



## ASSESSMENT OF THE WEST COAST OF NEWFOUNDLAND (DIVISION 4R) HERRING STOCKS IN 2005

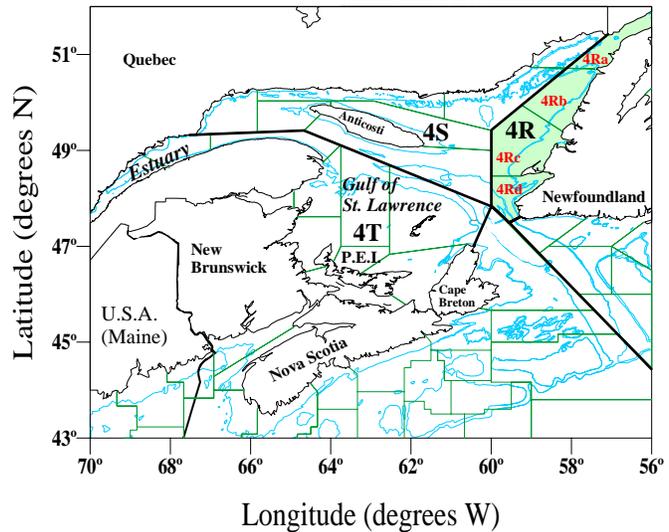


Figure 1. Map of unit areas of NAFO Division 4R (west coast of Newfoundland). Division 4R is identified by the coloured area.

### Context

During their annual migrations, herring are subject to a very intense commercial fishery in certain areas. In Canadian waters, the main fishery areas are located southwest of Nova Scotia, in the Bay of Fundy, in the southern Gulf of St. Lawrence and in Newfoundland. On the west coast of Newfoundland (Figure 1), mean annual landings have been around 15,000 t since 1990. The main gear used is the purse seine, with annual average landings totalling nearly 14,000 t. The seine fishery is followed by the gillnet fishery, of which the main market is bait.

The herring fishery on the west coast of Newfoundland is managed by a Total Allowable Catch (TAC) for both spawning stocks combined. The current 20,000 t TAC was set during the last analytical assessments. However, because there are no acoustic surveys, there are no longer any analytical assessments being conducted on these two spawning stocks. Consequently, it is no longer possible to calculate their respective abundance, fishing mortality, minimum biomass limits and a new TAC.

### SUMMARY

- Herring landings on the west coast of Newfoundland (NAFO Division 4R) in 2005 were 17,274 t, up 2,574 t compared with 2004. Average annual landings (1990-2004) were 15,246 t and all fishery sectors, except for the gillnet fishery, reached or almost reached their respective quotas.

- The most significant herring landings were mainly harvested by large (>65') and small (<65') senners in unit areas 4Rc and 4Rd. Average annual landings made by large senners were 10,875 t, compared with 2,919 t for small senners.
- A new very effective fishing gear, the "tuck-ring" senne, is responsible for landing 1,106 t in 2005. The "tuck-ring" senne, considered a fixed gear, is increasingly popular for the pelagic fishery in Newfoundland.
- The dispersion index, which is calculated from data from bottom trawl scientific surveys, has varied only marginally during the 1990s. Nevertheless, it has shown a considerable increase between 1998 and 2001, followed by a drop until 2004 and a slight increase in 2005.
- Biological indicators were not available at the time of the assessment, and because there was no abundance survey, it was impossible for us to assess the status of both spawning stocks on the west coast of Newfoundland in 2005 and to formulate a scientific advice regarding a Total Allowable Catch (TAC) for 2006.
- As mentioned over recent years, we recommend that fishing effort be distributed along the coast and over the entire year in order to conserve both herring spawning stocks on the west coast of Newfoundland.

## INTRODUCTION

### Species Biology

Herring (*Clupea harengus harengus*) is a pelagic fish that frequents cold Atlantic waters. Its distribution in Canada extends from the coasts of Nova Scotia to the coasts of Labrador. It travels in tight schools in order to feed, to spawn near the coast and to overwinter in deeper waters. The same herring return to the same spawning, feeding and wintering sites year after year. This homing phenomenon is attributed to a learning behaviour with the recruitment of young year-classes in a population.

At spawning, eggs attach themselves to the sea floor, forming a carpet of a few centimetres thick. The egg incubation time and larval growth are linked to ambient characteristics of the environment such as water temperature. Most herring reach sexual maturity at four years of age, at a length of about 25 cm. Compared with other herring populations, the west coast of Newfoundland herring are characterized by two spawning stocks. Spring herring generally spawn in April and May, and fall herring in August and September.

In the mid-1980s, the data showed that herring in the northern Gulf of St. Lawrence and on the west coast of Newfoundland fed mainly on small (< 5 mm) zooplankton (Figure 2), mostly copepods. New estimates made in the mid-1990s and early 2000s indicated that small and large zooplankton (euphausiids, amphipods) represent the two main prey for herring. During these three periods, benthic invertebrates accounted for approximately 10% of the herring diet.

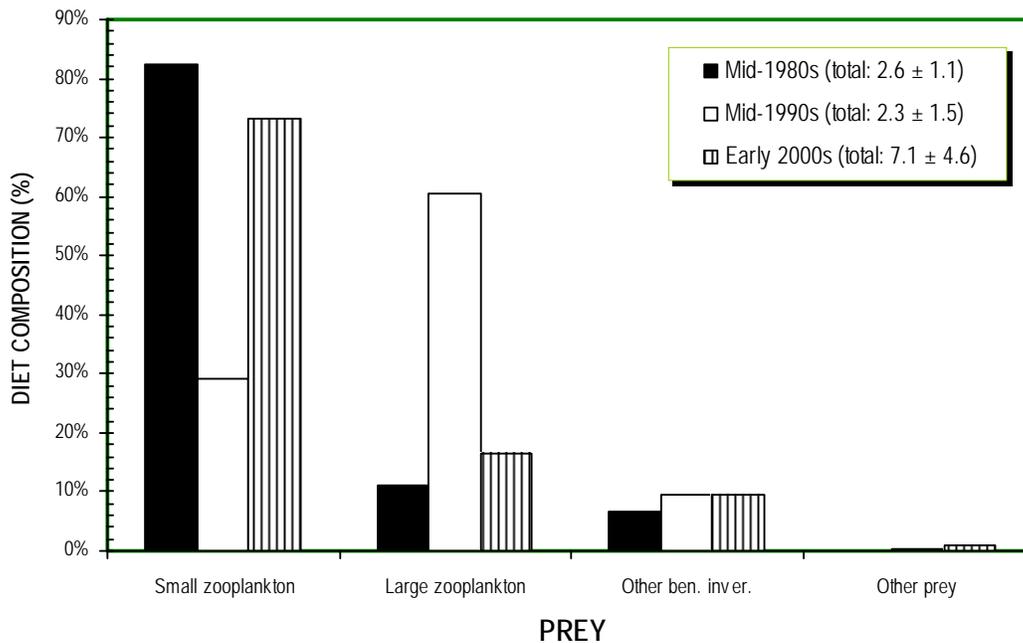


Figure 2. Diet composition (%) of herring in the Northern Gulf of St. Lawrence and on the west coast of Newfoundland from the mid-1980s to the early 2000s (legend units are in  $t\ km^{-2}\ yr^{-1}$ ).

Results from various models of the northern Gulf of St. Lawrence marine ecosystem indicate that the main cause of mortality for herring is predation (Figure 3A). During the mid-1980s, the main predators for herring were redfish (*Sebastes* spp.) and large cod (*Gadus morhua*) (Figure 3B). They were replaced by cetaceans during the 1990s and 2000s and by the harp seal (*Phoca groenlandica*) in the 2000s.

## Fishery

### Historical perspectives

The two herring stocks of the west coast of Newfoundland are harvested separately during spawning gatherings or collectively when the stocks are mixed between April and December. These stocks are mainly harvested by a fleet of large (>65') and small (<65') senners, and by several gillnet fishermen. Herring is also harvested for bait. These catches are not accounted for and could be substantial, especially since the snow crab (*Chionoecetes opilio*) and lobster (*Homarus americanus*) fisheries have recently shown record highs.

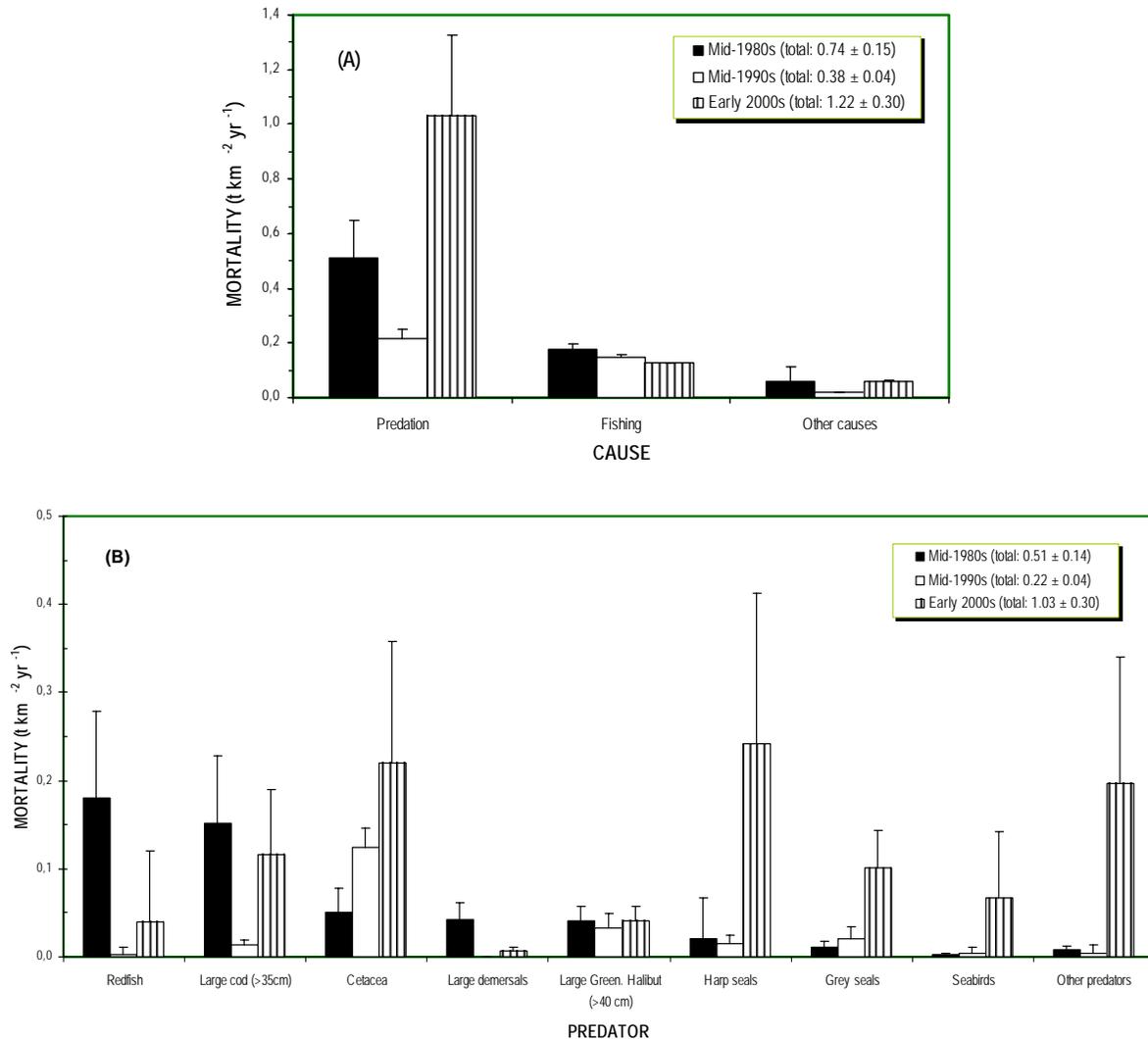


Figure 3. Main causes of herring mortality ( $t\ km^{-2}\ yr^{-1}$ ) (A) and mortality by predation details (B) according to different models of the northern Gulf of St. Lawrence and west coast of Newfoundland marine ecosystem from the mid-1980s to the early 2000s.

## ANALYSIS

### Landings in 2005

Herring landings on the west coast of Newfoundland have been rising since 1999 (Figure 4). In 2005, they totalled 17,274 t compared with 14,700 t in 2004 (Table 1). A total of 7,003 t were caught in unit area 4Rd, compared with 5,768 t, 4,260 t and 243 t for unit areas 4Rc, 4Rb and 4Ra. Large senner landings totalled 11,006 t in 2005, compared with 3,938 t for small senners and 731 t for gillnetters (Table 2). Since 1999, large senner quotas have been reached every year (Figure 5). However, small senners experienced a significant drop in the proportion of the quota caught in 2003, but it has been rising since. In the case of gillnetters, herring catches usually represent under 40% of the allocated quota due to the lack of market.

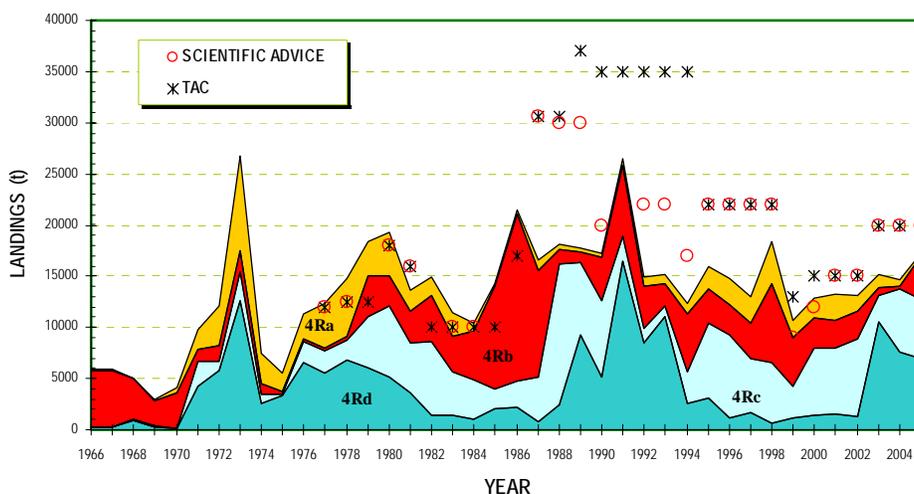


Figure 4. Cumulative commercial herring landings (t) for unit areas of NAFO Division 4R, 1966 to 2005 (TAC and scientific advice shown).

Table 1. Annual herring catches (t) in the main unit areas on the west coast of Newfoundland, NAFO Division 4R.

UNIT AREA	YEAR											AVERAGE	
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005*	(1995-2004)	(1990-2004)
<b>4Ra</b>	2 283	2 584	2 572	4 128	1 653	1 981	2 613	1 604	1 290	712	243	<b>2 142</b>	<b>1 682</b>
<b>4Rb</b>	3 273	2 952	3 451	7 729	4 766	2 995	2 643	2 621	714	252	4 260	<b>3 140</b>	<b>3 641</b>
<b>4Rc</b>	7 321	8 173	5 300	5 891	3 088	6 469	6 379	7 660	2 594	6 162	5 768	<b>5 904</b>	<b>4 962</b>
<b>4Rd</b>	3 133	1 115	1 637	611	1 201	1 471	1 589	1 232	10 533	7 574	7 003	<b>3 010</b>	<b>4 962</b>
<b>TAC</b>	<b>22 000</b>	<b>22 000</b>	<b>22 000</b>	<b>22 000</b>	<b>13 000</b>	<b>15 000</b>	<b>15 000</b>	<b>15 000</b>	<b>20 000</b>	<b>20 000</b>	<b>20 000</b>		
<b>TOTAL</b>	<b>16 010</b>	<b>14 824</b>	<b>12 960</b>	<b>18 359</b>	<b>10 708</b>	<b>12 916</b>	<b>13 224</b>	<b>13 117</b>	<b>15 131</b>	<b>14 700</b>	<b>17 274</b>	<b>14 195</b>	<b>15 246</b>

\* Preliminary data

Table 2. Annual herring catches (t) for the main fishing gear used on the west coast of Newfoundland, NAFO Division 4R.

FISHING GEAR	YEAR											AVERAGE	
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005*	(1995-2004)	(1990-2004)
<b>Gillnet</b>	1 658	2 175	1 803	4 217	869	1 277	1 215	1 256	1 629	499	731	<b>1 660</b>	<b>1 310</b>
<b>'Tuck-ring' senne</b>											1 106		
<b>Trap</b>	145	102	350	233	92	59	150	73	104	127	491	<b>144</b>	<b>144</b>
<b>Small senner (&lt;65')</b>	3 392	3 072	3 053	4 435	2 599	3 153	3 418	3 382	2 307	2 972	3 938	<b>3 178</b>	<b>2 919</b>
<b>Large senner (&gt;65')</b>	10 814	9 473	7 751	9 468	7 147	8 427	8 344	8 392	11 090	11 100	11 006	<b>9 201</b>	<b>10 875</b>
<b>Other</b>	2	1	3	4	0	0	96	13	0	2	1	<b>12</b>	<b>37</b>

\* Preliminary data

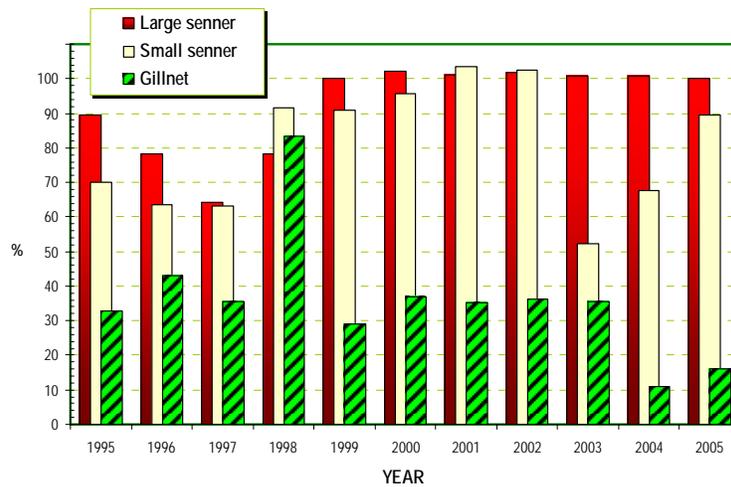


Figure 5. Proportion (%) of annual quotas caught by each herring fishery sector in 2005 in NAFO Division 4R.

In 2005, catches by large senners were mostly made in unit areas 4Rc and 4Rd, and for small senners in areas 4Rd, 4Rb and 4Rc (Figure 6). Senners catches made in November 2005 were almost twice as large as those recorded during previous years (Figure 7). This increase can be explained by a later start of the autumn herring fishery because of the extended presence of mackerel (*Scomber scombrus* L.) in the same fishing sites. In fact, on the west coast of Newfoundland, capelin (*Mallotus villosus* M.), herring and mackerel are caught almost in the same areas by the same senners fleet, but in different periods that are related to these species' seasonal migrations. However, over recent years, mackerel has not been leaving the west coast of Newfoundland until late fall, which considerably delays herring fishing activities.

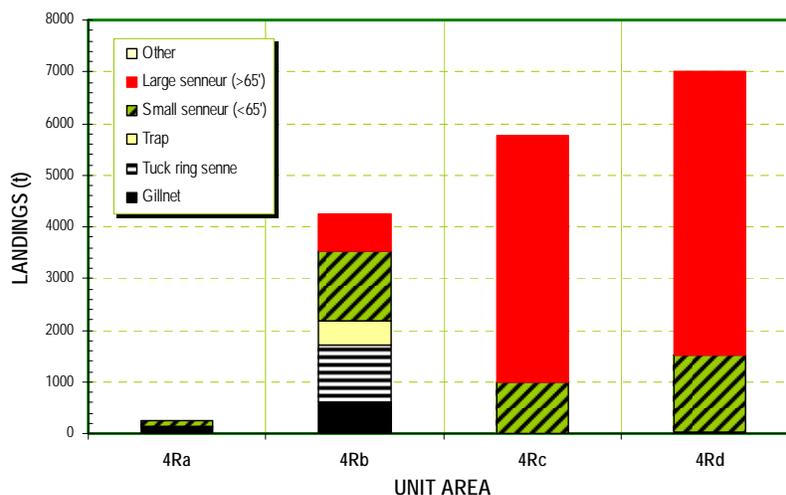


Figure 6. Herring landings (t) in 2005 per fishing gear and for unit areas of NAFO Division 4R.

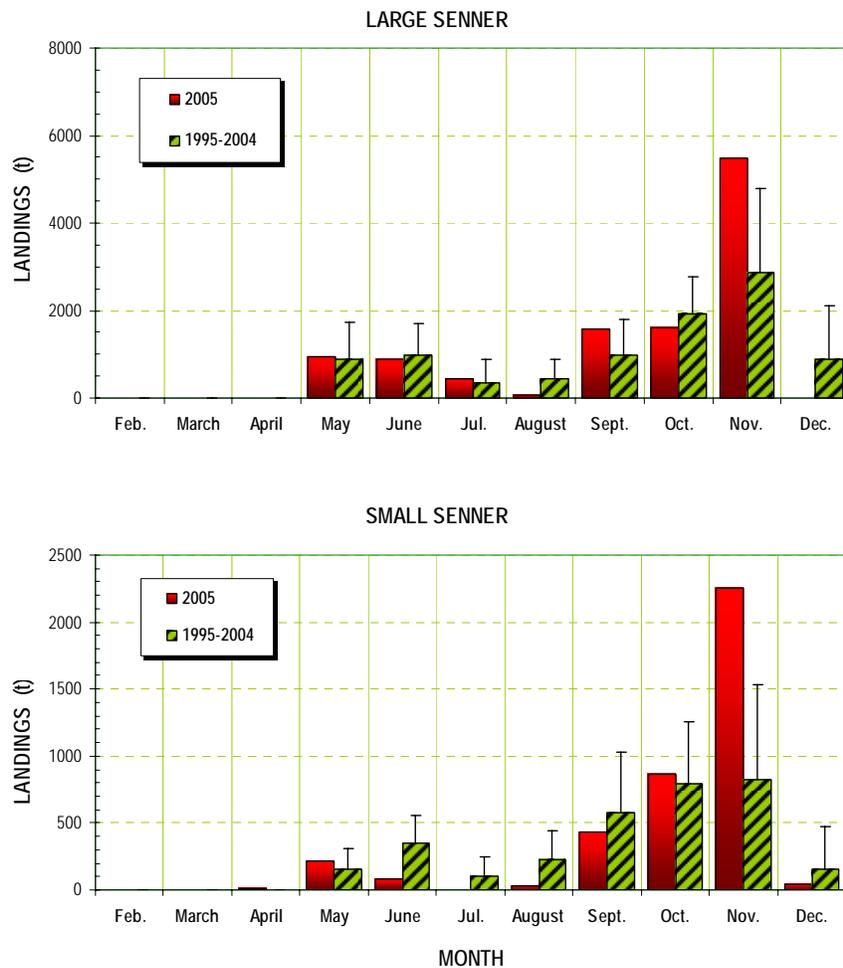


Figure 7. Monthly herring landings (t) in 2005 for large and small senners and mean annual landings (t) for the period 1995-2004 (standard deviations are indicated).

A new fishing gear, the “tuck-ring” senne, is responsible for landing 1,106 t of herring in 2005 (Table 2). Most of these catches were made in unit area 4Rb (Figure 6). This fishing gear is increasingly popular for the pelagic fishery in Newfoundland.

## **Resource status**

### **Abundance**

There is no longer an acoustic survey to measure the abundance of the two herring spawning stocks of the west coast of Newfoundland; the last one was conducted in the fall of 2002. Nevertheless, herring is a regular by-catch of bottom trawl abundance surveys of the CCGS *Alfred Needler* and *Teleost* that are conducted annually in the northern Gulf of St. Lawrence and on the west coast of Newfoundland. Although catches by set are small, herring is caught in almost the entire sampled area (Figure 8).

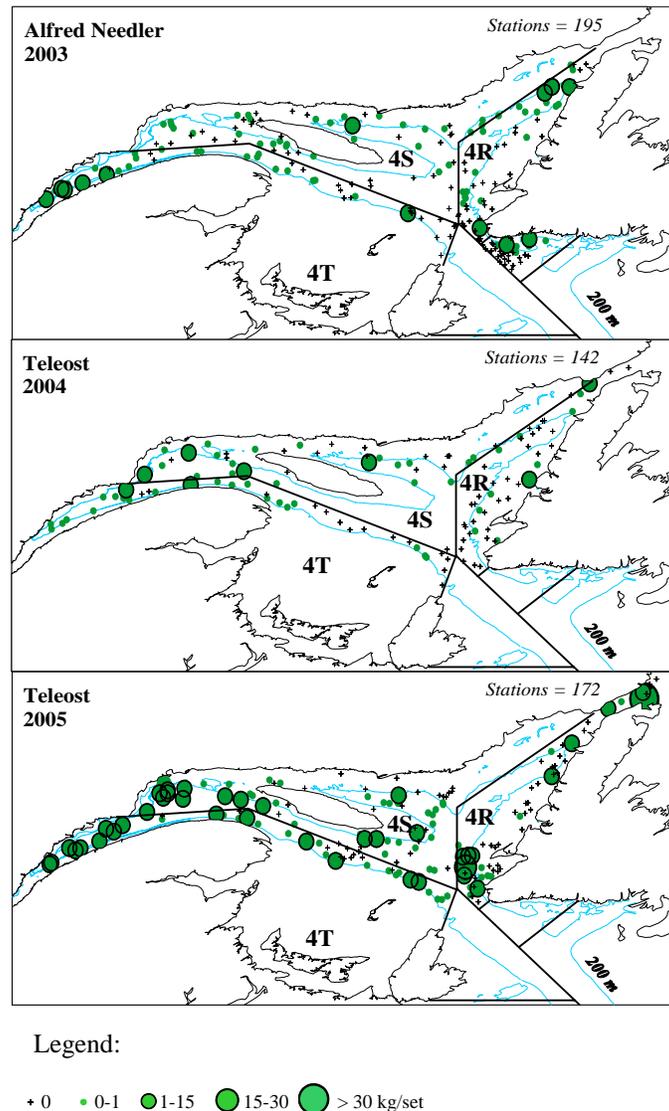


Figure 8. Herring abundance distribution (kg/set) for the last three bottom trawl surveys by the CCGS Alfred Needler and Teleost in the northern Gulf of St. Lawrence and on the west coast of Newfoundland.

Bottom trawl surveys are not appropriate for catching and measuring the abundance of a pelagic fish such as herring. Consequently, it was decided to only use presence and absence data per set to calculate, using indicator kriging, the surface associated with different probabilities of finding herring (Figure 9). These probabilities also help calculate a species dispersion index. This index has varied only marginally during the 1990s (Figure 10). Nevertheless, it has shown a considerable increase between 1998 and 2001, followed by a drop in 2003 and 2004 and a slight increase in 2005.

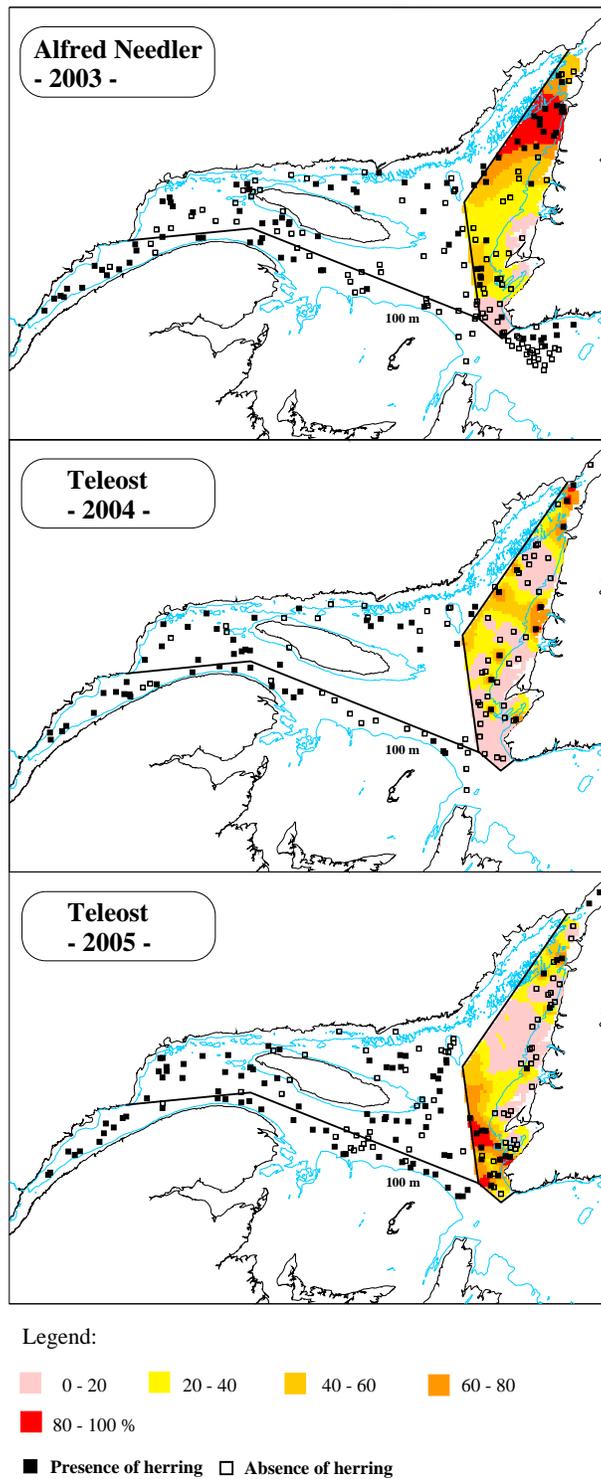


Figure 9. Herring occurrence probability surface contours (%) in NAFO Division 4R for the last three bottom trawl surveys conducted by the CCGS Alfred Needler and Teleost in the northern Gulf of St. Lawrence and on the west coast of Newfoundland.

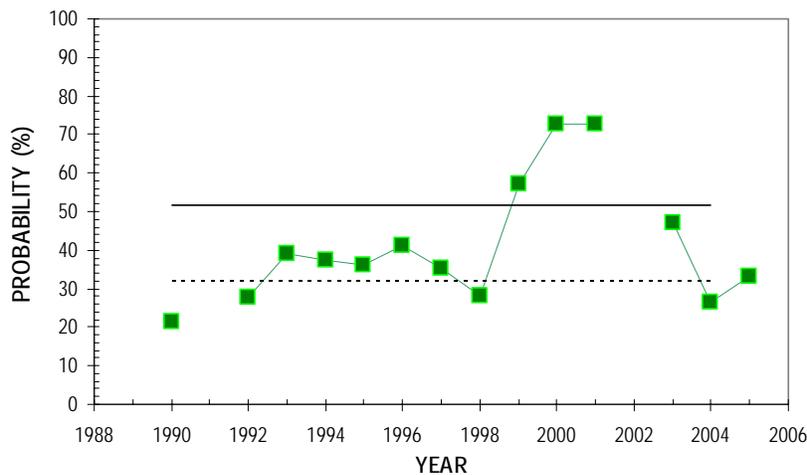


Figure 10. Mean probabilities of finding herring in NAFO Division 4R. The horizontal lines indicate upper and lower limits of the confidence interval (95%) of the 1990-2004 average.

### Analytical assessment

Without an abundance survey, there is no analytical assessment (Sequential Population Analysis or SPA) being carried out on the two herring spawning stocks of the west coast of Newfoundland. Consequently, it is no longer possible to calculate their respective abundance, fishing mortality, a minimum biomass limit or even a new TAC.

### Sources of uncertainty

The main source of uncertainty is the absence of information regarding the size of the two herring spawning stocks on the west coast of Newfoundland. There is also a significant lack of information on the number, the location and the size of spawning grounds. Furthermore, there is very little information concerning annual migration patterns, species distribution, as well as its' role in the Northern Gulf of St. Lawrence ecosystem.

## **CONCLUSION AND ADVICE**

The last acoustic survey to measure the abundance of the two herring spawning stocks of the west coast of Newfoundland was conducted in the fall of 2002. For the time being, these two stocks are managed by a common TAC of 20,000 t, which was set at the last analytical assessments of 2003 and 2004. However, without an acoustic survey, it is now impossible to calculate the abundance of these stocks, fishing mortality, a minimum biomass limit or a new TAC.

Biological indicators were not available at the time of the assessment and because there was no abundance survey, it was not possible for us to assess the status of both herring spawning stocks on the west coast of Newfoundland in 2005 and to formulate a scientific advice regarding a TAC for 2006.

Finally, we recommend that fishing effort be distributed along the coast and over the entire year in order to conserve both herring spawning stocks on the west coast of Newfoundland.

**SOURCES OF INFORMATION**

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ISSN 1480-4913 (Printed)

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## CORRECT CITATION FOR THIS PUBLICATION:

DFO, 2006. Assessment of the west coast of Newfoundland (Division 4R) herring stocks in 2005. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2006/021.