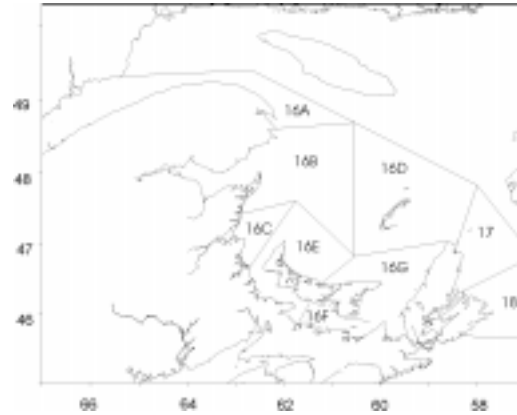


Southern Gulf of St. Lawrence Herring



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 active seiners (>65'). These 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.

Summary

Fall Spawners

- Reported 1997 landings of fall spawners were 43,156t compared to the fall spawner TAC of 50,000t.
- Inshore catch rates increased from 1996 to 1997.
- A new method used in this assessment was to divide the abundance index into two time periods to reflect increases in gillnet mesh size since 1992.
- This method changed the view of the two most recent year-classes (1992, 1993) from projections made in last years assessment from slightly above average and average to two of the strongest year-classes since 1978.
- The most recent year-class (1993, 4 year-olds) were 40% and 5 year-olds were 32% of the 350,000t estimated age 4+ biomass in 1997.
- The $F_{0.1}$ fall spawner fishing level for 1998 is 66,000t, which is 46% higher than the 45,000t projected in last year's assessment. The preliminary projected $F_{0.1}$ level for 1999 is 60,000t.
- The 1993 year-class comprises 38% of the 66,000t $F_{0.1}$ 1998 fishing level. Given the present age structure and the uncertainty of the size of the 1993 year-class fishing below $F_{0.1}$ in 1998 would be prudent.

Spring Spawners

- Reported 1997 landings of spring spawners were 16,531t compared to a TAC of 16,500t.
- The abundance index used to estimate population size was inshore catch rates from the New Brunswick market co-ordinator program prior to 1997 and the 1997 dockside catch monitoring program in Escuminac, NB and Southeast NB.
- This abundance index indicates an increase in catch rates from 1996 to 1997.
- The time-series for the spring abundance index is not as long as for the fall spawners and there is greater uncertainty in the spring than the fall assessment.
- The 1991 year-class is dominant in the population at this time; the incoming 1993 year-class was below average, and age 4+ spring spawner biomass was 70,000t in 1997.
- The $F_{0.1}$ fishing level for 1998 is 16,500t equivalent to 1997 and 10% above the 15,000t projected for 1998 from last year's assessment.

The Fishery

The allocation of the southern Gulf of St. Lawrence TAC remained at 77% for the inshore and 23% for the seiners (>65') in 1997. The $F_{0.1}$ fishing level for fall spawners in 1997 was 50,000t, compared to 58,749t in 1996. The $F_{0.1}$ fishing level was 16,500t for spring spawners compared to 15,114t in 1996. As in 1996, the seiners were restricted to taking no more than 50% of their fall season 4TVn allocation within Chaleur Bay in 1997. In addition, they could not start fishing within the bay until September 1. The seiner 4Vn allocation was 4,200t.

In the fall inshore fishery, dockside monitoring, implemented in 1996, was continued in all areas. This monitoring was 100% in all areas except Quebec, where it was approximately 80% with a 100% hail in

system. A two-day weekend closure was also implemented in all areas except 16A and 16D. In the spring inshore fishery, there was approximately 20-25% monitoring with a 100% hail in system.

1997 FALL FISHERY (Statistics Branch)

Area	Allocation	Landings (t)
INSHORE		
Isle Verte	172	17
Chaleur Bay	17,527	16,540
Escuminac-West PEI	5,936	5,977
Magdalen	1,018	163
Pictou	6,200	6,218
Fisherman's Bank	6,160	6,132
Quebec Small Seiners	550	240
4Vn	169	0
Total Inshore	37,732	35,287
SEINERS (>65')		
Within Chaleur Bay	5,734	5,669
Outside Chaleur Bay	2,334	134
4Vn	4,200	3,665
Total Seiners	12,268	9,468
Grand Total	50,000	44,755

1997 SPRING FISHERY (Statistics Branch)

Area	Allocation	Landings (t)
INSHORE		
Escuminac (Jan-May)	4,326	2,997
Rest of 4T (Jan-May)	7,549	8,826
Bait and Roe all 4T	1,300	1,607
Quebec Small Seiners	200	0
4Vn	133	0
Total Inshore	13,508	13,430
SEINERS(>65') (All 4T)	2,992	1,502
Grand Total	16,500	14,932

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 1997

Season	Gear	Spawning Group	
		Spring	Fall
Spring	Fixed	99	1
	Mobile	85	15
Fall	Fixed	1	99
	Mobile	28	72
4Vn	Mobile	4	96

The tables below show the TAC and landings separated by spawning group and include catches in the 4Vn overwintering fishery. The allocation for 4Vn has been included with the fall spawners because a minimum of 83% of the landings since 1992 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 38,000t with average landings for both groups combined of 37,000t.

Fall spawner landings (000s of t)

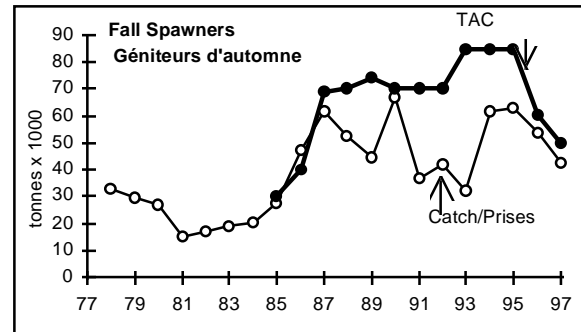
Year	85-93	1994	1995	1996	1997
TAC	64	85	85	56	50
Landings	46	62	66	54	45

Spring spawner landings (000s of t)

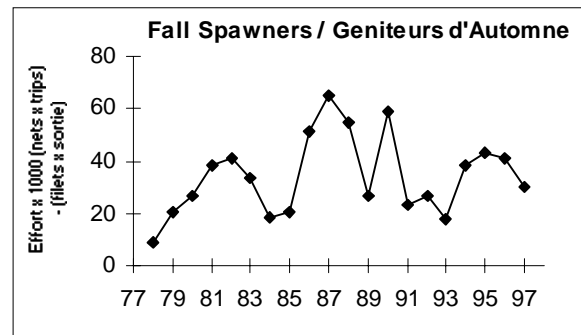
Year	85-93	1994	1995	1996	1997
TAC	15	21	21	17	17
Landings	17	25	23	21	15

Since 1988, landings of fall spawners have been below the TAC. In 1997, each of the major fishing areas except 16A and 16D were closed because allocations were caught. Landings are primarily market driven. The primary market for the inshore fleet, which has 77% of the allocation, is the roe market. From 1991-1993, the price for roe herring was 3-4 cents/pound. In 1994, markets improved to 6-8 cents/pound and increased

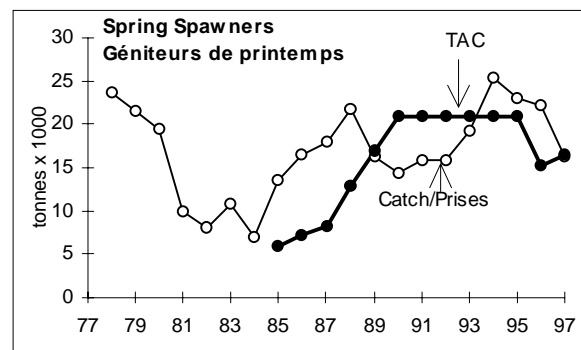
up to 18-20 cents/pound in 1996. In 1997, the price decreased to 6-8 cents/pound.



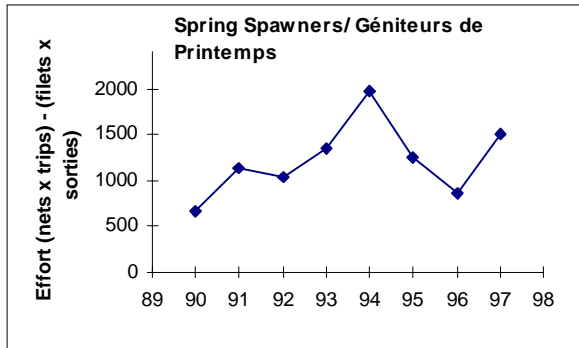
Effort levels in 1997 were similar to those in the early 1980s and below high levels in 1987 and 1990.



Landings of spring spawners have been above the TAC from 1994 to 1996, and were close to the TAC in 1997. The market for the spring fishery is different from the fall fishery. Spring herring caught by the inshore fleet are sold primarily for bait and to the bloater markets. There is a small experimental fishery for roe-on-kelp in Escuminac. This fishery uses a trapnet to catch spawning herring in June.



Effort increased in the 1997 fishery from 1996 but was below peak levels in 1994.

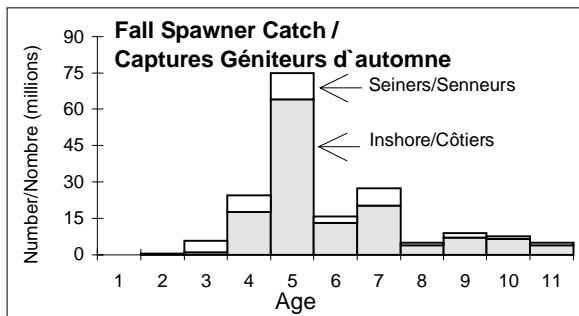


FALL SPAWNERS

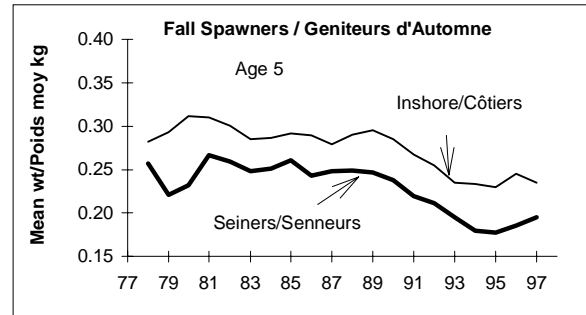
Resource Status

Resource status of 4T fall spawning herring is determined using a population analysis which combines two sources of information: the fishery catch-at-age and an abundance index determined from catch rates in the inshore fishery.

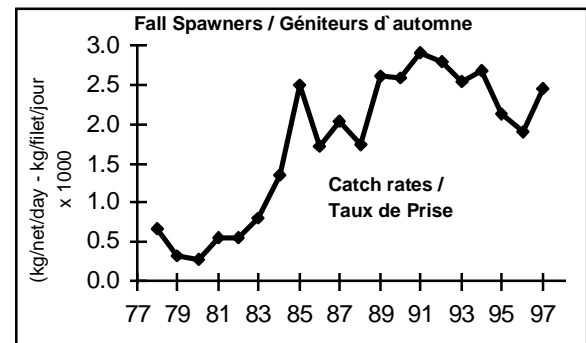
The 1992 year-class (age 5) was dominant in the 1997 **catch** of fall spawners.



Average **weights-at-age** of age 5 fall spawners caught by inshore and purse seine fleets since 1990 have, like most other ages, been below those observed during the 1980s. This decline in mean weights has stopped and they have started to increase in most ages.



The **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 to 1997. Catch rates in 1997 were above 1995 and 1996 but slightly below the 1989 to 1994 rates.



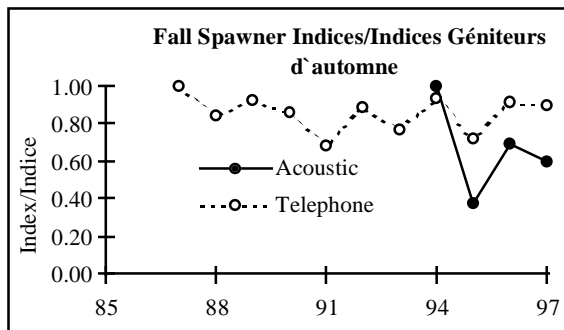
Catch rates increased in each area from 1996 to 1997 but trends among areas have differed over time. For example, Escuminac, Chaleur Bay, and West Prince Edward Island form one group of similar trends in catch rates, while Eastern Prince Edward Island and Pictou form a second group of similar catch rate trends. Trends in catch rate are different between these two groups. Changes in timing of catches are not similar amongst areas. For example, a late year in one area does not mean that it is late everywhere.

Analyses of age structure by area indicated that dominant year-classes were similar in all major areas of the southern Gulf of St. Lawrence fishery from 1995 to 1997. Mean

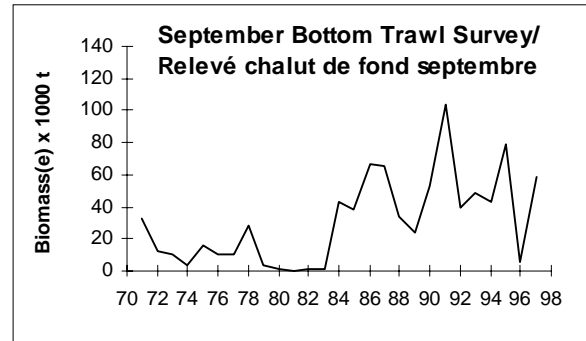
weights-at-age were also similar among all areas and the declining trends observed in the overall stock were seen in each area.

Three other abundance indices are used to provide information on population trends for southern Gulf of St. Lawrence herring. These are an acoustic survey of the southern Gulf of St. Lawrence, a phone survey of gillnetter's opinions of abundance, and, the herring biomass index (fall and spring spawners combined) from the September bottom trawl survey.

The **acoustic survey** fall spawner biomass index, for years in which the same strata were surveyed (1994-1997), and opinions of abundance collected during the **phone survey** for fall spawners indicate little change from 1996 to 1997. These indices have followed the same trends for the past four years.



The **bottom trawl survey** has not yet been examined separately for spring and fall spawners or its ability to track year-classes. It does, however, indicate general overall agreement with the catch rate indices. The low stock levels during the late 70s and early 80s and the rebuilding to current levels in the mid 80s are indicated by both indices.



The Fisherman's Bank **spawning bed survey**, on the east coast of Prince Edward Island, does not seem to be a good indicator of abundance trends or year-class strengths at the present time.

Key indicators for Chaleur Bay, which were very low in 1995 showed mixed signs of improvement in 1997. Catch rates in 1997 have returned to 1995 levels but are still below previous levels. Spring spawner abundance indices from the acoustic survey are higher than previous years but fall spawner abundance indices are not. The age structure of the Chaleur Bay population resembles the remainder of 4T.

Two analyses were completed for fall spawners to estimate population abundance. The first, was identical to last year and indicated a break in the time-series where there was a tendency to estimate new year classes, observed for the first time as 4 year-olds, lower in the current year of the assessment than in subsequent years. This break was also coincident with a trend for some areas of the southern Gulf gillnet fishery to use larger mesh sizes.

A second and new analysis incorporated the changes in mesh size by splitting the abundance index into two time periods. The time periods were (1978-1991), when a greater percentage of the fleet used 2 5/8" mesh compared to the more recent time period (1992-1997), when an increasing

percentage of gillnetters have been using 2 3/4" mesh.

Percentage of 2 5/8" mesh used in fall gillnet fishery.

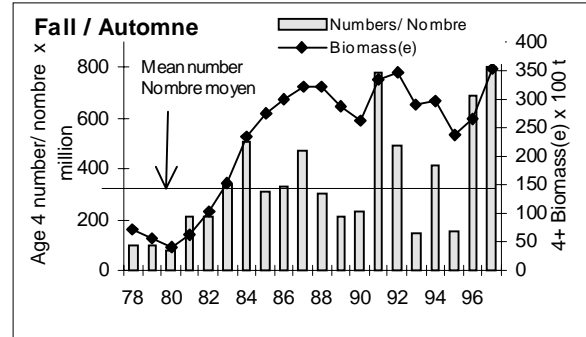
Year/ Année	Percentage
86	75
87	92
88	91
89	89
90	81
91	79
92	67
93	61
94	60
95	54
96	58
97	57

The new analysis removed the tendency to estimate new year-classes lower in the current assessment years than in subsequent years. The major difference between these two analyses was the 1997 estimate for the incoming 1993 year-class (4 year-olds).

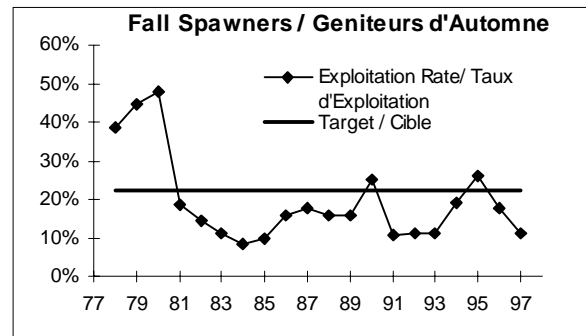
A comparison was completed using both analyses for 1995 and 1996. Estimates of age 4+ biomass were similar for these two analyses. In addition, an examination of several statistical criteria indicated that overall the second analysis was superior to the first. The age structure for 1997 from the new analysis was also consistent with a high percentage of four year-olds in the acoustic survey, with the observations by the seiner fleet of large numbers of releases of small fish, and with ages observed in experimental small mesh gillnets fished in the Northumberland Strait. The population estimate from the new analysis is provided below and formed the basis for calculations of $F_{0.1}$ fishing levels for 1998 and 1999.

Population Abundance of age 4+ fall spawners in 1997 was similar to 1991 when

the 1987 year-class entered the fishery. Three of the last four year-classes (1990 to 1993) are above average. This increase in biomass in 1997 is the result of the 1993 year-class being estimated as the largest in the time series. The 1997 fall spawner age 4+ biomass estimate was 350,000t.



The target **exploitation rate** for fall spawners is 22% on the age 4+ biomass. The age 4+ fishing mortalities have been below the target exploitation rate for each year since 1981 except for 1990 and 1995.

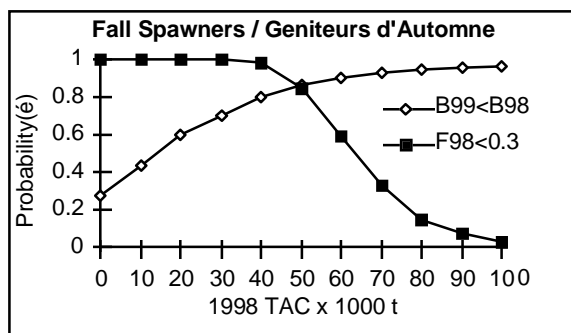
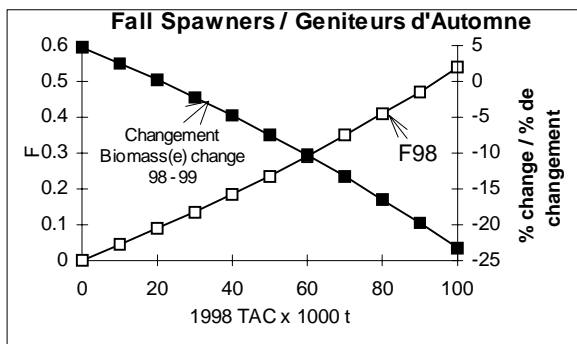


This year is the first time that the analysis accounting for increasing mesh size has been used in the assessment. It is also the first time that the 1993 year-class, which represents 40% of the estimated age 4+ biomass has been observed. As a result, a major source of **uncertainty** in the assessment is that the 1993 year-class is the largest since 1978 and that it is being observed for the first time.

Outlook

The $F_{0.1}$ fishing level for 1998 is 66,000t and the preliminary estimate for 1999 is 60,000t. The 66,000t is an increase over the projected 45,500t for 1998 based on the 1996 assessment of the fishery. The 60,000t for 1999 would represent a 10% reduction from the 1998 $F_{0.1}$ fishing level.

A risk analysis indicates that the TAC at which biomass can be expected to remain stable from 1998 to 1999 is about 20,000t. At a TAC of 66,000t the biomass has a greater than 80% probability of decline from 1998 to 1999. The probability that fishing mortality will be below the target for fully recruited ages declines sharply at TACs over 40,000t.



The 1993 year-class accounts for 40% of the age 4+ biomass estimate and changes in relative strength of this year-class in subsequent assessments will have a major effect on future $F_{0.1}$ fishing levels. Given the present age structure and the uncertainty

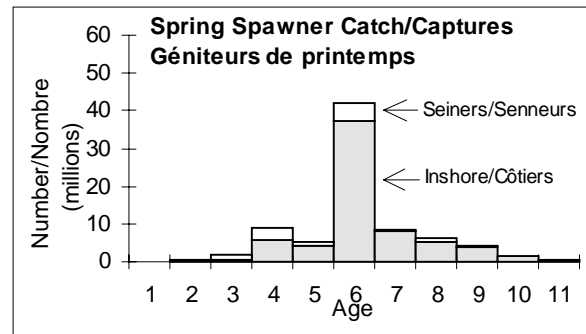
regarding the size of the 1993 year-class, fishing below $F_{0.1}$ in 1998 would be prudent.

SPRING SPAWNERS

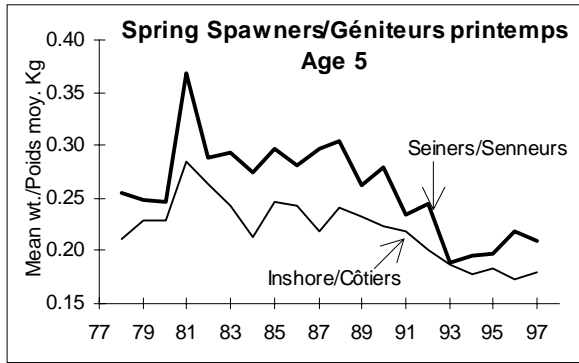
Resource Status

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 long 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.

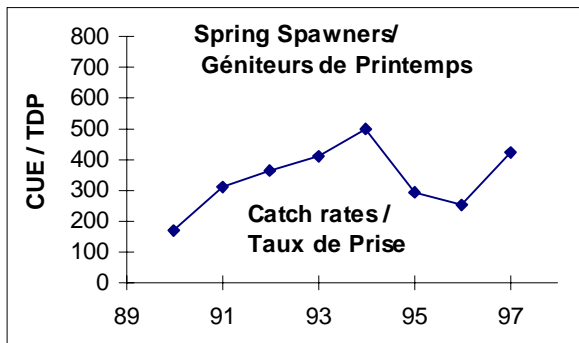
The 1991 year-class (age 6) was dominant in the 1997 **spring spawner catch**. The previously dominant 1988 year-class is no longer a major contributor to this fishery.



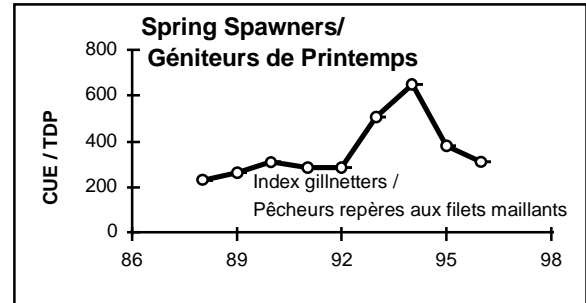
Average **weights-at-age** of age 5 spring spawners caught by inshore and purse seine fleets since 1990 have, like most other ages been below those observed during the 1980s. This decline in mean weights has stopped and they have started to increase in most ages.



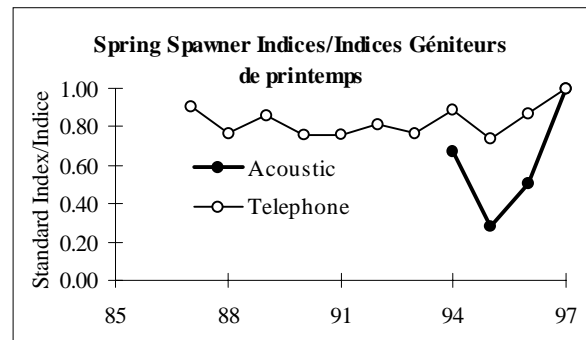
Catch data for the **abundance** index was obtained from the New Brunswick market co-ordination program from 1990 to 1996 and from the catch monitoring program in 1997. The market co-ordinator program operated in conjunction with the Maritime Fishermen's Union. Co-ordinator's data were collected by individuals checking sales to plants and recording the number of gillnetters fishing and their landings on a daily basis in Escuminac and Southeast New Brunswick. The catch monitoring data was collected as described above with 100% hauls of which 20 to 25% were verified at dockside. The difference between the hauls and the verifications was about 3% on average and the data from all the hauls were used to estimate catch rates. Effort is the average number of nets used in each area as determined by the phone survey. Catch rate was defined as kg/net/day. The 1997 catch rate developed from the catch monitoring programs was higher than the 1995 and 1996 values, and close to the 1994 index.



This index shows similar trends to the index developed from the volunteer gillnetter logbook program used in the previous assessment. A lack of participants in the logbook program in 1997 precluded its use as an index in this assessment.

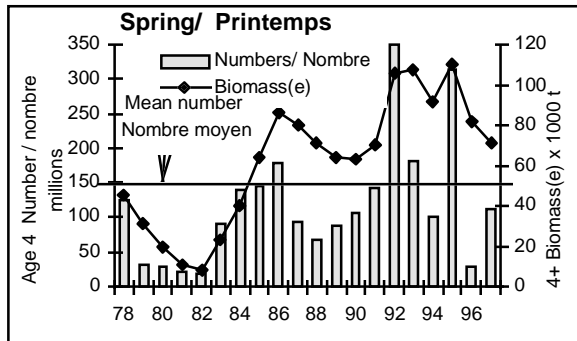


The **other abundance indices** for spring spawners seem to follow similar trends since 1994. Abundance of spring spawners age 4+ biomass in the 1997 acoustic survey for years in which the same strata were surveyed (1994-1997) in Chaleur Bay was higher than previous years. Opinions of abundance, reported during the phone survey, in the two areas (Escuminac and Southeast New Brunswick) used in the catch rate index were that abundance was greater in 1997 than 1996. These areas account for about 70% of the spring inshore landings. In other areas, opinions were mixed but overall indicators from the phone survey were that abundance in 1997 was the highest year since 1987.



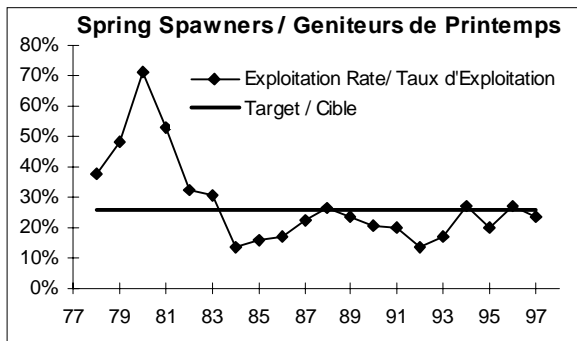
Population abundance of age 4+ spring spawners has declined from the peak in 1995 and is similar to levels observed in the late 1980s. The incoming 1993 (age 4) and 1992

(age 5) year-classes are below average, while the 1991 year-class (age 6) is well above average.



The decline in age 4+ biomass is consistent with the below average estimates of the 1992 and 1993 year-classes.

The target **exploitation rate** for age 4+ spring spawners is 26%. The age 4+ fishing mortality has been very close to the target exploitation rate in recent years.



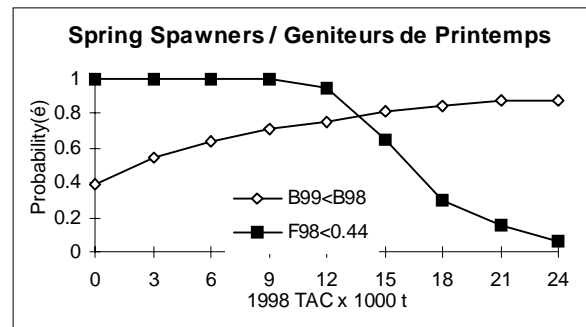
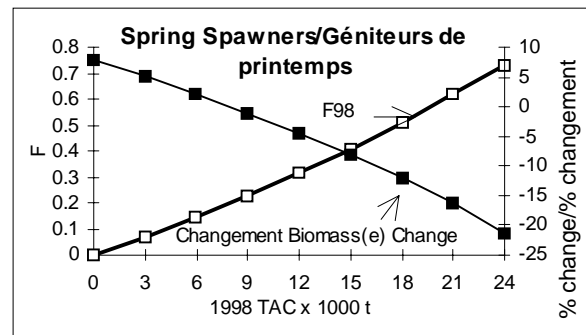
The major **source of uncertainty** in the estimation for spring spawners is the shortness of the abundance index time series. There is also some uncertainty about the combination of the two data sets and any bias that may be associated with the last point.

The age structure estimated using the population model based on the fishery index matches that expected from the age structure derived independently from the acoustic survey and roe-on-kelp experimental trapnet.

Outlook

The **F_{0.1} fishing level** for spring spawners in 1998 is 16,500t and the preliminary estimate for 1999 is 13,000t. The 16,500t is 9% greater than the 15,000t F_{0.1} fishing level for 1998 based on the previous assessment.

A risk analyses indicated that the TAC at which biomass can be expected to remain stable from 1998 to 1999 is about 8,000t. Regardless of TAC, the probability that the spring biomass will decline is ≥ 0.40 . The probability that fishing mortality will be below the target for fully recruited ages declines at TACs over 12,000t.



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