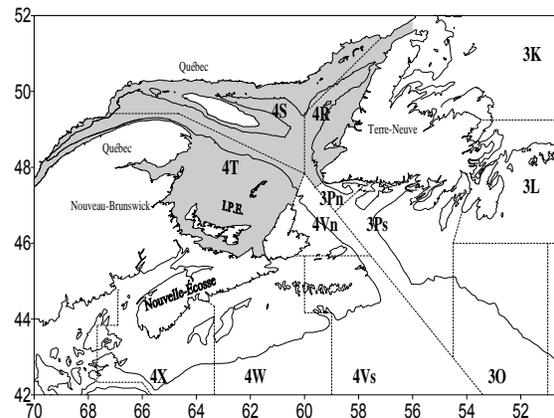
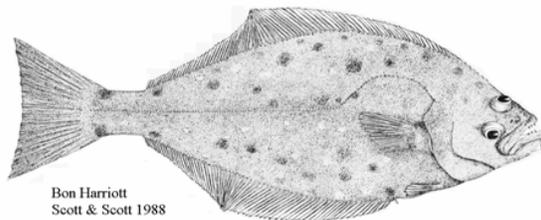




STOCK ASSESSMENT OF ATLANTIC HALIBUT OF THE GULF OF ST. LAWRENCE (DIVISIONS 4RST) IN 2008



Map of the Estuary and Gulf of St. Lawrence and neighbouring regions showing NAFO divisions 4RST.

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. It was quite common to see annual landings totalling thousands of tons. Beginning in the second half of the 20th century, exploitation was almost exclusively carried out by the Canadian fleet, the four Atlantic Provinces as well as Quebec. From over 600 t during the 1960s, landings have steadily decreased until the early 80s, totalling 90 t in 1982. Landings increased again in the late 90s and now exceed 500 t. Managed by TAC since 1988, landings were set at 475 t in 2007 for the 2007 and 2008 fisheries.

Although it is the largest flatfish and a prized species on the market, knowledge pertaining to its biology and halibut stock status in the Gulf is limited. The only available information on stock abundance stems from estimates done during scientific trawl surveys. The annual mean growth rate for Atlantic halibut was measured at 7.5-8.5 cm. The growth rate is comparable for males and females. However, females reach a larger maximum size than males. Recently, the size at sexual maturity for female halibut from the Gulf stock was measured at 130 cm. Some observations gathered from scientific trawl surveys in January and May revealed that halibut from the Gulf can spawn during these periods.

Resource assessments were conducted on an annual basis up to 2005, and then every two years. A Regional Advisory Process meeting was held in February 2009 at Mont-Joli in order to analyze the status of the resource in Divisions 4RST, to support the management of the 2009-2010 fishing seasons.

SUMMARY

- Preliminary landings declared for the May 15 to December 31, 2008 period totalled 514 tons, which was 8% more than the TAC (475 t) for the 2008-2009 fishing season. These landings represent the highest recorded quantity since the end of the 1960s.
- A fifth (111 t) of the 2008 Atlantic halibut landings were by-catches from the gillnet fishery. Of these 111 t, 80% were associated to the Greenland halibut directed fishery. Observers' data indicate that most of the catches (86% in numbers) during this fishery were made up of individuals whose sizes were under the minimum legal size of 81 cm. This portion of catches is not landed and must be discarded at sea according to the applicable regulations for the species.
- During the 2000s, abundance and biomass indices from scientific trawl surveys showed a considerable increase in the Gulf, and culminated in 2007. The 2008 index values remained among the highest of the series. The range of sizes recorded in the catches is large. The mean size varies between 60 and 70 cm in the Northern Gulf and is smaller in the Southern Gulf.
- Catches per unit effort recorded for the directed halibut longline fishery have been increasing steadily since 2000. This increase has been more noticeable over the last four years. Longline catches recorded at sea showed a significant presence of halibut measuring <81 cm (40% in numbers).
- A study revealed that 50% of females from the Gulf stock reach sexual maturity at 130 cm. Thus, modal size, recorded at sea from fixed gear halibut catches and from landings, averaged around 81 cm, which equals the minimum legal size. Therefore, it is likely that the females caught are almost all sexually immature.
- Any fishery management measure should be aimed at reducing Atlantic halibut catches of less than 81 cm, particularly in the case of the gillnet fishery where the fish mortality rate is very high.
- Over the last four years, halibut catches have increased far more rapidly than the TAC, due to the fact that the TAC was exceeded, but mostly because of the increasing number of fish under the legal size being discarded, mostly in gillnets where survival is presumably almost nil. In such conditions, it is recommended that exploitation on this stock not be increased (i.e. landings and discarding at sea) and that all directed catches and by-catches be recorded. These measures are vital for assessing and limiting the impact of exploitation on the stock's reproductive potential since current fishing practices are targeting sexually immature fish.

INTRODUCTION

Species Biology

Atlantic halibut (*Hippoglossus hippoglossus*) of the Gulf (NAFO Divisions 4RST) can be found throughout the Estuary and Gulf of St. Lawrence. In the Northern Gulf, the species is more abundant in the Esquiman, Laurentian and Anticosti channels, at depths of 200 m and over. In the Southern Gulf, the greatest concentrations occur in shallower waters (at depths less than 100 m), near the Miscou Bank, north of Prince Edward Island, northwest of Cape Breton and around the Magdalen Islands.

Atlantic halibut grows fast. The annual average growth rate in the Gulf was evaluated to 7.5-8.5 cm per year. Male and female growth rates are comparable. However, it was observed that females reach a larger maximum size than males. This could be due to the fact that Atlantic halibut females reach sexual maturity at a larger size than males, as observed for the Scotian Shelf and Southern Grand Banks stock (NAFO Divisions 3NOPs4VWX). Furthermore, a study conducted on Gulf halibut ovaries (microscopic exam) revealed that 50% of females reach sexual maturity at 130 cm (Figure 1). Based on observations made during scientific trawl surveys conducted in January and May, Gulf halibut is able to spawn during those periods. The diet of smaller halibut (<30 cm) is mostly made up of invertebrates, whereas larger size halibut are more piscivorous.

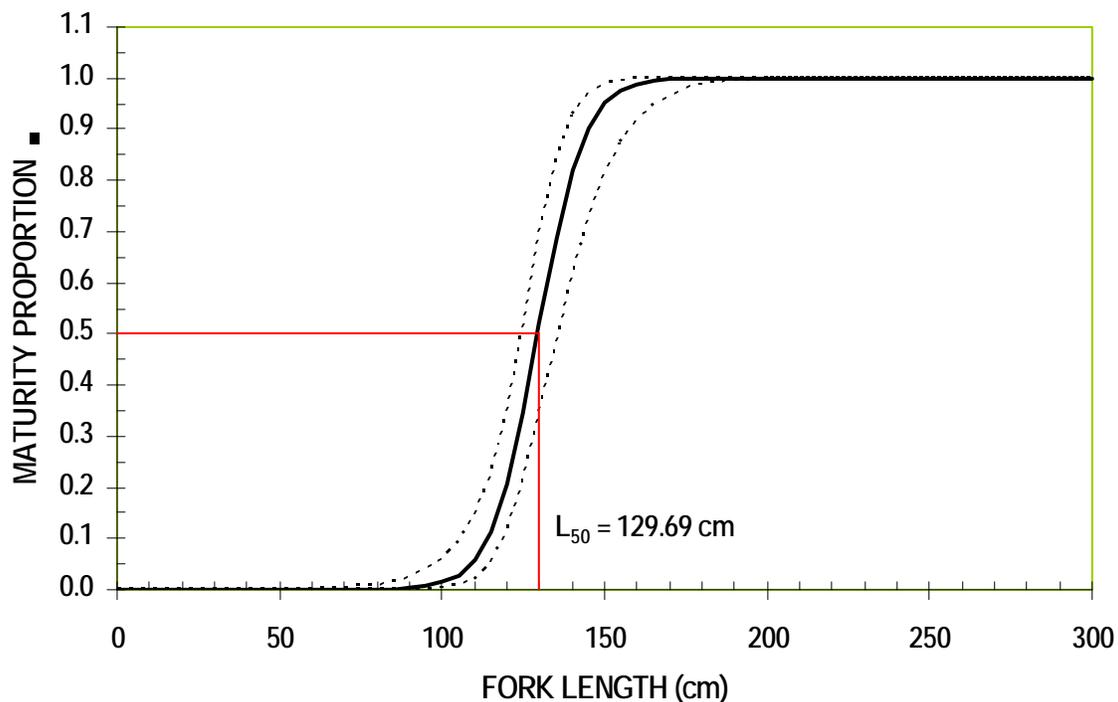


Figure 1. Maturity ogive determined from a microscopic exam of ovaries from female Atlantic halibut from the Gulf stock.

The current Atlantic halibut management unit for the Gulf, which corresponds to Divisions 4RST, was established in 1987 based on the findings of tagging–recapture studies and by taking into

account additional biological data such as size and growth rate. Results from a tagging program, introduced in 1988, confirmed the stock definition since 85% of the tagged fish in the Gulf were recaptured.

Description of the Fishery

The significant landings (average of 1,500 t) of Atlantic halibut harvested in the Gulf of St. Lawrence during the first half of the 20th century indicate that this stock was once very abundant and that it was subjected to an intense fishing pressure (Figure 2). Halibut landings, which were around 650 t in the early 1960s, hit a record low in 1982 at 91 t. Until 1995, they seldom exceeded the threshold of 300 t, which is equivalent to the TAC established in 1988. From 1996 to 2003, landings ranged between 230 and 320 t and then exceeded 400 t in 2004, and reached a level comparable to that of the early 1970s (500 t).

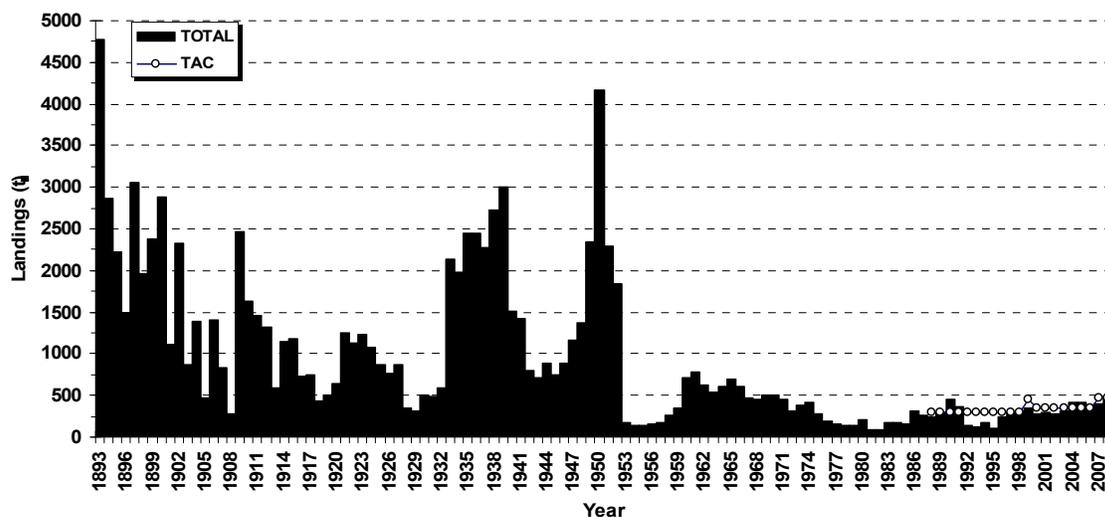


Figure 2. Atlantic halibut annual landings (t) and Total Allowable Catches (TAC) for NAFO divisions 4RST. The 2008 data are preliminary.

Following a recommendation of the Fisheries Resource Conservation Council, the TAC for the 1999 fishing season was increased to 350 t. Following a Management decision, since 2000, the fishing season and the authorized TAC refer to the period from May 15 of the current year to May 14 of the following year. In 2007, in response to a recommendation in the Science Advisory Report (DFO, 2007) the TAC was increased by 25% to 475 t for the 2007 and 2008 fishing seasons. This increase was supposed to include a gradual increase in terms of minimum legal size. However, this management measure was not implemented because it was rejected by fishery stakeholders during consultations due to its negative economic impacts. The TAC is divided into 8 geographic fleets within Quebec and the four Maritime provinces. Sharing between the fleets is based on their historic share. Directed fishing for Atlantic halibut is practiced on a competitive basis and is carried out by longliners.

In addition to TAC, other management measures have been introduced over the years to protect the resource. Thus, in 1997, a minimum legal size of 81 cm, based on a yield and value per recruit model, was added to the Canadian Atlantic halibut commercial fishery conditions. Since 2007, the discarding of legal size (≥ 81 cm) halibut by-catches by longliners in the Atlantic

cod fishery has been mandatory in the Maritimes and prohibited in Quebec. It should be noted that halibut discarding is not recorded or accounted for. There are other existing management measures such as: dockside commercial catch monitoring program, at-sea coverage by observers (percentage varies based on the fleets), mandatory logbook, predetermined fishing periods, limits on the number of hooks per line, minimum opening of the hook.

As of December 31, 2008, reported preliminary landings totalled 514 t, or 8% more than the 475 t TAC granted for the fishing season ending on May 15th, 2009 (Table 1). Most of the catches (more than 95%) were taken with fixed gear, primarily longliners. However, since 2005, there has been a significant increase in halibut by-catches made by gillnetters, representing 22% (111 t) of the 2008 landings and 80% of these were from the Greenland halibut (turbot) directed fishery. The increase in landings included a drop in fishing effort. The 2008 landings (514 t) are comparable to those made in the late 1960s, but are still well below the landings recorded during the first half of the 20th century (Figure 2).

Table 1. Atlantic halibut landings in the Gulf of St. Lawrence (t)

Division	Year						
	1988- 2002 ¹	2003	2004	2005	2006	2007	2008 ²
TAC	300-350	350	350	350	350	475	475
4R	85	138	140	155	144	142	243
4S	86	87	141	82	101	163	126
4T	93	82	135	177	144	127	145
Total	263	307	416	413	388	432	514

¹ Average

² Preliminary data as of December 31, 2008

RESOURCE ASSESSMENT

Abundance and Biomass

Data on the abundance of Atlantic halibut in the Estuary and Gulf were provided by the two summer scientific trawl surveys conducted by the DFO in the Northern and Southern Gulf and the summer mobile-gear Sentinel fishery program conducted in the Northern Gulf.

Halibut catches made during surveys are distributed throughout the Estuary and Gulf of St. Lawrence, mainly at depths of 200+ m at channel level (Esquiman, Anticosti, Laurentian) and in shallower water (less than 100 m) around the Magdalen basin in the southwest part of the Gulf (Figure 3). Since the early 2000s, abundance and biomass indices have more than tripled on the DFO surveys in the Northern and Southern Gulf. The values recorded over the last three years have been among the highest of the series (Figure 4). The Sentinel fisheries survey indicated more or less the same trend.

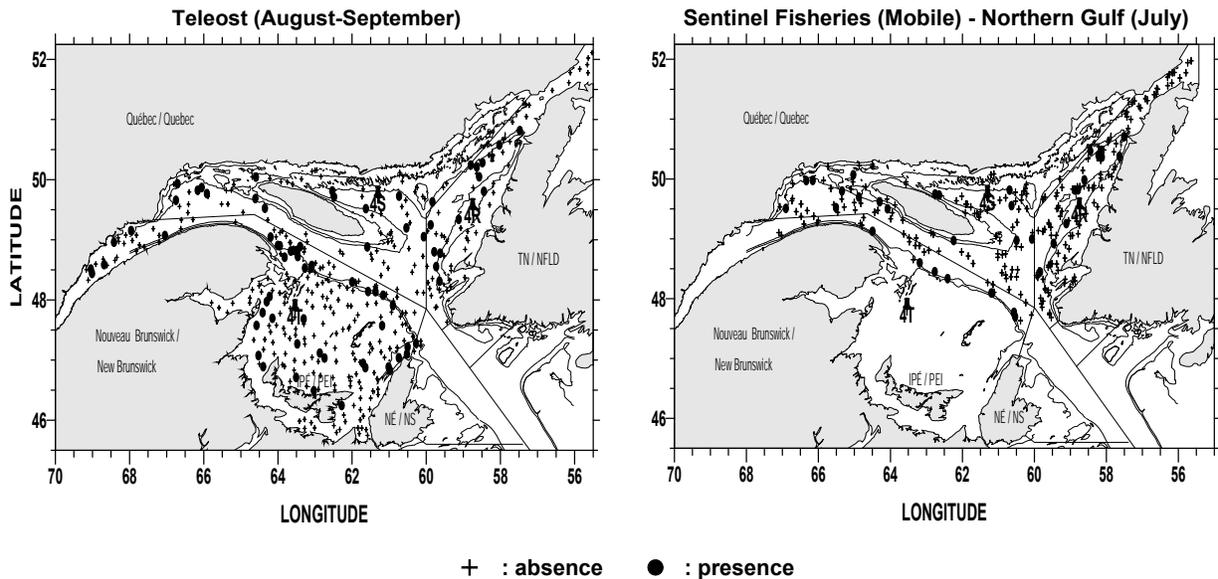


Figure 3. Location of Atlantic halibut catches made during the scientific trawl surveys conducted in the summer of 2008.

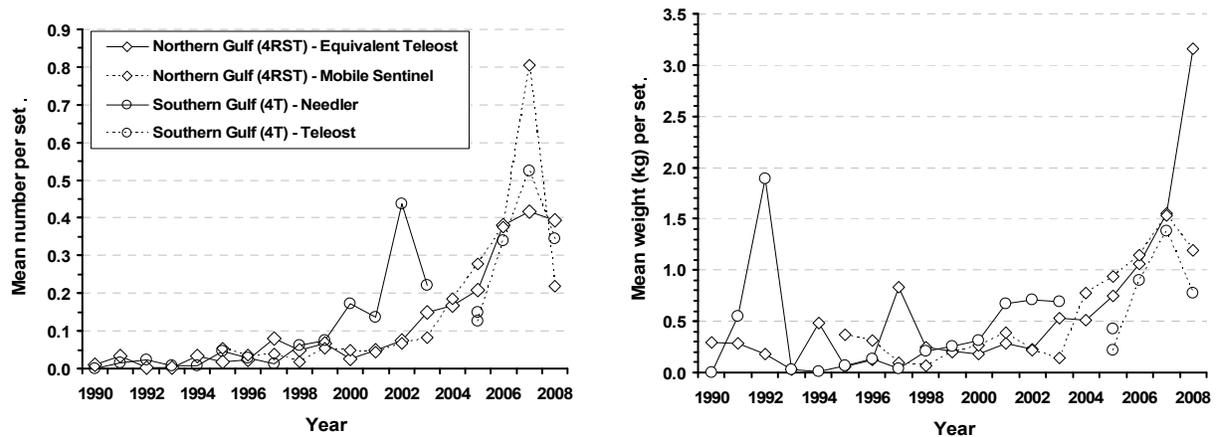


Figure 4. Abundance and biomass indices of Atlantic halibut calculated from summer scientific trawl surveys, between 1990 and 2008.

Fishing Effort and Catch Rate

Fishing effort and catches per unit effort (CPUE) were calculated using statistics from the commercial longline fishery (catches and effort) (directed Atlantic halibut and Atlantic cod fishery) and gillnet fishery (directed turbot fishery). The CPUE calculated for longline is defined as the total weight (kg) of halibut caught per 1,000 hooks, whereas the CPUE calculated for gillnet is based on the total weight of halibut caught per net. CPUE data were standardized to account for differences between fleets and fishing areas and for seasonal variations.

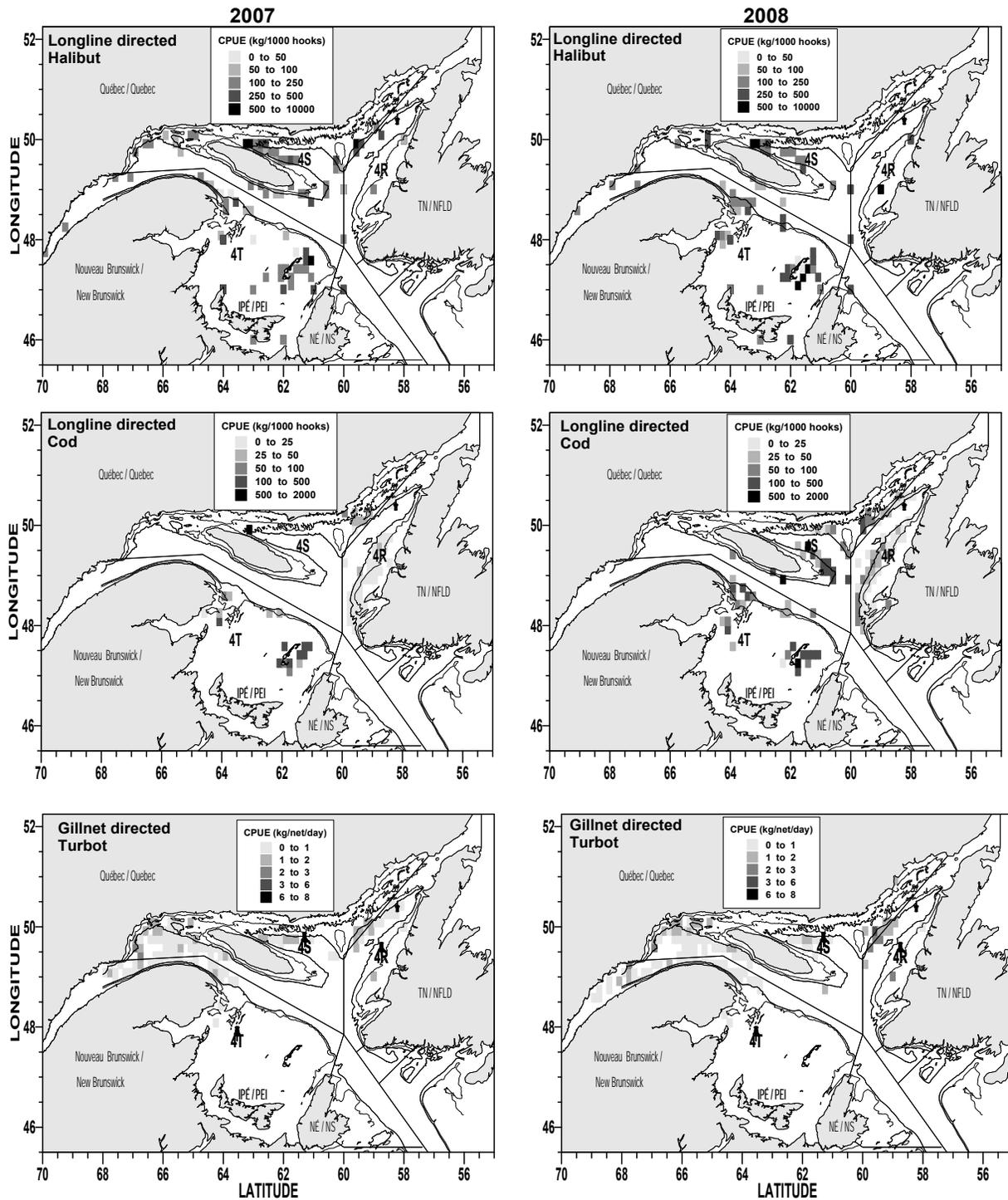


Figure 5. Catch rate distribution per fishing activity, in 2007 and 2008.

The catch rate distribution pattern observed in 2007 and 2008 closely followed the halibut geographic distribution in the Estuary and Gulf (Figure 5). Based on the available data for the longliner fleet, the highest halibut catch rates are mostly found around the Magdalen Islands in the Southern Gulf, and near the channels (Anticosti, Esquiman and Laurentian) in the north. Halibut catches made by gillnet that were directed on turbot were limited to the Estuary and the northern part of the Gulf, and the highest catch rates were mostly found on the northwest edge of the Esquiman Channel. In fact, the distribution of halibut by-catches by directed fishing activities on other fish is strongly linked to the fishing pattern of each fleet aimed either at cod or turbot.

Since the early 2000s, CPUE for the halibut directed fishery have been increasing both for the entire management area 4RST and for individual divisions (Figure 6). The values from the last four years are among the highest of the series. On the other hand, fishing effort, for the same years, presented an overall downward trend.

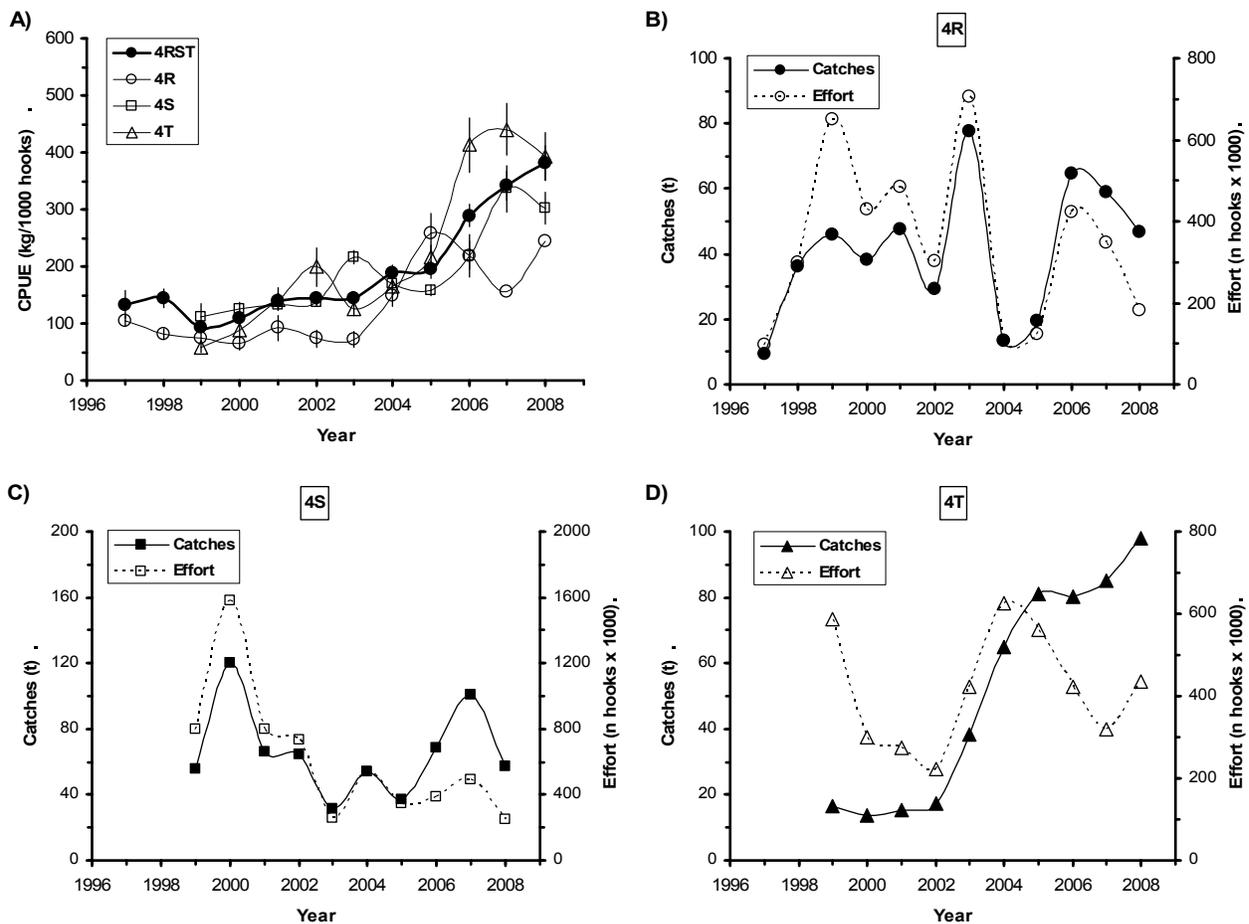


Figure 6. Atlantic halibut directed longline commercial fishery indicators, per NAFO division from 1997 to 2008. A) Standardized annual catch per unit effort. B-D) Annual catches and efforts.

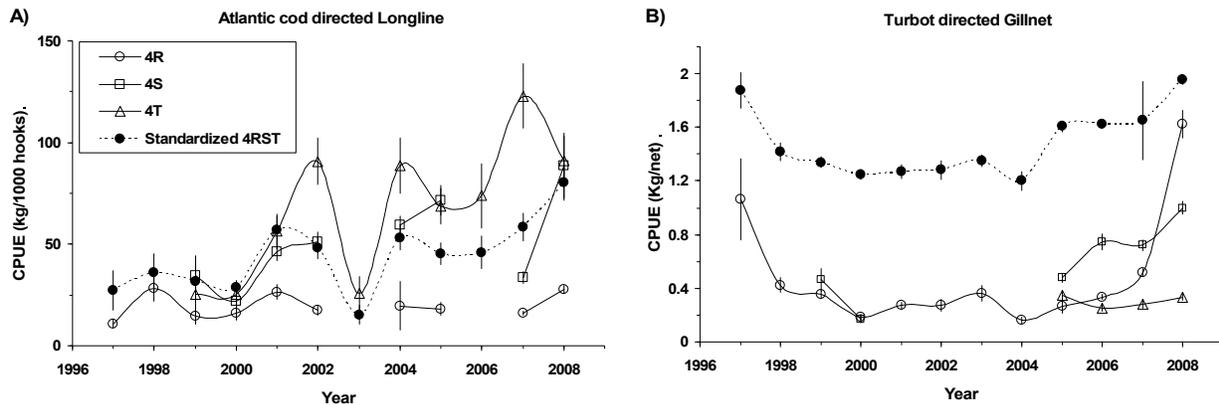


Figure 7. Atlantic halibut catch rates in the commercial fishery from 1997 to 2008. A) Annual catch per unit effort for the Atlantic cod directed longline fishery. B) Annual catch per unit effort for the turbot directed gillnet fishery.

The catch rates for halibut by-catches in the Atlantic cod directed longline fishery have increased since 2006 and reached a high in 2008 (Figure 7). The situation is rather similar for halibut by-catches made by gillnets directed on turbot (Figure 7). Between 2004 and 2008, the CPUE calculated for 4RST increased considerably and reached another high in 2008.

Size and Recruitment

The size range of halibut measured during the **scientific trawl surveys** is mostly between 20 and 120 cm. Catches are mostly made up of halibut measuring less than 81 cm. During the 2000s, the mean size in the Northern Gulf was generally above 60 cm, as opposed to the Southern Gulf where it rarely exceeded 50 cm. The weak representativeness of individuals measuring more than 120 cm in the catches can be explained by the reduced catchability by the trawl for larger size halibut which are able to avoid the gear.

Since 2004, the size of landed fish by the fixed gear **commercial fishery** has been between 81 and 120 cm (80+% of the landings), with a mean size varying between 95 and 98 cm, which was slightly lower than in the early 2000s (Figure 8). Based on the samples measured at sea by the observers, the proportion of fish under the legal size (<81 cm) was significant (45+% in numbers) in the catches, and the estimated median size for this group was around 65 cm.

A more in depth analysis of the halibut catches made with longlines and gillnets was conducted with at-sea observers' data from 2007 and 2008 (Figure 9). During these two years, the proportion of commercial size halibut (≥ 81 cm) found in catches made by longliners was around 85% in weight and 63% in numbers (Table 2). However, the portrait from the catches made by gillnetters is quite different. The proportion of pre-recruits (<81 cm) in the catches was very significant; 85+% in numbers and in weight only represented between 45 and 55%. The mean size for all the gillnet catches was under 65 cm. Preliminary results from an ongoing study indicate that less than 50% of halibut caught in gillnets were alive when the nets were raised. There was no recorded data on the survival of fish released back into the water.

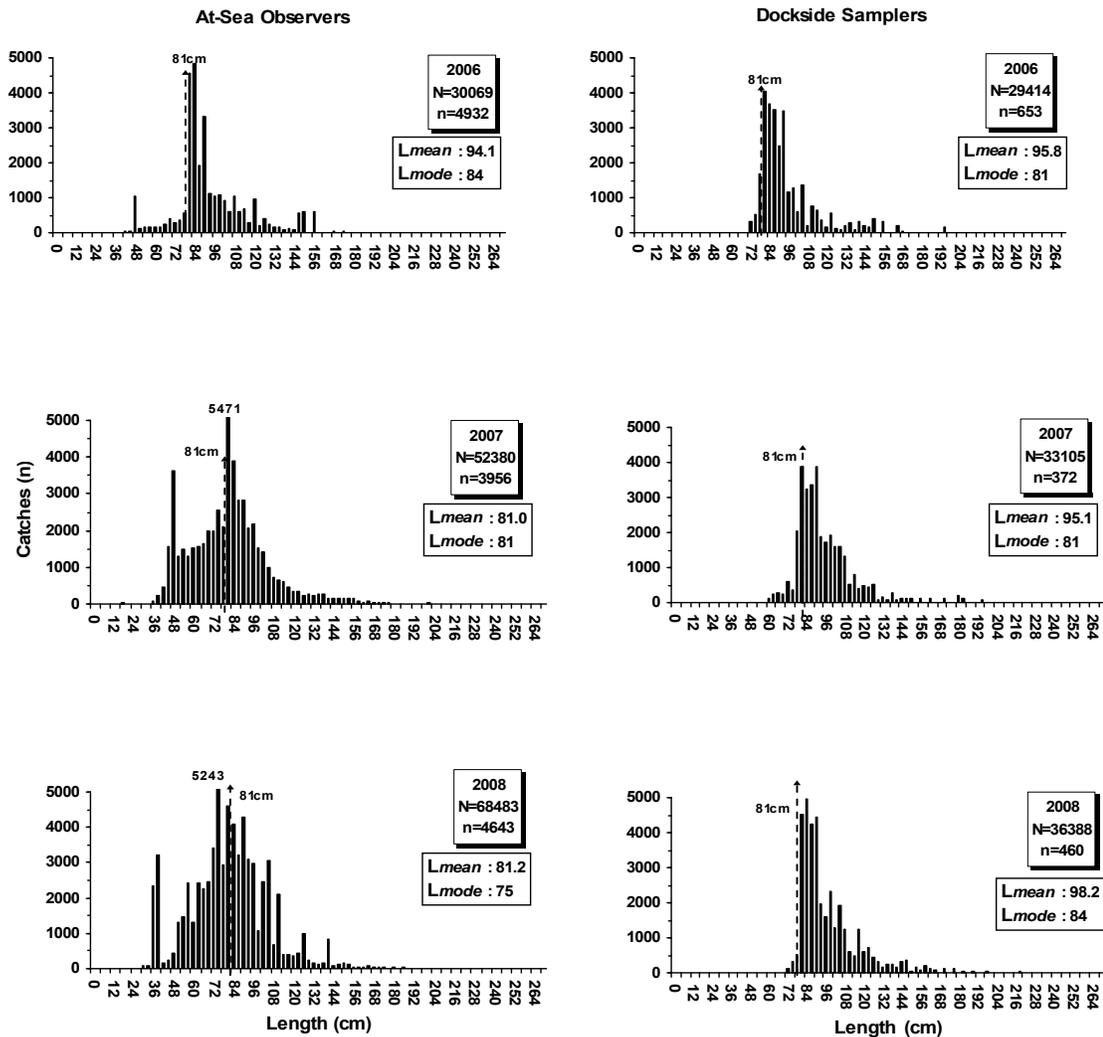


Figure 8. Size frequency distribution of Atlantic halibut measured at sea and dockside in commercial catches using fixed gears, (N: estimated total number of Atlantic halibut found in catches; n: total number of Atlantic halibut measured in samples; L_{mean} : mean length (cm); L_{mode} : modal length (cm)).

Table 2. Importance of Atlantic halibut size categories in catches made at sea, according to fishing gear type.

Year (Gears)	Proportion (%) of total catches at sea					
	Sublegal size (<81cm)		Commercial size (≥81cm)		Large size (≥120cm)	
	Weight	Number	Weight	Number	Weight	Number
Longlines						
2007	11.60	34.06	88.40	65.94	32.22	8.07
2008	15.89	39.73	84.11	60.27	24.77	6.54
Gillnets						
2007	54.77	84.51	45.23	15.49	12.50	0.98
2008	45.13	86.54	54.87	13.46	14.06	1.34

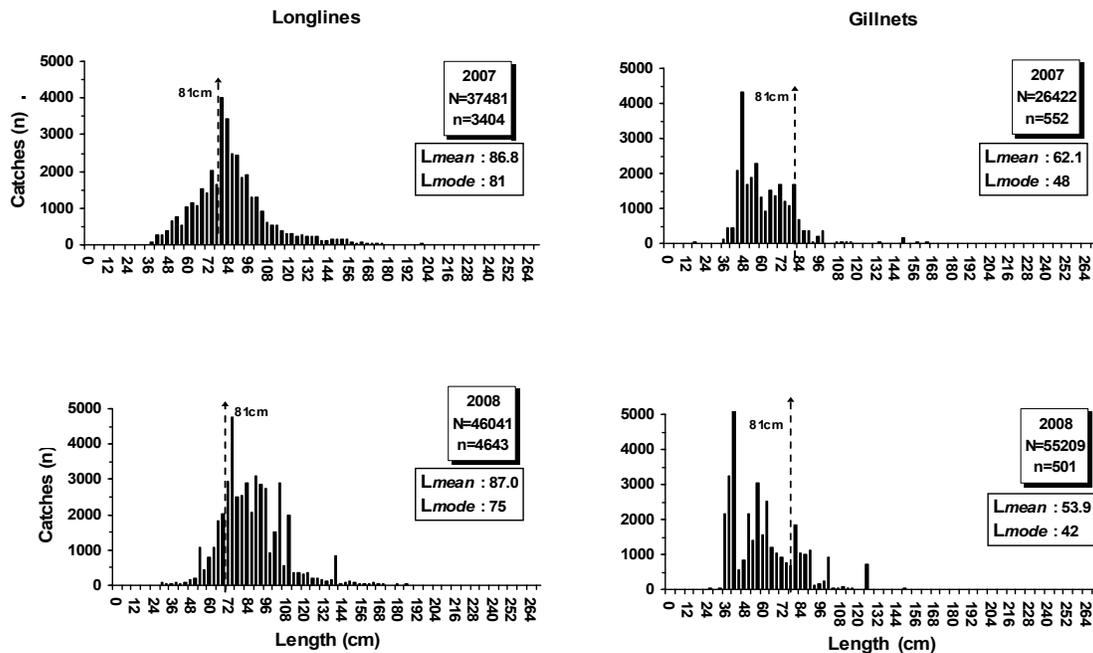


Figure 9. Size frequency distribution of Atlantic halibut measured at sea in commercial catches using longlines and gillnets, (N: estimated total number of Atlantic halibut found in catches; n: total number of Atlantic halibut measured in samples; L_{moy} : mean length (cm); L_{mode} : modal length (cm)).

Sources of Uncertainty

Release back into the water of Atlantic halibut

The survival rate of halibut released back into the water remains a concern. Studies conducted on the survival rate of Atlantic halibut from the Scotian Shelf showed that after 48 hours, in normal fishing conditions, only 35% of halibut of less than 81 cm caught in the trawl had survived whereas the rate for longline catches was more than double (77%). Other studies, conducted on the west coast of Canada, also estimated the survival and mortality rates associated to the release of Pacific halibut by-catches (closely related to Atlantic halibut) of various sizes caught by longlines directed at groundfish (Trumble *et al.*, 2000). The estimated survival rates dropped from 97% to nil depending on the severity of the injuries, the occurrence and significance of bleeding and the infestation of the fish by sand fleas. This same study also considered the characteristics of the hook used as well as the procedure used to remove it from the fish, as these factors could affect the severity of the injuries.

The survival potential of halibut under the legal size (<81 cm) released back into the water is therefore still of great concern. For **longline catches**, the survival of smaller fish could be good in ideal handling conditions. However, in a fishery where the discarding of by-catches is mandatory (e.g. Atlantic cod directed fishery), the survival rate can be greatly reduced for larger size individuals (100+ cm) because of their weight (15+ kg) and their combative strength which increases the difficulty of handling them without injuring them. With larger sizes, the general practice used by fishermen is to “gaff” the fish to bring it onboard the ship. With **gillnets**, it has been well documented in the literature that the survival rate of a fish released back into the water can be greatly reduced as a result of the injuries sustained by the gear, even several

months after its capture (Suuronen, 2005). Based on the preliminary results from an ongoing study in the Gulf which indicated that 50% of halibut were dead as nets were raised, it is likely that the survival rate of halibut released back into the water is quite low or almost nil. The number of discards is high in numbers (Table 2) and likely accounts for a significant share of the total halibut mortality. **Trawls** also present a relatively reduced survival rate and could become a problem in the event mobile gear is reintroduced.

Subdivision 3Pn and the management units

Subdivision 3Pn was not included in the two Atlantic halibut management units created in 1987. In 2002, the FRCC recommended as a temporary measure to set the catch limit (preventive TAC) at 40 t, until the stock structure had been better defined. Since the early 2000s, the reported halibut landings in 3Pn have remained under 40 t. However, in 2008, preliminary numbers indicate that they reached 42.5 t.

ADDITIONAL STAKEHOLDER PERSPECTIVES

The comments presented in this section are those made by some of the halibut fishing industry stakeholders based on the west coast of Newfoundland (FFAW). Their opinion is that the Atlantic halibut stock in the Gulf has shown an unprecedented increase over the last few years, based on commercial catch data which has sharply increased to reach record levels and on the stock's expanded area in the Northern Gulf. The main reasons presented by Industry for this remarkable increase is the absence of the mobile gear fishing fleet and the use of the Nordmore grate in the shrimp fishery. According to Industry, the resource increase has been so significant that over the last two years and for the first time in the history of the Atlantic halibut fishery, the Department had to close directed fisheries on other groundfish species, such as lumpfish and turbot, because of the high Atlantic halibut by-catch rate by these fisheries.

The abundance of commercial (≥ 81 cm) and non commercial (< 81 cm) size halibut has lead Industry to believe that there are a number of significant year-classes in the Gulf's halibut population and that the current exploitation rates are extremely low. Industry is very confident that this stock is able to support considerably higher harvesting rates without it impacting its growth and productivity.

CONCLUSION

As was shown from the data collected during the commercial fishery (CPUE) and from the scientific surveys (abundance indices), the abundance of Atlantic halibut in the Gulf has been consistently increasing in recent years, while the longliner fishing effort directed on this resource has dropped. However, in light of current management measures, the reproductive stock's recovery is still of some concern. In fact, the minimum legal size of 81 cm is far below the size at sexual maturity (L_{M50} of 130 cm) determined for females from the halibut Gulf stock.

The commercial fishery, halibut directed or not, for the most part land individuals measuring between 81 and 120 cm, representing optimal sizes for the current market conditions. However, a management measure requires that halibut by-catches in gillnets from all fisheries as well as individuals measuring less than 81 cm be released back into the water. Studies suggest that the

survival rate of halibut measuring less than 81 cm caught in nets and released back into the water does not exceed 50%. In addition, because it is impossible to calculate the number of halibut released back into the water, it is difficult to adequately assess the damage on the stock.

It seems that landings over the last four years have increased much faster than what the official statistics report, particularly in terms of unaccounted halibut catches made by gillnets measuring less than 81 cm. In these conditions, it is recommended that stock exploitation not be increased (for landings and for releases back into the water) and that all halibut removals made by the directed or non-directed fisheries be accounted for. These measures are vital in order to assess the impacts on recruit performance and on the spawning potential, while limiting the exploitation on the stock's actual spawning potential.

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