

Science

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ASSESSMENT OF THE SAGUENAY FJORD WINTER **RECREATIONAL GROUNDFISH FISHERY, 2013–2014**



Photo: J. Gauthier, DFO



Figure 1. Main winter fishing sites in the Saguenay Fjord

Context:

The winter recreational fishery in the Saguenay Fjord took off in the early 80s. It is unique in Quebec due to its magnitude and the variety of species that are caught in the area. Its socio-economic effects make it a driving force for the region's tourism industry.

As a result of the growing interest in this recreational and tourism activity, various stakeholders were concerned about resource conservation and the sustainable development of the fishery. In this context, a monitoring program was launched in 1995 under an agreement involving Saguenay Fjord fishermen associations and committees, Promotion Saguenay, the Musée du Fjord, the Quebec Ministère des Forêts, de la Faune et des Parcs, the Société des établissements de plein air du Québec and the Parks Canada Agency, which co-manage the Saguenay-St. Lawrence Marine Park, as well as Fisheries and Oceans Canada (DFO).

The main groundfish species targeted by this recreational fishery are, in order of importance, Redfish, Atlantic Cod, Greenland Cod and Greenland Halibut. Recent scientific studies have concluded that marine fish in the Saguenay are sink populations whose recruitment depends on the arrival of juveniles from the St. Lawrence Estuary.

The assessment of halieutic resources is performed every second year, with the main indicators derived from recreational fishery data and abundance indices arising from a DFO research survey.

This assessment was prepared in response to a request made by Fisheries Management regarding the status of the winter recreational groundfish fishery in the Saguenay Fjord. This fishery is currently managed by way of a fishing season and daily catch limits.



SUMMARY

- The popularity of the winter recreational fishery in the Saguenay continues unabated. For the 2013 and 2014 seasons, around 1,600 fishing huts were set up on the pack ice.
- The 2013 and 2014 fishing seasons were 43 days long, as specified in the management plan. They opened the third week of January and ended the first week of March. In 2014, insufficient ice cover in La Baie delayed set-up of the huts by one week.
- Redfish accounted for 89% of groundfish catches in the recreational fishery in 2013 and 2014. The number of Redfish catches per unit effort (NUE) from the fishery and from the research survey shows a considerable drop, with stabilization at a low level in recent years. The size structure of catches suggests that exploitation rests on a limited number of cohorts.
- Atlantic Cod, Greenland Cod and Greenland Halibut (Turbot) accounted for 4%, 5% and 2% of groundfish catches, respectively, in the recreational fishery in 2013 and 2014. The NUEs for these three species are low. The size structures suggest the presence of several cohorts for each species in the fishery.
- The daily catch limit set at five groundfish since 2004 and reductions in the fishing season to 43 days since 2011 appear to have helped stabilize catches and reduced the fishing pressure over the past four years.
- Groundfish recruitment in the Saguenay relies on the arrival of juveniles from the Estuary. Therefore, the winter recreational fishery would not affect recruitment of these fish in the Saguenay.
- In 2013 and 2014, a high abundance of juvenile Redfish was identified in the Estuary and Gulf of St. Lawrence. These juveniles were also observed in the Saguenay. However, there is no further information on the scope of these inflows of Redfish or their potential impact on the success of the fishery in a few years. In the short term, harvesting contributes to a lower abundance of adult Redfish.
- Since groundfish in the Saguenay are a component of a unique ecosystem, the precautionary principle justifies protecting their populations. We recommend maintaining a level of effort and catches similar to those in previous years.

INTRODUCTION

Background

During the Saguenay winter recreational fishery, the main groundfish species caught, in order of importance, are Redfish (*Sebastes* spp.), Atlantic Cod (*Gadus morhua*), Greenland Cod (*Gadus ogac*) and Greenland Halibut, also called Turbot (*Reinhardtius hippoglossoides*). Rainbow Smelt (*Osmerus mordax*), a pelagic species, is also of considerable interest to fishermen. Those interested in obtaining information on the Saguenay Fjord Rainbow Smelt can contact the regional branch of the Quebec Ministère des Forêts, de la Faune et des Parcs, Direction de la Gestion de la Faune, in Jonquière.

The work of Sévigny et al. (2009) showed that Cod, Redfish and Greenland Halibut populations in the Saguenay and Gulf of St. Lawrence were not genetically differentiated but were rather from the same population, indicative of the connectivity between the populations from the two environments. Moreover, Sévigny et al. (2009) hypothesize that, based on the phenotypic signature of fish in the Saguenay, migration to the Saguenay Fjord occurs at the juvenile stage. Furthermore, studies by Sirois et al. (2009) indicated that larval survival of these species in the Fjord would be compromised by the warm and brackish surface layer conditions, preventing a significant local contribution to fish

recruitment in the Fjord, especially for Redfish and Cod. These studies suggest that marine fish populations in the Saguenay Fjord are considered "sink" populations, the recruitment of which is assumed to be closely tied to the status of populations in the Estuary and Gulf of St. Lawrence. Moreover, some of these stocks were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). As a result, Cod in the southern and northern Gulf, Deepwater Redfish and White Hake were all designated as endangered. In addition, the conclusions of the most recent science advisory reports on Cod and Redfish in the Gulf of St. Lawrence are not optimistic and indicate that:

- The Cod stock in the northern Gulf of St. Lawrence is still in the critical zone, well below the limit reference point (LRP). Implementing a precautionary approach is a priority for promoting its recovery (DFO 2014).
- The southern Gulf Cod population is at the lowest level observed in the 61-year record and is declining (DFO 2011).
- The *S. mentella* population [main Redfish species found in the Saguenay] in Units 1 and 2 has declined and now represents only a low proportion of the biomass estimated in 1960. This population's biomass continues to decline (DFO 2012).

Although the status of Redfish stocks in the Gulf of St. Lawrence is precarious, a high abundance of juvenile Redfish was identified in the Estuary in 2013 and 2014. Genetic analyses confirmed that the cohort observed in 2013 is composed nearly entirely of Deepwater Redfish (*S. mentella*) from the northern Gulf population, a species found in the Saguenay (Claude Brassard, DFO, personal communication). Juveniles from this population were also observed in the Saguenay, mainly in the stomachs of adult Redfish. However, there is no further information on the scope of these inflows of Redfish or their potential impact on the future success of the fishery for the Saguenay.

Fishery Description and Conservation Measures

Ice fishing for groundfish is a winter recreational fishery that is practised without a licence. It took off in the early 80s and has been monitored by DFO since 1995. The conservation measures put in place focus mainly on two aspects, the length of the fishing season and the number of daily groundfish catches. The fishing season was reduced in 2005 and 2011 from an average of 59 days between 2005 and 2009 to 43 days since 2011. The daily limit was cut down from 25 to 15 groundfish in 2003, and then to 5 in 2004. The regulations also contain a catch-and-release clause for certain species, set out a maximum immersion time and prohibit the sale, barter and waste of fish.

Fishing is practised over the entire upper basin of the Saguenay Fjord, between Saint-Fulgence and Petit-Saguenay (Figure 1). The main fishing villages are associated with the municipalities of L'Anse-Saint-Jean, Rivière-Éternité, Saint-Félix-d'Otis, Sainte-Rose-du-Nord, Saint-Fulgence and the La Baie area (the city of Saguenay), the latter encompassing the Anse-à-Benjamin, Grande-Baie and Les Battures sites until 2012. The Les Battures site has been closed since 2013. More than 80% of the fishing effort is deployed annually in the La Baie sites. In 2013 and 2014, 1,357 and 1,192 fishing huts, respectively, were set up in the area (Guy Girard, Promotion Saguenay, personal communication). Fishing sites generally have two areas where huts are set up: a "pelagic fish" area near the shore where mainly Smelt is caught, and a "groundfish" area further out on the ice where the species discussed in this report are caught. The second area is located in deeper waters and, during the 2014 season, accommodated 61% of all the huts set up for all sites combined.

Two main types of fishing gear are used in this fishery: a conventional or short fishing rod, and a roller. The latter consists of a line mounted on a pulley, largely replacing the tip-up. The roller and tip-up are generally set up on the ice outside the huts, whereas the fishing rod is used inside the huts. There are three main approaches to ice fishing. The first consists in being on site continuously and paying close attention to the gear. When a fish takes the bait, the fisherman pulls up the line, removes the fish, baits

the hook and lowers it back into the water. The second approach is of a social nature. Gears are baited and lowered into the water, but fishermen are less attentive. Therefore, a fish that takes the bait could be on the line for a number of hours before being pulled up, thus reducing the possibility of another fish being caught on the gear during this time to virtually nil. The third approach consists in baiting and lowering gears in the evening, for example, and checking the lines only the next day, at the beginning or at the end of the day. This approach is more common for tip-ups and rollers. The prevalence of these three approaches varies from one site to another.

The average for 1996-2012 (Figure 2) was approximately 39 000 fishermen-days. In 2008 and 2009, favourable ice conditions resulted in higher-than-average numbers. By contrast, in 2010, sites were set up one to two weeks after the season opened and fishing ended three to four weeks earlier than scheduled due to the thinning ice cover, reducing the number to roughly 22 000 fishermen-days. Since 2011, a new management measure reduced the fishing season to 43 days, which resulted in a decrease in fishermen-days, with values below the series average. In 2012 and 2014, lower fishermen-day values were also linked to poor ice conditions, particularly at the highly frequented sites of L'Anse-à-Benjamin and Grande-Baie.



Figure 2. Annual fishermen-day index. Horizontal lines represent the respective series average for the period 1996-2012. The Saguenay combines data from all sampled sites. Baie des Ha! Ha! includes data from L'Anse-à-Benjamin, Les Battures and Grande-Baie. The marine park includes the Sainte-Rose-du-Nord, L'Anse-St-Jean, Rivière-Éternité and Saint-Félix-d'Otis sites.

ASSESSMENT

Data Source

The main indicators for this assessment are derived from recreational fishery monitoring (Gauthier et al. 2013B) and abundance indices arising from a DFO research survey (Gauthier et al. 2013A). DFO has been monitoring marine fish populations in the Saguenay since 1995 and focuses on the main species harvested, namely Redfish, Atlantic and Greenland Cod, and Greenland Halibut. The monitoring program comprises two components and requires the participation of fishermen recruited from the main sites as well as close cooperation with a number of institutions, including Parks Canada, SÉPAQ, Promotion Saguenay, the Quebec Ministère des Forêts, de la Faune et des Parcs, and the Musée du Fjord. All these stakeholders contribute significantly to the monitoring of fish populations harvested in the Saguenay Fjord.

The first component of the program involves interviewing recreational fishermen. The aim is to make 20 visits per site and interview 15 fishermen per visit. These visits are divided between weekdays and weekends throughout the fishing season. Data regarding catches (number, species), fishing effort (total number of fishhook, hours fished) and the number of active fishermen at the time of the visit are gathered. The main purpose is to identify trends in catches per unit effort. Since 2010, the use of a depth sounder has also been noted. The second sampling component involves collecting biological data on the main species fished. Each finding is characterized by site, species, and fish size and weight.

Since 2000, DFO's Science Branch has been conducting a research survey in the Saguenay Fjord using a Coast Guard research vessel. This gillnet survey, conducted annually from 2000 to 2010 and now every second year, takes place soon after the winter recreational fishery closes. Sampling stations are grouped in the Baie des Ha! Ha! and Bras Nord regions, upstream from the marine park boundaries. The fishing effort has increased from some 30 moorings in the first few years to an average of 83 between 2006 and 2014.

Resource Status

Redfish

Redfish is the most widely harvested species during the winter recreational groundfish fishery in the Saguenay Fjord, accounting for 89% of catches in 2013 and 2014.

For the Saguenay as a whole, the recreational fishery catch rate index showed a continuous downward trend from 1996 to 2006, followed by stabilization at low values (Figure 3A). The 2013 and 2014 values are low and below the series average. Similar analyses conducted at sites located within the marine park boundaries show comparable trends (Figure 3C). However, the downward trend there is more marked. The situation is different if the analysis is done with the three Baie des Ha! Ha! sites. The abundance index, which had stayed fairly stable from 1996 to 2011, increased in 2012. The values for 2013 and 2014 are falling and are below the series average (Figure 3B).

This general downward trend is also evident in the research survey abundance index, which shows a decrease between 2000 and 2008, followed by stabilization at low values since then (Figure 3D). The 2014 value is the lowest of the series.

The estimated total catch of Redfish (Figure 4) shows a general downward trend between 1998 and 2014, with significant annual variations. This decrease was more marked within the boundaries of the marine park. Since 2006, Redfish catches in the marine park accounted for less than 7% of total catches for this species.

Gears used to catch Redfish, i.e. hook and line in the recreational fishery and gillnet in the DFO research survey, have different selectivity. Thus, hook and line is less selective and allows a wider range of fish sizes to be caught than gillnet (Figure 5). In the recreational fishery, Redfish measuring less than 20 cm are occasionally seen, indicating the sporadic presence of young individuals. However, the gradual increase in mean size from 28 to 32 cm between 1996 and 2014 suggests that the recreational fishery has not experienced a major inflow of recruits and that the fishery is supported by a small number of cohorts. In the DFO survey, the narrow selectivity of gillnet, with a mesh size of 5.5", prevents recruitment from being assessed.



Figure 3. Redfish catch rates from the recreational fishery (A, B, C) and the research survey (D). The vertical lines represent a 95% confidence interval. The horizontal solid lines indicate the series average and the upper and lower horizontal dashed lines indicate the reference limits.



Figure 4. Estimated total catch of Redfish in the recreational fishery



Figure 5. Redfish size frequency distribution from the recreational fishery (A) and the research survey (B). Boxand-whisker plot: the median is shown by the line in the middle of the box, the box has a range from percentile 25 to 75, the whiskers (vertical lines on each side of the box) represent 1.5 times the interquartile (distance between Q1 and Q3), the circle represents the average and the crosses represent extreme values.

Atlantic Cod

Given that the distinction between Atlantic and Greenland Cod has only been made since 2000, the recreational fishery abundance indices are not presented for the preceding period. Generally speaking, the catch rates for Atlantic Cod are low. For the Saguenay as a whole, the recreational fishery abundance index (Figure 6A) decreased between 2000 and 2007. The index surged in 2008 and continued to increase until 2010 to a value close to that recorded at the beginning of the series. It then declined until 2013 and is again on the rise in 2014. It is above the series average. The general trend is similar for marine park sites (Figure 6C). The 2014 value is comparable to the series average. For Baie

des Ha! Ha! sites, major annual fluctuations in the catch rate have been observed. The 2013 and 2014 values are lower than or equal to the series average (Figure 6B).

Atlantic Cod catches were also low during the research survey (Figure 6D). Between 2 and 66 Cod were caught per survey. The catch rate index fluctuated without showing a clear trend between 2000 and 2005. The index then increased until 2010 with a value above the series average. The values were down in 2012 and 2014, and the 2014 data are below the series average.

The estimated total catch of Atlantic Cod (Figure 7) in the recreational fishery show major fluctuations, reaching a maximum in 2004 and a minimum in 2007. Since 2012, the estimated value has been low and stable, with an average of close to 950 Cod.

The small number of Atlantic Cod measured both in the recreational fishery and the research survey prevents separate tracking of cohorts. The catch of Cod of varying sizes (20–100 cm) and the presence of fish measuring less than 30 cm every year in the recreational fishery (Figure 8A and B) indicates a regular inflow of new individuals into the Saguenay population.



Figure 6. Atlantic Cod catch rates from the recreational fishery (A, B, C) and the research survey (B). The vertical lines represent a 95% confidence interval.



Figure 7. Estimated total catch of Atlantic Cod in the recreational fishery



Figure 8. Atlantic Cod size frequency distribution from the recreational fishery (A) and the research survey (B)

Greenland Cod

Greenland Cod catch rates are low. For the Saguenay as a whole, the recreational fishery abundance index for Greenland Cod (Figure 9A) decreased between 2000 and 2007. A slight increase has been noted since then, but the 2014 value is still below the series average. The pattern is similar when only the marine park sites are considered (Figure 9C).

Greenland Cod is also an occasional catch in the research survey, which makes data interpretation somewhat uncertain. Greenland Cod catches have ranged from 1 to 23 fish annually. Nevertheless, there appears to be a decrease in this abundance index between 2000 and 2008, with stabilization at a low level until 2014 (Figure 9D).

The estimated total catch of Greenland Cod (Figure 10) in the recreational fishery shows a major decline between 2000 and 2007 from 27,101 to 563 fish, followed by stabilization since 2008 at an average annual value of close to 1,270 individuals.

The small number of Greenland Cod caught both in the recreational fishery and the DFO research survey prevents tracking of cohorts (Figure 11). However, a regular presence of individuals measuring 30 cm or less has been noted in the recreational fishery, suggesting a constant inflow of young fish.



Figure 9. Greenland Cod catch rates from the recreational fishery (A, B, C) and the research survey (B). The vertical lines represent a 95% confidence interval.



Figure 10. Estimated total catch of Greenland Cod in the recreational fishery



Figure 11. Greenland Cod size frequency distribution from the recreational fishery (A) and the research survey (B)

Greenland Halibut

Greenland Halibut is a rare catch in the Saguenay recreational fishery, making the interpretation of catch rates for this species as an abundance index very speculative (Figure 12A, B, C). However, catches in the research survey are significant, and this abundance indicator suggests higher catch rates between 2005 and 2012 than in the 2000-2004 period (Figure 12D). In 2014, the index showed a substantial decrease, with a value below the series average at a level similar to that observed in 2000-2004.

Estimated total catches for the recreational fishery are generally low and strongly influenced by sampling (Figure 13). Since catches at a given site are multiplied by the effort at that site, a few extra fish at a very busy site will induce a large variation. The estimated annual catches over the past five years average 400 individuals.

The size structures of Greenland Halibut in the recreational fishery and in the research survey are indicative of the presence of a number of cohorts in the Saguenay (Figure 14).



Figure 12. Greenland Halibut catch rates from the recreational fishery (A, B, C) and the research survey (D). The vertical lines represent a 95% confidence interval.



Figure 13. Estimated total catch of Greenland Halibut in the recreational fishery



Figure 14. Greenland Halibut size frequency distribution from the recreational fishery (A) and the research survey (B)

Sources of Uncertainty

The calculation of the annual effort (Figure 2) and, consequently, the total catch (Figures 4, 7, 10 and 13) requires knowing the length of the fishing season, the average number of fishermen per day and, for the total catch, the average daily effort. The approximation methods used to determine these three variables entail many biases, and the available information is insufficient to quantify their uncertainty.

The use of a depth sounder has become widespread in recent years in the Saguenay recreational fishery. This technological development is said to result in increased fishing efficiency and thus poses a challenge in comparing indicators at the beginning and at the end of the time series. A comparison of annual catch rates with and without the use of the depth sounder was presented during the peer review, but did not lead to a conclusion on the matter. New analyses will be presented at the next review slated for 2016.

Theoretically, the best abundance indices are those that cover the entire stock in terms of both its range and its age classes (area sampled and gear selectivity). It is also preferable that the sampling be done when fish are dispersed and catchable. For the Saguenay, we only have partial abundance indices. The recreational fishery takes place in winter in very localized areas in bays of shallow to medium depth. Spatial coverage is therefore poor compared to the expected distribution of the targeted species. The selectivity of the gear used, i.e. hook and line, allows a fairly wide range of fish sizes to be caught, but seems inadequate for catching juveniles. The DFO survey is not optimal either. The spatial and temporal coverage is restricted and the gear used (gillnet) has a fairly narrow selectivity that targets certain ranges of fish size. The survey does not give an indication of the presence of recruitment of fish populations in the Saguenay. During the 2014 survey, nets with smaller meshes were deployed with a view to developing recruitment indices for the groundfish populations in the Saguenay. This initiative did not yield the expected results. These tests will be repeated in 2016 during the next survey.

CONCLUSIONS AND ADVICE

Interest in the winter recreational fishery in the Saguenay has grown substantially since the early 90s. Information from Promotion Saguenay indicates that the number of huts increased from 1,000 to more than 1,620 between 1998 and 2014. The number of fish caught in this recreational fishery is considerable. The data available suggest that the status of marine resources harvested in the Saguenay is of concern. Estimated Redfish, Cod and Greenland Halibut catches have dropped compared to the mid-90s and have stabilized at a low level for a number of years now. Abundance indices derived from the recreational fishery and the gillnet survey show a significant decline in Redfish, which is by far the main catch for this fishery. The daily catch limit set at five groundfish since 2004 and reductions in the fishing season to 43 days since 2011 appear to have helped stabilize catches and reduce the fishing pressure over the past four years, without decreasing the popularity of this activity.

In 2013 and 2014, a high abundance of juvenile Redfish was identified in the Estuary and Gulf of St. Lawrence. These juveniles were also observed in the Saguenay. However, there is no further information on the scope of these inflows of Redfish or their potential impact on the success of the fishery in a few years. In the short term, harvesting should contribute to a lower abundance of adult Redfish.

Since groundfish in the Saguenay are a component of a unique ecosystem, the precautionary principle justifies protecting their populations. We recommend maintaining a level of effort and catches similar to those in previous years.

OTHER CONSIDERATIONS

Industry members who attended the peer review point out that the winter recreational fishery has become a family activity in recent years. Ice fishing is becoming more of a pretext for other sports and social activities taking place at various sites, particularly on weekends.

SOURCES OF INFORMATION

This Science Advisory Report is from the October 30, 2014 on the Assessment of the Saguenay Fjord winter recreational groundfish fishery. Additional publications from this meeting will be posted on the <u>Fisheries and Oceans Canada (DFO) Science Advisory Schedule</u> as they become available.

- Gauthier, J., Bourdages, H., Morneau, R., Desgagnés, M., Rondeau, J.G. and Goudreau, P. 2013A. <u>Update of data from a gillnet research survey in the Saguenay Fjord from 2000 to 2012</u>. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/167. [Available in French only]
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- DFO. 2011. <u>Recovery Potential Assessment for the Laurentian South Designatable Unit of Atlantic Cod</u> (<u>Gadus morhua</u>). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/028.
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- DFO. 2014. <u>Update of Indicators of the Status of the Northern Gulf of St. Lawrence (3Pn, 4RS) Cod</u> <u>Stock in 2013</u>. DFO Can. Sci. Advis. Sec. Sci. Resp. 2014/009.
- Sévigny, J.-M., A. Valentin, A. Talbot and N. Ménard. 2009. Connectivity between Saguenay Fjord populations and those of the Gulf of St. Lawrence. Journal of Water Science. Vol. 22: 315–39. [Available in French only]

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