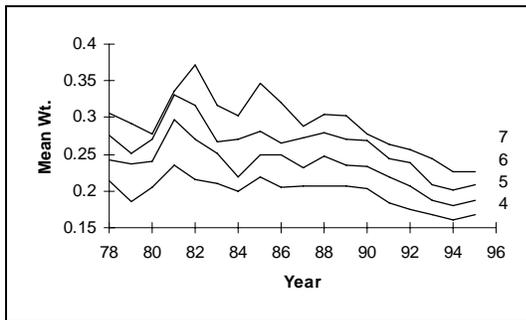


Figure 5. Mean weights at age for 4-7 spring spawners.

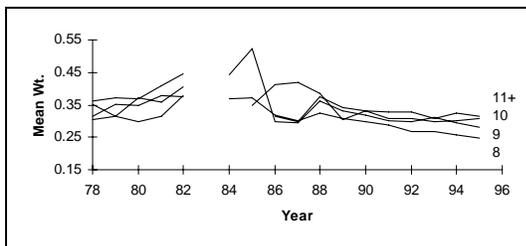


Figure 6. Mean weights at age for 8-11+ spring spawners.

## FALL SPAWNERS

### Resource Status

**Inputs:** Principal inputs for determining abundance of fall spawners are the catch-at-age and the catch rate index from the purchase slips and phone survey. This index is compared to the fall acoustic survey in Chaleur Bay, gillnetter phone survey, and herring biomass estimates from the September bottom trawl survey.

**Catch rates:** Catch rates for fall spawners showed a significant decline from 1994 to 1995 (Fig. 7). Major increases in effort have occurred in the last two years with improved market conditions (Fig. 8).

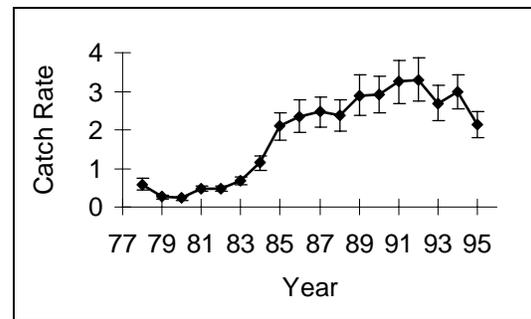


Figure 7. Fall Spawner catch rates (kg/net/trip x 1000).

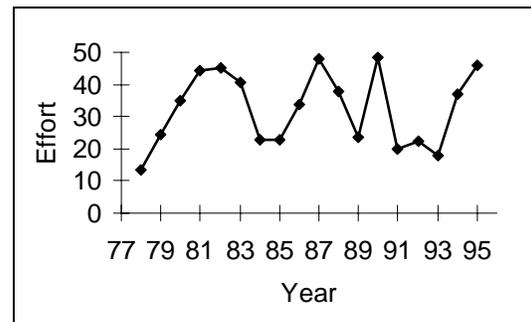
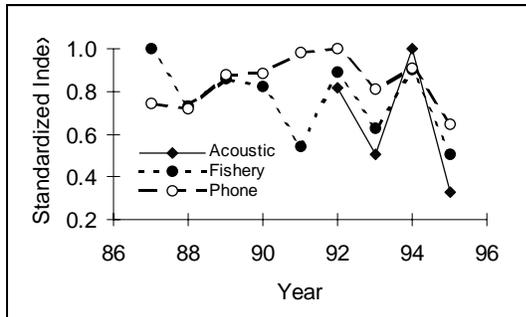


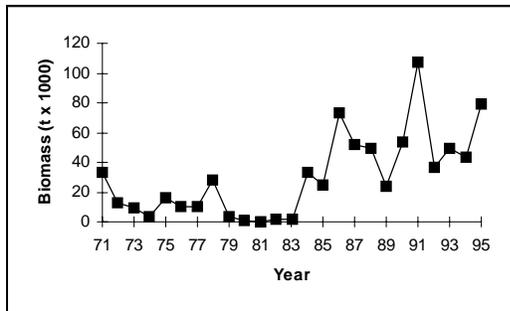
Figure 8. Effort trends in fall gillnet fishery (Nets x Trips x 1000).

**Surveys:** The acoustic survey has concentrated on Chaleur Bay in the last four years during the month of October. Biomass trends from this survey during the last four years correspond well with the catch rate series and the gillnetter phone survey (Fig. 9).



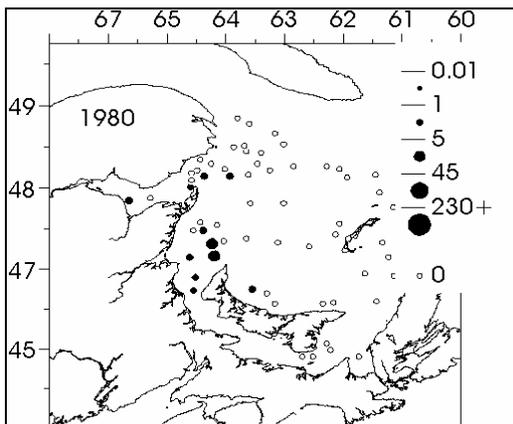
**Figure 9. Comparison of fall spawner survey indices.**

Catch rate indices and biomass estimates from the September bottom trawl survey both suggest that the population abundance was low during the late 1970s and early 1980s but increased rapidly in the mid-1980s to a higher level (Fig. 10).

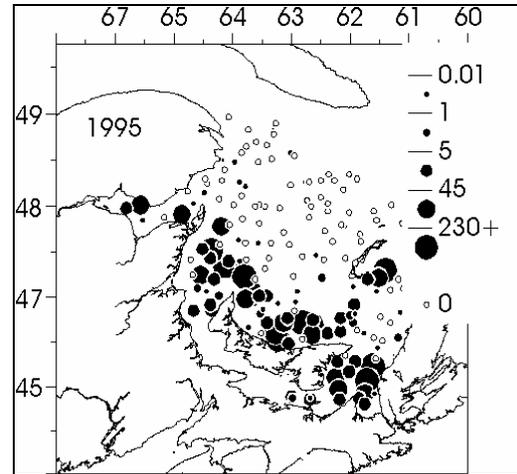


**Figure 10. Herring biomass estimates from September bottom trawl survey.**

Distribution maps from the September bottom trawl survey indicate that herring are widely distributed compared to the early 1980s. Distributions for 1980 and 1995 are typical of the contrasting time periods (Figs 11, 12).

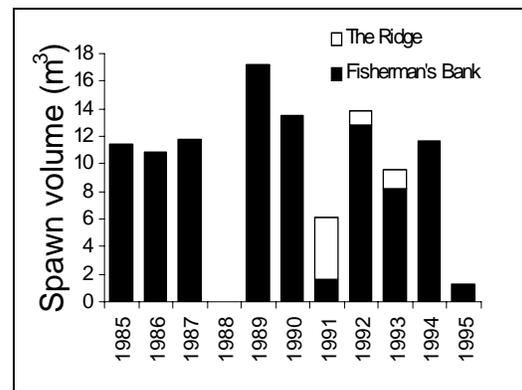


**Figure 11. Distribution of fall and spring herring in the 1980 bottom trawl survey (kg/tow).**



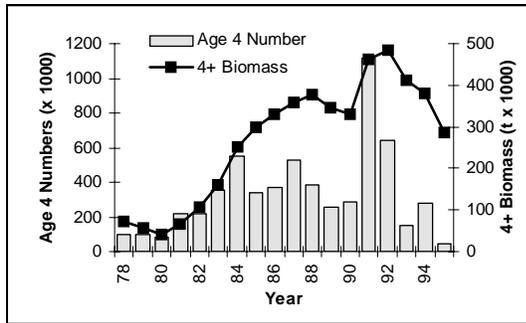
**Figure 12. Distribution of fall and spring herring in the 1995 bottom trawl survey (kg/tow).**

A survey of egg deposition at Fisherman’s Bank indicated that 1995 was the lowest egg deposition since 1985 (Fig. 13). Local gillnetters felt that changes in spawning behaviour, herring spawning deeper and later than usual, would explain the low estimate on the bank. In addition, an area about 2 km east of Fisherman’s Bank known as the Ridge was not surveyed in 1995. In some years, 1991, this area has accounted for a major portion of the spawning activity in the area (Fig. 13).



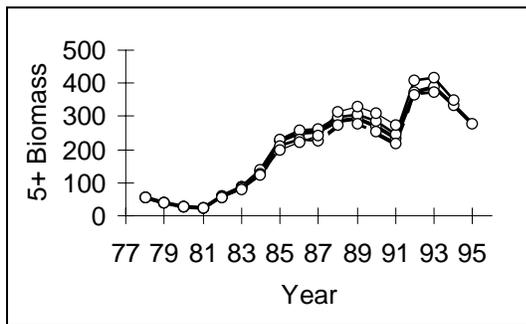
**Figure 13. Estimated egg deposition (x 1000) at Fisherman's Bank.**

**Population Abundance:** Estimated biomass of 4+ fall spawners from the population analysis, using catch rates and catch-at-age, has declined from the peak in 1992 and is now similar to levels in 1985 and 1986 (Fig. 14). The large 1987 year-class reversed a downward trend in biomass when it entered the population in 1991 (Fig. 14).



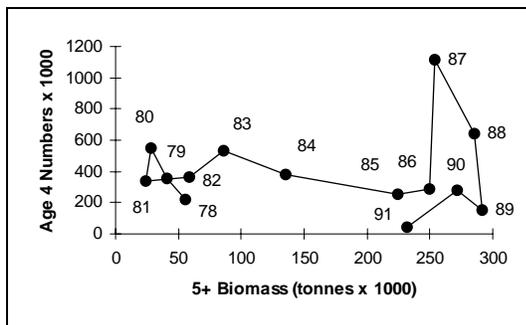
**Figure 14. Trends in fall spawner biomass (x 1000 tonnes).**

Estimates of population abundance have been stable over the past three years for 5+ biomass (Fig. 15). This consistency during the last three years supports the conclusions regarding biomass estimates and  $F_{0.1}$  levels for 1996.



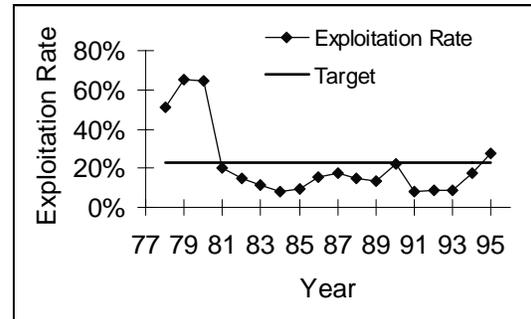
**Figure 15. Changes in 5+ biomass (t x 1000) estimates of fall spawners in the last three years using population model.**

**Recruitment:** There is no predictive relationship between spawning stock biomass (5+ biomass) and four year old recruits (Fig. 16).



**Figure 16. Spawning biomass and recruitment pattern for fall spawners. Spawning year is indicated.**

**Exploitation rate:** The target exploitation rate for fall spawners is an average of 21% for all ages older than 4 years-old. The target was slightly exceeded in 1995.



**Figure 17. Comparison of exploitation rates to the target exploitation rates for fall spawners.**

**Outlook**

**Projection:** The  $F_{0.1}$  TAC for 1996 is 56,000 tonnes and for 1997 is 49,000 tonnes. The 56,000 tonne level is a 34% reduction from the 85,000 tonne TAC in effect from 1993 - 1995. The main reason for the decline in TAC for 1996 is the decrease in importance of the 1987 year-class and below average recruitment of four year-olds to the fishery.

The 56,000 t TAC projected for 1996 is lower than the 66,000 t projection for 1996 made two years ago after the 1994 assessment. The 66,000 t projection was based on the assumption of average recruitment of four year-olds but included information on the declining 1987 year-class. Additional information available in the current assessment indicates that recruitment of four year-olds was below average and is the reason for the additional reduction in  $F_{0.1}$  TAC for 1996.

Similar assumptions apply to the projection for 1997 which may be revised after the assessment of the 1996 fishery in mid-April of 1997.

**Uncertainty:** The major uncertainty associated with the projections is the estimation of four year-olds. Information on this age group is imprecise for projections made two years in the future. When the projection was made in 1994 for the 1996 fishery, it was necessary to assume average recruitment. All surveys and fishery results, however, indicate that the number of four year-olds was below average in 1995. This below average recruitment means that the abundance of five year-olds will be less than expected and supports a reduction in the  $F_{0.1}$  catch calculations for 1996.

**Conservation Issues:** Principal issues raised by the inshore fleet concerning fall spawners were the minimum size limit for purse seiners fishing in the fall and the opening date of the purse seiners in the fall fishery. The inshore concern regarding the minimum size limit was that large numbers of immature fish would be caught by the seiner fleet. The principal concern of the inshore fleet regarding the opening date of the seiner fall fishery was that spawning fish would be caught and interfere with the ability of the inshore fleet to catch roe bearing herring.

Sampling during the fishery indicated that the percentages of immature and spawning fish caught by the seiner fleet were small. With current size regulations less than 3% of the purse seine catch were immature fish.

In 1994, the seiner fleet started fishing in mid-September before the inshore fleet was finished. In 1995, purse seiners started fishing on August 21 shortly after the inshore fleet started fishing. In both these years the catch of spawning fish was less than 6%.

Area differences in stock size trends arose because of two survey results in 1995. The decline in biomass estimates and indications of poor four year-old recruitment in Chaleur Bay from the acoustic survey and egg deposition estimates on Fisherman's Bank that were the lowest since the survey began in 1985.

Concern regarding effort in Chaleur Bay occurs because the purse seiners have concentrated all their fall effort in the bay since 1984. Distributing the fishing mortality among the geographical components of the 4T herring population would reduce this concentration.

Concern for Fisherman's Bank occurs because of the survey results (Fig. 13) but also because the quota has not been caught in recent years. From 1991 to 1995 catches have varied from 1,800 to 3,800 tonnes out of a 10,000 to 11,000 tonne quota. These low catches occurred in 1994, 3,400 t, and 1995, 3,800 t, in spite of good markets in these years when quotas were caught in all other areas of 4T. In contrast to these warning signs are gillnetter reports and distribution of herring in the bottom trawl survey. Gillnetters in the area report spawning in deeper water off the bank and later in the year in 1995 than normal. These eggs would have been missed in the survey. Herring distributions offshore in the September bottom-trawl survey indicate good

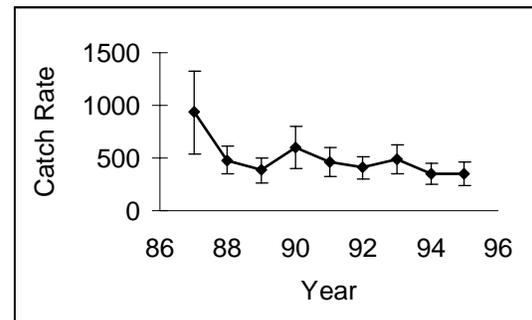
concentrations of herring in the Eastern PEI area (Fig. 12).

## SPRING SPAWNERS

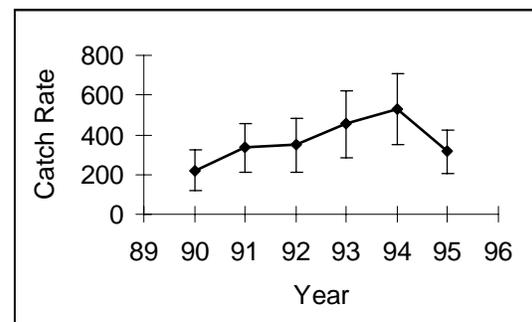
### Resource Status

**Inputs:** Principal inputs for determining abundance of spring spawners are the catch-at-age and the proportion of spring spawners in the population estimated from the acoustic survey. Catch rates from the index gillnetter logbook program and province of New Brunswick data from Escuminac and Southeast New Brunswick, the estimate of number of nets used in the spring gillnet fishery from the telephone survey, and the phone survey results regarding relative abundance were also examined.

**Catch rates:** Catch rates from the index gillnetter program, which covers all of 4T, (Fig. 18) and those derived from data collected by the province of New Brunswick at Escuminac and Southeast New Brunswick (Fig. 19) show no statistical differences from 1990 to 1995. Catches by the purse seiners were lower in the spring of 1995 than in 1994. Comments from the purse seiners on the spring fishery were that the herring were too deep to catch.

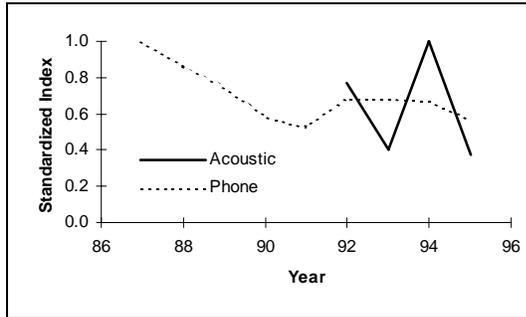


**Figure 18.** Catch rates (kg/net) from spring index gillnetter logbooks (all 4T).



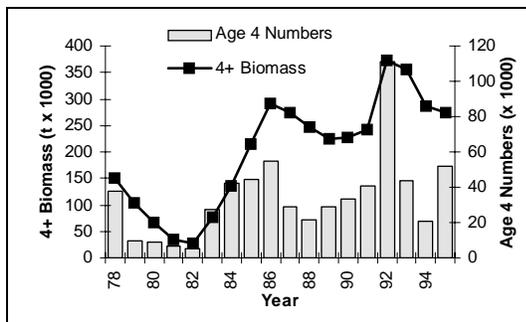
**Figure 19.** Catch rates (kg/fisher/net) using province of New Brunswick data collected at Escuminac and Southeast New Brunswick.

**Surveys:** The acoustic and phone surveys in Chaleur Bay in October indicate a decline in spring spawners in that area from 1994 to 1995 (Fig. 20).



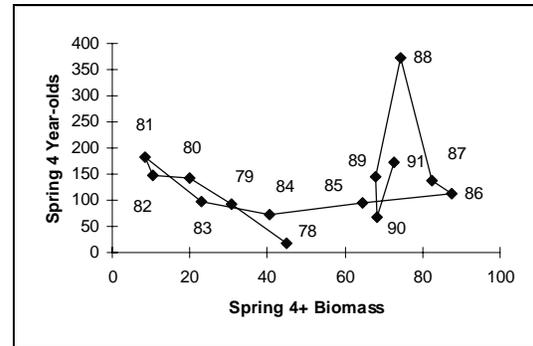
**Figure 20. Comparison of abundance indices for spring spawners in Chaleur Bay.**

**Population Abundance:** Estimated biomass of 4+ spring spawners has declined from the peak in 1992 and like fall spawners is similar to levels observed in the mid-1980s (Fig. 21). The large 1988 year-class which entered the population as four year-olds in 1992 reversed a downward trend (Fig. 21). The low population levels in the late 70s and early 80s and higher levels since 1985 are consistent with September bottom trawl survey results (Figs. 10,11,12).



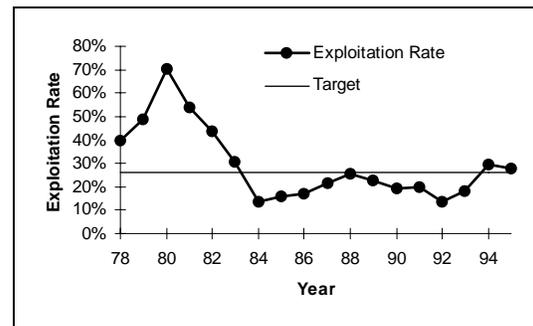
**Figure 21. Trends in spring spawner 4+ biomass and age four numbers.**

**Recruitment:** There is no predictive relationship between spawning stock biomass (4+ biomass) and four year-old recruits (Fig. 22). Like fall spawners, however, the largest year-classes have occurred when spawning stock biomass was high.



**Figure 22. Spawning year and recruitment patterns for spring spawners.**

**Exploitation Rate:** The target exploitation rate for spring spawners is an average of 26% for all ages older than 4 years-old. The target has been slightly exceeded in the last two years (Fig. 23).



**Figure 23. Exploitation rates for spring spawners compared to target exploitation rates.**

**Uncertainty:** The main assumption in the estimate of spring spawners is that the acoustic survey provides an accurate representation of the ratio of spring and fall spawners in the Southern Gulf. The method used to estimate spring spawners does, however, reduce the uncertainty associated with past methods of determining  $F_{0.1}$  TACs for spring spawners. Past  $F_{0.1}$  levels were based exclusively on changes in catch rates using purchase slip data which have been shown to be unreliable input data for abundance indices of spring spawners.

**Outlook**

**Projection:** The  $F_{0.1}$  TAC for spring spawners for 1996 is 17,000 tonnes and for 1997 is 15,000 tonnes. The TAC in 1995 was 21,000 tonnes. The decline in the 1988 year-class is the main reason for the reduction from the 1995 level. The projections for 1996 are similar to the 16,000 tonnes projected using the information available after the assessment of the 1994 fishery.

The projection for 1997 may be revised after the assessment of the 1996 fishery in mid-April of 1997.

**Uncertainty:** Estimates of four year-olds are also the major source of uncertainty in making projections for spring spawners. Estimates of four year-olds in the acoustic survey and the fishery indicate average recruitment for this age group.

***For more information***

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