UPDATE OF STOCK STATUS INDICATORS FOR GREENLAND HALIBUT IN THE GULF OF ST. LAWRENCE (4RST) IN 2021

Context

The Gulf of St. Lawrence (NAFO Divisions 4RST) Greenland halibut (*Reinhardtius hippoglossoides*) stock is assessed and managed on a two-year cycle. In the intervening years, an update of the key indicators of the status of the resource is presented to determine if there has been a significant change in the status of the stock. The next full assessment of this stock is planned for winter 2023.

This Science Response is a result of the Regional Science Response Process of February 25, 2022 on the Update of Stock Status Indicators for Greenland halibut in the Gulf of St. Lawrence (4RST) in 2021.

Background

The indicators selected to monitor the status of the stock in the interim years are landings from the commercial fishery and indices of biomass and abundance from the bottom trawl survey conducted by Fisheries and Oceans Canada (DFO) in the northern Gulf of St. Lawrence (nGSL).

Environmental and ecological context

The Gulf of St. Lawrence (GSL) ecosystem has undergone significant changes in recent decades. Deep water warms and depletes oxygen. These changes appear to disadvantage cold-water species such as northern shrimp (*Pandalus borealis*) and Greenland halibut. Preliminary data from 2021 shows warming and dissolved oxygen saturation levels in deep water reaching new records in the GSL. The massive influx of two species of redfish into the GSL ecosystem could cause and/or contribute to intensify interactions of direct (for food resources) or indirect (for habitat) inter-species competition with Greenland halibut. Because they are long-lived species, they will share the ecosystem with Greenland halibut for many years to come.

The fishery

Since 1993, only fixed-gear fleets have been permitted to participate in the directed 4RST Greenland halibut fishery, with a portion of the allocation transferred from the mobile-gear fleets to the fixed-gear fleets on an annual basis. In this document, the terminology "fishing allocation (F-ALL)" is used to indicate the portion of the TAC that can be caught annually by fixed gear fleets.

A TAC of 2 025 t was established for the 2021-2022 fishing season which takes place from May 15, 2021 to May 14, 2022. The F-ALL is 1 688 t and is distributed between the Quebec (83%) and Newfoundland and Labrador (NL) (17%) fleets. As of December 22, 2021, landings totalled

1 089 t or 64.5% of the F-ALL (Figure 1). The fixed gear fleets under 65 feet from Quebec and NL had landed respectively 68% and 44% of their allocation. The closure of the estuary fishery (Area 4T4) as of August 2, 2021 due to the overabundance of fish below legal size would be partly responsible for the low landings in the estuary. These landing data are preliminary, but are not expected to increase significantly with the continuation of the fishery next spring.

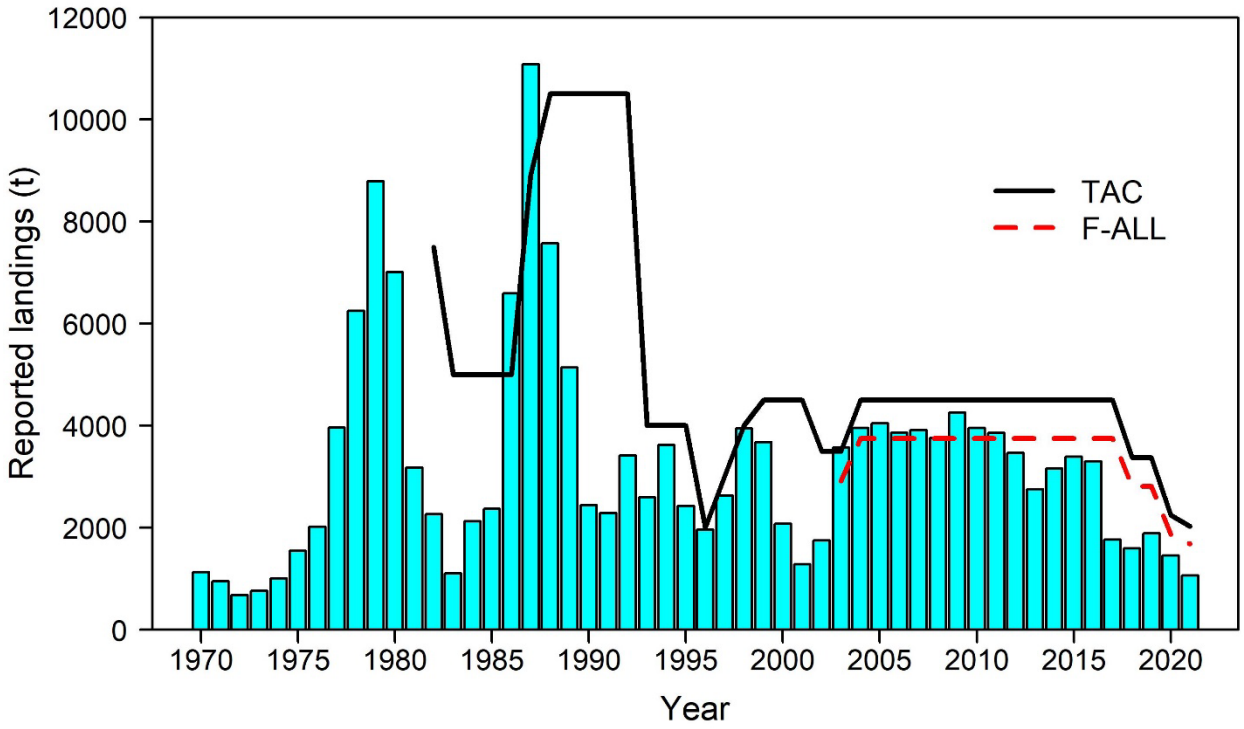

Figure 1: Reported landings of Gulf of St. Lawrence Greenland halibut, total allowable catch (TAC) and fishing allocation (F-ALL) available to fixed gear fleets. Data for 2020 and 2021 are preliminary.

Analysis and Response

Stock Status Indicators

The DFO nGSL abundance index (mean number per tow) for Greenland halibut shows a slight decrease in 2021 compared to 2020 and is slightly below the 1990-2020 series average (Figure 2). The biomass index (mean weight per tow) increased in 2021 and is slightly above average.

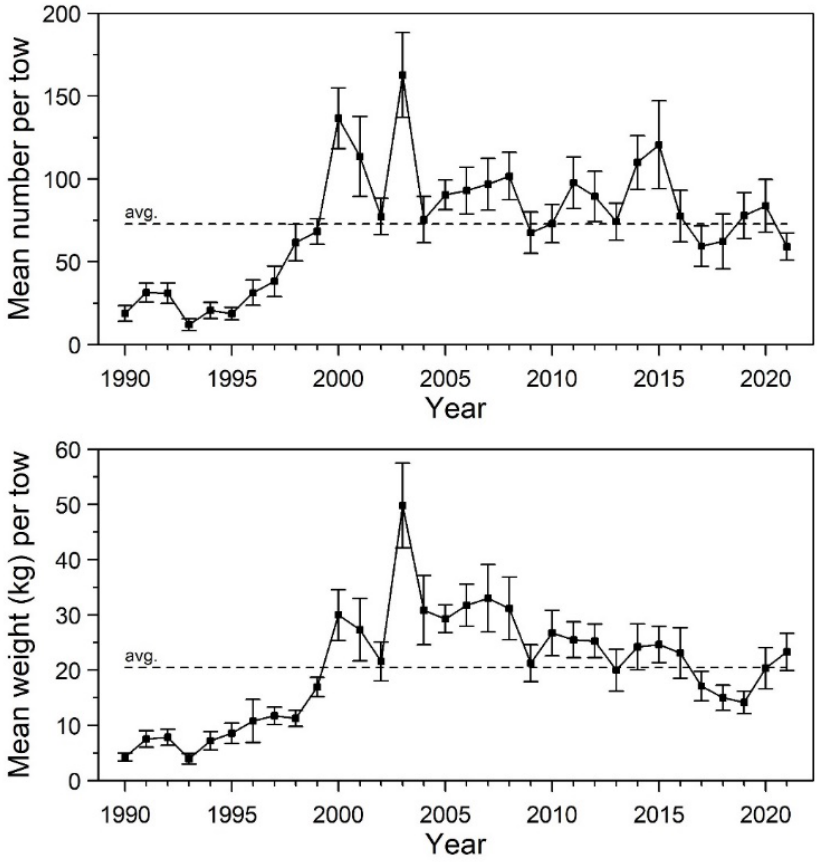

Figure 2: Mean number and weight per tow of Greenland halibut estimated from the DFO nGSL (1990-2021) survey. The dotted lines indicate the long-term average of each series (1990-2020). The error bars indicate the 95% confidence interval.

Trends in abundance indices (mean number per tow) of Greenland halibut vary by size class (Figure 3). There is a alternation of strong and weak cohorts and a very good correlation between the 0-20 cm (1 year) and 20-30 cm (2 year) fish abundance the following year. In 2020 and 2021, abundances in the 0-20 cm size class were very low, indicating the absence of large cohorts in 2019 and 2020. Fish abundances of 20-30 cm were above and below average in 2020 and 2021 respectively. Fish abundance of 30-40 cm increased in 2020 and 2021 compared to 2019, and abundances for these size classes were above average for these two years. For the size class > 40 cm, the abundance index was below the series average from 2017 to 2020 whereas the 2021 value increased compared to that of 2020 and was at the average level (Figure 3).

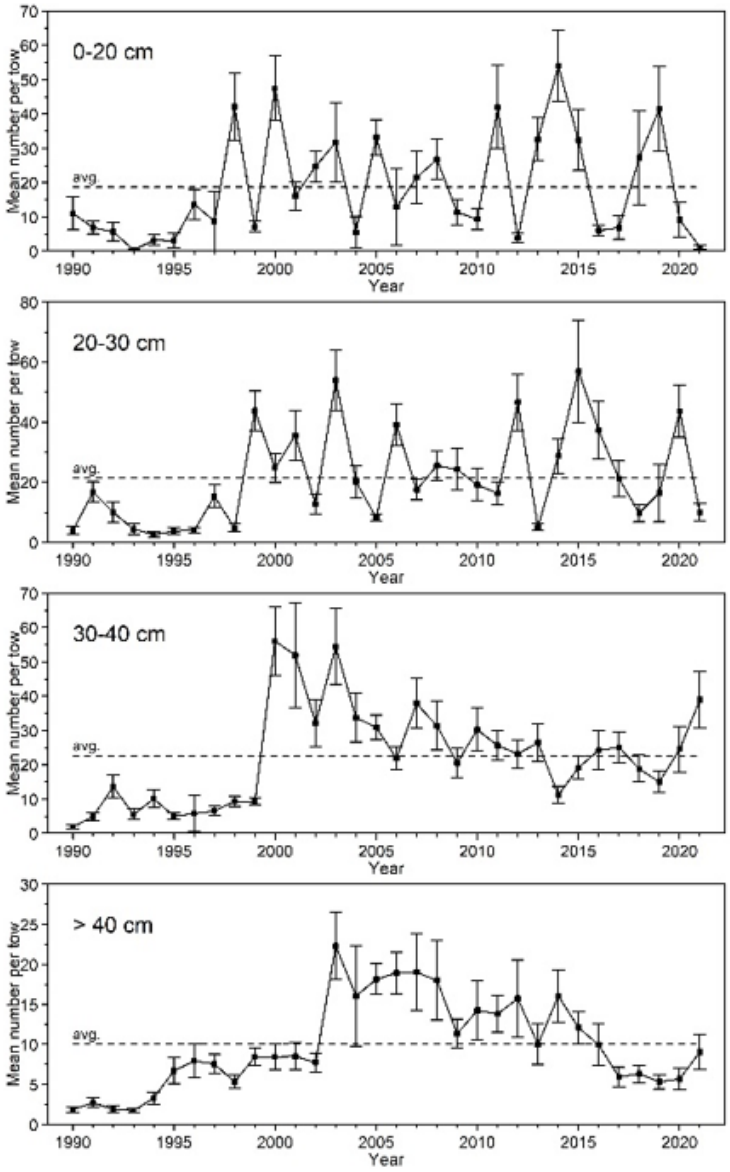

Figure 3: Abundance indices (mean number per tow, NUE) for different size classes of Greenland halibut estimated from the DFO's nGSL survey. The dotted lines represent the long-term average (1990-2020) of each series. The error bars indicate the 95 % confidence interval.

The size structure observed in the nGSL survey is consistent from year to year for fish less than 40 cm, but cohorts quickly disappear as soon as they exceed or approach 40 cm (Figure 4). The high abundance of the 2013 and 2014 cohorts (1 year in 2014 and 2015) is however no longer noticeable at > 35 cm and these cohorts showed lower than average growth. The last two high abundance cohorts (2017 and 2018) appear to be growing at or faster than average. The 2017 cohort would be responsible for the increase in fish abundance index > 40 cm in 2021. However, these strong cohorts will be followed by two years of very low recruitment (Figure 4).

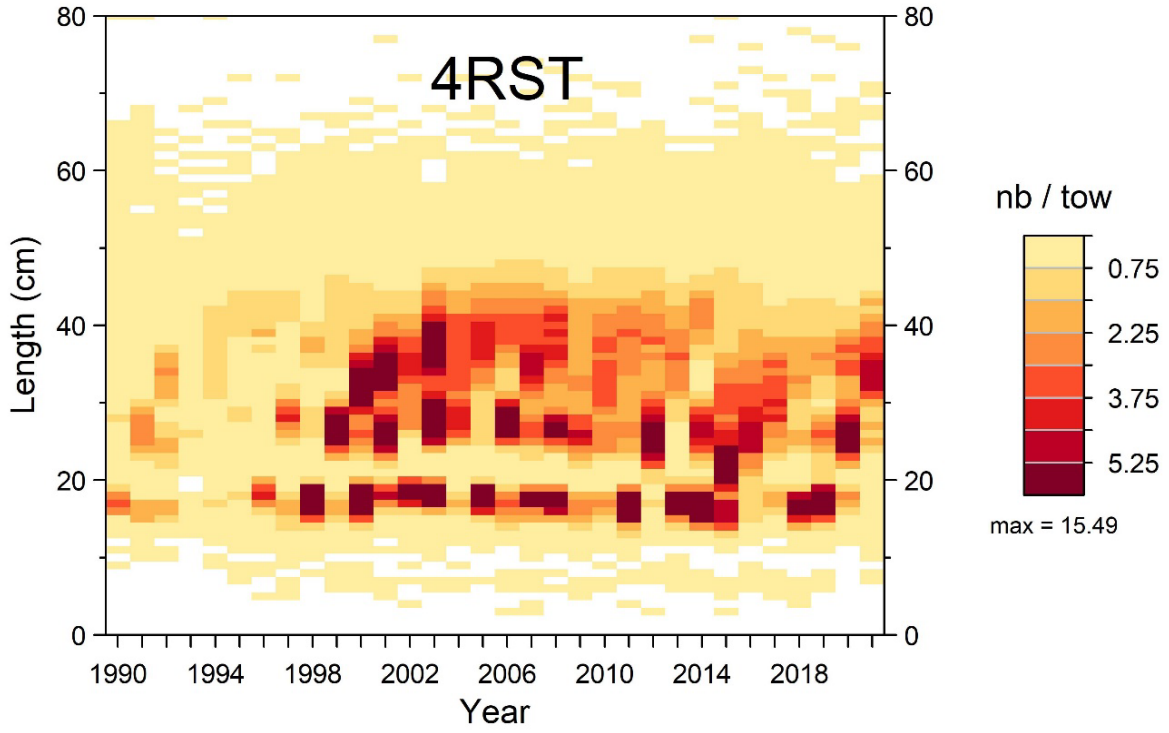

Figure 4: Greenland halibut length frequency distributions (mean number per 15 minutes tow) observed during the nGSL survey.

Relative exploitation rate

An annual indicator (management year) of the relative exploitation rate is obtained by dividing the weight of total commercial landings of Greenland halibut by fish biomass > 40 cm, estimated with DFO nGSL research survey (Figure 5). These relative exploitation rates (hereinafter referred to as exploitation rates) have been available since 1996, when the fishery was regulated by a mesh size of 6 inches (152 mm) and a minimum regulatory size (42 cm in 1996 and 44 cm thereafter). For the Gulf of St. Lawrence, the average exploitation rate was 6.7% for the period 1996-2020 (Figure 5). High exploitation rates in 1998, 1999, 2009 and 2019 are explained by an increase in landings coinciding with a decrease in fish biomass > 40 cm. In 2021, the exploitation rate was below average (3.0%) due to the lowest (preliminary) landings registered since 1996 and increased biomass > 40 cm (Figure 3). Low landings in recent years could have contributed to decrease fishing mortality, including landings and unreported mortality (net-dropping and discards at sea).

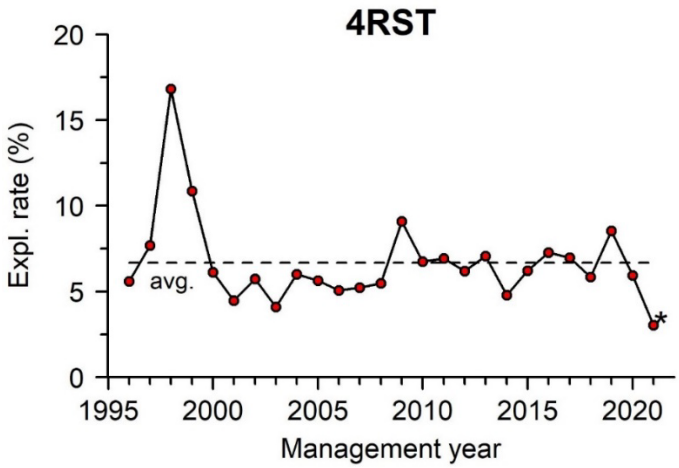

Figure 5: Relative exploitation rate of Greenland halibut in the Gulf of St. Lawrence per management year. The dotted line represents the average of the series (1996-2020). The asterisk above the most recent point indicates that the value is preliminary as the 2021-2022 fishing season is not over.

Precautionary Approach

The indicator selected for monitoring the status of the Greenland halibut stock is the biomass of fish > 40 cm estimated from the DFO nGSL survey (Figure 6). This indicator is considered to be an approximation of the mature biomass of the stock as well as the biomass that will be available for fishing the following year. The selected Limit Reference Point (LRP) is 10 000 t and is the average of the lowest biomasses from which recovery was observed. The Target Reference Point (TRP) is an approximation of the maximum sustainable yield biomass and corresponds to the average biomass of the 1996-2002 and 2004-2012 periods, that is 47 170 t. The Upper Stock Reference (USR) is 80% of the TRP at 37 740 t (DFO 2022). The stock status indicator was in the middle of the Cautious zone from 2017 to 2020 and in 2021 was at the top of the Cautious zone at a biomass level of 35 859 t (Figure 6).

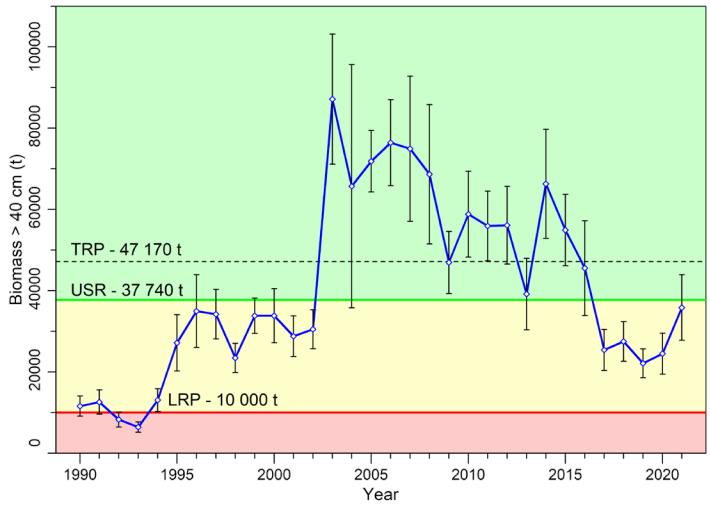

Figure 6: Greenland halibut > 40 cm biomass index estimated from the nGSL survey. The horizontal solid line at the bottom (red) identifies the limit reference point (LRP) that delineates the critical (red) and cautious (yellow) zones. The green horizontal line identifies the upper stock reference point (USR) that delineates the cautious and healthy zones (green). The black dotted line indicates Target Reference Point (TRP). The error bars indicate the 95% confidence interval.

Three harvest control rule (HCR) scenarios were proposed to complement the precautionary approach for the GSL Greenland halibut stock (Figure 7, DFO 2022). The proposed HCR determine the projected exploitation rate based on the stock status indicator. In Healthy and Cautious zones, the projected exploitation rates include all reported landings. This projected exploitation rate is then converted into a projected removal, which is a recommended total catch limit. In the Critical zone, no directed fishing is permitted and bycatch must be kept to the minimum possible level (DFO 2022). Mechanisms for exceptional circumstances related to a significant fluctuation in the stock status indicator relative to the previous year may be identified as necessary in the next assessment of the Greenland halibut stock.

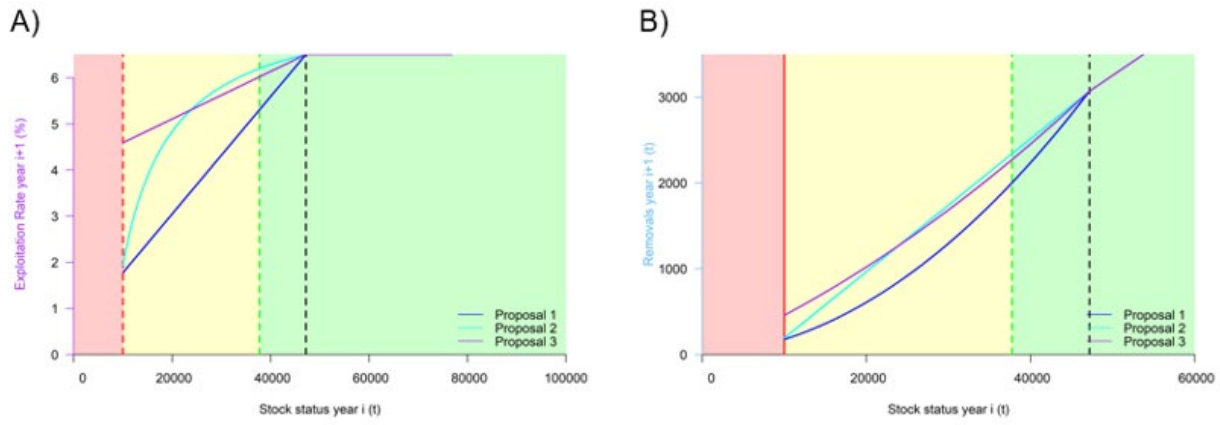

Figure 7: Comparison of RCP 1, 2 and 3 proposals in terms of A) exploitation rate and B) removals. The horizontal red line is the limit reference point that delineates the critical (light red) and cautious zones (yellow). The green horizontal line is the upper stock reference point that delineates the cautious and healthy zones (green). The dashed black line indicates the target reference point.

Based on the HCRs established under the Precautionary Approach, the projected exploitation rate for the 2022-2023 season would be 5.06%, 6.12% and 5.93% for HCR 1, 2 and 3 respectively. In terms of projected removals, these values correspond respectively to 1 818 t, 2 195 t and 2 125 t.

Conclusions

The unfavorable environmental conditions for Greenland halibut in the Gulf of St. Lawrence did not improve in 2021. The deep waters have continued to warm and oxygen saturation is at its lowest level observed in the St. Lawrence estuary. In addition, recruitment indices were well below average in 2020 and 2021. The main stock status indicator has increased to near the USR level in 2021 and the abundant 2017 and 2018 cohorts are expected to recruit to the fishery in the coming seasons. In contrast, low recruitment to spawning stock biomass is expected for at least two years due to low abundances for the 2019 and 2020 cohorts. Analysis of the main stock status indicator shows that the stock is at the top of the cautious zone.

The TAC for 2022-2023 will be determined by fisheries management from the projected removals according to the HCR that will be selected.

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Date : March 17, 2022

Sources of Information

DFO. 2021. Assessment of the Gulf of St. Lawrence (4RST) Greenland halibut stock in 2020. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2021/017.

DFO. 2022. Development of a precautionary approach for the Gulf of St. Lawrence (4RST) Greenland halibut stock. DFO Can. Sci. Advis. Sec. Sci. Resp. 2022/002.

This Report is Available from the:

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Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-3769
ISBN 978-0-660-42859-8 Cat. No. Fs70-7/2022-016E-PDF

Correct Citation for this Publication:

DFO. 2022. Update of stock status indicators for Greenland Halibut in the Gulf of St. Lawrence (4RST) in 2021. DFO Can. Sci. Advis. Sec. Sci. Resp. 2022/016.

Aussi disponible en français :

MPO. 2022. Mise à jour des indicateurs de suivi de l'état du stock de flétan du Groenland du golfe du Saint-Laurent (4RST) en 2021. Secr. can. des avis sci. du MPO. Rép. des Sci. 2022/016.