Fisheries and Oceans Canada | Pêches et Océans Canada
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Quebec Region

Canadian Science Advisory Secretariat
Science Advisory Report 2025/012

ASSESSMENT OF THE GULF OF ST. LAWRENCE (4RST) GREENLAND HALIBUT (*REINHARDTIUS HIPPOGLOSSOIDES*) STOCK IN 2024

CONTEXT

The Fisheries Management Branch of Fisheries and Oceans Canada (DFO) has requested a stock assessment and advice on catch option for the Greenland Halibut fishery in the Gulf of St. Lawrence (GSL) (Integrated Fisheries Management Plans for the Quebec and Gulf regions).

This Science Advisory Report is from the regional peer review of February 20-21, 2025 on the Gulf of St. Lawrence (4RST) Greenland Halibut (*Rheinhardtius hippoglossoides*) Stock Assessment in 2024. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SCIENCE ADVICE

Status

- The stock status indicator for Greenland halibut in 2024, estimated at 11,240 t, is above the LRP with a moderately high probability, placing the stock in the lower end of the Cautious Zone of the Precautionary Approach (PA).
- The relative exploitation rate in 2024 is close to zero and has reached the lowest value in the series starting in 1996.

Trends

- The stock status indicator has been trending downward since the mid-2000s and reached, in 2024, one of the lowest values in the time series starting in 1990.
- The relative exploitation rate has been declining sharply since 2020.
- Since 2020, no high abundance cohort has been observed.

Ecosystem and Climate Change Considerations

- Although temperatures and dissolved oxygen concentrations in deeper waters have stabilized over the past two years, this stock remains exposed to unfavorable environmental conditions and no changes in its depth distribution have been observed.
- Low prey availability for Greenland halibut appears to have had a recent negative impact on feeding intensity and condition, which is likely to have negatively affected growth and survival, which are key factors determining stock productivity.

Stock Advice

- Stock status may continue to decline in the short term due to lack of strong recruitment since 2020.
- According to the harvest control rule for this stock, the 2024 stock status indicator would correspond to a maximum exploitation rate of 2.58% and a catch option of 290 t for the 2025-2026 and 2027-2028 fishing seasons in the GSL.

Other Management Considerations

- The prolonged soak times of gillnets used in the directed fishery for Greenland halibut lead to significant losses of decomposed fish that are not retained in the nets. A recent study estimated that the total number of fish killed by fishing would have been, on average, five times higher than the quantities landed annually.

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

This assessment follows the framework developed in 2021 during the development of the precautionary approach for the Greenland halibut stock in the GSL (DFO 2022).

Assessment Type

Full assessment

Most Recent Assessment Date

1. Last Full Assessment: February 2023 (DFO 2023, Chamberland and Benoît 2024)
2. Last Interim Year Update: November 2023 (DFO 2024)

Assessment Approach

1. Broad category: Index-based (trends in empirical indices only)
2. Specific category: Index-based (fishery-independent indices)

Stock Structure Assumption

Since 1993, Greenland halibut in the GSL has been recognized as an isolated population distinct from the main population in the Northwest Atlantic, based on the species composition of certain parasites (Arthur and Albert 1993). More recently, two genomic studies have shown the genetic distinction between the GSL and Northwest Atlantic populations (Carrier et al. 2020, Ferchaud et al. 2022). In addition, individuals found in the Laurentian Channel outside the GSL would belong to the GSL population according to a study on length at maturity (Yan et al. 2023).

Reference Points

- Limit Reference Point (LRP): 10,000 t of the biomass above 40 cm
- Upper Stock Reference (USR): 37,740 t of the biomass above 40 cm
- Target Reference (TRP): 47,170 t of the biomass above 40 cm
- Maximum Reference Relative Exploitation Rate (Umax): 6.51% above the TRP

Harvest Control Rule

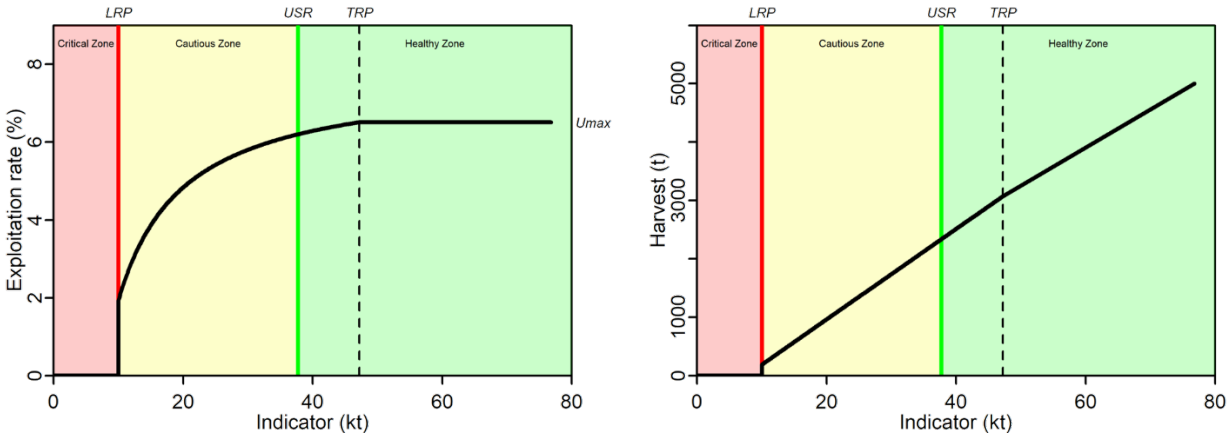

Figure 1. Harvest control rule showing relative exploitation rate (left) and catch option (right) as a function of the stock status indicator. Reference points are shown on the graphs by the vertical lines that define the three PA zones. Umax corresponds to the maximum reference relative exploitation rate.

Data

- Commercial landings: 1970-2024
- Ecosystemic survey in the Estuary and northern Gulf of St. Lawrence (nGSL survey): 1990-2024

ASSESSMENT

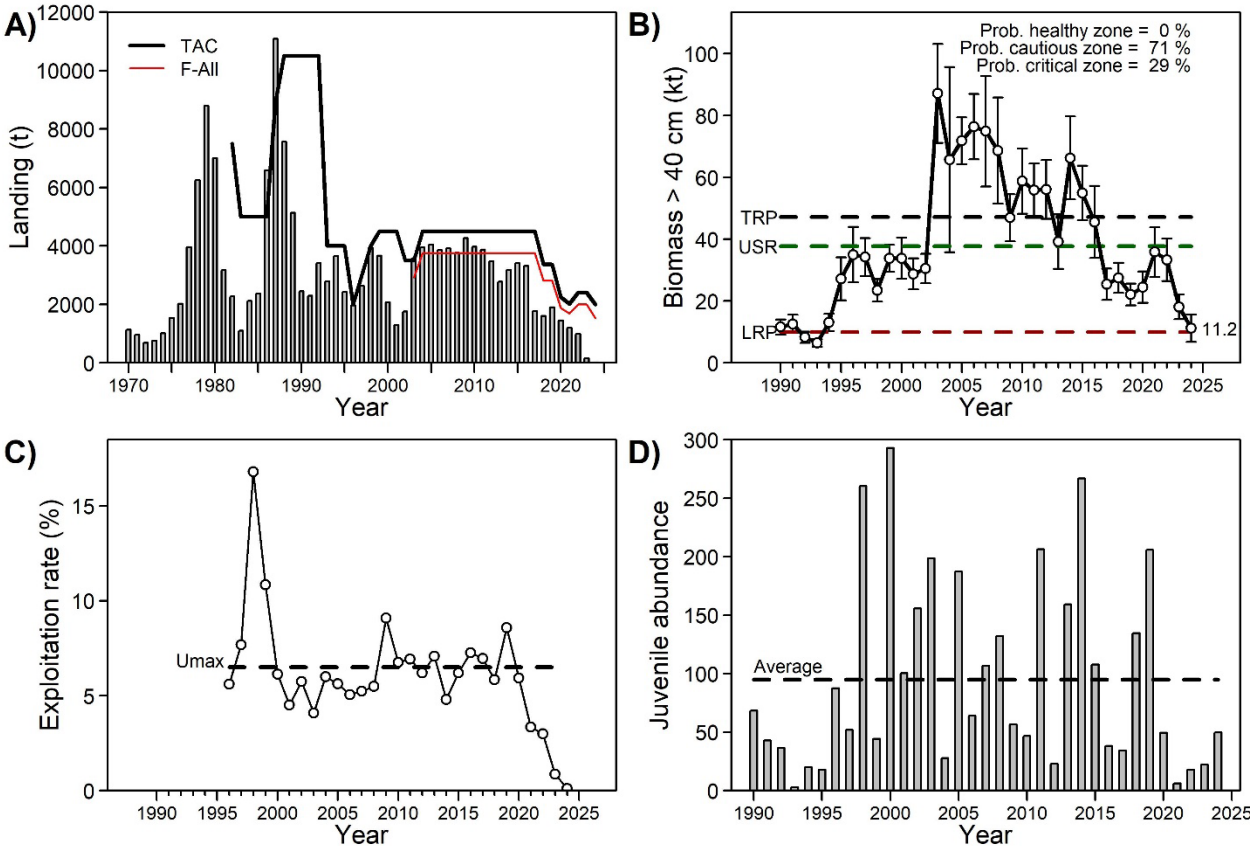

Figure 2. (A) Landings, Total Allowable Catch (TAC) and fixed gear fishing allocation (F-All) by management year, (B) stock status indicator (biomass > 40 cm), (C) relative exploitation rate compared to maximum reference relative exploitation rate (Umax) and (D) recruitment (1 year, in millions).

Historical and Recent Stock Trajectory and Trends

Biomass

The stock status indicator, the biomass of fish > 40 cm estimated from the NGSL survey, declined by 67% between 2008 and 2017, transitioning from the healthy zone to the cautious zone. The indicator was stable in the middle of the cautious zone from 2017 to 2020, increased to values close to the USR in 2021 and 2022, and then declined to reach one of the lowest values (11,240 t) of the series which started in 1990, just above the LRP (Figure 2B). The probabilities of the stock being in the cautious and critical zones are 71 and 29%, respectively.

Exploitation Rate

Following a spike in the relative exploitation rate during the late 1990s, this indicator increased progressively until 2009. It then fluctuated around the maximum reference relative exploitation rate (6.51%) during the period 2010-2019. From 2020 to 2024, the relative exploitation rate declined sharply in response to the decrease in landings, reaching a value close to zero in 2024 (Figure 2C).

Recruitment

Since the late 1990s, this stock has produced alternating cohorts of high and low abundance. The last cohorts of high abundance produced by this stock were those of 2017 and 2018 (1 year in 2018 and 2019). Since 2020, no cohort of high abundance has been observed (Figure 2D).

Size structure

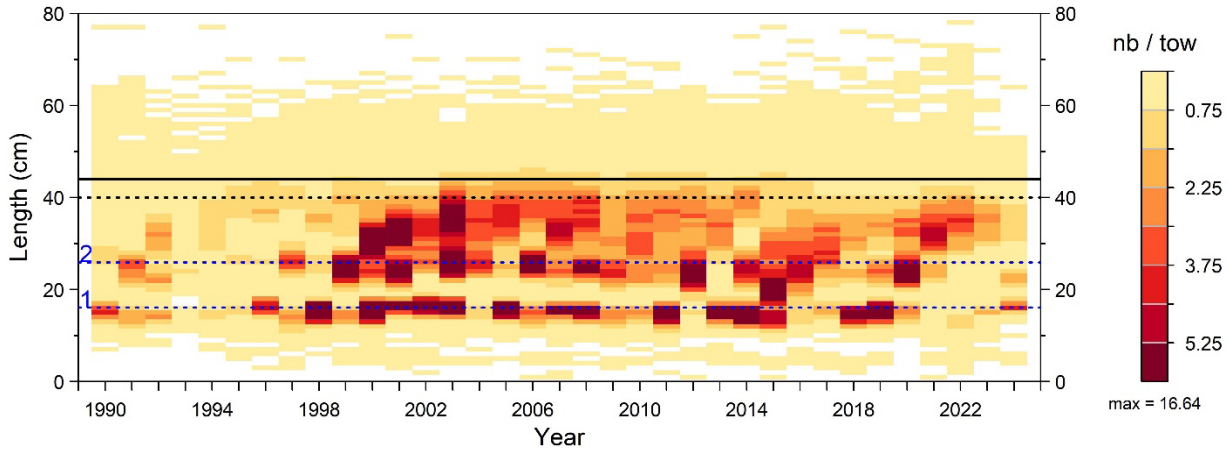

Figure 3. Length frequency distributions estimated with the DFO NGSL (1990-2024) survey. The blue dotted lines indicate the average lengths expected for 1- and 2-year-old fish. The black dotted line at 40 cm indicates the limit for biomass indices for fish over 40 cm. The black solid line at 44 cm indicates the minimum size of the small fish protocol (44 cm).

The size structure observed in the NGSL survey allows cohorts to be tracked from year to year, but cohorts decline rapidly once they exceed or approach a size of 40 cm, indicating high mortality (Figure 3). The last two cohorts of high abundance (2017 and 2018) appear to have experienced normal growth rates, but their abundance declined sharply in 2023. These cohorts are responsible for the increase and maintenance of the biomass index of fish over 40 cm in the upper part of the cautious zone in 2021 and 2022. In 2024, abundance for all size classes was low in response to the decrease in the last cohorts of high abundance and the absence of strong recruitment since 2020 (Figure 3).

Current Status

The Greenland halibut stock is currently above but very close to the LRP. The stock is within the PA Cautious Zone with a 71% probability. The biomass of fish over 40 cm has trended downward since the mid-2000s and there is no indication in the size structure in 2024 that this trend could change.

History of Landings

The directed gillnet fishery for Greenland halibut expanded from 1977 onwards, with landings peaking at over 8,000 t in 1979 and 1987, both followed by a steep decline. Landings subsequently ranged from 2,000 to 4,000 t in the 1990s, declined to around 1,300 t in the early 2000s, and remained at 3,000 to 4,000 t until 2016. Landings have been declining since 2017, reaching the two lowest values since 1970 in 2023-2024 and 2024-2025 (Figure 2A, Table 1).

Since 1993, only fixed gear fleets have been allowed to participate in the GSL directed Greenland halibut fishery and over 94% of landings come from gillnet fisheries. A portion of the

mobile gear coastal fleet's fishing allocation was transferred annually to the fixed gear fleets on a temporary basis between 1993 and 2023-2024.

Table 1. Landings, fixed gear fishing allocation (F-ALL) and TAC of the last 5 fishing seasons. Landing data last updated on 2025-01-15.

Management year	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025[1]
TAC (t)	2,250	2,025	2,400	2,400	2,000
F-All (t)	1,875	1,688	2,000	2,000	1,524
Landings (t)	1,454	1,203	997	158	8.7*

*value from Fisheries Management Branch

Ecosystem and Climate Change Considerations

GSL Greenland halibut habitat warmed and became increasingly depleted in dissolved oxygen (DO) between 2010 and 2023, but the situation appears to have stabilized in the last two years at historically warm and DO-poor conditions (Figure 4). Despite these habitat changes, the depth distribution of Greenland halibut has remained constant. In 2024, over 50% of the Greenland halibut biomass was exposed to temperatures above 6.6°C and DO levels below 20%. A significant proportion of the stock is therefore exposed to DO levels close to critical thresholds observed in the laboratory (between 11 and 15% DO at 5°C, Dupont-Prinet et al. 2013). These changes could negatively affect Greenland halibut productivity. Projections suggest that the situation is likely to remain unfavourable, at least in the short term.

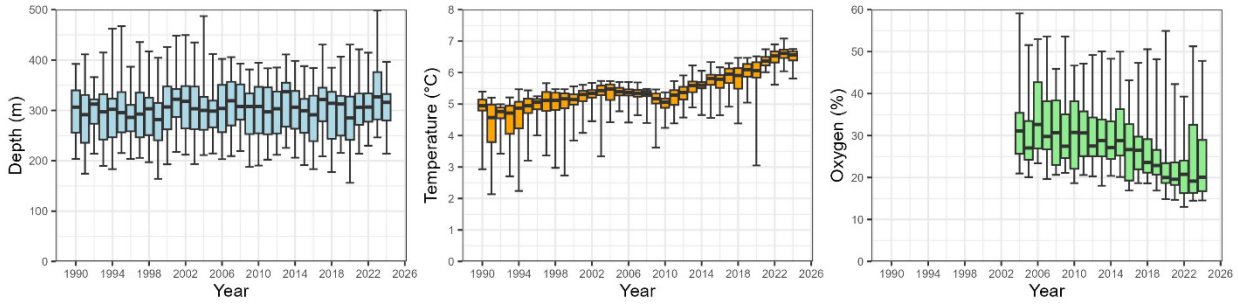

Figure 4. Annual cumulative distributions of Greenland halibut biomass as a function of depth, temperature, and dissolved oxygen saturation level in the NGSL survey. Box plots represent the 5th, 25th, 50th, 75th, and 95th percentiles of the cumulative distribution.

Body condition of Greenland halibut 35 cm and larger reached the three lowest values of the series in 2022, 2023 and 2024. These observations are consistent with historical lows in an index describing feeding intensity, as well as a decrease in the contribution to the stomach fullness index of its two main prey, namely capelin (*Mallotus villosus*) and northern shrimp (*Pandalus borealis*). Low condition indices have been associated with decreased growth and increased mortality in Greenland halibut (Ghinter et al. 2021).

Harvest Control Rule Outputs

According to the harvest control rule agreed in the PA, the value of the stock status indicator corresponds to a maximum exploitation rate of 2.58% and a catch option not exceeding 290 t for the each of the 2025-2026 and 2026-2027 fishing seasons in the GSL.

PROCEDURE FOR INTERIM YEAR UPDATES

In the interim year, an update of the stock status indicator will be produced. In the event of a variation of more than 30% of this indicator or a change in the stock status according to the PA, the projected catch option according to the harvest control rule will be recalculated.

OTHER MANAGEMENT QUESTIONS

Estimated unaccounted mortality in the gillnet fishery

The Greenland halibut directed fishery employs extended gillnet soak times (Figure 5a), which have long been suspected of generating unaccounted fishing losses resulting from fish decomposition and drop out of the gear. Median soak times since 2000 have generally been about 72 hours. A recent study (Benoit et al 2025) based on a simple theoretical process model defined two independent modeling approaches to estimate unaccounted mortalities in this fishery, one based on available catch statistics and the other on field experiments. Both modeling approaches produced similar results: after soak times of 24 hours (h), the total Greenland halibut death from fishing was estimated to be 3 times the amount landed and after 72 h to be approximately 5 times (Figure 5B). On an annual basis, the total Greenland halibut death from fishing was on average 4.7 to 5.4 times the landings recorded over the period 2000 to 2024. This result is consistent with the high mortality levels suggested by the stock assessment.

The study demonstrated that catch rates in the fishery using very short soak times can be similar to those using extended soak times. Significantly shortening soak times could help mitigate unaccounted fish losses while maintaining acceptable yield. In addition, fishing with baited gillnets could increase fishing efficiency and minimize soak times and therefore losses. Finally, identifying fishing sites and seasons that minimize decomposition by scavengers could help mitigate drop out rates. However, these potential solutions require further research.

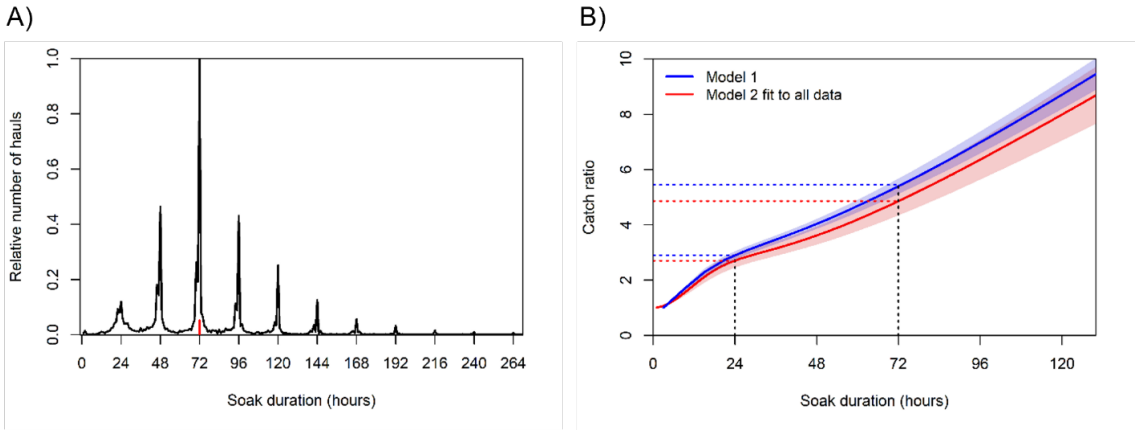

Figure 5. A) Histogram of soak times in the gillnet fishery, 2000–2024. The red line indicates the regulatory soak time of 72 hours. B) Ratio of total Greenland halibut killed by fishing to those landed, as a function of soak time. Ratios corresponding to 24- and 72-hour soak times are indicated by the dotted lines. Model 1 was fitted to catch and effort data only, while Model 2 was fitted to all relevant data.

SOURCES OF UNCERTAINTY

The acquisition of new data on maturity, growth and age will provide information on biological processes determining the productivity of the stock, which will be an asset for the development

of a population dynamics model. The GSL is undergoing significant ecosystem changes that could negatively affect Greenland halibut productivity, but the relative influence of these changes and fishing mortality on population dynamics is not quantified.

The sum of the evidence (unaccounted mortality in the fishery, unfavourable ecosystem conditions, decreasing length at maturity and stock productivity) demonstrates that the assessment framework for this stock should be re-evaluated.

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