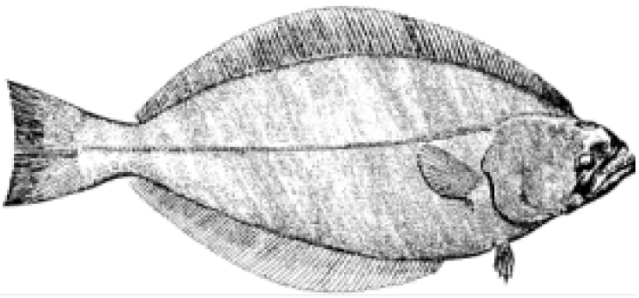
Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat
Quebec Region **Science Advisory Report 2015/056**

ASSESSMENT OF GREENLAND HALIBUT IN THE GULF OF ST. LAWRENCE (4RST) IN 2014



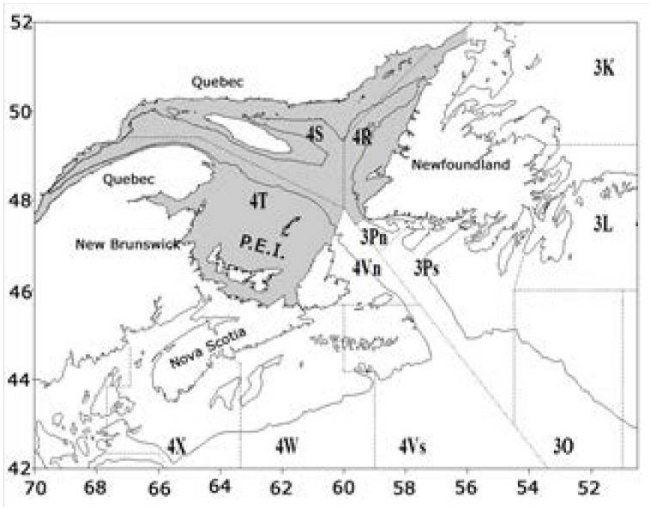


Figure 1. Map of the Gulf of St. Lawrence and neighbouring regions.

Context

Until the mid-1970s, Greenland Halibut (commonly called black turbot or turbot) from the Gulf of St. Lawrence (4RST) were not subjected to any directed fishery. At the end of the 1970s, a Greenland Halibut fishery developed using gillnets and bottom trawls. Following the closure of the Atlantic cod mobile gear in 1993, any mobile gear directed fishery for Greenland Halibut has been prohibited. This fishery is now dominated by boats equipped with gillnets, whose home ports are located in Quebec or on the west coast of Newfoundland.

The fishery is regulated by a number of management measures, including the setting of total allowable catches (TAC). This TAC management limits fishing to protect the population's reproductive potential.

Resource assessment is conducted every two years to highlight changes in the status of the resource justify adjustments to the conservation approach and management plan. The main indicators used for the assessment are taken from fishery statistical data, sampling of commercial catches and research surveys. A science peer review meeting was conducted February 18, 2015 in Mont-Joli, Qc. Participants at the science review were from DFO Science, DFO Fisheries Management, fishing industry, provincial governments, Academia and Aboriginal organisations. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- Greenland Halibut landings reached 2,753 t in 2013-2014 and 2,986 t (preliminary as of December 31) in 2014-2015, out of an allocation of 3,751 t. The fishing season will run until May 14, 2015.
- Landings and fishing effort have significantly dropped in northern Anticosti and in Esquiman since 2012, but have increased in the western Gulf.

- Catch per unit of effort (CPUE) from fishing decreased significantly across the Gulf in 2013. The CPUE for the western Gulf improved in 2014, while it continued to drop in northern Anticosti and in Esquiman. Overall, the CPUE of 2014 is comparable to the average between 1999 and 2014.
- Biomass indices from research surveys for fish over 40 cm increased in 2014 and were higher than average, though they had decreased in 2013. Fish from 30 to 40 cm, pre-recruits to the fishery, are low in abundance. The 2012 and 2013 cohorts are very strong and will begin to recruit to the fishery in 2018.
- The condition index for fish over 30 cm increased in 2013 and 2014 and is higher than average. This increase could be explained by the arrival of new redfish cohorts in the Gulf, an important prey for large Greenland Halibut.
- Deep water temperature significantly increased in northern of Anticosti and in Esquiman. Fish were found on average at temperatures over 6°C, which is more than 1°C above the average between 1990 and 2014. The temperature increase is lower in the western Gulf.
- Locally, in northern Anticosti and at the head of Esquiman, we observe a decrease in catches, CPUE and biomass. A combination of factors could explain these decreases, such as the increased exploitation rate from previous years and higher deep water temperature.
- A new population dynamic model (SCALE) was presented and identified a slight decrease in exploitable biomass since 2010. The value observed in 2014 remains high compared to the average of 1990-2013. The arrival of 2012 and 2013 cohorts should contribute to increase exploitable biomass starting in 2018.
- In the short term, there is likely to be a slight decrease in abundance for commercial size fish, but in the medium term, the forecast is more optimistic. The landings of the past 10 years have helped maintain a stable exploitation rate. The SCALE model projection indicates that exploitation biomass will remain stable, with an annual landing of 3,750 t for the next two seasons.

INTRODUCTION

Species Biology

The Greenland Halibut population of the Gulf of St. Lawrence (Figure 1) is considered to be a stock isolated from the main Northwest Atlantic population found east and north of Newfoundland's Grand Bank. Parasite studies conducted in the early 1990s showed that the Gulf population was distinct, which led to the conclusion that Greenland Halibut complete their entire life cycle within the Gulf.

Greenland Halibut are found mainly in the channels of the Gulf of St. Lawrence at depths of more than 130 m, specifically at depths ranging between 200 and 375 m. Juveniles are predominant in the Estuary and north of Anticosti.

Spawning takes place primarily in winter, from January to March. Males reach sexual maturity at a smaller size than females, at about 36 cm for males compared to 45 cm for females. This difference helps explain why females grow to be larger than males and make up the majority of commercial catches.

The diet of the Greenland Halibut varies depending on its size. Turbot under 40 cm have a diet that consists mainly of shrimp, capelin, small demersal fish and macrozooplankton. Larger turbot eat mainly shrimp, herring, small demersal fish, redfish and capelin. The turbot's main predators are Harp, Grey and Hooded seals and Atlantic Halibut.

Description of the Fishery

In 2014, the number of active licences was 167 from Quebec and 116 from Newfoundland. The fishery management measures include the imposition of a minimum mesh size of 152 mm (6.0 inches) and a implementation of a small-fish tolerance protocol for commercial catches of 44 cm. Fishermen must also keep a log book, have their catches weighted by a dockside monitoring program and agree to have an observer on board at the Department's request (5% coverage). The fishery opens on May 15 and closes on May 14 of the following year. The fishery has been managed by TAC since 1982. Some fishermen have individual quotas while others are under competitive regime.

Until the mid-1970s, Greenland Halibut landings in 4RST consisted mainly of by-catches from other fisheries (Figure 2). Subsequently, a directed gillnet fishery developed and landings fluctuated substantially, exceeding 8,000 t in 1979 and 1987. These peaks were both followed by sharp drops. Catches remained between 2,000 t and 4,000 t from 1989 to 1998. Landings decreased between 1999 and 2001, dropping from 3,600 tons to less than 1,300 tons. Landings increased to 3,900 tons between 2001 and 2004 and have been relatively stable since. TAC was set at 4,500 tons since 2004 and the allocation for the fixed gear directed fishery for Greenland Halibut was set at 3,751 t.

In 2013, landings for NAFO Divisions 4RST amounted to 2,727 t for fixed gear and 26 t for mobile gear, for a total of 2,753 t (Table 1). In 2014, preliminary landings by December 31 were 2,973 t for fixed gear and 13 t for mobile gear, for a total of 2,986 t.

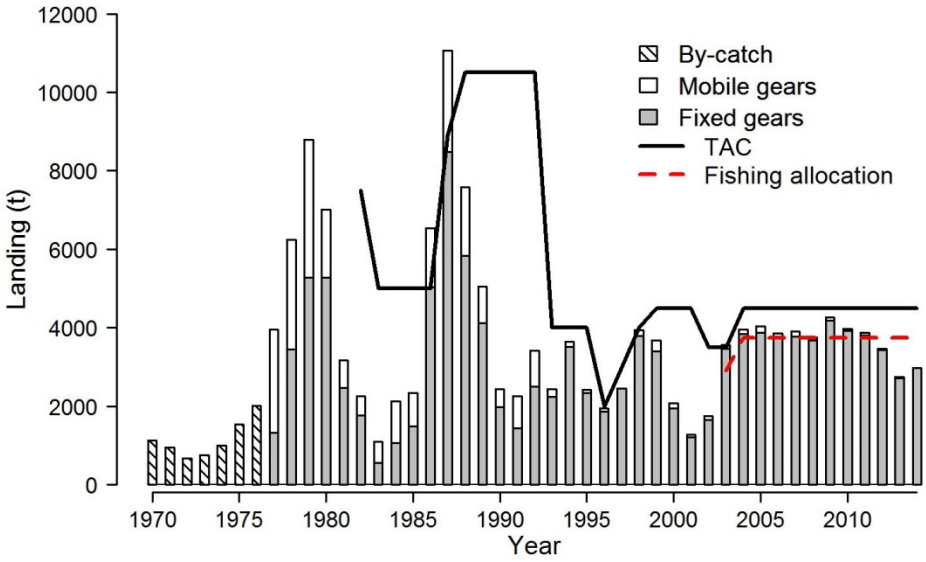


Figure 2. Greenland Halibut landings and total allowable catch (TAC) since 1970. Data for 2014 are preliminary. The 3,751 t allocation to fixed gear is also highlighted.

Table 1. Annual landings (tons) by 10 years period to 2010 and by fishing season after.

	Gear			
Period	Fixed	Mobile	Total	TAC
1980-1989	3612	1215	4827	7175
1990-1999	2558	309	2868	5700
2000-2010	3143	108	3251	4300
2010-2011	3924	47	3972	4500
2011-2012	3811	61	3872	4500
2012-2013	3432	35	3468	4500
2013-2014	2727	26	2753	4500
2014-2015[1]	2973	13	2986	4500

[1] *Preliminary data by December 31 2015.*

RESOURCE ASSESSMENT

The assessment of the Greenland Halibut stock is mostly based on analysis of commercial fishery data and from research surveys. The fishery data come from three different sources of information; purchase slip, fisherman's daily logbook and samples of commercial catches. Two research surveys with trawl were conducted annually in the northern Gulf. The first one in July with the Sentinel program and the second in August with a DFO vessel. During sampling of commercial and survey catches, the fish are scaled and sexed. In addition, data on weight, sexual maturity of males and females and the condition of the fish are collected during the DFO survey.

Biological Data

The size at maturity Greenland Halibut has dropped between 1996 and 2001 and has remained generally stable after that (Figure 3A). The size at 50% of maturity dropped from 40 cm to 36 cm and from 50 cm to 45 cm for males and females respectively. The size at maturity for males is considerably lower than the minimum size of 44 cm established for the small fish protocol. Moreover, the proportion of mature individuals at length indicates that at 44 cm, 39% of females and 95% of males are mature. Because the growth rate drops after reaching sexual maturity, there exists a size dimorphism between males and females that increases the proportion of females in commercial catches. The proportion of females in the catch was 78% in 2013-2014.

From 2002 to 2012, the average size of caught turbot increased from 45 cm to 49 cm (Figure 3B). In the last two years, it declined, to 47 cm in 2014. These variations can be explained by the displacement of harvesting effort, especially a recent increase in fishing effort in the western Gulf, and by the strength of the various cohorts in the fishery.

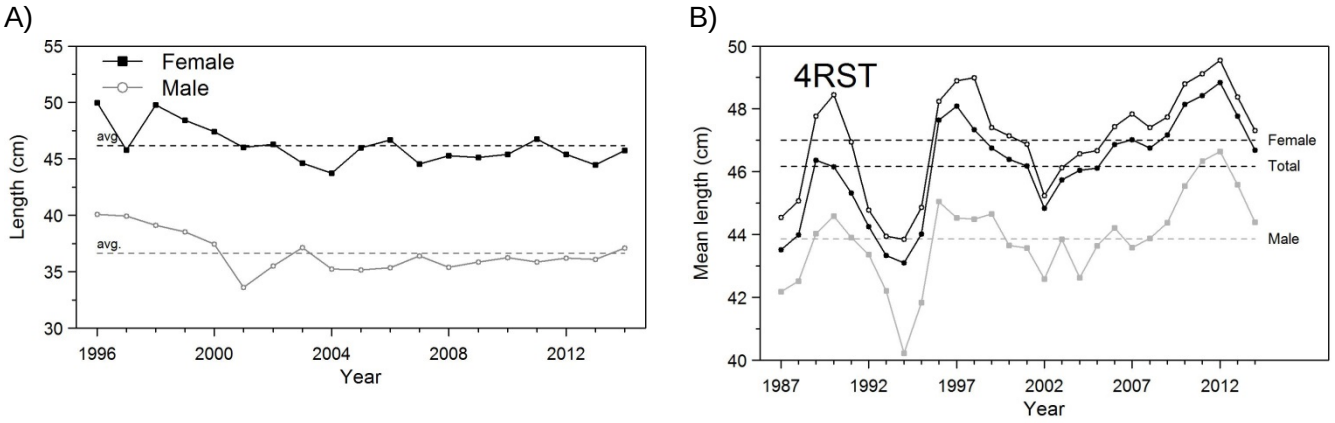


Figure 3. Size at 50% maturity for fish caught in the DFO research survey (A) and mean length of fish caught in gillnets commercial catches (B). The horizontal lines indicate the mean of the series.

Commercial Fishery Performance

With the exception of the Esquiman area, fishing effort increased in 2013 compared to 2012 in all sectors and throughout area 4RST. Landings, however, decreased in all areas (Figure 4). In 2014, fishing effort and landings increased in the western Gulf and decreased in the northern sectors of Anticosti and Esquiman. For all divisions of area 4RST, landings were higher and fishing effort lower than in 2013. However, 2014 landings were comparable to those of 2012 for a slightly greater fishing effort.

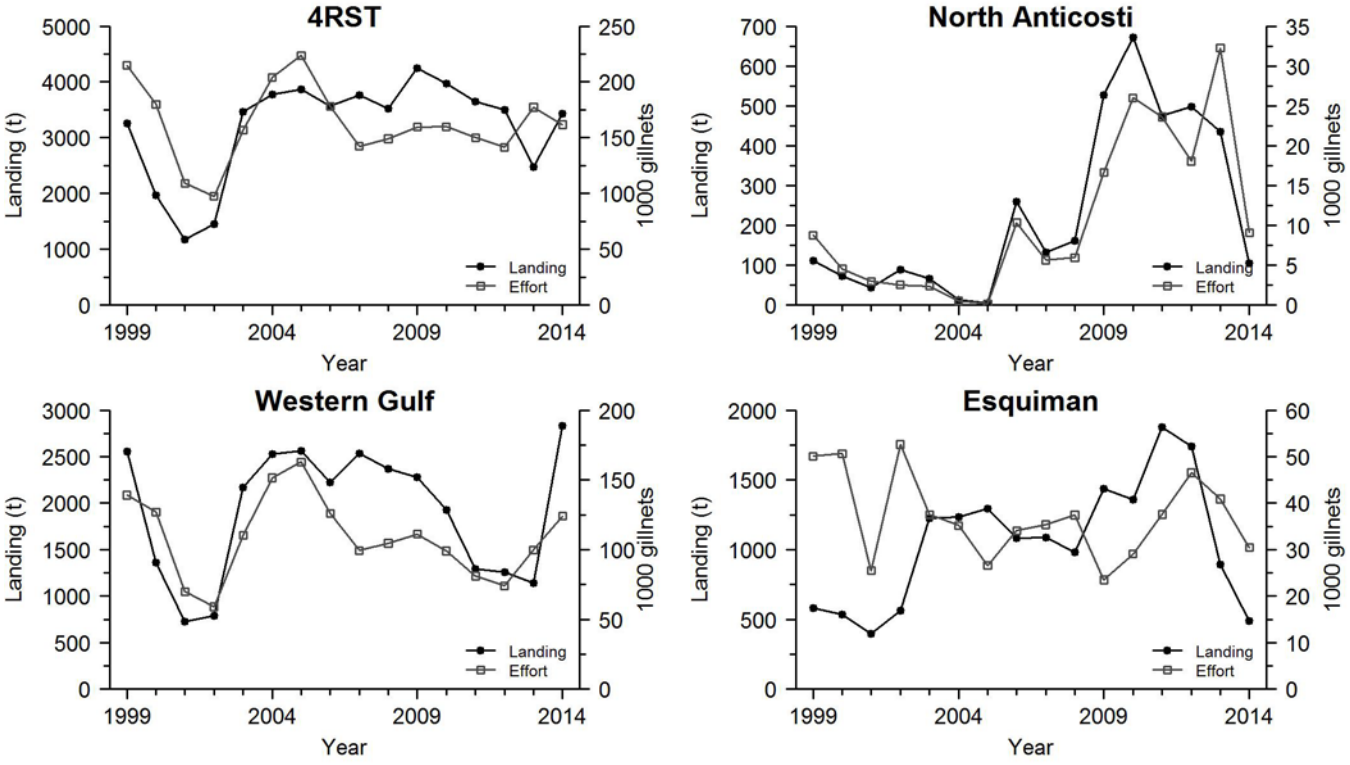


Figure 4. Landing and fishing effort for the Gulf (4RST) and per fishing sector.

In 2013, the effort was spread over a larger area (Figure 5). An expansion of the fishing effort eastward in the Laurentian Channel, as well as to the south and north of Anticosti Island, was observed. However, the fishing effort in the area southwest of Esquiman was lower in 2013 than in 2012. The spatial distribution of fishing effort changed significantly in 2014. Between 2012 and 2014, fishing effort increased by 67% in the western Gulf and declined by 50% and 35% in northern Anticosti and Esquiman, respectively. In the northern sectors of Anticosti and Esquiman, fishing effort was concentrated on a small area compared to previous years. The increase in effort in the western Gulf occurred mainly along the Gaspé Peninsula and in the Estuary.

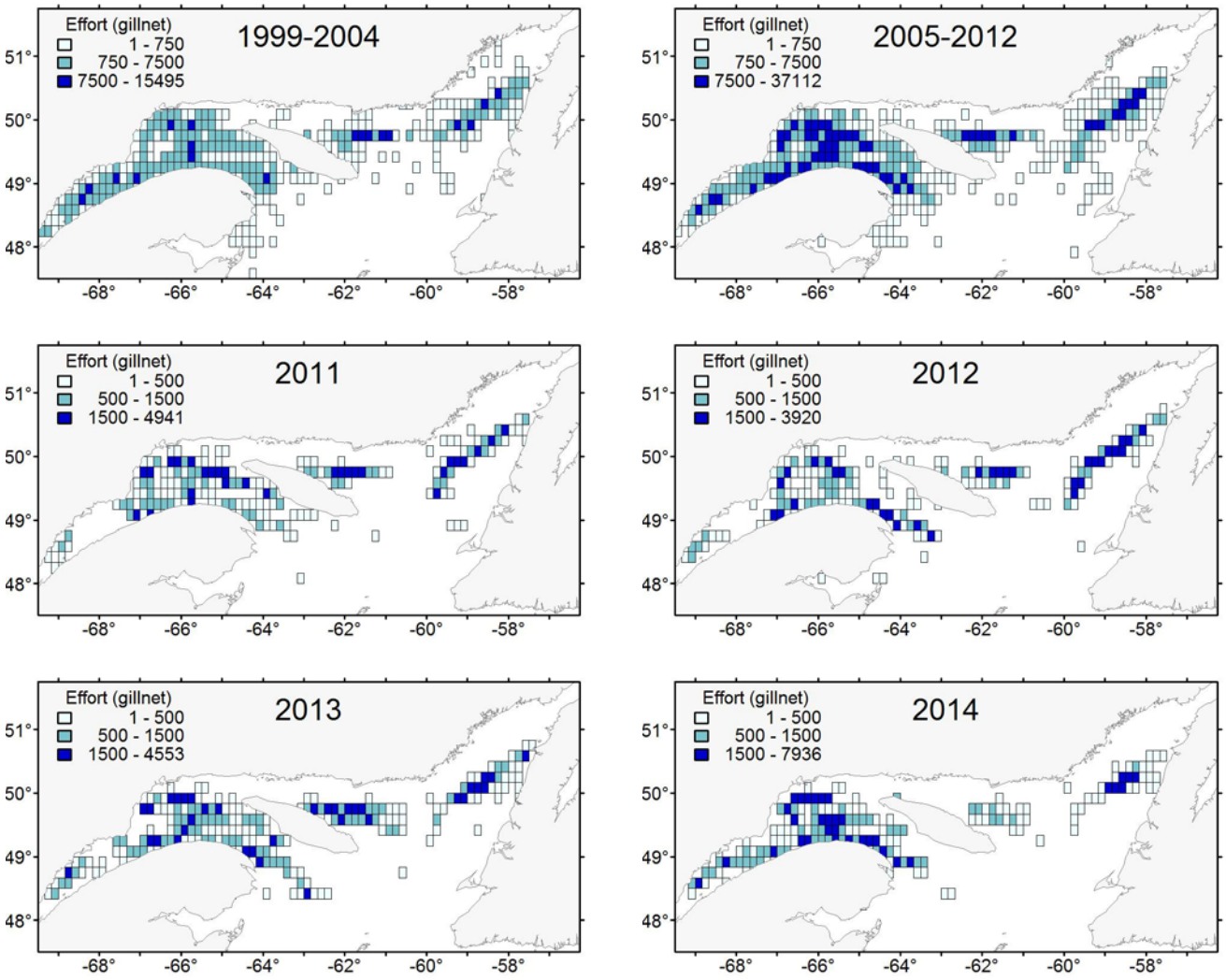


Figure 5. Distribution of the directed Greenland Halibut fishing effort, total number of gillnets hauled per statistical square by period 1999-2004 and 2005-2012 and annually from 2011 to 2014 (partial data, some catches are not geo-referenced).

The commercial catch rate is used as an index of fishery performance and not as an index of abundance of exploitable stock. This index is standardized to account for changes based on NAFO subarea, soak time and seasonal pattern.

The catch rate in 4RST declined by 42% in 2013 (Figure 6). This decline was observed in the three geographic fishing areas in the Gulf. In 2014, catch rates improved in the western Gulf, increasing by over 83% to one of their highest values observed since 1999. Conversely, the decline in catch rates

continued in the northern sectors of Anticosti and Esquiman. CPUEs declined by 61% and 68%, respectively, in the last two years. These downward trends have been observable since 2010 in northern Anticosti and since 2012 in Esquiman. In the Gulf as a whole, the 2014 CPUE is comparable to the average between 1999 and 2014.

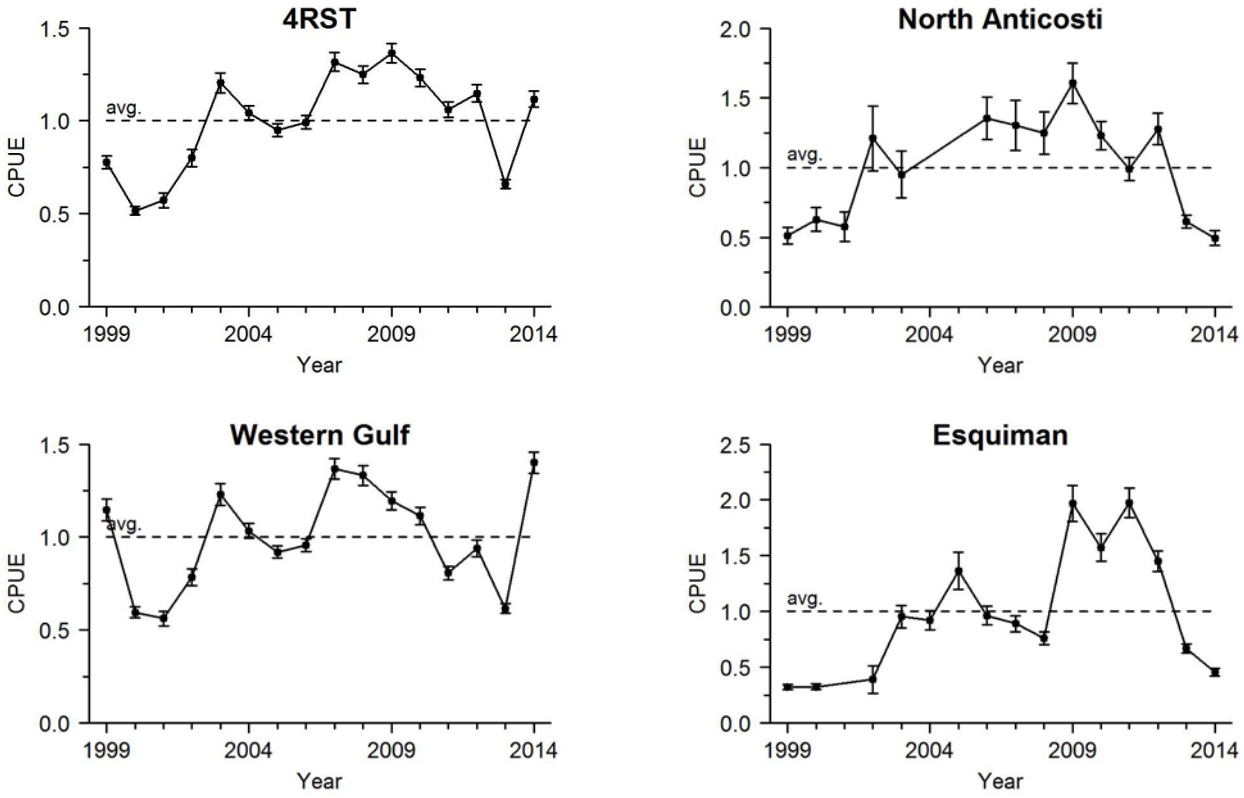


Figure 6. Standardized fishery indices for the Gulf (4RST) and per fishing sector.

Abundance Index

Biomass indices from DFO scientific surveys and sentinel surveys increased in 2014 after having declined in 2013 (Figure 7). The index from the DFO survey is slightly above the historical average and comparable to the estimated value in 2012. The downward trend observed by the sentinel fisheries from 2007 to 2013 was reversed in 2014, and the biomass index in 2014 is comparable to the historical average.

The abundance index of one-year-old fish (0–20 cm) in the DFO survey in 2014 is the highest in the historical series (Figure 8). This observation is not reflected in the sentinel fisheries survey because this survey does not cover the estuary and uses a trawl whose selectivity is very low for small fish. The abundance of two-year-old fish (20–30 cm) is above the average in the DFO survey and equal to the average in the sentinel fisheries survey. There was low abundance of fish between 30 and 40 cm in 2014 according to the two surveys. After declining in 2013, the abundance of fish over 40 cm (i.e. fish available to the fishery in 2015) increased in 2014 and is above the average abundance, according to the two surveys.

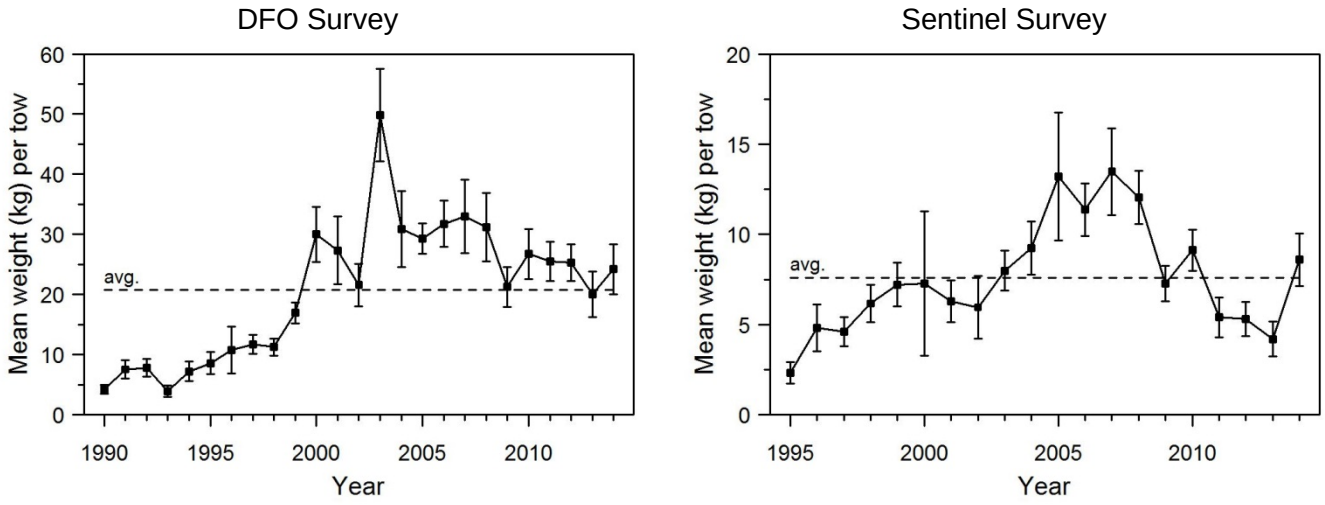


Figure 7. Minimum trawlable biomass indices estimated from the DFO research survey and the July Sentinel mobile survey.

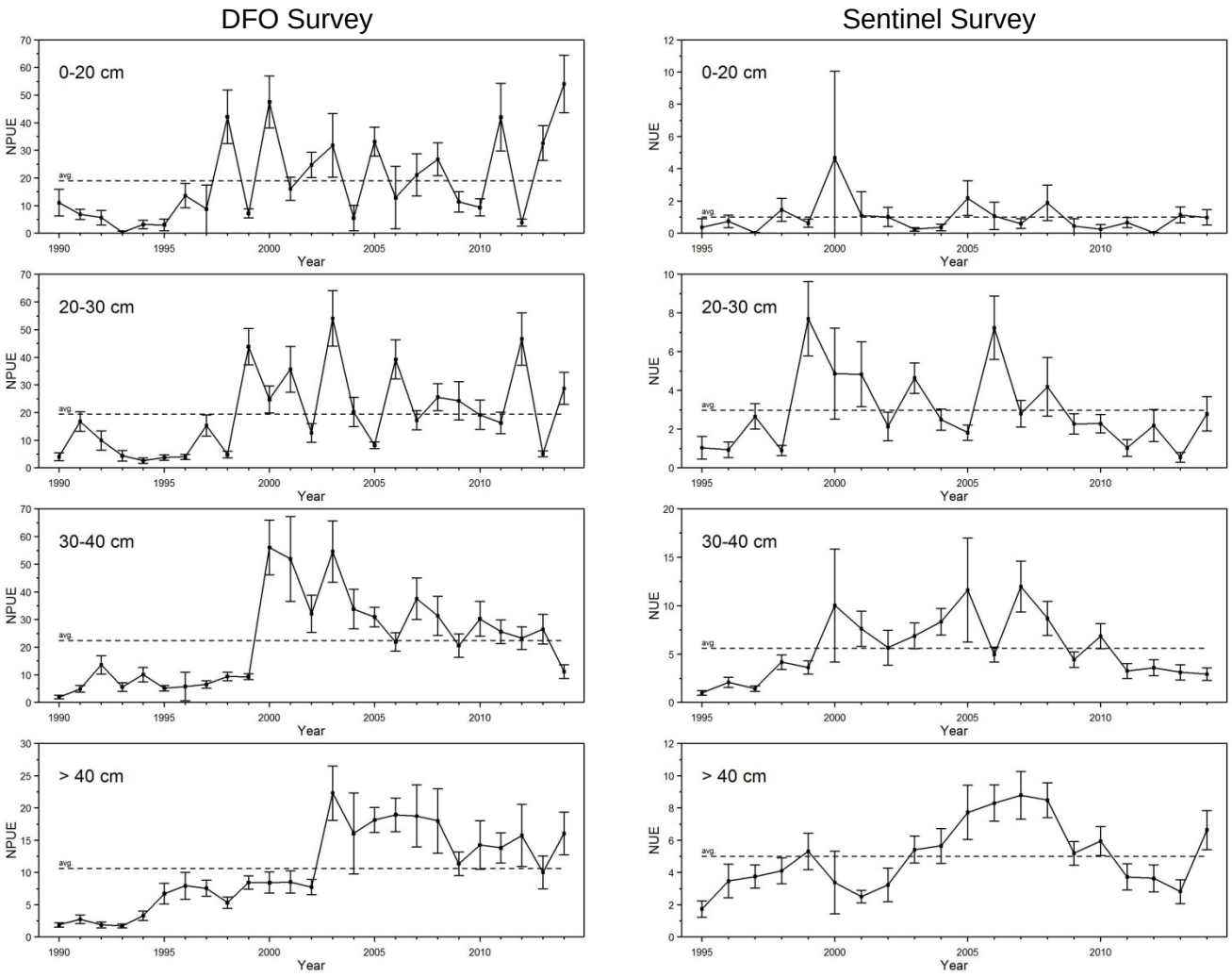


Figure 8. Abundance indices of Greenland Halibut for the different size categories observed in the DFO survey and Sentinel mobile survey.

The size frequency distribution in 2014 showed that the year-class 1 (15-20 cm), cohort of 2013, and the year-class 2 (20-30 cm), cohort of 2012, was more abundant than the average for the 1990-2013 period (Figure 9). The year-class 3 (30-37 cm), cohort of 2011, were few while the mean abundance of fish over three year-old (more than 37 cm) were above the average of the 1990-2013 period.

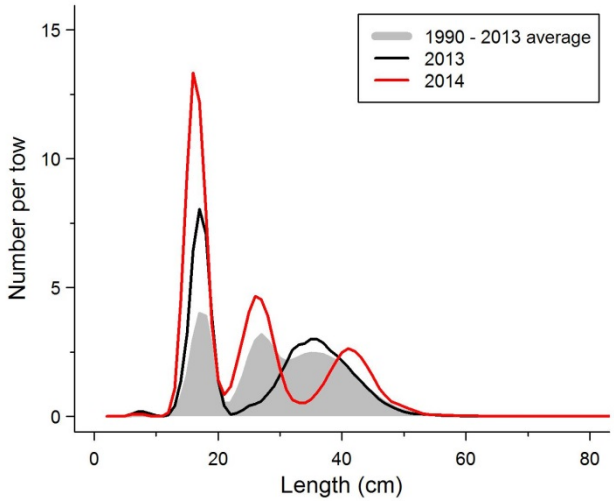


Figure 9. Length frequency distributions (mean number per 15 minutes tow) observed during the DFO survey for Greenland Halibut.

The condition index for fish over 30 cm increased in 2013 and 2014 and is above average (Figure 10). This increase could be explained by the arrival of new redfish cohorts in the Gulf, as they are significant prey for large Greenland Halibut. The condition index for two-year-old fish (25 cm) is stable, whereas the condition index for one-year-old individuals (15 cm) is low.

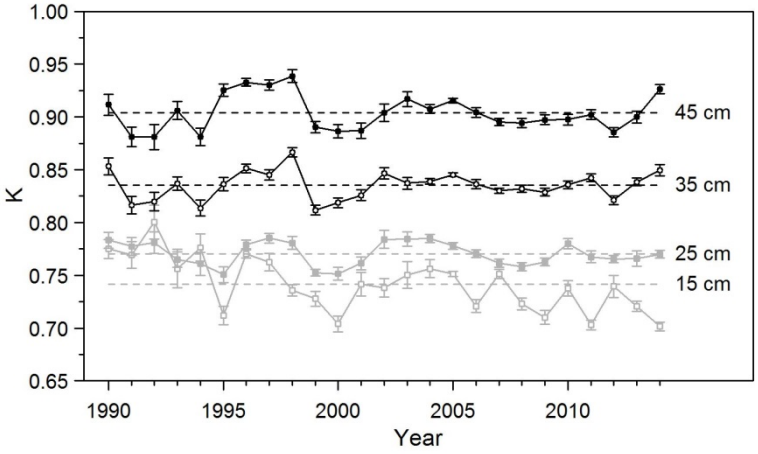


Figure 10. Fulton condition index by year for Greenland Halibut 15, 25, 35 and 45 cm measured during the DFO survey. The dotted lines represent the chronological series medians.

The pattern of distribution of Greenland Halibut observed in 2014 was similar to that which prevails since 2000 (Figure 11). The largest catch rates are found mainly in the Estuary and the western sector of Anticosti Island, and at the head of the Esquiman, Laurentian and Anticosti channels, at depths of over 200 m.

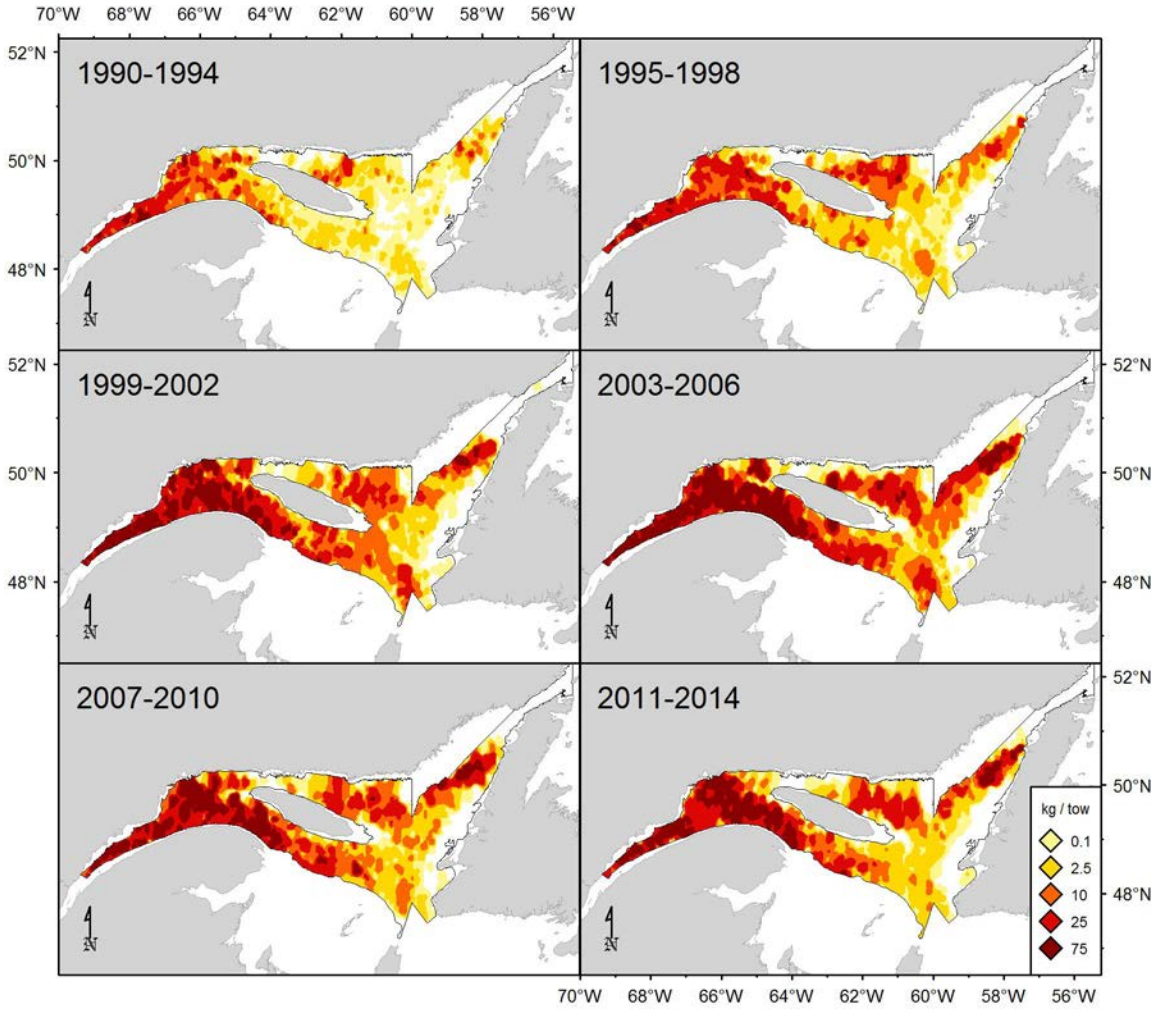


Figure 11. Greenland Halibut catch rates (kg/15 minutes tow) distribution during the DFO survey by period of 4 or 5 years.

An exploitation rate index is obtained by dividing the commercial catches in weight by the biomass of fish over 40 cm estimated in the research survey. This method cannot be used to estimate the absolute exploitation rate or to relate it to target exploitation rates. However, the method does make it possible to track relative changes over the years. In the Gulf, the exploitation rate has been relatively stable in recent years (Figure 12). However, in the northern sectors of Anticosti and Esquiman, there was an increase in exploitation rates from 2006 to 2013 and a significant decline in 2014. Conversely, the exploitation rate, which had declined from 2009 to 2012 in the western Gulf, increased in 2013 and is now comparable to that in the 2004–2011 period.

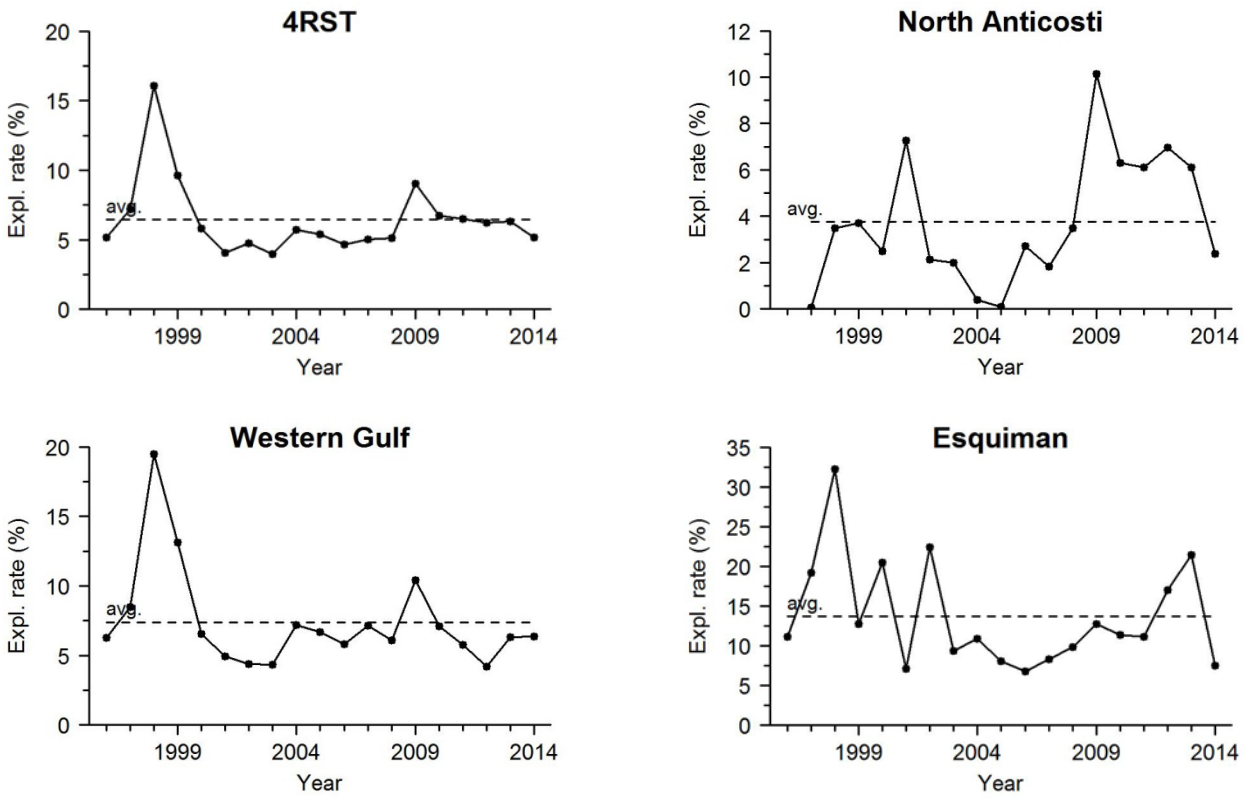


Figure 12. Index of the relative exploitation rate for the Gulf (4RST) and per fishing sector.

Perspectives

Juvenile abundance varies a lot from one year to the next. The strength of these annual year-classes, their growth, as well as environmental conditions influence stock abundance. These fluctuations of stock abundance have an impact on the fishery's success. According to growth estimates, females and males reach a size of 44 cm at age six and seven, respectively.

The 2008 and 2009 age classes that should contribute to the fishery in 2015 and 2016 are of low abundance (Figure 13). The strong 2010 cohort, the third strongest since 1990, will be recruited starting in 2016. The 2012 and 2013 cohorts are very strong and will be recruited to the fishery starting in 2018.

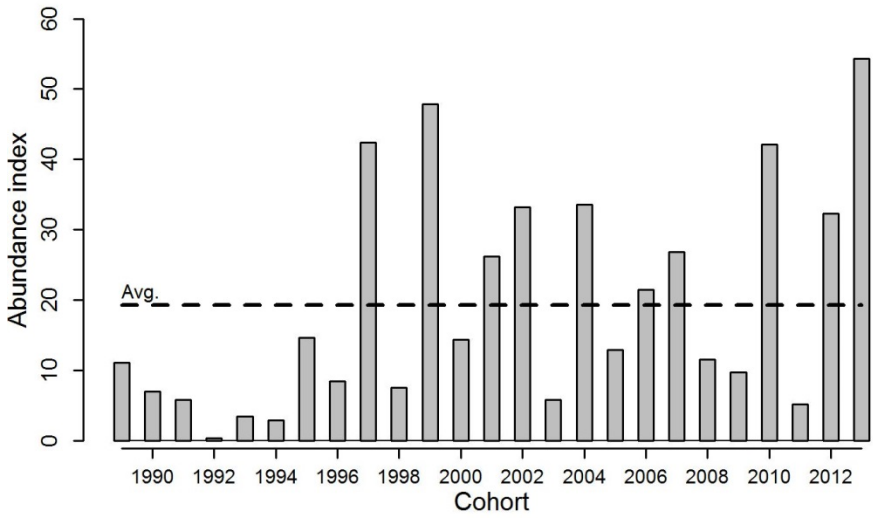


Figure 13. Recruitment index of Greenland Halibut measured for each cohort at age 1 on the DFO survey.

A new population dynamic model (SCALE) was used. This model, based on length data, provides an overview of the status of the population. The population's total and exploitable biomass and numbers have declined since 2008, but are still high compared to the series average. The increase in total biomass and numbers in 2014 is widely associated with the strong cohort of 2013. Projections indicate a decline in exploitable biomass and numbers for the 2015–2017 period for annual catches of 3,750 t in the fishery. An increase in exploitable biomass and numbers is predicted for 2018 with recruitment to the fishery of the 2012 cohort and partial recruitment to the fishery of the 2013 cohort.

Sources of Uncertainty

In 2013, the two primary sources of data used for the assessment of this stock (data from the commercial fishery and research surveys) showed similar trends and indicated a significant decline of the same order of magnitude in the abundance of commercial-size Greenland Halibut in 4RST. This decline was not anticipated in the previous assessment. However, in 2014, these indicators increased, and estimated values were comparable to those of 2012. Fluctuations in recruitment to the fishery cannot explain these sudden variations in abundance. This jump remains unexplained and is a source of unconfirmed theories.

Locally, in northern Anticosti and at the head of Esquiman, we observe a decrease in catches, CPUE and biomass. A combination of factors could explain these decreases, such as the increased exploitation rate from previous years and higher deep water temperature.

CONCLUSIONS AND ADVICE

In the short term, there is likely to be a slight decrease in abundance for commercial size fish, but in the medium term, the forecast is more optimistic. The landings of the past 10 years have helped maintain a stable exploitation rate. The SCALE model projection indicates that exploitation biomass will remain stable, with an annual landing of 3,750 t for the next two seasons.

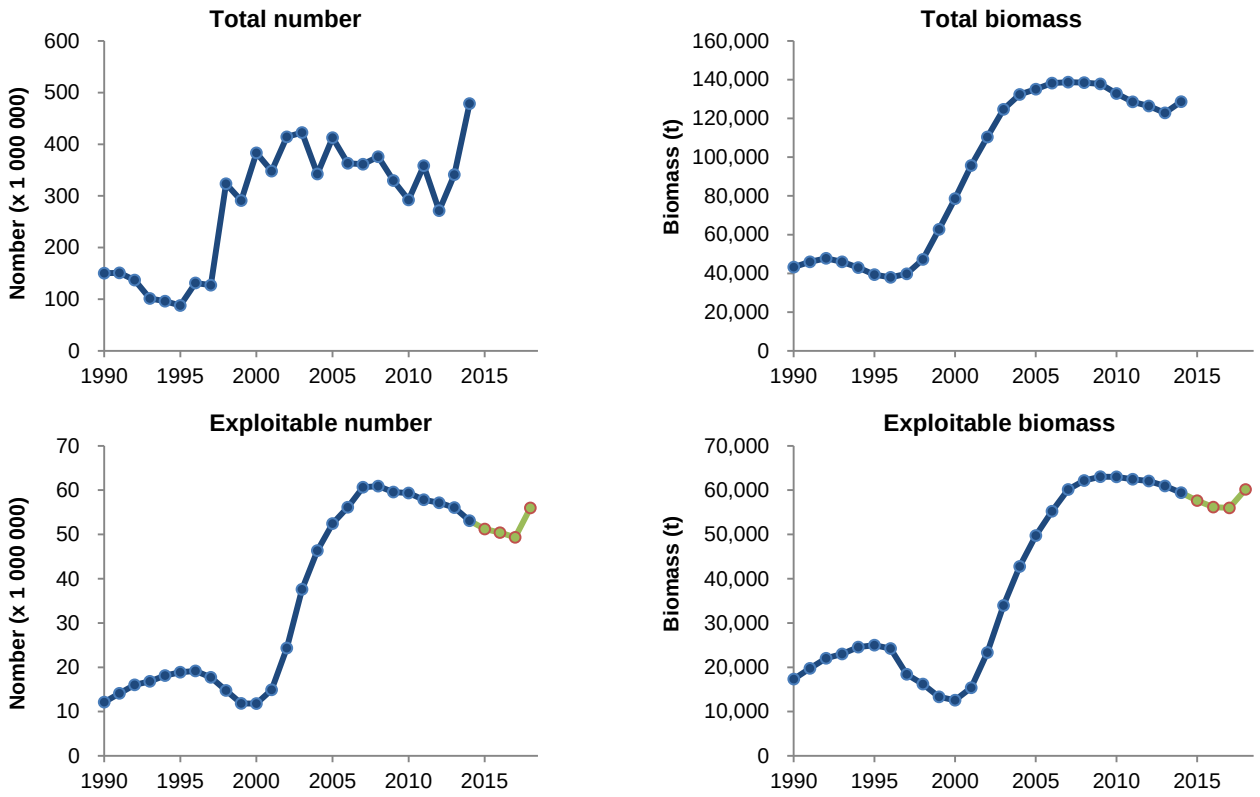


Figure 14. Total and exploitable number and biomass estimated by population dynamic model SCALE for 1990 to 2014 and projections for 2015 to 2018.

OTHER CONSIDERATIONS

The shrimp fishery is carried out using small-meshed trawls that catch and retain several fish and marine invertebrate species. Although large fish are released from trawls due to the mandatory use of a separator grate, catches still contain a certain number of small specimens. Greenland Halibut by-catches from the shrimp fishery from 2000 to 2013 were examined using the observers at sea database. Greenland Halibut were present on average in 89% of the activities observed. Greenland Halibut by-catches are mostly of the order of 3 kg or less per tow and are mostly made up of 1 year-old individuals, and in a lesser extent 2 year-old individuals. The average annual Greenland Halibut by-catches from the shrimp fishery in the Estuary and Gulf from 2000 to 2013 are around 85 tons. In 2013, there were estimated at 97 t of Greenland Halibut, representing approximately 0.79% of the estimated biomass of small turbot from the DFO survey.

In recent years, the temperature of deep waters has increased for the entire Gulf. The warming of waters at 300 m observed in the northwestern and central Gulf for the past three to four years should persist for another one to two. The colder temperature at the same depth in the estuary in recent years has now returned to normal and should increase in the next three to four years. Waters flowing in through Cabot Strait continue to be warmer than normal, which should contribute to maintaining warmer waters at 200 m and 300 m in the Gulf in the coming years. To the north of Anticosti and Esquiman, turbot were found on average at temperatures of over 6°C, or more than 1°C above the average between 1990 and 2014. These temperature changes may have an impact on Greenland Halibut population dynamics through, among other things, effects on growth, reproduction, trophic relationships and spatial distribution.

SOURCES OF INFORMATION

This Science Advisory Report is from the meeting of February 18, 2015 on the Assessment of the Gulf of St. Lawrence (4RST) Greenland halibut. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Bernier, B. and Chabot, D. 2012. *Évaluation de l'état du stock de flétan du Groenland (Reinhardtius hippoglossoides) du golfe du Saint-Laurent (4RST) en 2010 et description de son régime alimentaire*. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/140, 93 p.

Bourdages, H., Brassard, C., Desgagnés, M., Galbraith, P., Gauthier, J., Lambert, J., Légaré, B., Parent, E. and Schwab P. 2015. Preliminary results from the groundfish and shrimp multidisciplinary survey in August 2014 in the Estuary and northern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/115. v + 96 p.

Bourdages, H., and Marquis, M.C. 2014. Assessment of Northern Shrimp stocks in the Estuary and Gulf of St. Lawrence in 2013: commercial fishery data. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/051. v + 90 p.

Galbraith, P.S., Chassé, J., Nicot, P., Caverhill, C., Gilbert, D., Pettigrew, B., Lefaivre, D., Brickman, D., Devine, L., and Lafleur, C. 2015. Physical Oceanographic Conditions in the Gulf of St. Lawrence in 2014. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/032. v + 82 p.

THIS REPORT IS AVAILABLE FROM THE:

Centre for Science Advice (CSA)
Quebec Region
Fisheries and Oceans Canada
Maurice Lamontagne Institute
P.O. Box 1000
Mont-Joli (Quebec)
Canada G5H 3Z4

Telephone: (418) 775-0825
E-Mail: bras@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-5087

Correct Citation for this Publication:

DFO. 2015. Assessment of Greenland Halibut in the Gulf of St. Lawrence (4RST) in 2014. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/056.

Aussi disponible en français :

MPO. 2015. Évaluation du flétan du Groenland du golfe du Saint-Laurent (4RST) en 2014. Secr. can. de consult. sci. du MPO, Avis sci. 2015/056.