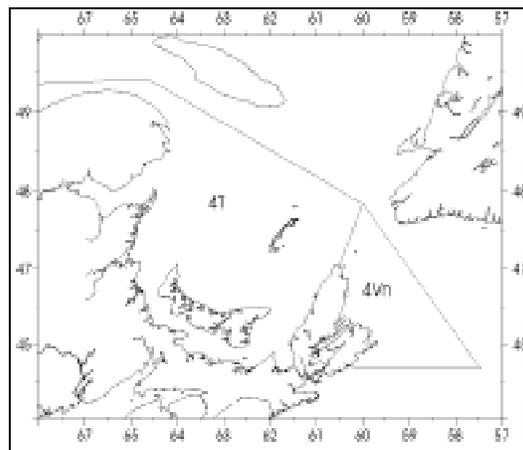


P. Buerschaper  
Scott & Scott 1988

## 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 large 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.

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 be below 24.5 cm fork length.

### The Fishery

While the division of the TAC remained at 77% for the inshore and 23% for the large seiners, several changes in the management of the fishery were made in 1996 compared to 1995. The  $F_{0.1}$  fishing level for fall spawners in 1996 was 56,000 tonnes and 17,000 tonnes for spring spawners. After quota transfers and adjustments, the 1996 fall season allocation was 58,749 tonnes compared to 85,000 tonnes in 1995. The 1996 spring season allocation was 15,114 tonnes compared to 21,000 tonnes in 1995. In 1996, the large seiners were restricted to taking no more than 50% of their fall season 4T allocation within Chaleur Bay and could not start fishing within the bay until September 1. In previous years, large seiners could fish their entire 4T fall allocation within Chaleur Bay and opening dates varied as described below:

Year	Opening Date
1991	September 20
1992	September 21
1993	September 3 (1,000 t in July)
1994	September 13 (suspended Sep. 17-20)
1995	August 15

Additional changes to the large seiner fishery were an experimental, June to August, mid-water trawl fishery in 4T, outside Chaleur Bay, and an increase in the 4Vn allocation from 4200 tonnes to 6423 tonnes. A special management report on the 4Vn fishery can be found in the DFO Maritimes Regional Fisheries Status Report 97/1. In the fall inshore fishery, 16F (Pictou) reduced their nightly boat limit from 20,000 pounds to 15,000 pounds. In addition, dockside monitoring was introduced in all areas of the fall inshore fishery. This monitoring was 100% in all areas except Quebec, where it was 20% monitoring with a 100% hail in system. All other management measures in 1996 were consistent with those in 1995.

#### 1996 FALL FISHERY

Area	Allocation	Landings (t)
<b>INSHORE</b>		
Isle Verte	407	86
Chaleur Bay	20,561	21,381
Escuminac-West	6,950	7,505
PEI		
Magdalen	1,450	1,448
Pictou	7,245	7,754
Fisherman's Bank	7,245	7,608
Roe-on-kelp	300	0
<b>Total Inshore</b>	<b>44,158</b>	<b>45,782</b>
<b>LARGE SEINERS</b>		
Within Chaleur Bay	6,422	6,670
Outside Chaleur Bay	1,746	1,353
4Vn	6,423	4,267
<b>Total L. Seiners</b>	<b>14,591</b>	<b>12,290</b>
<b>Grand Total</b>	<b>58,749</b>	<b>58,072</b>

#### 1996 SPRING FISHERY

Area	Allocation	Landings (t)
<b>INSHORE</b>		
Escuminac	4,550	5,252
Remainder of 4T	6,663	10,646
Bait and Roe all 4T	1,541	198
Quebec Small Seiners	200	0
<b>Total Inshore</b>	<b>12,954</b>	<b>16,096</b>
<b>LARGE SEINERS (All 4T)</b>	<b>2,160</b>	<b>1,907</b>
<b>Grand Total</b>	<b>15,114</b>	<b>18,003</b>

The percentage of spring and fall spawners in the catch varies according to season and gear type. As a result, **landings** during the fall and spring fisheries must be separated into the appropriate spring and fall spawning groups to determine if the TAC for these groups has been caught.

#### Percentage of spring and fall spawners by season and gear type for 1996.

Season	Gear	Spawning Group	
		Spring	Fall
Spring	Fixed	97	3
	Mobile	67	33
Fall	Fixed	2	98
	Mobile	44	56
4Vn	Mobile	17	83

The tables below show the TAC and landings separated by spawning group and include 4Vn. The TAC for 4Vn has been included with the fall spawners because 80% to 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.

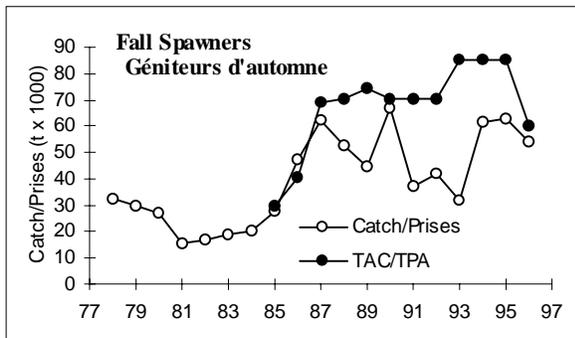
**Fall spawner landings (thousands of tonnes)**

Year	85-92	1993	1994	1995	1996	1997
TAC	62	85	85	85	56	50
Landings	47	32	62	66	54	

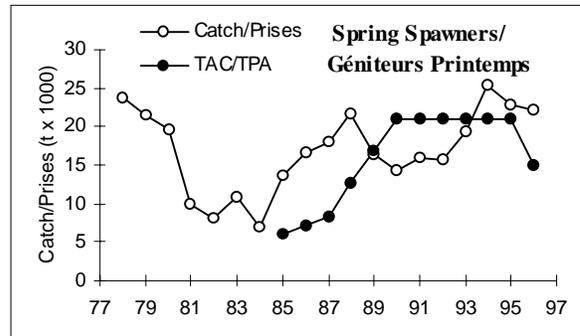
**Spring spawner landings (thousands of tonnes)**

Year	85-92	1993	1994	1995	1996	1997
TAC	14	21	21	21	17	17
Landings	17	19	25	23	21	

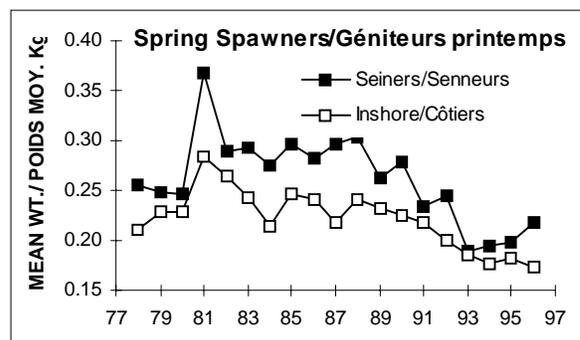
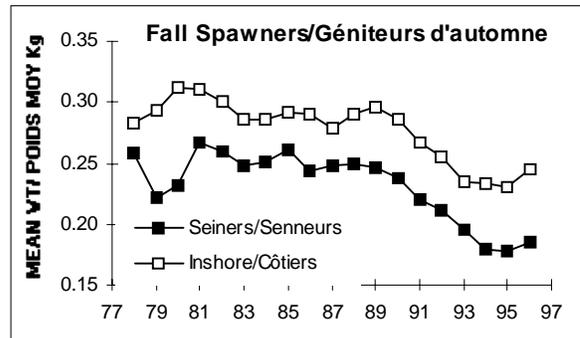
Since 1988, landings of fall spawners have been below the TAC. In 1996, each of the major fishing areas was closed because allocations were caught. Landings are primarily market driven. From 1991-1993 the price for roe herring was 3-4 cents/pound. In 1994, markets improved to 6-8 cents/pound and increased again to 10-12 cents/pound in 1995. In 1996, price increased to 18-20 cents/pound.



Landings of spring spawners have been above the TAC in the last three years. Catches in the Chaleur Bay spring inshore fishery have been below average since 1994.



Average **weights-at-age** of fully recruited fall and spring spawners (age 5) caught by inshore and purse seine fleets since 1990 have been below those observed during the 1980s. The decline in mean weights has not continued in recent years.



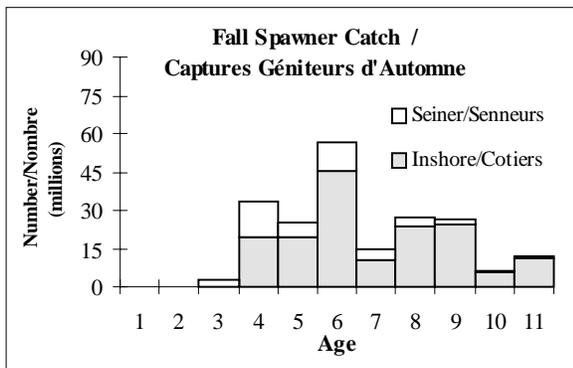
**FALL SPAWNERS**

*Resource Status*

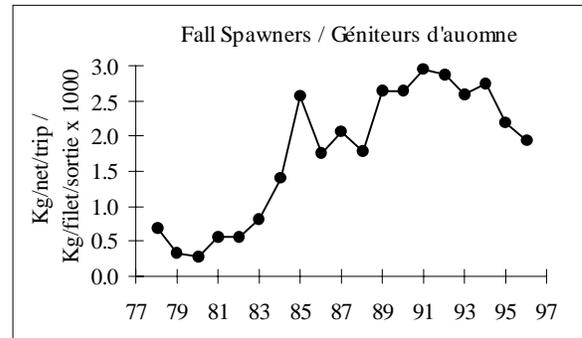
Resource status of 4T fall spawning herring is determined using a population analysis which combines two equally important sources of information: the fishery catch-at-

age and an abundance index determined from catch rates in the inshore fishery.

The 1990 year-class (age 6) was dominant in the 1996 catch of fall spawners. The 1987 and 1988 year-classes which dominated this fishery for many years and were the largest year-classes observed since 1978 are no longer major contributors to this fishery. Thus, because the population now consists primarily of average and below average year-classes, abundance in 1997 is estimated to be lower than in previous years.



The principal **abundance index** used to estimate stock status is the inshore catch rate index determined from purchase slip, dockside monitoring, and a phone survey to determine effort. This index covers the entire inshore fleet and extends from 1978-1996. A modest decline is indicated from 1995 to 1996 with levels in 1996 approaching those of the mid 1980s but still well above the lowest periods during the late 1970s and early 1980s.



Industry expressed several concerns with the catch rate index in 1996. These were: that the shortened season would lower catch rates because the season was closed during the peak fishing time, increased nightly effort would reduce catch rates because of boat interference, increased effort from inexperienced gillnetters would reduce catch rates, and lower nightly limits in one area, 16F (Pictou), may be the reason for the decline in 4T catch rates.

The effects of a shortened season on catch rates was examined by cutting off the 1978 to 1995 catch rate series in each area according to the date it closed in 1996. The catch rate series was then re-calculated with these shortened dates in all areas. No differences were found between trends for the shortened season and full-season time series. In all areas, the 1996 fall seasons were closed after the date when, on average, 50% of the catch occurred. In 16F (Pictou) and 16G (Fisherman's Bank) they were closed after the dates when 87.5% of the catch occurred on average.

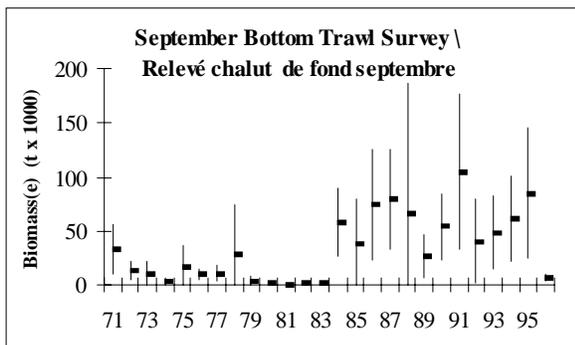
The effect of increased effort was examined by comparing catch rate and effort levels for periods of low, medium, and high abundance. These comparisons indicated there was no relationship between the index and effort levels.

The effect of inexperienced gillnetters on catch rates was examined by comparing

catch rates of participants in a voluntary logbook program from 1987 to 1996 with the catch rates used to estimate stock status. Lower catch rates from 1995 to 1996 were observed in both these data sets.

The effect of lowering the nightly limit in Pictou on catch rates for all of 4T was examined by setting all 1995 Pictou catches above 15,000 pounds to 15,000 pounds and re-calculating 4T catch rates for 1995. In 1995, 47% of the Pictou catches were above 15,000 pounds and in 1996, 50% were at or above 15,000 pounds. A 1% difference in 1995 catch rates was observed in this analysis.

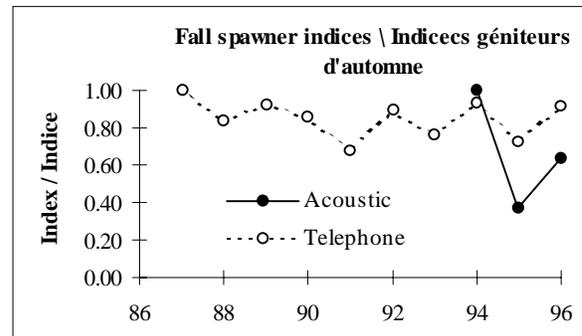
Mixed signals were observed among the inshore catch rates and other indices of abundance. Herring biomass estimates from the September bottom trawl survey were significantly lower than recent years. The bottom trawl survey has not yet been examined separately for spring and fall spawners and its ability to track year-classes.



Abundance of fall spawners in the acoustic survey was above 1995 but below 1994. The acoustic survey has only recently been standardized for vessel and time of year and in the past has concentrated primarily in Chaleur Bay.

Opinions of abundance collected during the phone survey were that abundance in 1996 was greater than 1995. Information was

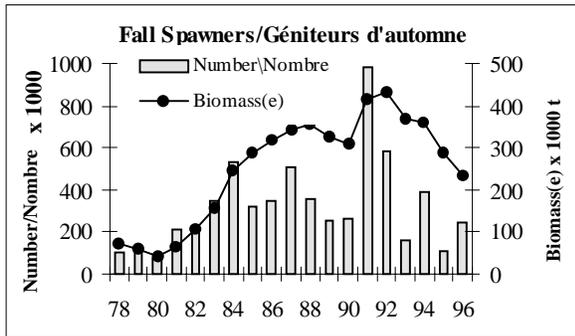
collected from a spawning bed survey at Fisherman's Bank but analysis is not yet complete.



Fixed gear catch rates were chosen as the most reliable indicator of abundance over time because their collection and evaluation has been the most consistent. Tests of interpretation regarding stock trends have been most extensive with these data and they have been found to be a robust indicator of stock abundance trends. Reasons for this robustness are the contrast in effort levels at low, medium, and high stock abundance. Catch rates have been measured at low abundance with both high and low effort and at high abundance with high and low effort. In addition, the measure of effort does not depend solely on the number of boats or trips made but incorporates the number of nets used to make the catch on a particular night. Trends in catch rates also match those observed from tracking strong and weak year-classes in the fishery.

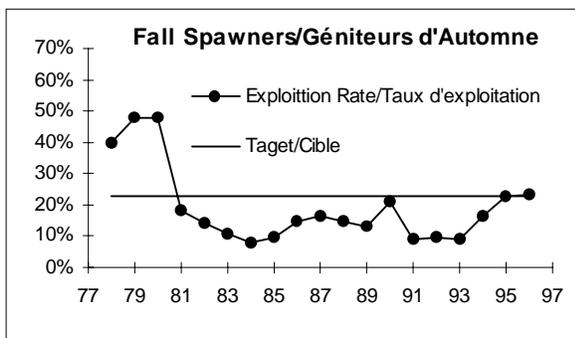
**Population Abundance** of 4+ fall spawners from the ADAPT population analysis, using catch rates and catch-at-age, has declined from the peak in 1992 and is now similar to levels in 1984. The large 1987 year-class reversed a downward trend in biomass when it entered the population in 1991. The strength of the 1989 and 1991 year-classes are among the lowest on record, and the 1992 year-class appear to be slightly below

average. Recruitment, as millions of age 4, and age 4+ biomass are shown below:



This decline in biomass is consistent with the less abundant incoming year-classes and the decline of previous very large 1987 and 1988 year-classes. The 1996 estimate is consistent with the projection made in 1995 for the 1996 population. In general, estimates of population abundance are consistent from year to year and do not indicate a trend to over- or under-estimate stock size.

The target **exploitation rate** for fall spawners is on average 23% for all ages older than 4 years-old. The target was met in 1995 and 1996.

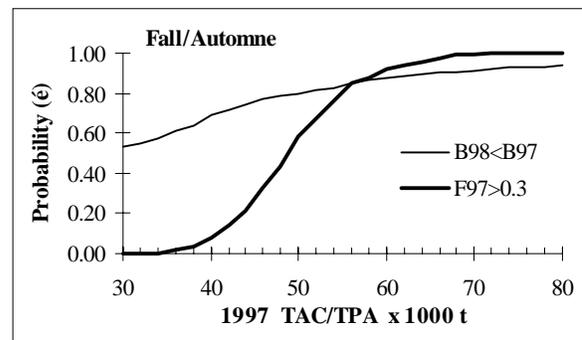


Major sources of **uncertainty** are the mixed signals from the various indices and the industry opinion relative to the inshore catch rates. The degree to which activities in the fishery may affect catch rate indices that may not be detectable by the analyses completed are an additional source of uncertainty.

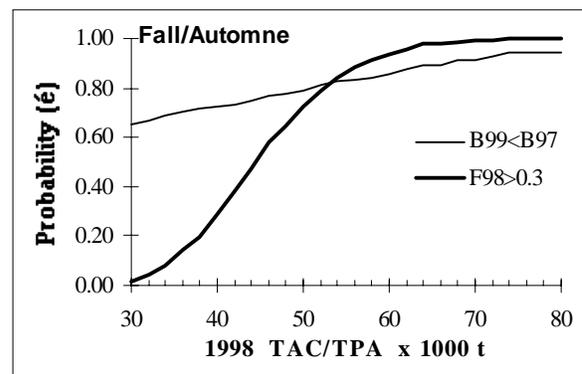
**Outlook**

The **F<sub>0.1</sub> fishing level for 1997** is 49,000 tonnes and for 1998 is 45,500 tonnes. The 49,000 tonne level is within plus or minus 5% of the 50,000 tonne level projected for 1997 in the assessment of the 1995 fishery. The 45,500 tonne level for 1998 represents a 7% reduction from 1997 F<sub>0.1</sub> fishing level of 49,000 tonnes.

A risk analysis for 1997 indicates that biomass is likely to decline in 1998 regardless of the TAC. The 1997 TAC for which there is a 20% probability that the target fishing mortality will be exceeded is 44,000 tonnes.



A risk analysis for 1998 indicates a similar declining trend for biomass regardless of TAC. The 1998 TAC corresponding to a 20% probability that the target fishing level will not be exceeded is 38,000 tonnes.

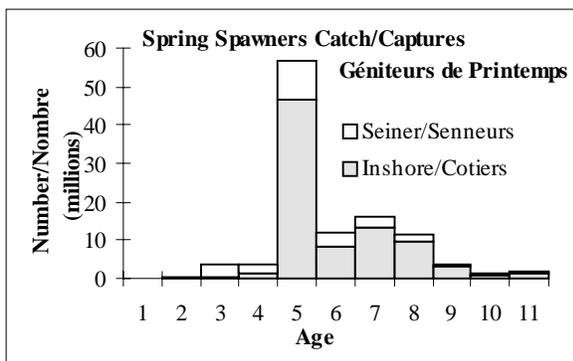


## SPRING SPAWNERS

### Resource Status

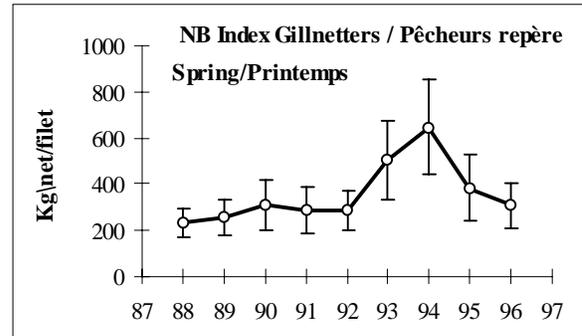
Resource status of 4T spring spawners is determined in a manner similar to 4T fall spawners. A population model which combines the age of herring caught in the fishery with an abundance index is used. Overall, the data set used for the spring spawners is not as good as for fall spawners. Thus, there is a higher degree of uncertainty for spring compared to fall spawners. This higher uncertainty influences the analytical results for spring spawners.

The 1991 year-class (age 5) was dominant in the 1996 **spring spawner catch**. The previously dominant 1988 year-class is no longer a major contributor to this fishery. The decline of this year-class and the apparent weakness of the 1992 year-class indicates that abundance is declining from earlier higher levels.

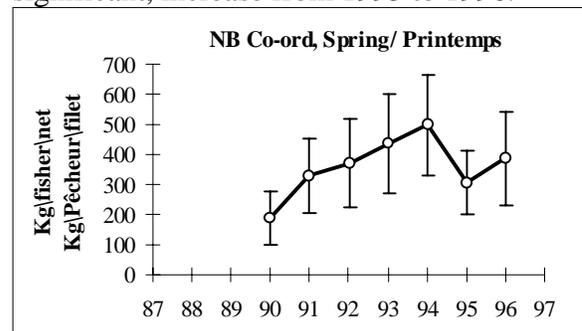


The **abundance** index used to estimate stock size is based on catch rates using index gillnetters from Escuminac and Southeast New Brunswick. These inshore gillnetters participate in a voluntary program which provides detailed information on fishing locations, amounts caught, and number of nets used. The data from 1988 to 1996 from

this program were used. Data from the first year, 1987, were not used because of low participation. A slight, although not statistically significant, decline from 1995 to 1996 is indicated by these catch rates.



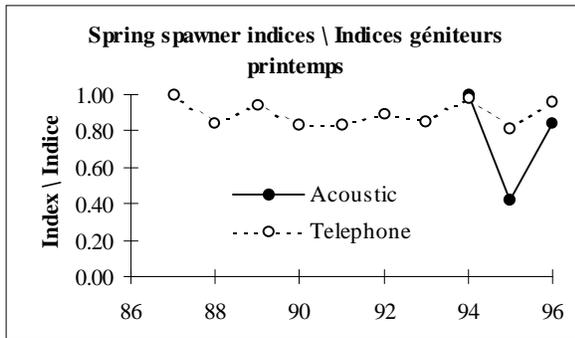
A second catch rate index from New Brunswick is available for 1990 to 1996. These data are collected by an individual checking catches as they are landed and sold to the plants at Escuminac and Southeast New Brunswick. The number of fishers active each day is recorded. Effort is the average number of nets used in each area as determined by the phone survey. These catch rates indicate a slight, but not statistically significant, increase from 1995 to 1996.



Common features of these two indices are increases from 1992 to a common peak in 1994, with values for 1995 and 1996 less than 1994.

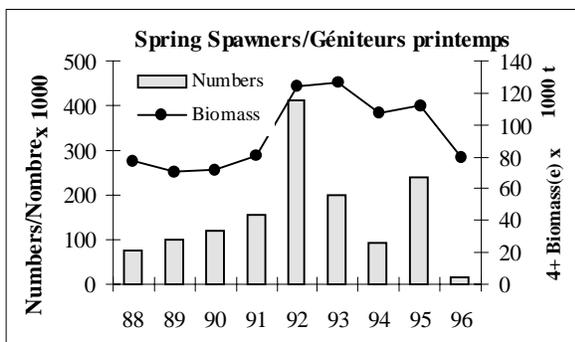
Some mixed signals also appear among these and other abundance indices for spring spawners. The September bottom trawl survey is very low for 1996 (see fall spawners) and the acoustic index for spring

spawners in Chaleur Bay is above 1995 but still slightly below 1994. The phone survey index indicates a mixed opinion in abundance trends among areas with an overall slight increase.



The spring gillnetter abundance index was chosen as the most reliable indicator of abundance over the time period analyzed. Previous analyses comparing this index to purchase slip data have shown them to be more indicative of activity in the fishery than purchase slips.

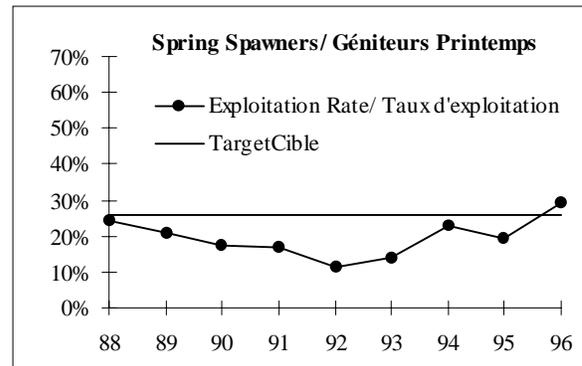
**Population Abundance** of 4+ spring spawners has declined from the peak in 1992 and is similar to levels observed in the late 1980s. The 1991 year-class appears to be above average but the 1990 and 1992 year-classes appear to be below average. The 1992 year-class is the lowest observed since 1988.



The decline in 4+ biomass is consistent with the low estimate of the 1992 (age 4) year-

class and the low numbers of this year-class in the fishery.

The target **exploitation rate** for spring spawners is on average 26% for all ages older than 4 years-old. The target was slightly exceeded in 1996.



The major source of uncertainty in the estimation for spring spawners is the new approach which uses the ADAPT-VPA framework. This year is the first year that this framework has been successfully fitted using an abundance index. The consistency of estimation is not as robust as for the fall spawners and there is a tendency to over-estimate biomass using this method. One reason for this may be the short time series. These considerations underscore the higher uncertainty associated with this analysis compared to the fall analysis.

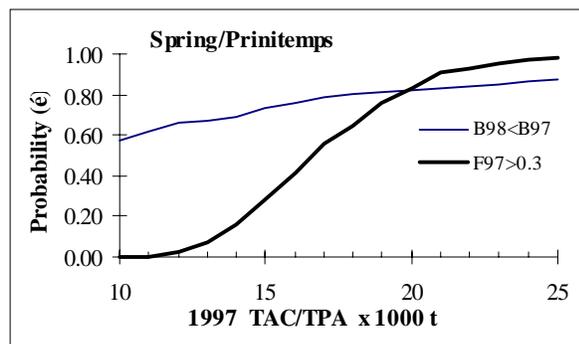
This analysis provided a result similar to the method used in previous assessments, which used the proportion of spring and fall spawners in the acoustic survey to estimate biomass using a simple VPA method. The main assumption in the estimate of spring spawners using this method was that the acoustic survey provides an accurate representation of the ratio of spring and fall spawners in the Southern Gulf. Past  $F_{0.1}$  levels were based exclusively on changes in catch rates using purchase slip data, which

have since been shown to be an unreliable index of abundance for spring spawners.

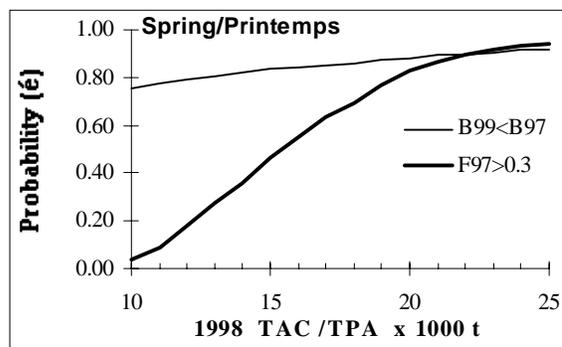
### Outlook

The  $F_{0.1}$  fishing level for spring spawners for 1997 is 16,500 tonnes and for 1998 is 15,000 tonnes. The 16,500 is 6% greater than the 15,500 tonne  $F_{0.1}$  fishing level for 1997 based on the assessment of the 1995 fishery. The 15,000 tonne level for 1998 would be a 10% drop from the 16,500 tonne level advised for 1997.

A risk analysis for 1997 indicates that biomass is likely to decline regardless of the 1997 TAC. The 1997 TAC at which there is a 20% probability that the target fishing mortality will be exceeded is 14,400 tonnes.



A risk analysis for 1998 indicates that biomass will continue to decline from 1998 to 1999 regardless of TAC. The TAC that corresponds to a 20% probability that the target fishing level will not be exceeded is just over 12,000 tonnes.



### For more information

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### References

- Claytor, R.R., C. LeBlanc, A. Sinclair, G. Poirier, and L. Paulin. 1997. Assessment of the NAFO Division 4T Atlantic herring stock, 1996. DFO Canadian Stock Assessment Secretariat Res. Doc. 97/30.
- Anon. 1997. Decision rules for managing overwintering fisheries. DFO Maritimes Regional Fisheries Status Report 97/1.

This report is available from the:

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