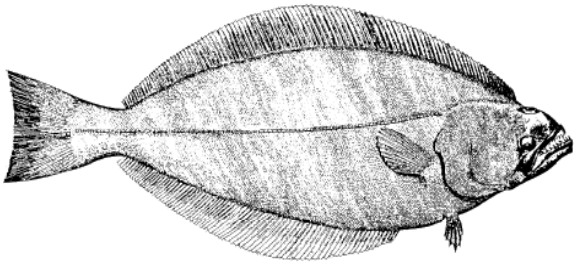

Gulf of St. Lawrence (4RST) Greenland Halibut in 2002

Background

Greenland halibut (also known as black halibut, or turbot) in the Gulf of St. Lawrence are considered to be a stock isolated from the main Northwest Atlantic population found to the east and north of Newfoundland's Grand Banks. Parasite research conducted in the early 1990s showed that Gulf halibut were distinct. All Greenland halibut in the Gulf, the Laurentian Channel and adjacent areas could be clearly distinguished from those of Labrador and the northern Grand Banks, suggesting that Greenland halibut complete their entire life cycle within the Gulf.

Greenland halibut are generally found in the Gulf of St. Lawrence at depths of 130–500 m (70–280 fathoms). Spawning takes place primarily in winter, from January to March. Males reach sexual maturity at a smaller size than females, meaning that their growth rate drops more sharply than that of females. This difference helps explain why females grow to be larger than males and make up the majority of commercial landings.

In the early 1990s, the fishery was characterized by low yields and a preponderance of small, immature fish in catches. Following recommendations made by the Fisheries Resource Conservation Council (FRCC) in 1994, conservation measures (reduced fishing effort, bigger mesh size, a small-fish tolerance protocol for commercial landings) were implemented to ensure better protection of the stock's reproductive potential.

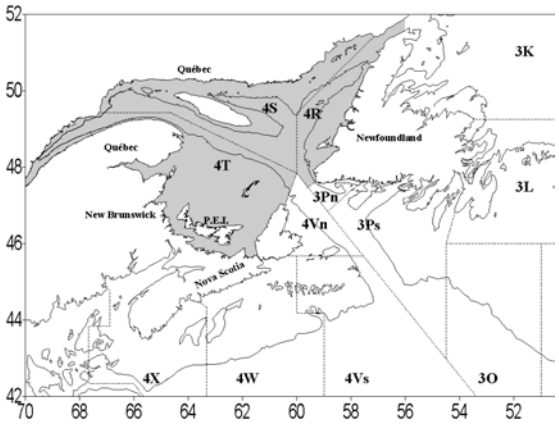

Figure 1. Map of the Gulf of St. Lawrence and adjacent areas, showing NAFO Divisions 4RST.

Summary

- Landings in 2002 were up by 25% from 2001 levels, mainly because Newfoundland fishers exceeded their allocation by around 100 t and the fact that significant catches (275 t) were recorded by an experimental fishery in Quebec. Yet again, the total allowable catch (TAC) was not met, despite it was reduced by 1,000 t.
- The catch rates of gillnet fishers rose in 2002, mainly in the Esquiman Channel. Landings consisted of females for the most part. The proportion of females in landings has been increasing since 1998, given the significant decline in the abundance of males longer than 42 cm. Mean catch size has decreased since 1998 and thus the number of Greenland halibut per ton landed is thought to have risen by 30% between 1998 and 2002.
- A comparative fishing experiment conducted in Quebec in 2002 using

5.5-inch and 6-inch mesh showed that the proportion of females in landings was high (greater than 80%) with either mesh size. Mean catch sizes for the 5.5-inch and 6.0-inch mesh were 43 cm and 45 cm, respectively. The proportions of immature females in landings made with 5.5-inch and 6-inch mesh were 62% and 42%, respectively. Catch per unit of effort (CPUE) was at least three times higher when using 5.5-inch mesh.

- Biomass indices increased between 1995 and 2000, but were down in 2001 and 2002. However, the 2002 DFO survey index was still higher than the 1990 index average. The higher index is due to the production of good year-classes (1989, 1990, 1991 and 1995). The DFO survey index was boosted by the large year-classes of 1997 and 1999.
- Survey indices show that abundance of fish longer than 44 cm (fish available to the fishery) has been declining since 1999. This drop is related to weak recruitment between 1992 and 1994 and the lower individual growth rate of the 1997 year-class that has been observed since 1999.
- The individual growth rate of the large 1997 year-class was lower than that of previous year-classes in the western Gulf, meaning that it will take longer for the 1997 year-class to reach commercial size. The lower growth rate had less of an effect in the Esquiman Channel, which explains why fishing was better there in 2002.
- However, in 2002, the diet, condition and growth rate of juvenile Greenland halibut improved and size at sexual maturity increased in males.
- Although the abundance of pre-recruits (1997 and 1999 year-classes) is high, it is difficult to predict how successful the fishery will be in 2003, considering the weaker growth rate of the 1997 year-class.

The Fishery

Landings (thousands of tons)

Year	77–97 av.	1998	1999–2000	2000–2001	2001–2002	2002–2003[1]
TAC	-	4.0	4.5[2]	4.5[3]	4.5[3]	3.5[3]
Fixed gear	3.0	3.8	3.4	2.0	1.2	1.6
Mobile gear	1.2	0.1	0.2	0.1	0	0
Total	4.2	3.9	3.6	2.1	1.2	1.6

[1] *Preliminary data*
[2] *TAC from January 1, 1999 to May 14, 2000*
[3] *TAC from May 15 of the current year to May 14 of the following year*

Until the mid-1970s, Greenland halibut landings in 4RST consisted primarily of by-catches of other fisheries. Later, a directed fishery using gillnets and bottom trawls developed, and the increased fishing effort led to record landings in 1979 (Figure 2). Soon after, landings plummeted and remained low between 1981 and 1985. The second period of high landings was between 1986 and 1988 and stemmed from a number of factors: resource abundance, fishers' growing interest, greater fishing efficiency thanks to technological advances in the early 1980s, and higher prices offered to fishers. In 1989, landings plummeted once again, falling as low as 2,306 t in 1991, and fluctuating between 2,000 t and 4,000 t

until 1999. Landings dropped by 67% between 1999 and 2001. This sharp

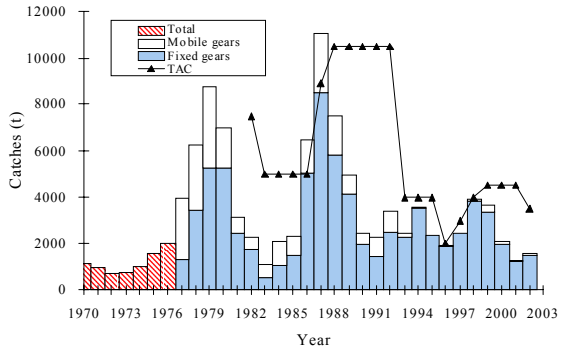

Figure 2. Annual Greenland halibut landings and total allowable catch (TAC) since 1970. Data for 2002–2003 are preliminary.

decline reflects the disappointing results that have been recorded since the 2000 fishing season, especially for Quebec fishers. However, preliminary data for 2002 indicate an increase of 25% in landings from the previous year (from 1,200 to 1,600 t), mainly due to the fact that Newfoundland fishers exceeded their allocation by around 100 t and the fact that significant landings (275 t) were recorded by the experimental fishery in Quebec using a 5.5-inch (140 mm) mesh, instead of the 6.0-inch (152 mm) mesh, as authorized in the conservation plan. This initiative was implemented by Fisheries Management and has enabled some of the fishers in Area 4T3 and all fishers in Area 4T4 to harvest part of their quotas using 5.5-inch mesh. A significant portion of the Quebec quota (more than 1,500 t) is still available to the fishery for spring of 2003.

Since 1993, virtually no landings have been made using mobile gear because of the moratorium on cod fishing with this type of gear and because shrimpers are required to use Nordmore grate. Fishing is now carried out by gillnetters, whose home ports are in Quebec and on the west coast of Newfoundland. An individual quota pilot project was launched in 1999 for traditional fishers in Quebec so that their fishing season could be extended. The project was continued in 2000 and 2001 and became permanent in 2002.

Conservation measures

The TAC was set at 4,000 t from 1993 to 1995. In 1996, it was cut to 2,000 t, but was raised to 3,000 t in 1997 and 4,000 t in 1998. The 1999 TAC was increased to 4,500 t, and the fishing season ran from January 1, 1999 to May 14, 2000. In 2000 and 2001, the TAC remained unchanged (4,500 t), but the season ran from May 15 of the current year to May 14 of the following year. The 2002–2003 TAC has been reduced to 3,500 t. Further to FRCC recommendations to reduce fishing effort and the number of immature fish taken, major conservation measures were implemented in 1995:

- increase in mesh size from 140 mm (5.5 inches) to 152 mm (6 inches)
- adoption of a fishing net configuration that is more selective
- implementation of a minimum catch size (42 cm in 1996 and 44 cm since 1997), along with the enforcement of a small-fish tolerance protocol for commercial landings
- establishment of a dockside monitoring program for commercial landings
- voluntary reduction in the number of nets used by Quebec fishers (from 120 to 80 nets) between 1996 and 2000.

Composition of commercial landings

Mean catch size of landings made with gillnets decreased between 1980 and

1985 (Figure 3). The large year-classes

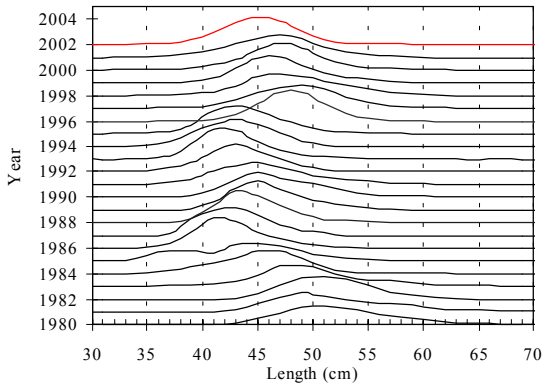

Figure 3. Size structure of Greenland halibut caught with gillnets, 1980–2002.

of 1979 and 1980 were first harvested in 1985, which led to a gradual increase in mean catch length as a result of their high growth rate. These cohorts had been completely harvested by 1990, when the fishery targeted new, smaller year-classes. Consequently, mean catch size decreased to approximately 43 cm in 1995, but increased to 48 cm in 1996 as a result of the bigger mesh size (increase in mesh size from 140 mm or 5.5 inches to 152 mm or 6 inches). Landings between 1995 and 1998 mainly consisted of fish from the 1989 to 1991 year-classes. The 1995 year-class began recruitment in 1999. In 2000 and 2001, females in the 1995 year-class likely accounted for the bulk of the landings, but the year-class's contribution to the fishery was not as strong as expected. In 2002, the 1997 year-class began recruitment in the Esquiman Channel. Mean catch size has decreased since 1998 (45 cm in 2002) that the number of Greenland halibut per ton landed is thought to have risen 30% between 1998 and 2002. However, the experimental fishery using 5.5-inch mesh contributed to the decrease of the mean catch size by 1 cm between 2001 and 2002.

In the first half of the 1990s, the proportion of females in gillnet catches averaged 58%. In 1996, this figure rose to 79% as a result of the bigger mesh size. The percentage of females in landings has been rising since 1998, hitting 86% in 2002.

Commercial fishery yields

Yields or catch rates for traditional gillnet (6-inch mesh) fishers in Quebec and Newfoundland have been estimated since 1996 using vessel logbooks. Logbooks have also been used to estimate the gillnet immersion period.

Since 1999, the gillnet immersion period has been at least three days, whereas between 1996 and 1998, nets were in the water for only a day or two 50% of the time. However, in 2001 and 2002, the number of immersion periods of at least four days decreased. Yields were calculated for each immersion period (one to four days and five days and more). Yields declined between 1998 and 2001 for each immersion period, which, along with the introduction of IQs (individual quotas) in Quebec, explains why the fishing season was extended during this period. However, in 2002, yields stabilized and even increased for immersion periods of 1, 3 and 4 days. Catch rates per subdivision were up in areas 4Ra and 4Rb (in the Esquiman Channel), while they remained relatively unchanged in areas further west of the Gulf. The fishing season in the Esquiman Channel lasted only two and a half months (June and July) in 2002, compared with seven months in 2001.

Comparative fishing using two mesh sizes

Comparative fishing experiments were conducted by a number of fishers in the St. Lawrence estuary and northern Gaspé using two sizes of mesh (5.5 inches and 6 inches) in the summer and fall of 2002. The objective of the initiative, which was carried out according to scientific protocol, was to describe catch size, the ratio of females to males, sexual maturity and yields by mesh size. Findings showed that catch size depended on the size of mesh used, as mean lengths were 43 cm (5.5-inch mesh) and 45 cm (6-inch mesh) for summer and fall combined (Figure 4). The proportion of females in landings was high (above 80%) when using either mesh. The proportion of immature females was 62% with the 5.5-inch mesh versus 42% with the 6-inch mesh. The CPUE was at least three times higher when using the 5.5-inch mesh.

Resource assessment

Resource status is determined by examining indicators from both the commercial fishery and scientific surveys. These indicators are examined for different periods so the status of the resource can be assessed for various time horizons. First, the values of a few indicators were compared with the 1990–2000 average to assess long-term trends. Then, the values of all the indicators were compared with the 1996–2000 average to assess recent stock trends. Lastly, the 2001 and 2002 values of all indicators were compared to gauge the direction and scale of any changes between these two years.

For medium- and long-term trends, the

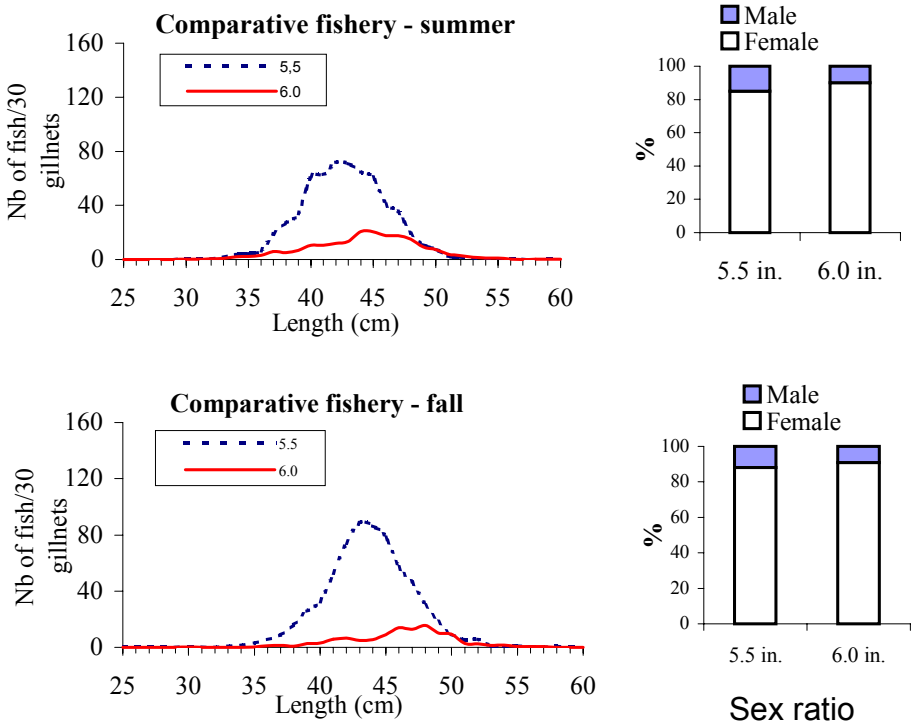

Figure 4. Comparative fishing results for 5.5-inch (140 mm) mesh and 6-inch (152 mm) mesh: length frequencies and sex ratios per period.

indicators were rated according to three categories:

Positive: the indicator's value differs from the average in such a way that positively affects resource status (e.g. biomass exceeding the average).

Neutral: the indicator's value is similar to the average.

Negative: the indicator's value differs from the average in such a way that adversely affects resource status.

The neutral category is delineated by the confidence intervals of the 1990–2000 or 1996–2000 averages. Indicators vary from the average when their value for the year is above the highest or below the lowest confidence interval. Indicator ratings are shown in two tables (long-term, and medium and short-term; tables 1 and 2).

Data used

Research surveys

Research surveys have been conducted in the St. Lawrence estuary and northern Gulf of St. Lawrence every year since 1990. The surveys follow a random stratified pattern and are conducted from the Department's research vessel, the *CCGS Alfred Needler*, which is equipped with a shrimp trawl.

Sentinel fishery cod surveys have been conducted in the northern Gulf by a number of otter trawlers since 1995. Seven of these surveys were carried out in the summer (July 2001) and fall (October). These surveys do not cover the St. Lawrence estuary, where about 20% of Greenland halibut biomass is found.

The minimum trawlable biomass, the abundance of juvenile fish (smaller than 30 cm) and pre-recruits (between 40 cm and 43 cm), and abundance indices for fish longer than the 1997 minimum catch size of 44 cm were calculated for the three surveys (DFO and sentinel).

Stock status

Data on the sexual maturity of males and females have been gathered since 1996, during DFO missions in August, i.e. several months before the spawning period between January and March. Sexual maturity is assessed according to morphological criteria for all fish measured on missions. The size at which 50% of fish are mature (L_{50}) has been determined for both males and females and is used as a stock status indicator.

The mean length of three-year-old fish was based on length frequencies determined from data provided by the DFO survey and is used as a growth indicator. The condition index (weight/length cubed) was also calculated using DFO survey data. Lastly, an annual distribution index was calculated for DFO surveys, using biomass estimates per stratum. The index corresponds to the minimal area that holds 95% of the biomass.

Commercial fishery

The primary indicator of fishing success is the difference between fixed-gear quotas and related landings. The catch rate indicator is derived by standardizing (by sector, immersion period and month) catch rates for traditional gillnet fishers who used 6-inch mesh between 1996 and 2002. Lastly, mean catch size of landings made with gillnets was calculated.

Table 1. Indicators used to assess long-term resource status (1990–2002). (See text for symbol key).

Indicators	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Alfred Needler (DFO)													
Stock Biomass	−	=	=	−	=	=	=	=	=	+	+	+	+
Juvéniles (< 30 cm)	=	=	=	−	−	−	=	=	+	+	+	+	=
Prerecruits (40-43 cm)	−	−	−	−	=	+	=	=	=	+	+	+	+
44 cm and more	−	−	−	−	−	=	+	+	=	+	+	+	=
Stock condition													
Distribution index	−	−	−	=	=	+	=	+	=	+	+	=	=
Growth index	+	+	−	−	−	+	+	+	+	=	−	−	−
Condition index	=	−	=	+	=	=	=	+	+	−	−	−	+
Fishery													
Difference between fixed gear allocation and landings	−	−	−	=	+	+	+	+	+	=	−	−	−
Mean size	=	=	−	−	−	−	+	+	+	=	=	=	=

Resource status

Long-term trends (Table 1)

Most stock status indicators were negative between 1990 and 1994. Total stock biomass was low (Figure 5), and pre-recruit abundance was below average. Abundance of males and females of commercial size declined. The growth rate of three-year-old fish and stock condition were either similar or inferior to 1990–2000 averages. Greenland halibut distribution was limited to the heads of Gulf of St. Lawrence channels. Mean catch size decreased and commercial landings were below 4,000 t, despite the fact that the TAC was 10,500 t.

From 1995 to 1998, most indicators were positive, reflecting an increase in Greenland halibut size, better stock condition and greater fishing success. The DFO survey indicates that juveniles between 15 cm and 20 cm were abundant between 1990 and 1992. These juveniles belonged to the 1989, 1990 and 1991 year-classes (Figure 6) and helped to improve the status of the stock. The biomass index showed an upward trend that began in 1994 as a result of the growing contribution of these year-classes. Mean catch size increased, as did the growth rate of three-year-old Greenland halibut. The stock's geographic range expanded, mainly south of Anticosti Island, along the Laurentian Channel.

The number of negative indicators began to rise in 1999, thereby illustrating the fishery's problems and the decrease in stock status indices. DFO survey

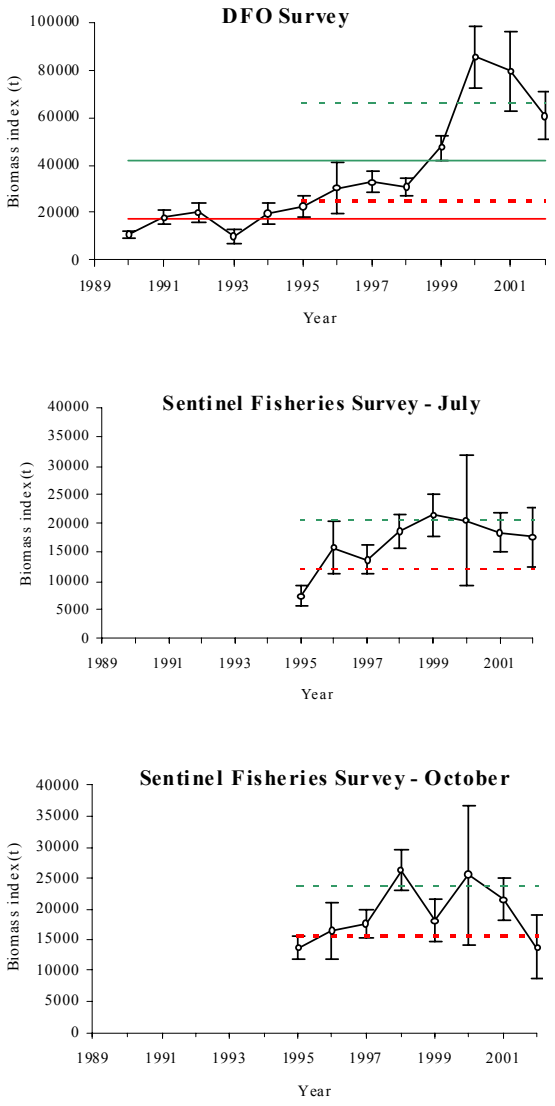

Figure 5. Minimum trawlable biomass indices for Greenland halibut in Divisions 4RST estimated using DFO and sentinel fishery survey data. The lines represent the highest and lowest confidence intervals for 1990–2000 (solid lines) and 1996–2000 (dotted lines) averages.

indicators have remained above or equal to averages in recent years, despite declining in 2002. The size structure of catches made in DFO surveys shows that juveniles have been very abundant since 1996, essentially because of the production of the large year-classes of 1995, 1997, 1999 and 2001 (Figure 6). These year-classes helped boost survey indices. The abundance of fish available for harvesting has been declining since 1999, especially for males. The decline is related to weak recruitment between 1992 and 1994 and the lower growth rate observed in the 1997 year-class. Values for condition and growth dropped below long-term averages in 2000 and 2001, but recovered slightly in 2002. Fishing success decreased after the TAC was met in 1998. Landings were down in 1999 and the difference between commercial catches and the TAC grew between 1999 and 2001, but shrank in 2002, considering the increase in landings and the TAC reduction.

Medium-term trends and changes between 2001 and 2002 (Table 2)

Biomass indices in sentinel fishery surveys confirm those of the DFO survey, indicating an upward trend between 1995 and 2000 (Figure 5) and a downtrend in 2001 and 2002. In the Esquiman Channel, biomass was down sharply between 2001 and 2002 (from 7,000 t to 2,500 t), according to the DFO survey. However, estimates provided by the two sentinel fishery surveys in the area show that biomass increased (July) or remained unchanged (October). The limited area covered by DFO survey sampling in 2002 in the Esquiman Channel raises doubts about the biomass estimates.

According to sentinel fishery surveys conducted in July and October, the distribution of length frequencies indicates the presence of the same year-classes (1995, 1997, 1999 and 2001) as those listed in the DFO survey (Figure 6). Abundance indices for juveniles and pre-recruits (40–43 cm)

Table 2. Indicators used to assess short- (2001–2002) and medium-term (1995–2002) resource status. (See text for symbol key).

Indicators	1995	1996	1997	1998	1999	2000	2001	2002	2001→2002
Stock biomass									
Alfred Needler (DFO)	−	=	=	=	=	+	+	=	↓
Sentinel July	−	=	−	=	+	=	=	=	±
Sentinel october	−	−	=	+	=	+	=	−	↓
Juvéniles (<30 cm)									
Alfred Needler (DFO)	−	−	=	=	=	+	=	=	↓
Sentinel July	−	−	=	=	+	+	=	=	↓
Sentinel october	−	=	−	=	+	+	=	=	↓
Prerecruits (40-43 cm)									
Alfred Needler (DFO)	=	=	=	−	+	+	+	+	↓
Sentinel july	−	−	=	=	+	=	=	+	↑
Sentinel october	=	=	=	+	=	=	=	=	↓
44 cm and more									
Alfred Needler (DFO)	=	+	+	−	=	=	=	−	↓
Sentinel july	−	=	=	+	=	=	=	=	±
Sentinel october	−	=	+	+	=	=	−	−	↓
Stock condition									
Distribution index	+	−	=	=	+	=	−	−	±
Condition index	=	=	=	+	=	−	=	=	±
Growth index	=	=	=	=	=	−	−	−	↑
Males maturity		+	=	=	=	−	−	−	↑
Females maturity		=	=	+	=	−	−	−	±
Fishery									
Difference Fixed gear allocation and Landing	+	+	+	+	=	−	−	−	↑
CPUE		=	=	=	=	−	−	−	↑
Mean size	−	=	+	=	−	−	−	−	±

± no or little change (0 à 5 %) ; ↑ ↓ change of 5 % to 10 %; ↑ ↓ Change of 10 % and more

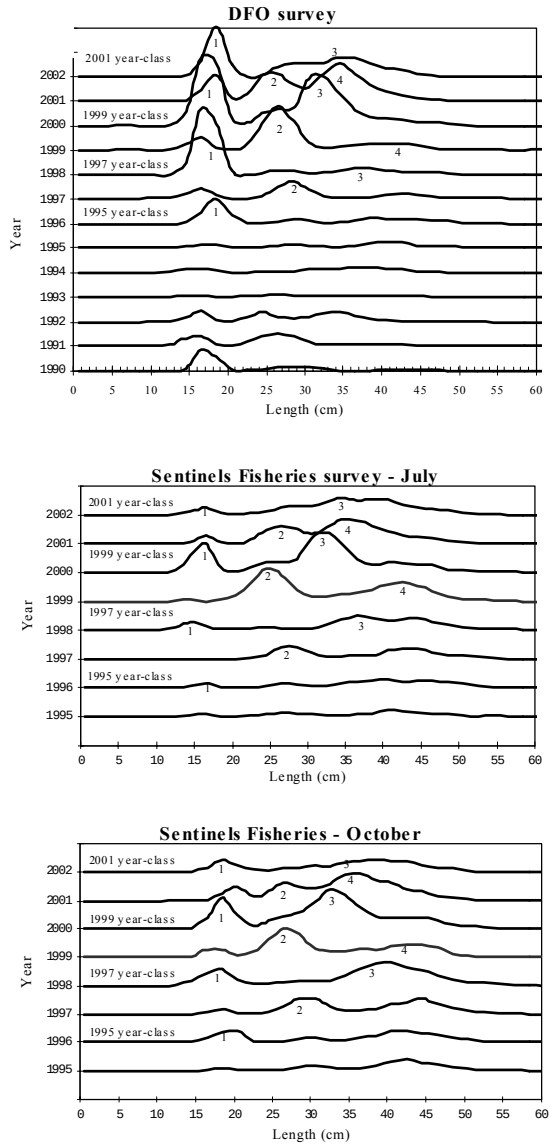

Figure 6. Size structures of Greenland halibut caught during DFO and sentinel fishery surveys. The strongest four year-classes (1995, 1997, 1999 and 2001) and the age of these fish in each year are indicated.

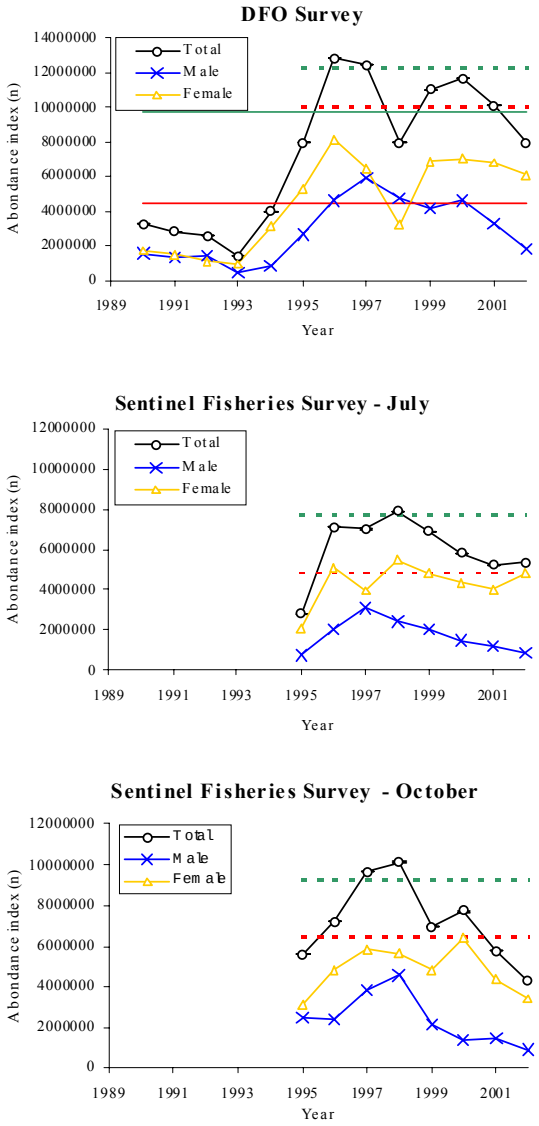

Figure 7. Abundance indices of Greenland halibut measuring 44 cm and over caught during DFO or sentinel fishery surveys. The lines represent the highest and lowest confidence intervals for 1990–2000 (solid lines) and 1996–2000 (dotted lines) averages.

have held steady at high levels since 1999. In contrast, the abundance of fish 44 cm or longer has indicated a downturn in harvestable stock since 1996 in DFO surveys, and since 1998 in sentinel fishery surveys (Figure 7). This decline is more marked among males than females.

Indicators show that the stock's condition deteriorated, particularly as of 1999 in the western Gulf. The 1997 year-class was found to have a lower growth rate and its modal length for four-

year-old Greenland halibut was only 35 cm in the summer of 2001. However, a breakdown by area revealed that growth in the Esquiman Channel, east of the Gulf of St. Lawrence, was adhering to a more normal pattern, and modal length there was about 40 cm in 2001 and greater than 40 cm in 2002 (Figure 8). Condition and growth indices rose in 2002.

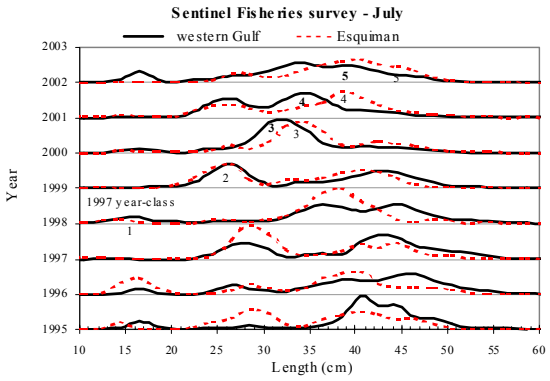

Figure 8. Size structure (%) of Greenland halibut landings made during the July sentinel fishery survey in the western Gulf (solid line) and in the Esquiman Channel (dotted line).The age of fish in the 1997 year-class is indicated for each year and both areas.

Data on Greenland halibut diet since 1993 show that diet and stomach content depend on fish size and harvesting area. Small fish (under 20 cm) feed mainly on invertebrates. Fish between 20 cm and 35 cm feed on invertebrates and fish in almost equal proportions. Larger Greenland halibut (> 35 cm) feed mainly on fish. Stomachs were also found to be less replete as fish size increased. The stomachs of fish were least full in the western Gulf, fuller in the Esquiman Channel and fullest north of Anticosti Island. The lowest stomach content values were observed between 1999 and 2001. In 2002, stomach content increased in all fish sizes. Low stomach content between 1999 and 2001 could be one of the reasons for the weaker growth observed in areas west of the Gulf.

Data on sexual maturity show that the size at which 50% of fish are mature (L_{50}) decreased between 1996 and 2001 (Figure 9), from 40 cm to 33.5 cm for males and from 50 cm to 46 cm for females. In 2002, this size was up slightly (35.5 cm) among males and remained unchanged among females. Size at maturity for males remains well below minimum legal size. Considering the slowdown in growth rate after sexual maturity, it is likely that it will take the males of a given year-class many more years than females to reach minimum catch size. This difference in size at sexual maturity and in growth rate has caused the female-to-male ratio to increase in commercial landings.

Standardized commercial yields were high between 1996 and 1998 (Figure 10), but dropped by 63% between 1999 and 2001. In 2002, standardized

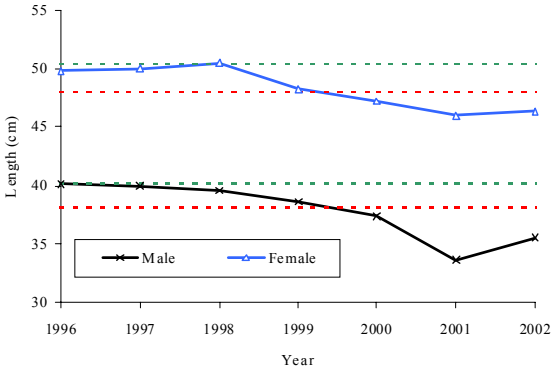

Figure 9. Length at which 50% of fish landed during the DFO survey were mature, 1996–2002. The dotted lines represent the highest and lowest confidence intervals for 1996–2000 averages.

commercial yields were up by 59%, mainly due to greater yields in the Esquiman Channel by Newfoundland fishers. To date, these yields have been used as indicators of fishing success, not of harvestable stock abundance.

Since 1999, the difference between fixed-gear allocations and related landings has increased, especially for Quebec fishers, reflecting the troubles in the fishery in recent years. Some fishers have switched their operations to other resources because of the low yields, which may have further depressed landings.

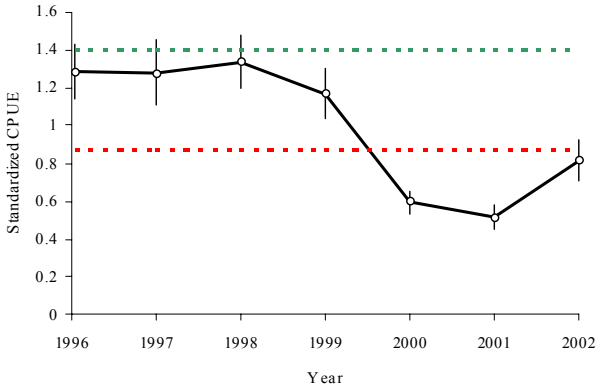

Figure 10. Standardized yields of gillnet fishers, 1996–2002. The dotted lines represent the highest and lowest confidence intervals for 1996–2000 averages.

Industry viewpoint

In Quebec, the low yields have prompted some fishers to cut back their Greenland halibut operations since 2001. The temporary snow crab quotas allocated to some of them have partially offset low revenue generated by Greenland halibut fishing activities. The 2002 fishing season was another difficult year for Quebec fishers. However, those who took part in the experimental fishery using 5.5-inch mesh posted good results. Newfoundland fishers mentioned better yields and fish sizes in 2002. Many Quebec fishers affirm that using 6-inch mesh is not good for the stock because too many large females are caught. They claim that this factor has been responsible for the decrease in catch rates since 2000.

Uncertainty

Stock growth and condition indicators have been down significantly since 1999, especially in the western Gulf. Owing to these changes and weak recruitment between 1992 and 1994, the fishery's yields have been declining since 1999. In the Esquiman Channel, the deterioration in the stock's condition and growth rate was not as severe, which allowed for greater recruitment of the 1997 year-class, and consequently, greater fishing success in 2002. Better biological conditions were noted in 2002 and their continuation in the coming years could lead to greater fishing success in the western Gulf, considering the presence of large juvenile year-classes (1999 and 2001).

Outlook

In 2003, the fishery will focus primarily on the 1995 to 1997 year-classes. However, it is difficult to predict the fishery's success in 2003, considering the slower growth noted in the 1997 year-class. Research survey abundance indices for juveniles and pre-recruits show that the 1997 and 1999 year-classes are abundant. Females in the 1997 year-class may be available for harvesting in 2003 in the western Gulf after they were recruited to the fishery in the Esquiman Channel in 2002. However, the lower growth rate of males and the fact that reach sexual maturity

at smaller sizes suggest that their contribution to the fishery in the western Gulf will be weak in 2003.

Mean catch size has declined since 1998 and thus the number of Greenland halibut per landed ton is thought to have risen by 30% between 1998 and 2002. If mean catch size continues to decline in 2003, the proportion of immature females in landings will increase, as will fishing mortality for the same TAC, because a greater number of fish will need to be caught.

Management considerations

Gillnet mesh size was reduced partially in 2002 (from 6 inches to 5.5 inches) to see whether it was possible to increase the proportion of males in landings. Findings of the comparative fishing experiment did not indicate a change in the female-to-male ratio, suggesting that this objective could not have been met in the commercial fishery. In addition, the percentage of immature females increased significantly (48 %) in landings made with the smaller mesh. As expected, CPUEs were up, but this increase is likely to be temporary, as the smaller mesh has given fishers access to a biomass that is not usually harvested with 6-inch mesh. Although the smaller mesh helps decrease the exploitation of larger females, it probably increases the exploitation of immature females. However, the abundance of larger females is declining (as revealed in surveys and poor fishing success), and under these conditions, the strategy of using a smaller mesh could seriously compromise the stock's reproductive potential in the short term.

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