Fisheries and Oceans Canada | Pêches et Océans Canada
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Canadian Science Advisory Secretariat
Quebec Region | Science Advisory Report 2019/038

STOCK ASSESSMENT OF GULF OF ST. LAWRENCE (4RST) ATLANTIC HALIBUT IN 2018

Atlantic halibut (Hippoglossus hippoglossus)
Photo: DFO, Claude Nozères

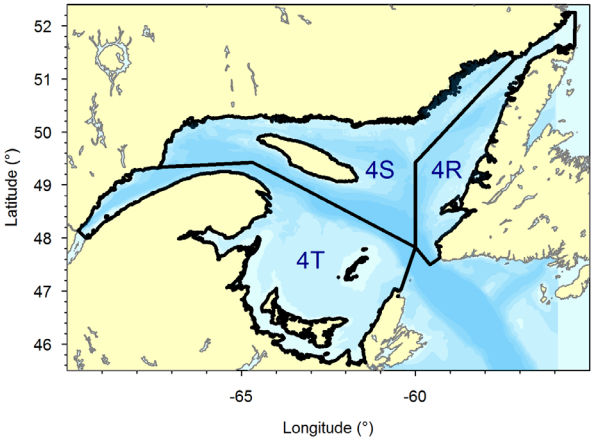

Figure 1. Atlantic halibut stock management area in the Gulf of St. Lawrence.

Context

The Atlantic halibut commercial fishery in the Gulf of St. Lawrence began at the end of the 19th century. During the first half of the 20th century, this resource was exploited by American and Canadian fleets. Since the second half of the 20th century, the species has been exploited almost exclusively by the Canadian fleet from the four Atlantic provinces as well as Quebec. From over 650 t during the 1960s, landings steadily decreased until the early 1980s, totalling 91 t in 1982. Landings increased again in the late 1990s and are now approaching 1,300 t, the highest level recorded in the past 60 years.

The current Gulf Atlantic halibut stock management unit (Figure 1), Northwest Atlantic Fisheries Organization (NAFO) divisions 4RST, was defined in 1987. In 1988, Fisheries Management introduced the first total allowable catch (TAC), followed in 1997 by a minimum legal size. The Atlantic halibut directed fishery is carried out by longliners on a competitive basis or by Individual Transferable Quota (ITQ).

Assessment of the resource is conducted every two years in order to highlight changes in the status of the resource that would justify adjustments to the conservation measures and management plan. The current assessment puts into perspective the available information from fishery statistics, commercial catch sampling and scientific survey data.

This Science Advisory Report is from the February 18–19, 2019, meeting in Mont-Joli, Quebec, on the Assessment of the Gulf of St. Lawrence (4RST) Atlantic Halibut. Participants in the science review included representatives of DFO Science, DFO Fisheries Management, the fishing industry, provincial governments and Indigenous organizations as well as university researchers. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- Atlantic halibut landings have been increasing since the early 2000s and have reached the highest values since 1960. For the 2017-2018 and 2018-2019 management years, preliminary landings are respectively 1,269 t and 1,089 t. There is no reason to believe that the TAC of 2018-2019 (1,297 t) will not be met.
- The catch per unit effort of the Atlantic halibut longline fishery increased from an average of 100 kg per 1,000 hooks in the years 2000 to 500 kg per 1,000 hooks in 2018.
- The abundance of Atlantic halibut prerecruits (65 to 85 cm) estimated by the scientific surveys with bottom trawls in 2017 and 2018 is among the highest values of the historical series.
- The abundance of Atlantic halibut of commercial sizes (greater than 85 cm) estimated by the scientific surveys with bottom trawls in 2017 and 2018 is among the highest values of the historical series.
- Potential winter reproductive areas for Atlantic halibut have been located a depths greater than 300 m in the Gulf's channels.
- Two years of longline survey and tagging of Atlantic halibut were successfully completed. Results from this collaboration between DFO and industry should contribute to the next Atlantic halibut stock assessment planned for 2021.
- The short and medium term outlook for the Atlantic halibut stock of the Gulf of Saint Lawrence is positive. The exploited component of the stock is at its highest historical level and recruitment to the fishery should remain high in the next years. However, the exploitation rate of this stock still remains unknown.

INTRODUCTION

Species biology

Atlantic halibut can be found throughout the lower estuary and Gulf of St. Lawrence. Figure 2 shows the distribution of catches made during mobile gear fishery-independent surveys between July and September. According to the figure, the probability of capture is higher on the channel banks at depths near 200 m, and around the 35 m isobath in the southern Gulf of St. Lawrence. Potential breeding areas were identified through geolocation by modelling locations where tagged fish made rapid vertical migrations likely associated with spawning. These behaviours were observed between mid-January and mid-March at depths greater than 300 m in the Gulf channels (Figure 3).

The mean annual male and female growth rate of Gulf Atlantic halibut was evaluated at 7.5–9.5 cm. However, females reach a larger maximum size than males. The size at which 50% of Atlantic halibut reach sexual maturity (L_{50}) is estimated at 130 cm for females and 92 cm for males.

In the Gulf of St. Lawrence, halibut of < 20 cm eat mostly shrimp, krill and other small invertebrates. Halibut 20–40 cm long eat shrimp and krill as well as cephalopods (octopus, squid), small crabs and small fish (small redfish, snake blenny, capelin and small cod). Halibut over 40 cm in length eat snow crab and fish, the most important being cod, redfish, herring, fourbeard rockling and turbot.

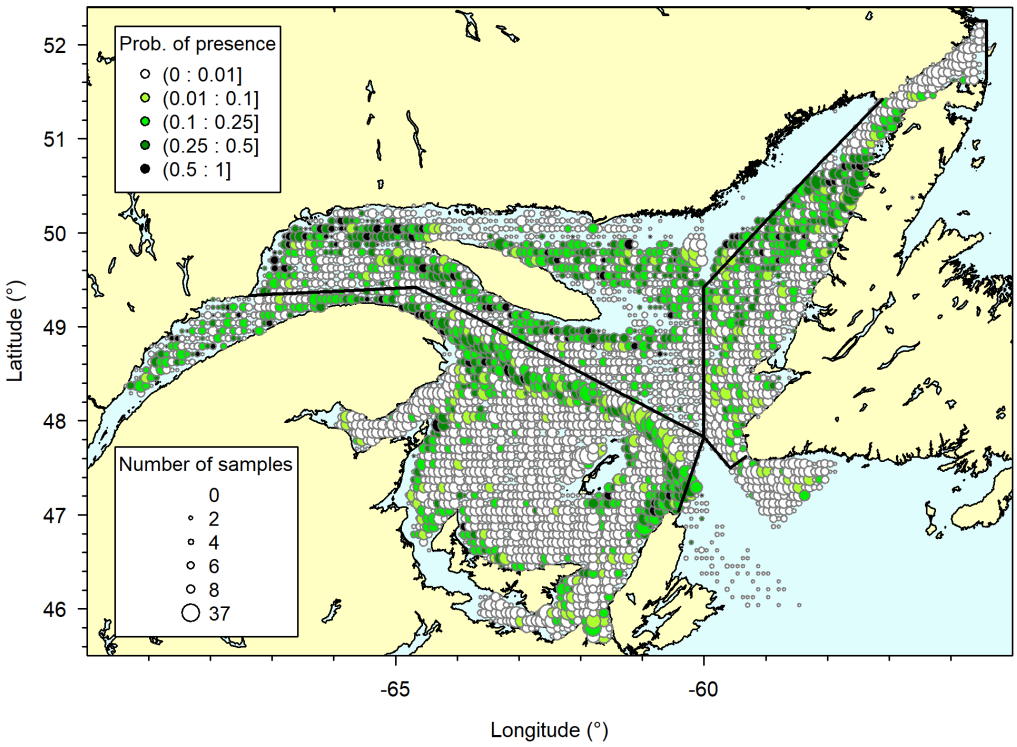

Figure 2. Probability of occurrence of Atlantic halibut in catches made during mobile gear research surveys, per 5-minute square. All available years for each survey are considered, and they vary depending on the survey.

It is noted that Atlantic halibut harvested after 2010 had fuller stomachs (more food in the stomach for a given length of fish) than they did from 1995 to 2010. While the level of invertebrate consumption has not varied since 1995, fish consumption levels have increased. The most commonly consumed fish in recent years have been cod and redfish. Very large halibut also feed on turbot, although consumption of this fish has decreased since 2010. It is also noted that halibut caught at depths of less than 100 m had fuller stomachs than halibut caught at depths greater than 100 m, this difference being attributable to higher consumption of shallow water fish, particularly herring, cod and various flatfish (excluding turbot).

Description of the fishery

The Gulf of St. Lawrence Atlantic halibut stock supported annual landings of 600 t in the early 1960s (Figure 4). Landings then decreased to hit a record low of 91 t in 1982. Total allowable catches (TACs) were established in 1988 and were reached on only four occasions between 1988 and 2004. Since 2004, TACs have been reached every year. Landings reached their highest levels in the past 60 years in 2017 and 2018 at nearly 1,300 t. In recent years, the TAC has been divided among 13 fleets in Quebec and the four Maritime provinces, 9 with fixed gear and 4 with mobile gear. Fixed gear fleets conduct a directed Atlantic halibut fishery, while catches by mobile gear fleets are bycatch.

A number of management measures have been implemented over the years to protect the Atlantic halibut. In 1997, a minimum legal size (MLS) of 81 cm was incorporated into the Atlantic halibut commercial fishing licence conditions. The MLS was increased to 85 cm in 2010. All Atlantic halibut smaller in size must be returned to the water. There are other existing management measures, such as a dockside commercial catch monitoring program (100%), at-

sea coverage by observers (percentage varies by fleet), mandatory logbooks (except for vessels < 10.67 m in Newfoundland), predetermined fishing periods, limits on the size and maximum number of hooks allowed per line, bycatch protocols and, for large longliners in Quebec, a vessel monitoring system (VMS). Finally, a quota reconciliation program has been in effect since the 2011 fishing season. Consequently, any fleet exceeding its quota in the fishery in a given year is subject to a quota reduction the following management year corresponding to its quota overage.

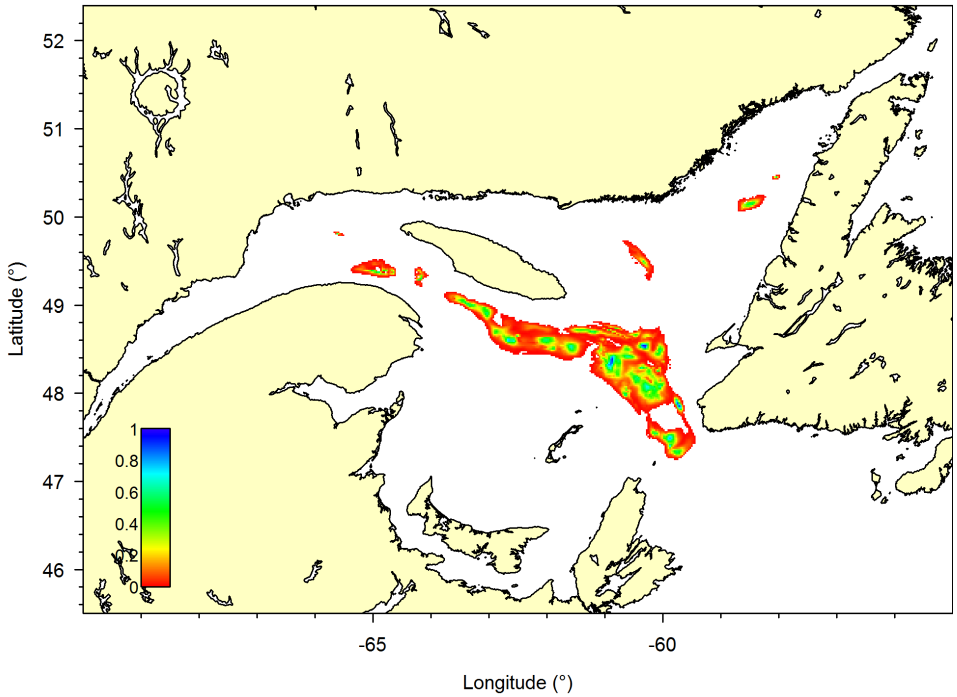

Figure 3. Distribution of the density of the probabilities of the presence of 35 Atlantic halibut in which reproductive behaviour is presumed, between mid-January and mid-March of 2014–2018.

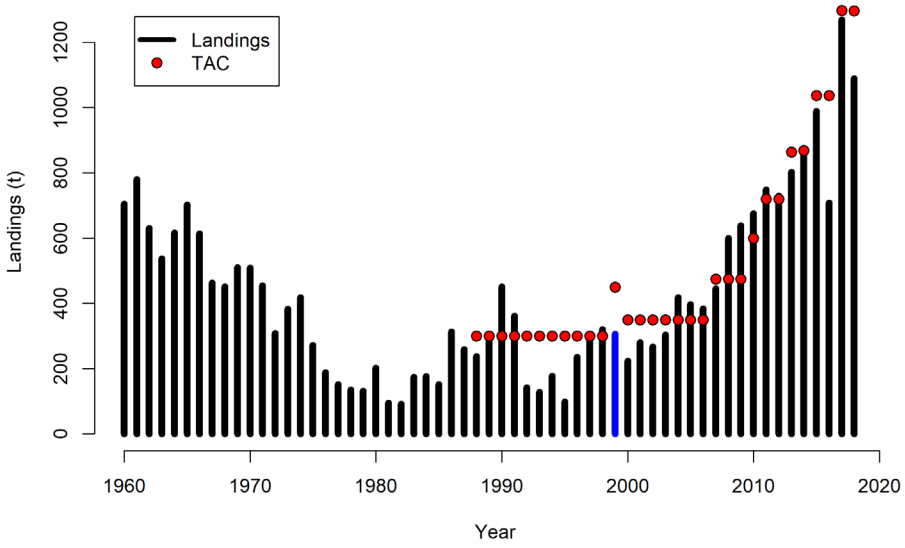

Figure 4. Atlantic halibut landings (t) and TACs by fishery management year for NAFO divisions 4RST. Data for 2016 to 2018 are preliminary. In 1999, the management year was changed from the calendar year to the quota year (May 15 of each year to May 14 of the following year).

Since 2010, more than 98% of Atlantic halibut landings have been made by the fixed gear fleet, primarily longliners as part of the Atlantic halibut directed fishery (Table 1). The fixed gear Greenland halibut and cod directed fishery are the two main fisheries responsible for Atlantic halibut bycatches (Table 2).

Table 1. Average commercial landings (t) of Atlantic halibut by type of fishing gear

Management Year	Longline	Gillnet	Other	Unknown	Total
1993–1999	161.8	23.8	22.1	17.4	225.1
2000–2009	350.2	42.9	14.8	0.2	408.0
2010–2016[1]	754.4	75.4	11.4	0.1	841.3
2017–2018[1]	1202.4	54.9	13.6	4.6	1275.4
2018–2019[1]	851.9	113.8	5.7	0.0	971.4

[1]: Preliminary data as at December 31, 2018.

Table 2. Average annual commercial landings (t) of Atlantic halibut from various directed fisheries.

Management Year	Atlantic Halibut	Greenland Halibut	Cod	Other	Unknown	Total
1993–1999	109.7	6.1	8.0	10.8	90.5	225.1
2000–2009	284.6	36.1	54.0	11.1	22.2	408.0
2010–2016[1]	720.9	73.0	32.5	13.7	1.2	841.3
2017–2018[1]	1175.2	48.5	38.7	12.9	0.0	1275.4
2018–2019[1]	881.9	55.6	28.4	5.6	0.0	971.4

[1]: Preliminary data as at December 31, 2018.

The distribution of Atlantic halibut catches in 2017 and 2018 (Figure 5) shows that these catches were made at about the 200 m isobath on the slope along the Esquiman, Anticosti and Laurentian channels and at a depth of about 35 m on the north side of Prince Edward Island, on the Miscou bank and around the Magdalen Islands. It should be noted that only 70% of the catches could be associated with a geographic location. As a result, catches from some fleets may be entirely absent from the maps, notably along the west coast of Newfoundland.

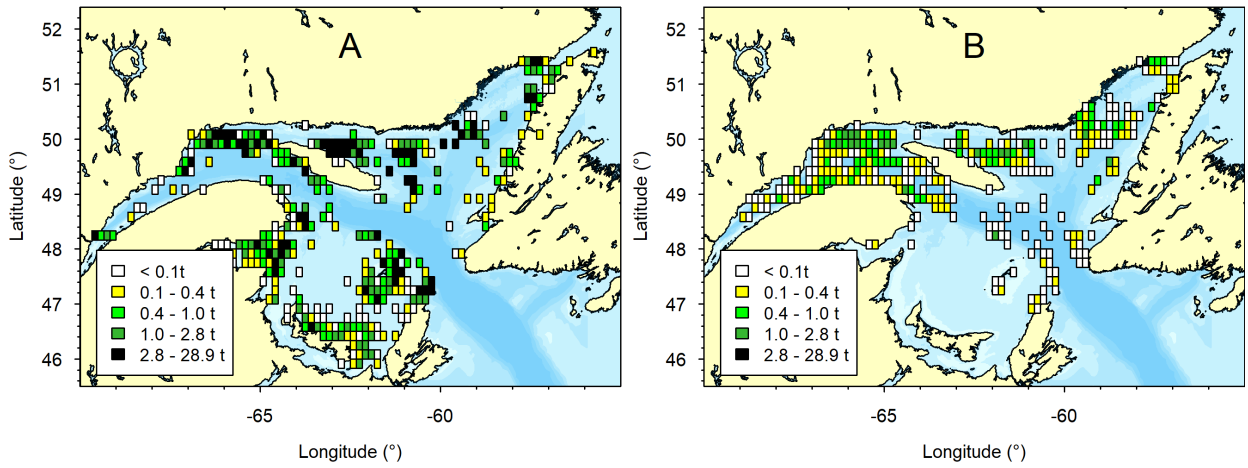

Figure 5. Distribution of Atlantic halibut catches per 10-minute square for the 2017–2018 and 2018–2019 fishing seasons combined, according to whether the target species is Atlantic halibut (A) or another species (B). Data are preliminary and 70% of catches are geolocated.

RESOURCE ASSESSMENT

Assessment of the Atlantic halibut stock status is based primarily on analysis of fishery-independent research surveys and commercial fishery data. Three research surveys with trawls are conducted annually in the Gulf between July and September. Two are conducted aboard a DFO vessel and the third by the sentinel fishery program. Commercial fishing data are taken from three different sources: purchase slips, fishers' daily logbooks and commercial catch samples collected at sea and dockside.

Size structures

Data from the two DFO surveys (Figures 6A and B) conducted in the northern and southern Gulf of St. Lawrence (nGSL and sGSL, respectively) and the sentinel fishery program survey in the nGSL (Figure 6C) consistently suggest the existence of cohorts of variable strength. The presumed trajectory of some cohorts shows that the expected age of individuals available to the fishery (85 cm) is about 10 years, for average growth of 8.5 cm per year.

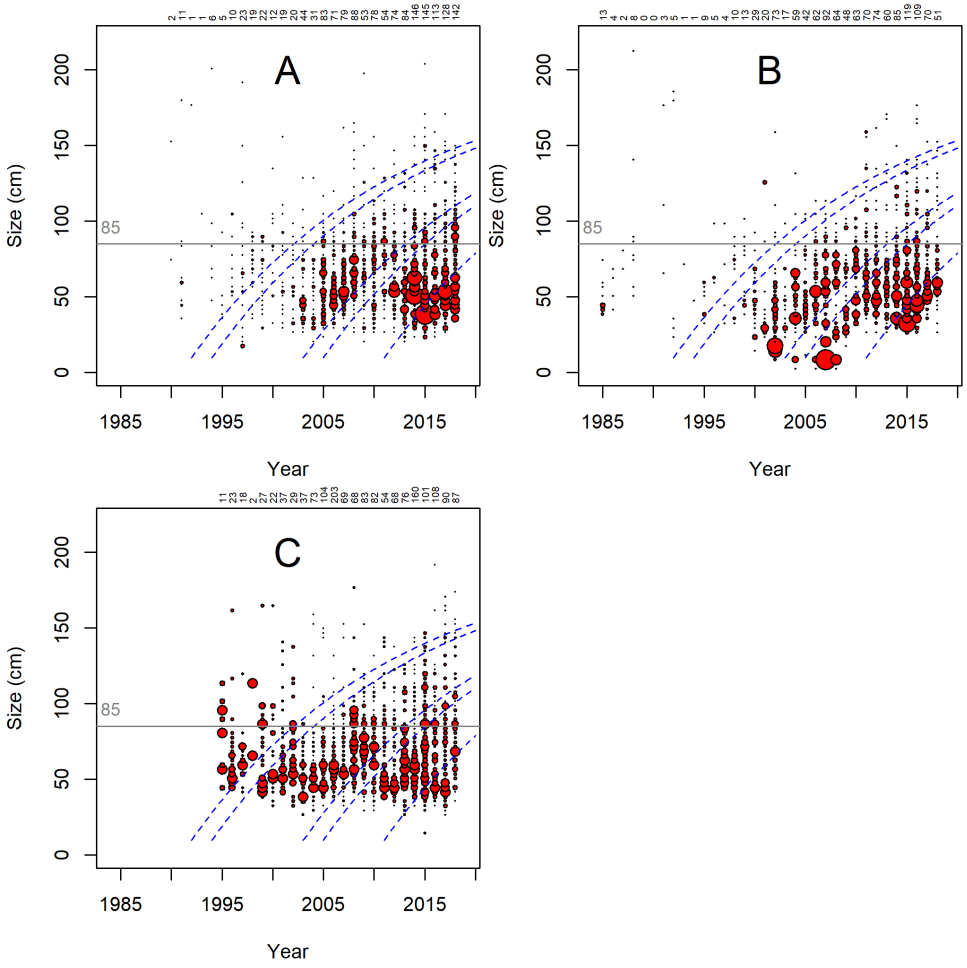

Figure 6. Atlantic halibut size frequency distributions for the surveys conducted using a DFO vessel in the nGSL (A) and sGSL (B) and the mobile gear sentinel fishery program in the nGSL (C). The diameter of each bubble is proportional to the number of individuals caught per 3-cm size class (A and B) and standardized by dividing by the number of measured individuals in the most abundant size class of the year (C). The total number of individuals sampled per year is indicated at the top of the graph. The dotted lines highlight the presumed trajectory of selected cohorts, and the minimum legal size in effect in 2018, 85 cm, is shown in grey.

The size frequency distributions of commercial catches sampled at sea show a slight variation in the size of Atlantic halibut fished with longlines before 2014 (Figure 7A) and an increase in the size caught from 2014 onward. The proportion of Atlantic halibut smaller than 110 cm was 80% until 2015 and has decreased to 60% since 2015. Gillnet catch sizes are smaller than longline catch sizes, and modal values are more variable over the years (Figure 7B). Figure 7C shows that once a catch is landed at the wharf, fish smaller than the MLS in force are virtually absent from the samples.

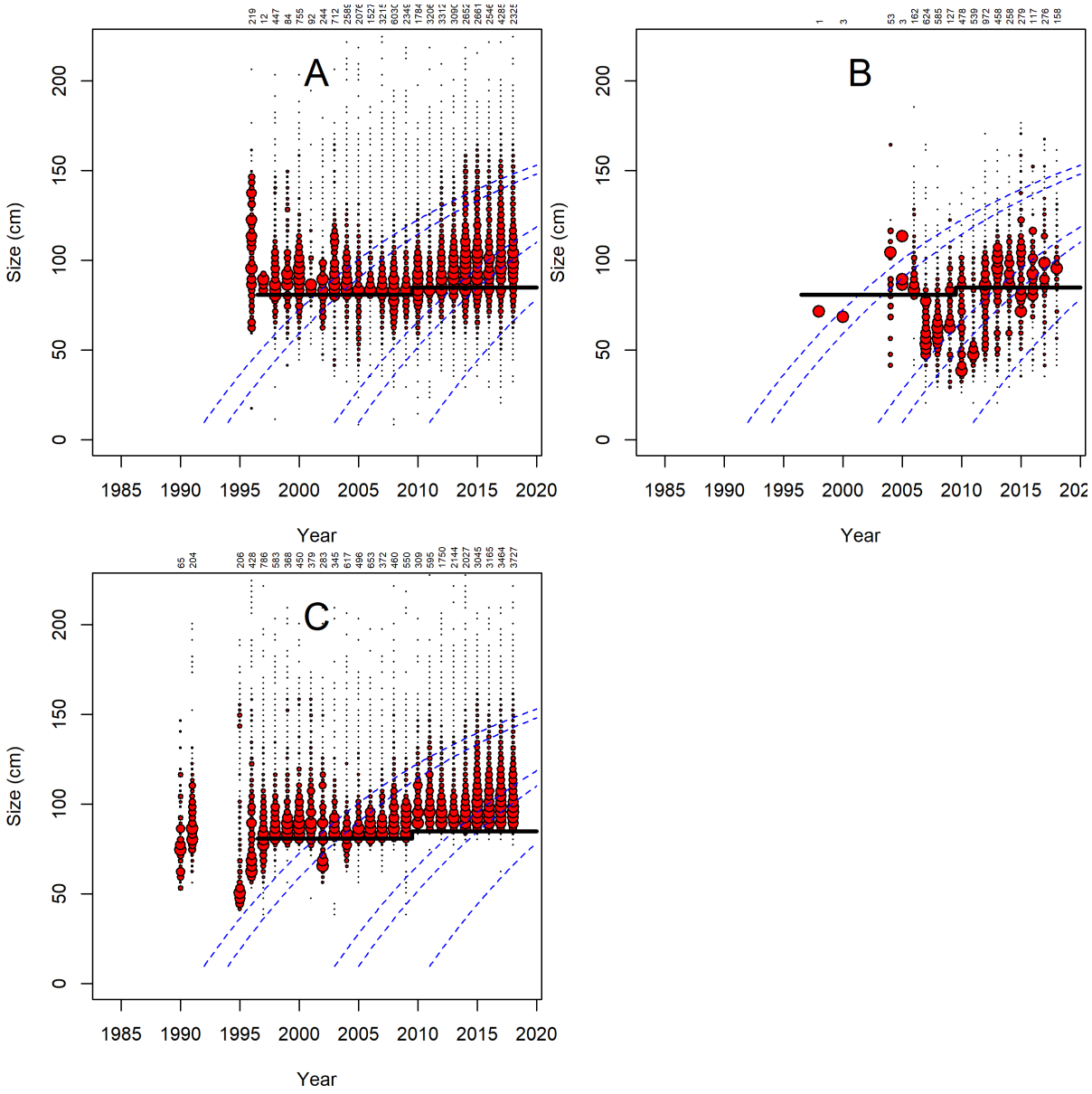

Figure 7. Distribution of Atlantic halibut size frequencies for commercial catches sampled during the at-sea observer program in the (A) longline and (B) gillnet fisheries as well as for commercial catches sampled at dockside (all gear types combined). The diameter of each bubble is proportional to the number of individuals measured for the 3-cm size class and standardized by dividing by the number of measured individuals in the most abundant size class of the year. The total number of individuals sampled per year is indicated at the top of the graph. The dotted lines highlight the presumed trajectory of selected cohorts, and the minimum legal size in force is shown in black.

In the catches sampled at sea, the proportion of fish smaller than 85 cm decreased by more than 60% between 2007 and 2018 in the longline and gillnet fisheries (Figure 8A), while the proportion of individuals larger than 130 cm increased for both gear types, approaching 25% in 2017 and 2018 for the longline fishery (Figure 8B).

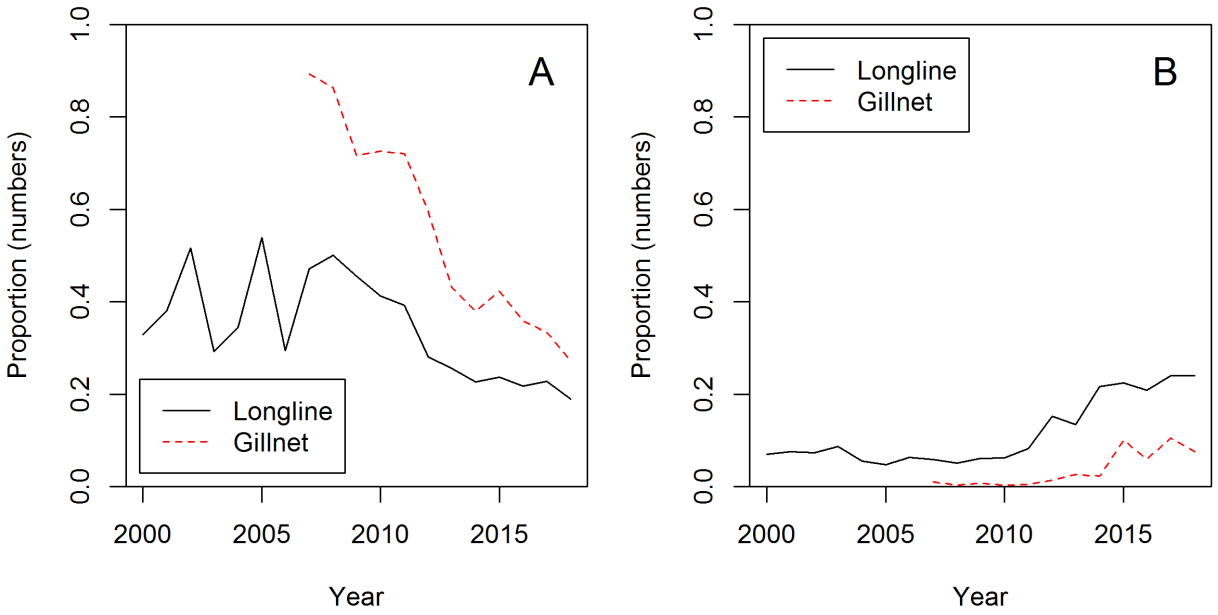

Figure 8. Proportion of Atlantic halibut smaller than 85 cm (A) and larger than 130 cm (B) caught by gear type, by year.

Abundance indices from commercial fishery-independent surveys

In 2017 and 2018, the catch rates in number per tow in commercial fishery-independent surveys were among the highest in the historical series, and recent trends are stable or increasing among both pre-recruits (65–85 cm, Figure 9) and fish larger than 85 cm (Figure 10). For all these surveys, the magnitude of the confidence intervals generally does not allow the increase in these abundance indicators to be considered significant. However, the consistency among the various surveys and years suggests that the increase in indicators during the past 15 years is not a sampling artifact and instead reflects an increase in the abundance of the size classes monitored.

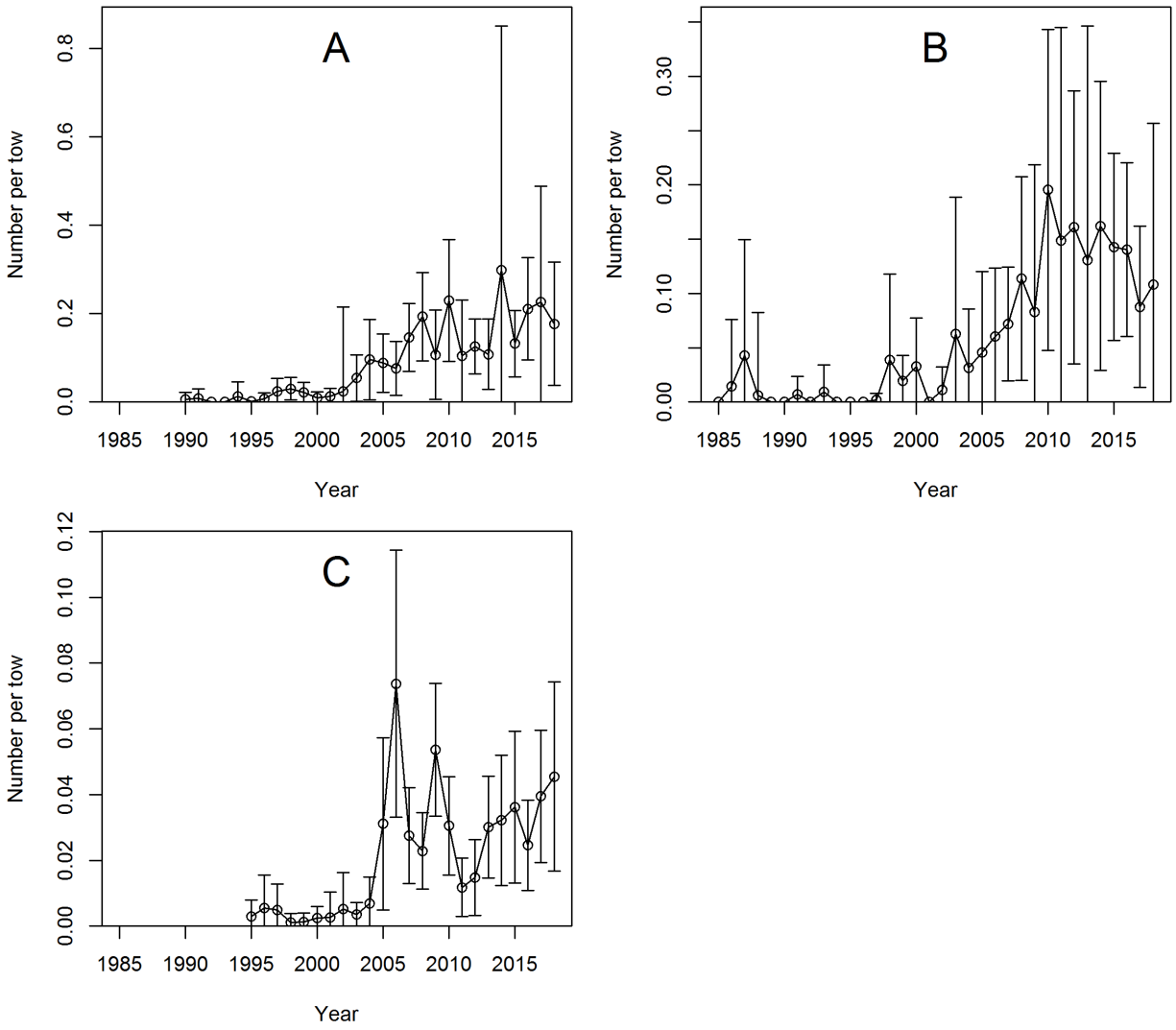

Figure 9. Average number of fish taken per tow measuring 65–85 cm as observed in 3 fishery-independent surveys: DFO research vessel surveys in the nGSL (A) and sGSL (B) and the sentinel fishery program survey in the nGSL (C). The 95% confidence intervals are shown.

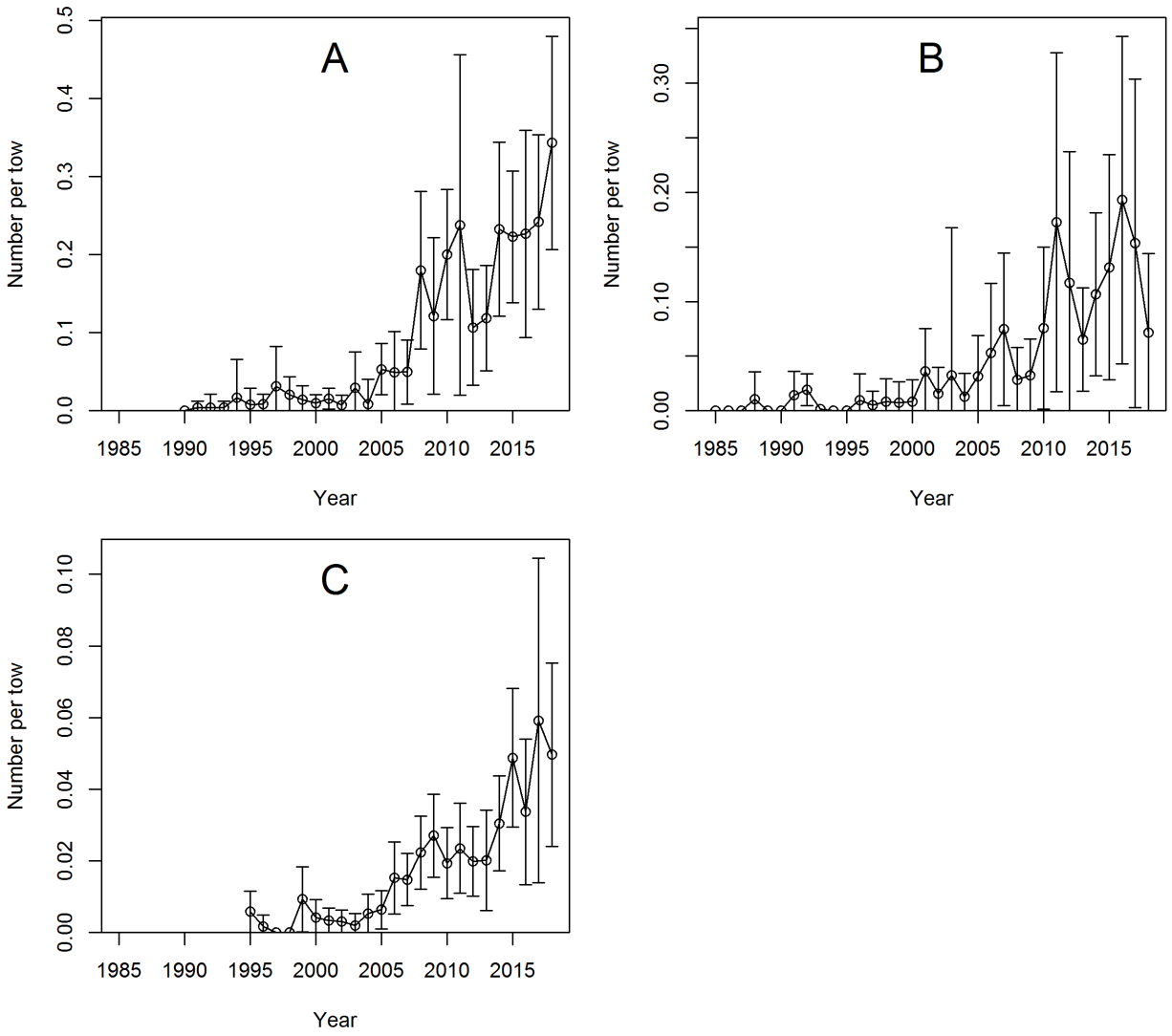

Figure 10. Average number of Atlantic halibut per tow measuring larger than 85 cm in 3 commercial fishery-independent surveys: DFO research vessel surveys in the nGSL (A) and sGSL (B) and the sentinel fishery program survey in the nGSL (C). The 95% confidence intervals are shown.

Commercial fishery standardized catch rate

The standardized catch rate for the commercial longline fishery, the catch per unit effort (CPUE) measured in weight per 1,000 hooks, is used as an indicator of fishery success (Figure 11). This rate was standardized using a generalized linear model to consider the effect of the following variables: month of the year, NAFO sub-area and vessel size. In 2018, the catch rate was 500 kg per 1,000 hooks, the highest level in the historical series. This is five times higher than the 100 kg per 1,000 hooks observed up to 2006 and corresponds to a mean annual increase of 12% between 1997 and 2018.

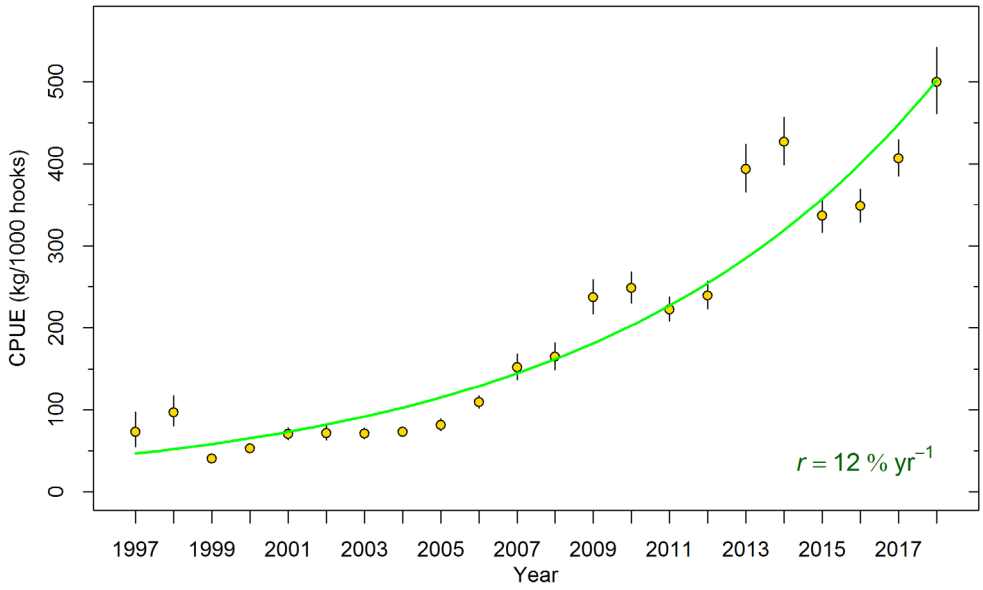

Figure 11. Standardized catch rate in the Atlantic halibut fishery. The data-adjusted exponential curve is characterized by an annual increase (r) of 12%.

Sources of uncertainty

Among the data describing the fishery, valid fishing effort (Figure 12A) and catch locations (Figure 12B) are less documented in NAFO sub-area 4R than elsewhere. At-sea observer (Figure 13A) and dockside sampling (Figure 13B) coverage is also low to almost nonexistent. Regional disparities in the availability of this information can lead to a bias in the interpretation of results and the representativeness of catches per unit effort that are calculated for the commercial fishery. In addition, the volume of recent data available at the time of the assessment varies from one year to the next, with the fishing season and data entry not completed at the time of the peer review.

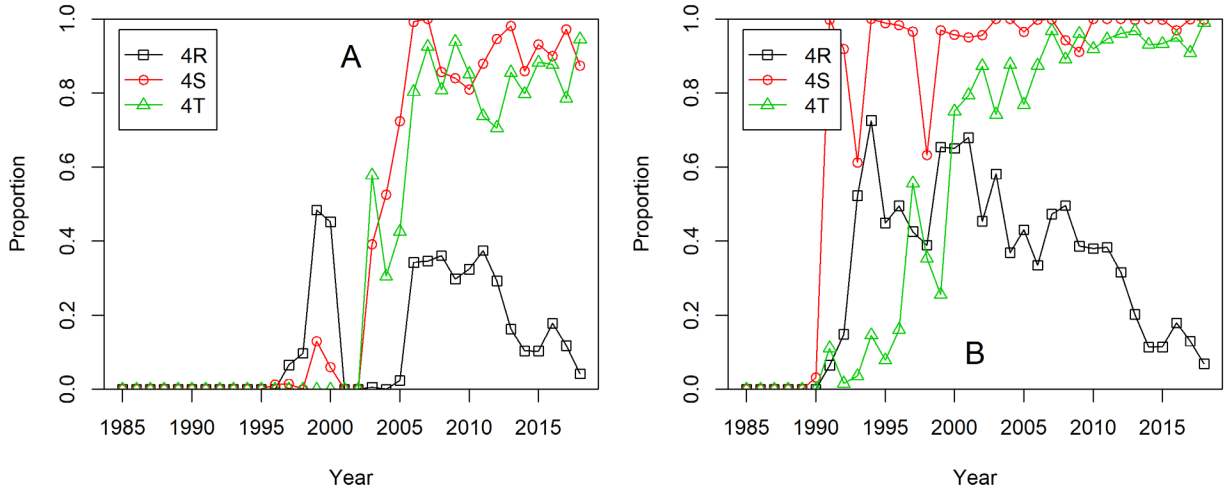

Figure 12. Proportion of Atlantic halibut longline fishery landings with an associated valid measure of effort (A) and catch location (B).

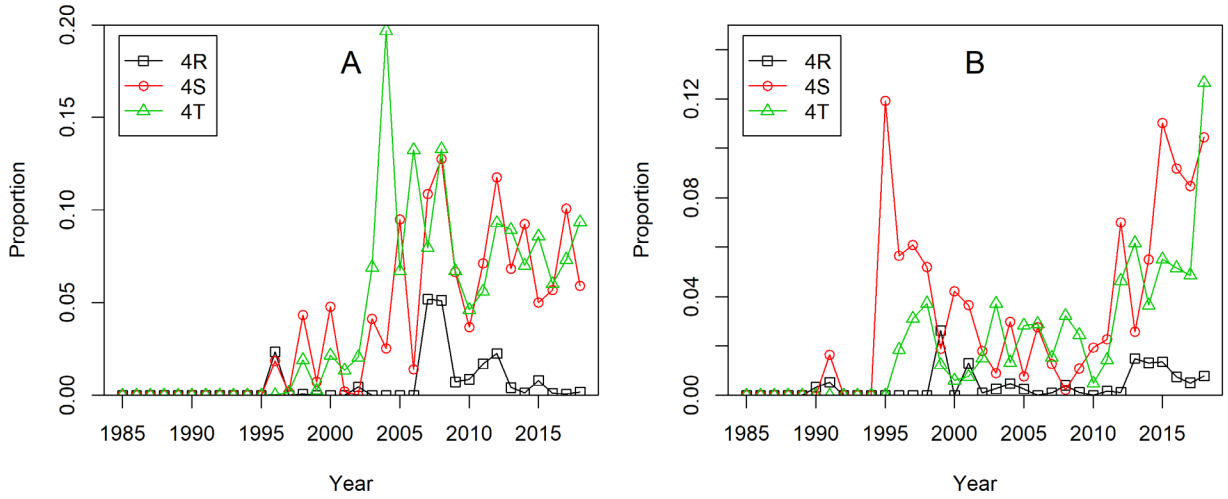

Figure 13. Proportion of Atlantic halibut landings sampled by at-sea observers (A) or dockside samplers (B).

The release of Atlantic halibut caught by longline, gillnet or mobile gear remains a concern. Although the survival rate is generally high for Atlantic halibut discards caught with longlines, it is low for Atlantic halibut caught with gillnets or mobile gear. This fishing mortality is not quantified as part of the resource status assessment. However, the proportion of at-sea catches of sublegal halibut has been decreasing since 2008 in the longline and gillnet fisheries. As a result, although not assessed, fishing mortality is certainly higher than the number of halibut landed.

CONCLUSIONS AND ADVICE

All indicators of the status of the Gulf of St. Lawrence (4RST) Atlantic Halibut stock are positive. The fished component of the stock is at its highest historical level, and recruitment to the fishery is expected to remain high in the coming years. The short- and medium-term outlook for this stock is consequently encouraging. However, the exploitation rate is still unknown.

OTHER CONSIDERATIONS

A longline survey and tagging program for the entire Gulf of St. Lawrence have been in place since 2017. Nearly 125 stations were sampled in 2017 and 2018, and a total of 948 fish were tagged and released. Discussions are ongoing with industry partners to continue the project in 2019 and subsequent years. These initiatives should provide information that can be incorporated into the next resource status assessment scheduled for the winter of 2021, including an initial estimate of fishing mortality. Over the medium term, this work should lead to the development of a relative indicator of spawning biomass, the determination of biological reference points and the adjustment of a population dynamics model to this stock.

ASSESSMENT SCHEDULE

The status of the Atlantic halibut stock in NAFO divisions 4RST is currently assessed on a two-year cycle. In the intervening year, no indicators are reviewed, since the probability of a change in stock status to an undesirable condition has been deemed very low.

LIST OF PARTICIPANTS

Name	Affiliation	Feb 18	Feb 19
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Syvrais, Pascal	Ass. des morutiers traditionnels de la Gaspésie	x	x
Talbot, Héléna	DFO - Science	x	x
Trottier, Steve	DFO – Fisheries management	x	x

SOURCES OF INFORMATION

This Science Advisory Report is from the February 18–19, 2019, meeting on the Assessment of the Gulf of St. Lawrence (4RST) Atlantic Halibut. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

Bourdages, H., Brassard, C., Desgagnés, M., Galbraith, P., Gauthier, J., Nozères, C., Scallon-Chouinard, P.-M. and Senay, C. 2019. Preliminary results from the groundfish and shrimp multidisciplinary survey in August 2018 in the Estuary and northern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/037. iv + 87 p.

Le Bris, A., Fisher, J. A. D., Murphy, H. M., Galbraith, P. S., Castonguay, M., Loher, T., and Robert, D. Migration patterns and putative spawning habitats of Atlantic halibut (*Hippoglossus hippoglossus*) in the Gulf of St. Lawrence revealed by geolocation of pop-up satellite archival tags. ICES J. Mar. Sci. 75: 135–147.

Neilson, J. D., Waiwood, K. G., and Smith, S. J. 1989. Survival of Atlantic halibut (*Hippoglossus hippoglossus*) caught by longline and otter trawl gear. *Can. J. Fish. Aquat. Sci.* 46: 887–897.

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