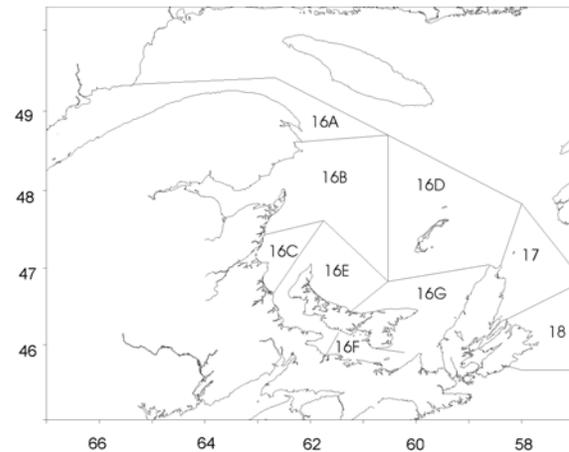


## Southern Gulf of St. Lawrence (4T) Herring



### Background

Herring are a pelagic species which form schools during feeding and spawning periods. Herring in the southern Gulf of St. Lawrence consist of a spring spawner component and a fall spawner component. Spring spawning occurs primarily in April-May but extends into June at depths <10m. Fall spawning occurs from mid-August to October 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, southeast New Brunswick and Magdalen Islands areas and the largest fall spawning population is in Chaleur Bay.

The stock area for southern Gulf of St. Lawrence herring extends 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 percentage of spring and fall spawner component 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 attained. Spawning group assignment is done using a gonado-somatic index to assign maturity stage and a monthly key that links maturity stage and month to spawning group. Juvenile spawning group assignment is done by otolith shape type.

The inshore fleet harvests almost solely the spring spawner component in the spring and almost solely the fall spawner component in the fall. The purse seine fleet harvests a mixture of spring and fall spawner component 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, north PEI and western Cape Breton, and harvests a mixture of fall and spring spawner component.

TAC management was initiated in 1972. Currently there are approximately 3,500 inshore licenses and 6 active seiners (>65').

### Summary

#### Fall Spawner Component

- Reported 2001 landings of the fall spawner component were 52,125t against the fall spawner TAC of 60,500t. There was no fishery in the 4Vn overwintering area.
- Inshore catch rates in 2001 were slightly less than in 2000, which were the highest in the time series starting in 1978.
- This assessment is based primarily on the CPUE index and estimates of total mortality calculated from the CPUE series.
- Indices of population biomass and abundance are currently high.
- Total mortality for the last three years is estimated to have been very high.
- The 1995 to 1997 year-classes are above average. Current rates of removals would likely result in a rapid depletion of the stock at average recruitment.

- It is suggested that fishery removals in 2002 be reduced from those in 2001 by a minimum of 10 to 15%. If catch rates decline in 2002, further reductions to the catch may be required.

### Spring Spawner Component

- Reported 2001 landings of spring spawner component were 14,598t against a TAC of 12,500t.
- Inshore catch rates in 2001 were similar to those in 1999 and 2000; these were the lowest since 1990.
- Year-classes produced after 1991 were average or below average.
- Age 4+ spawning biomass has been declining since 1995 and is estimated to be 20,000t at the beginning of 2002.
- The age 7+ fully recruited exploitation rate was well above target in 2001.
- The  $F_{0.1}$  catch for the spring spawner component in 2002 is 7,000t.

### The Fishery

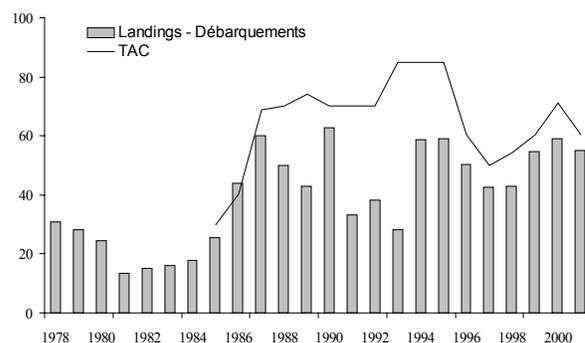
The catch allocations for the fall and spring seasons are based on the  $F_{0.1}$  fishing levels set for each spawning component. Landings are compiled by fishing season.

### 2001 FALL FISHERY (Statistics Branch)

Area	Allocation	Landings (t)
<b>INSHORE</b>		
Isle Verte	363	3
Chaleur Bay	21,875	21,750
Escuminac-West PEI	7,261	7,982
Magdalen	1,513	0
Pictou	7,502	6,764
Fisherman's Bank	7,503	8,262
4Vn	605	-
<b>Total Inshore</b>	<b>46,622</b>	<b>44,761</b>
<b>SEINERS (&gt;65')</b>		
All of 4T	9,678	10,270
4Vn	4,200	0
<b>Total Seiners</b>	<b>13,878</b>	<b>10,270</b>
<b>Grand Total</b>	<b>60,500</b>	<b>55,031</b>

Since 1987, landings in the fall season have been below the TAC for the fall spawning component.

### 4T Fall Season Landings and TAC (000 t)



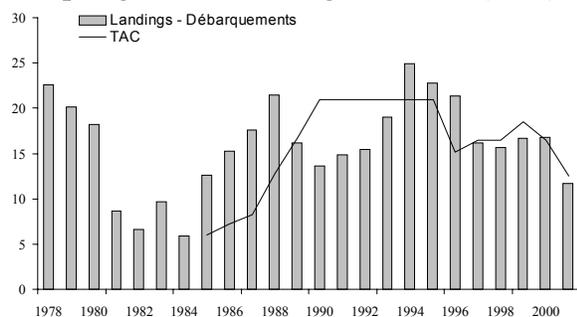
The spring season landings are less than the fall season.

**2001 SPRING FISHERY**  
(Statistics Branch)

Area	Allocation	Landings (t)
<b>INSHORE</b>		
Chaleur Bay (Jan-June 15)	606	582
Escuminac (Jan-May)	3,107	1,287
Magdalen (Jan-June 15)	909	2,624
Southeast NB – West PEI (Jan-May)	3,864	5,242
Bait and Roe all 4T (Jan –June 30)	1,141	861
<b>Total Inshore</b>	<b>9,627</b>	<b>10,596</b>
<b>SEINERS(&gt;65') (All 4T)</b>	<b>2,873</b>	<b>1,097</b>
<b>Grand Total</b>	<b>12,500</b>	<b>11,693</b>

Landings in the spring season were below the TAC for the spring spawning component in 2001.

**4T Spring Season Landings and TAC (000 t)**



Catches made throughout the year are attributed to the spring or fall spawning components based on a gonado-somatic index to assign maturity stage and a monthly key that links maturity stage and month to spawning group. Juvenile spawning group assignment is made using otolith characteristics. Revisions to the GSI assignments were made in 2001. Generally, this resulted in a higher proportion of spawners being assigned to the spring spawning component.

**2001 Percentage of Spring and Fall Spawning Components by Season and Gear Type**

Season	Gear	Spawning Group %	
		Spring	Fall
Spring	Inshore	98	2
	Seiner	41	59
Fall	Inshore	2	98
	Seiner	27	73

The TAC has been set separately for spring and fall spawner components since 1985. The 2001 allocation of the southern Gulf of St. Lawrence herring TAC was 77% for the inshore fleet and 23% for the seiner (>65') fleet.

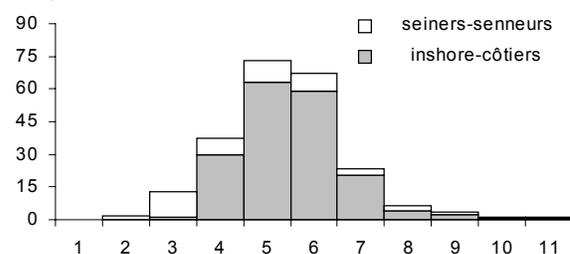
The TAC for the fall spawner component in 2001 was 60,500t, compared to 71,000t in 2000. The allocation for 4Vn is included with the fall spawner component. The 2001 **landings of the fall spawner component** in both seasons were 52,125t. Fall inshore landings are primarily driven by the roe market.

**Fall component landings (000s t)**

Year	Average 1988-97	1998	1999	2000	2001
TAC	71.7	58.4	60.5	71.0	60.5
Landings	51.0	43.0	53.6	59.1	52.1

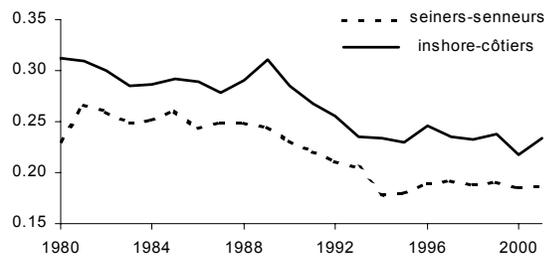
For the **fall spawner component**, the 1996 year-class (age 5) and the 1995 year-class (age 6) were dominant in the 2001 catch at age. There was no fishery in the in 4Vn overwintering area.

**Fall Spawner 2001 Catch-at-Age (millions of fish)**



Since 1990, the **average weights-at-age** for the fall spawner component have been below those observed during the 1980s. This decline in mean weights has leveled off for most ages in recent years.

**Fall Spawner Component Weight-at-Age 5 (kg)**



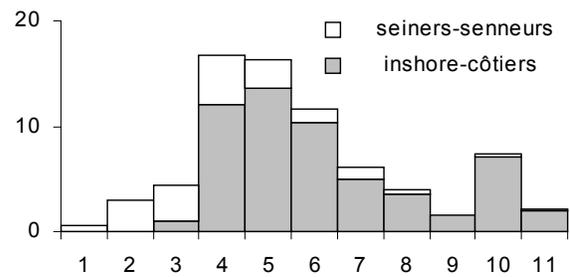
The 2001 TAC for the spring spawner component was 12,500t compared to 16,500t in 2000. The 2001 **landings of the spring spawner component** in both seasons were 14,598t. The overrun results from post-season assignment of catches to spawning components. The market for the spring fishery is different from that of the fall fishery. Spring herring caught by the inshore fleet are sold primarily for bait and to the bloater (smoked herring) markets.

**Spring component landings (000s t)**

Year	Average 1988-97	1998	1999	2000	2001
TAC	17.7	16.5	18.5	16.5	12.5
Landings	17.1	15.7	17.0	16.7	14.6

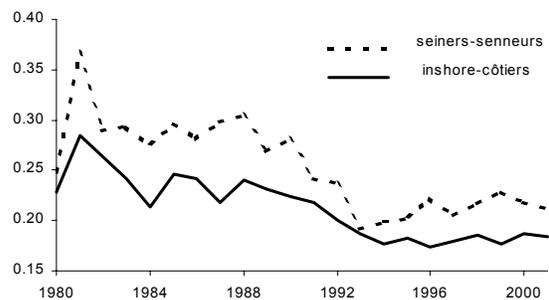
The **catch-at-age** of the 2001 **spring spawner component** was composed of many age groups. The 1996 year-class (age 5) and the 1997 year-class (age 4) were dominant in the 2001 catch. The strong 1991 year-class (age 10) was still apparent in the landings.

**Spring Spawner 2001 Catch-at-Age (millions of fish)**



Since 1990, average **weights-at-age** for the spring spawner component also have been below those observed during the 1980s. This decline in mean weights has leveled off for most ages in recent years.

**Spring Spawner Component Weight-at-Age 5 (kg)**

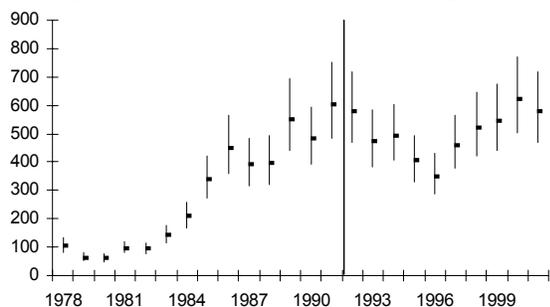


**FALL SPAWNER COMPONENT**

**Resource Status**

The principal **abundance index (CPUE)** for the fall spawning component is based on fishery data of inshore catches determined from purchase slips and effort information derived from a phone survey of 25% of the active inshore fishers. This index covers the entire inshore fleet and extends from 1978 to 2001. The CPUE in 2001 was slightly less than in 2000. CPUE in the last two years are the highest in the time series, indicating high biomass.

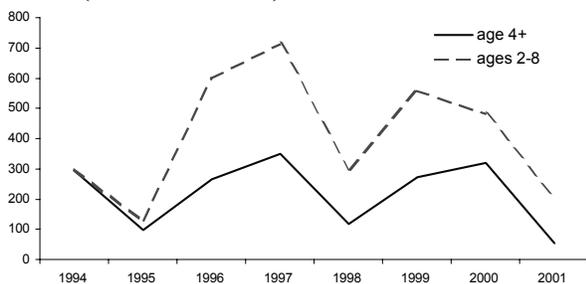
**Fall Spawner Catch Rate (kg/net/trip)**



The CPUE abundance index is split into two time periods (line in graph). The time periods were (1978-1991), when a higher percentage of the inshore fleet used 25/8" mesh, compared to the more recent time period (1992-2001), when a higher percentage of gillnetters have been using larger mesh.

The 2001 acoustic survey index indicates that abundance was lower than in 2000. The age 4+ estimate is the lowest for the time series. For the fall spawning component, this survey is considered too variable and inconsistent to be an index of abundance.

**Fall Spawner Component Acoustic Survey Index (millions of fish)**



Opinions of abundance expressed by fishers during the annual phone survey of the inshore fleet indicated equal or higher abundance from 2000 to 2001, except for the Chaleur Bay area where abundance was rated slightly lower.

In previous assessments of this resource, the stock status of the 4T fall spawning herring

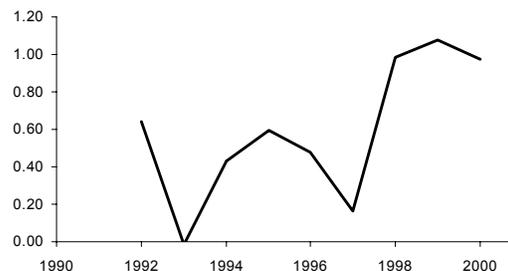
was determined using a sequential population analysis (SPA) that combined the fishery catch-at-age and the abundance index derived from catch rates in the inshore fishery.

Retrospective patterns (in this case, a tendency to overestimate stock abundance) in the population models have been a cause of uncertainty in previous assessments. In this assessment, the retrospective pattern was worse than in previous years. Thus, the population estimates from this analysis were considered unreliable. As a result, this assessment is based primarily on the CPUE index and estimates of total mortality calculated from the CPUE series.

The CPUE index by age groups suggests that the abundance of the 1995-1997 year-classes in the commercial fishery is well above average. It also suggests that abundance is currently high.

However, mortality rates (ages 6-8) based on the CPUE series also suggest that the rate of removal has increased in recent years. Older fish are becoming less abundant at a faster rate than in the mid-1990's.

**Total Mortality (Z – Ages 6-8)**



This suggests that the current rates of removal would likely result in a rapid depletion of the stock at average recruitment.

**Sources of Uncertainty**

The tendency to overestimate ages 4 to 7 in the most recent years, evidenced by the large retrospective patterns in the SPA, and rendering the SPA unreliable, is a source of uncertainty. Catch rates from the gillnet fishery continue to be among the highest in the series. Total mortality for 1998-2000, calculated from the catch rate at age, is much higher than previously. It is unclear whether the increase in total mortality is due entirely to fishing, or also due to an increase in natural mortality.

While the acoustic survey index is not used in the determination of stock status, the unprecedented low numbers of 3+ herring in 2001 is a concern. It could indicate declining abundance, but this is unclear due to the survey timing in relation to herring migration.

There is uncertainty about the recent year classes (1999-2000) as there are no estimates of recruitment prior to age 4.

**Outlook**

Despite the high abundance, the current high mortality rates will lead to a rapid depletion of the spawning stock component should recruitment return to average values. It is suggested that removals in 2002 be reduced from those in 2001 by a minimum of 10 to 15%. If the catch rates decline in 2002, further reductions to the catch may be necessary.

**SPRING SPAWNER COMPONENT**

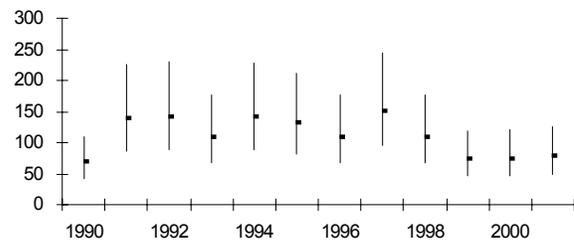
**Resource Status**

Resource status of the 4T spring spawning herring was determined using an SPA that

included both catch rate and acoustic survey indices.

The spring catch rate analysis included dockside monitoring data from all areas with recorded landings data. Effort was calculated using the average number of nets used in each area, as determined by the phone survey. Catch rate was defined as kg/net/trip. Catch rates in 2001 were similar to those in 1999 and 2000; these are the lowest since 1990.

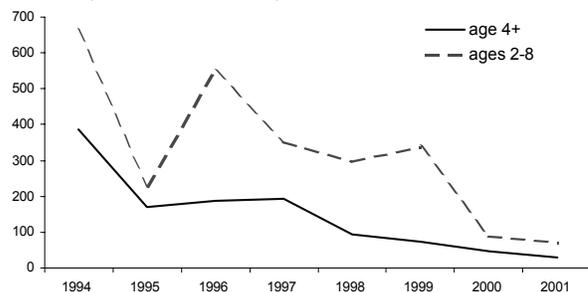
**Spring Spawner Catch Rate (kg/net/trip)**



Opinions of abundance from fishers from three main fishing areas (Escuminac, southeast New Brunswick and western Prince Edward Island) contacted in the **phone survey** were that herring abundance was lower in 2001 than in 2000. The Magdalen Islands opinion of abundance was higher. These areas account for at least 70% of the spring inshore landings.

The 2001 acoustic abundance of the spring spawner component was the lowest in the series.

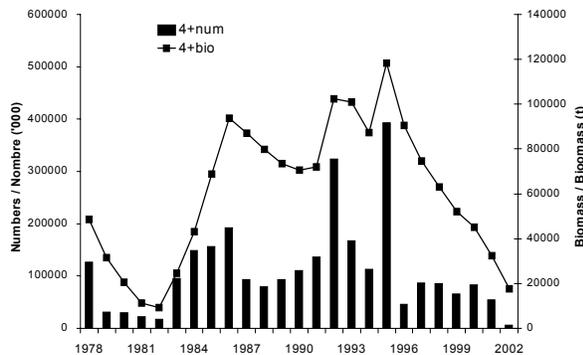
**Spring Spawner Component Acoustic Survey Index (millions of fish)**



As in previous assessments, an SPA including the gillnet catch rate index and the acoustic survey index was conducted. The analysis showed no retrospective pattern.

The analysis indicates that **population biomass** of age 4+ spring spawner component peaked in 1995, when the large 1991 year-class entered the fishery as 4 year-olds. Biomass has been declining since 1995. The 2002 beginning-of-year age 4+ biomass is estimated to be about 20,000t.

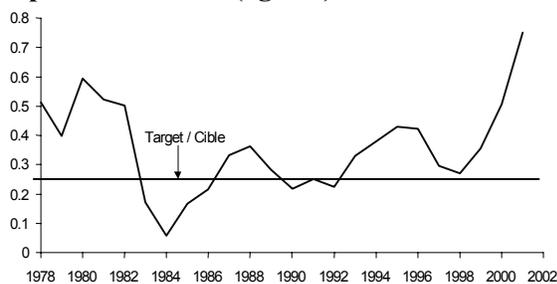
**Spring Spawner Component Stock Size CPUE plus acoustic indices**



**Recruitment estimates** from the analysis indicate that year-classes after 1991 were average or below average.

The target **exploitation rate** at  $F_{0.1}$  for spring spawner component is about 25%, calculated for ages 7+. The estimated exploitation rate was well above the target in 2001.

**Exploitation Rates (age 7+)**



**Sources of Uncertainty**

The acoustic survey index is at its lowest level in the time series. The estimated age 4 population number from the analysis using gillnet catch rate index and the acoustic survey index is very imprecise. The 2001 acoustic survey showed an unprecedented low number of age 3+ herring. This could indicate declining abundance, but this is unclear due to the survey timing in relation to herring migration.

While gillnet catch rates have declined in recent years, the decline has been more pronounced in the acoustic survey. An SPA excluding the acoustic survey index indicated a less severe decline in population abundance and a lower age 7+ exploitation rate.

There is uncertainty about the recent year classes (1999-2000) as there are no recruitment estimates prior to age 3.

It is unclear whether the decrease in population numbers is due entirely to fishing, or also due to an increase in natural mortality.

**Outlook**

The indices of abundance indicate a decline in stock size since the mid-1990s. The analysis using gillnet catch rate index and the acoustic survey index gives an  $F_{0.1}$  catch for the spring spawner component in 2002 of 7,000t. This assessment represents a more pessimistic view of the resource than provided in 2001.

The 4T spring spawning herring stock has declined since 1995. There is uncertainty in the extent of the decline as the two indices show different rates of decline. This outlook

is based on an approach consistent with previous assessments.

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***References***

LeBlanc, C.H., C. MacDougall, and G. A. Poirier. 2002. Assessment of the 4T southern Gulf of St. Lawrence herring stocks in 2001/ Évaluation des stocks de hareng de la zone 4T de l'OPANO dans le sud du Golfe du St. Laurent en 2001. DFO CSAS Res. Doc 2002/053 / MPO SCES Doc de rech. 2002/053.

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