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Maritimes Region

Canadian Science Advisory Secretariat
Science Response 2021/024

STOCK STATUS UPDATE OF ATLANTIC HALIBUT (*HIPPOGLOSSUS HIPPOGLOSSUS*) ON THE SCOTIAN SHELF AND SOUTHERN GRAND BANKS IN NAFO DIVISIONS 3NOPs4VWX5Zc FOR 2020

Context

Atlantic Halibut (*Hippoglossus hippoglossus*) is the largest of the flatfishes and ranges widely over Canada's East Coast. The management unit definition, Northwest Atlantic Fisheries Organization (NAFO) Divisions 3NOPs4VWX5Zc, is based largely on tagging results that indicate that Atlantic Halibut move extensively throughout the Canadian North Atlantic with smaller fish moving further than larger fish.

The Atlantic Halibut fishery was unregulated until a Total Allowable Catch (TAC) was implemented in 1988 and a legal size limit (≥ 81 cm total length) was established in 1994. The Fisheries and Oceans Canada (DFO) Summer Research Vessel (RV) Survey provides an index of abundance for incoming recruitment for the stock. An Industry-DFO Longline Halibut Survey (Fixed Station Halibut Survey) on the Scotian Shelf and southern Grand Banks (NAFO Divs. 3NOPs4VWX5Zc) was initiated in 1998 to provide an index of exploitable (≥ 81 cm total length) Atlantic Halibut on the Scotian Shelf and southern Grand Banks. An assessment model and procedures were adopted in November 2014 (Cox et al. 2016) to inform Resource Management of the status of the Halibut resource and to provide harvest-level advice based on standardized catch rates from the Halibut Survey and stratified mean numbers-per-tow from the DFO Summer RV Survey (NAFO Divs. 4VWX). Science advice provided in December every year since 2014 used this new procedure (DFO 2015, 2016, 2017, 2018, 2019, 2020). In 2017, a new Stratified Random Halibut Survey was initiated that extended the survey into areas and depths that were not well sampled by the Fixed Station Survey. One hundred (100) Fixed Stations have continued to be fished for the last four years (2017–2020) to calibrate the Stratified Random Survey with the Fixed Station Survey and provide TAC advice until the next framework review.

Resource Management has asked Science to update and evaluate Atlantic Halibut abundance indicators, landings, and fishing mortality estimated from tagging data. This response provides the 2020–2021 TAC advice based on the Objectives and Harvest Strategy adopted at the Scotia-Fundy Groundfish Advisory Committee (SFGAC) meeting in March 2015.

This Science Response Report results from the Regional Science Response Process of December 1-2, 2020, on the Stock Status Updates of Groundfish Stocks in the Maritimes Region.

Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Background

Biology

Atlantic Halibut are most abundant at depths of 200–500 m in the deep-water channels running between the banks and along the edge of the continental shelf, with larger individuals moving into deeper water in winter. The geographic range of Atlantic Halibut in the Northwest Atlantic extends from the coast of Virginia in the south to the waters off northern Greenland.

Female Atlantic Halibut grow more quickly than the males and attain a much larger maximum size. Atlantic Halibut grow rapidly (approximately 10 cm per year) until the age of maturity, which, for this region, is estimated to be at 77 cm for males (age 5–6) and 119 cm for females (age 9–10).

Description of the Fishery

The management unit definition (NAFO Divs. 3NOPs4VWX5Zc, Figure 1) was based largely on tagging results that indicated that Atlantic Halibut move extensively throughout the Canadian North Atlantic. Within the management unit, Atlantic Halibut are fished mostly along the edges of the continental shelf and mainly by longline. Until 1988, the fishery was unregulated. A TAC of 3,200 tonnes (t) was first established in 1988 and, in response to an 8-year decline in landings, was reduced to a low of 850 t in 1995. Since 1994, management plans and licence conditions require the release of Atlantic Halibut < 81 cm. Beginning in 1999, the TAC has been increased several times and was last set at 5,507 t in 2020 (Table 1; Figure 2).

The NAFO statistics are used to describe removals up to 2019 because landings occur in two DFO regions (Maritimes Region, and Newfoundland and Labrador Region), and other countries including Portugal, Spain, France, and the United States (US) take Halibut within the stock area but outside Canada's Exclusive Economic Zone (EEZ). Only the Canadian landings (MARFIS) are reported for 2020, and these numbers are preliminary. The majority of landings in 2019 occurred on the Scotian Shelf (NAFO Divs. 4VWX) and were 12% greater than in 2018. Foreign catches for 2019 were 30% greater than reported in 2018. In some years, Canadian quota carry-forward provisions and foreign catches result in total landings above the TAC.

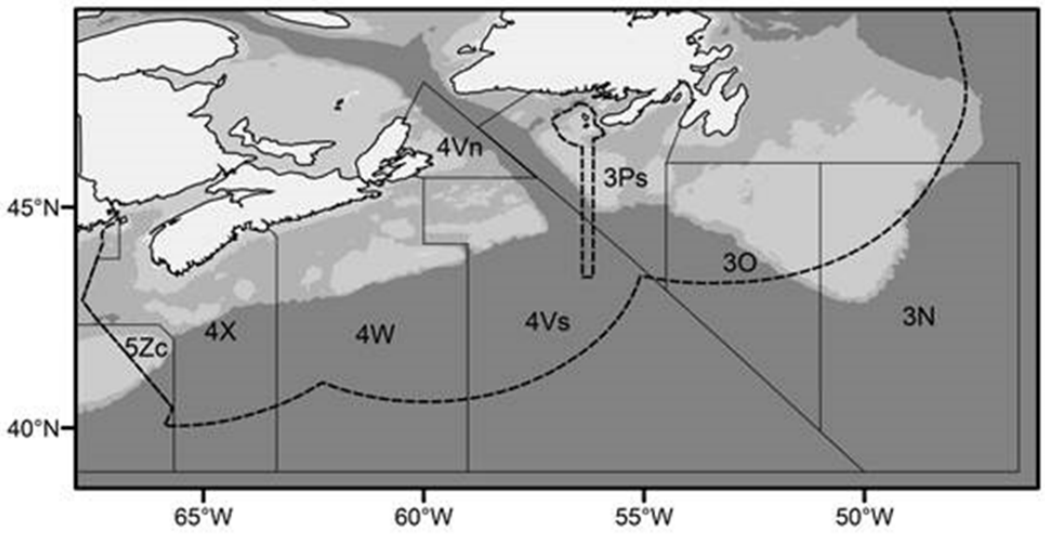

Figure 1. Management unit Northwest Atlantic Fisheries Organization Divisions 3NOPs4VWX5Zc.

Table 1. Total reported Canadian and foreign landings (tonnes) of Atlantic Halibut from Northwest Atlantic Fisheries Organization Divisions 3NOPs4VWX5Zc[1]. Ten-year annual average landings are presented for 1960 to 2009. The NAFO 21A table of landings by country are reported by calendar year; however, the Total Allowable Catch (TAC) for the stock is set for the period of April–March. Data were extracted from the NAFO 21A database on Nov 18, 2020. Dash (-) indicates data not available.

Year(s)		Canada			Foreign			3NOPs4VWX+5Zc	
		3NOPs	4VWX+ 5Zc[1]	Total	3NOPs	4VWX+ 5Zc[1]	Total	Grand Total	Canadian TAC
Decadal Avg.	1960-1969	638	1431	2070	492	73	565	2634	-
Decadal Avg.	1970-1979	428	874	1302	74	44	117	1419	-
Decadal Avg.	1980-1989[2,3]	738	1625	2363	217	28	245	2608	-
Decadal Avg.	1990-1999	323	815	1139	180	4	184	1323	1855
Decadal Avg.	2000-2009	461	878	1339	148	0	148	1487	1318
Annual	2010	464	1296	1760	131	14	145	1905	1850
Annual	2011	373	1346	1719	218	15	233	1952	1850
Annual	2012	531	1491	2022	200	18	218	2240	2128
Annual	2013	562	1836	2398	205	21	226	2624	2447
Annual	2014	839	1811	2650	312	27	339	2989	2563
Annual	2015	693	2174	2867	395	31	426	3293	2738
Annual	2016	626	2186	2812	393	43	436	3248	3149
Annual	2017	759	2353	3112	403	43	446	3558	3621[4]
Annual	2018	699	3171	3870	343	27	370	4240	4164[4]
Annual	2019	841	3414	4255	480	0	480	4735	4789[4]
Annual	2020[5]	596[5]	3564[5]	4160[5]	-	-	-	-	5507[4]

[1]Canadian landings in 5Y are assumed to have been in the Canadian portion and are included in the 4VWX+5Zc value. Foreign/US landings in 5Y are not included.
[2]Landings were first listed in 5Zc in 1986; 5Zc and 5Ze are used to indicate same area.
[3]Prior to 1988 the Atlantic Halibut catch was unregulated.
[4]Since 2017, 100 t of the Canadian TAC has been set aside annually to cover catches by US and France within the stock area.
[5]Landings from the Maritimes Fisheries Information System (MARFIS) for 2020 are preliminary, as of November 18, 2020.

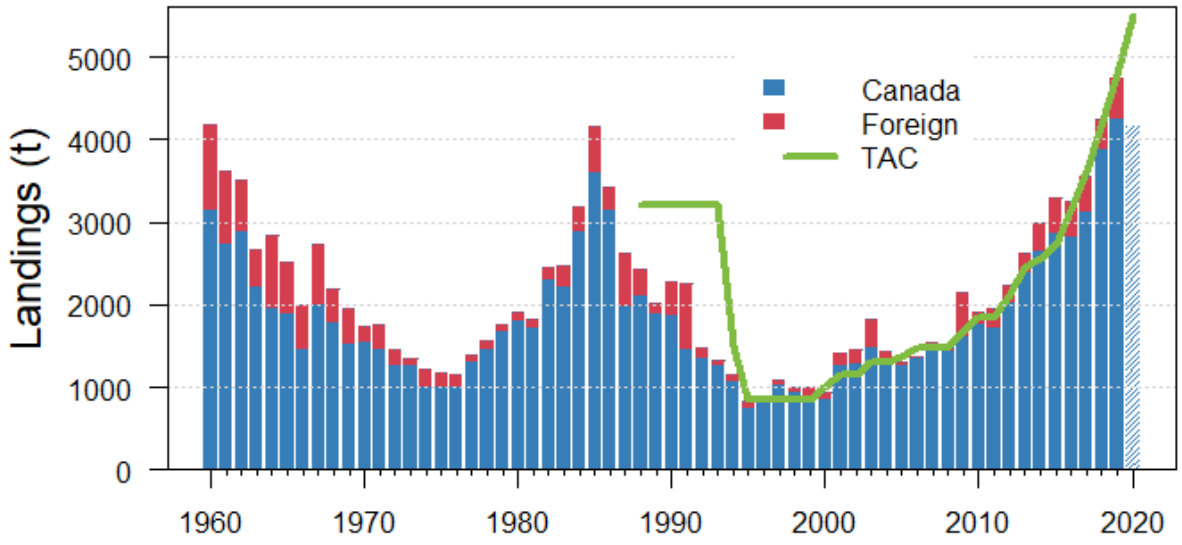

Figure 2. Northwest Atlantic Fisheries Organization (NAFO) reported Canadian (blue) and foreign (red) landings (tonnes) for 3NOPs4VWX5Zc Atlantic Halibut. Landings for 2020 (hashed bar) are preliminary, and taken from the Maritimes Fisheries Information System (MARFIS) as of November 18, 2020. The solid green line is the Canadian Total Allowable Catch (TAC). The NAFO 21A table of landings by country are reported by calendar year; however, the TAC for the stock is set for the period of April-March.

Assessment Framework

A new Assessment Framework was adopted in November 2014 (Cox et al. 2016). This Framework used a new Statistical Catch-At-Length (SCAL) model to assess the stock status and an operating model (HAL) to evaluate the impact of a suite of harvest strategies on the biomass/population trends and landings. In March 2016, the SFGAC adopted a Fishing Mortality (F) of F = 0.14 harvest strategy with a cap on annual changes in TAC of 15%. Stock status in interim years is assessed based on the Halibut Survey index of exploitable biomass and the DFO Summer RV Survey (NAFO Divs. 4VWX). The next Assessment Framework review is currently scheduled for 2021. In interim years, Science advice on TAC is based on the 3-year mean Halibut Survey index of exploitable biomass.

Analysis and Response

DFO Summer RV Survey (4VWX)

The DFO Summer RV Survey (NAFO Divs. 4VWX) has been conducted every July since 1970. The median size of Halibut caught in the trawl survey is between 40 and 50 cm. The catch of Atlantic Halibut in this survey increased between 2000 and 2011 (Figure 3). Since 2011, catch rates have remained above the long-term mean. The mean numbers-per-tow in 2020 were lower than they have been since 2011 but still above the long-term mean. The 2018 DFO Summer RV Survey did not cover all strata due to mechanical issues, so the mean numbers of Halibut per tow in 4VWX for 2018 cannot be estimated (Figure 3).

The biomass index from the RV survey (not shown here) is comparable to the level in 2015 (DFO 2021) reflecting the greater number of large fish in the survey. Although the 2017 RV survey did not catch halibut less than 38 cm (DFO 2021) roughly 20% of the 2020 catch was under 38 cm, indicating that some of the youngest cohorts are still present in the survey.

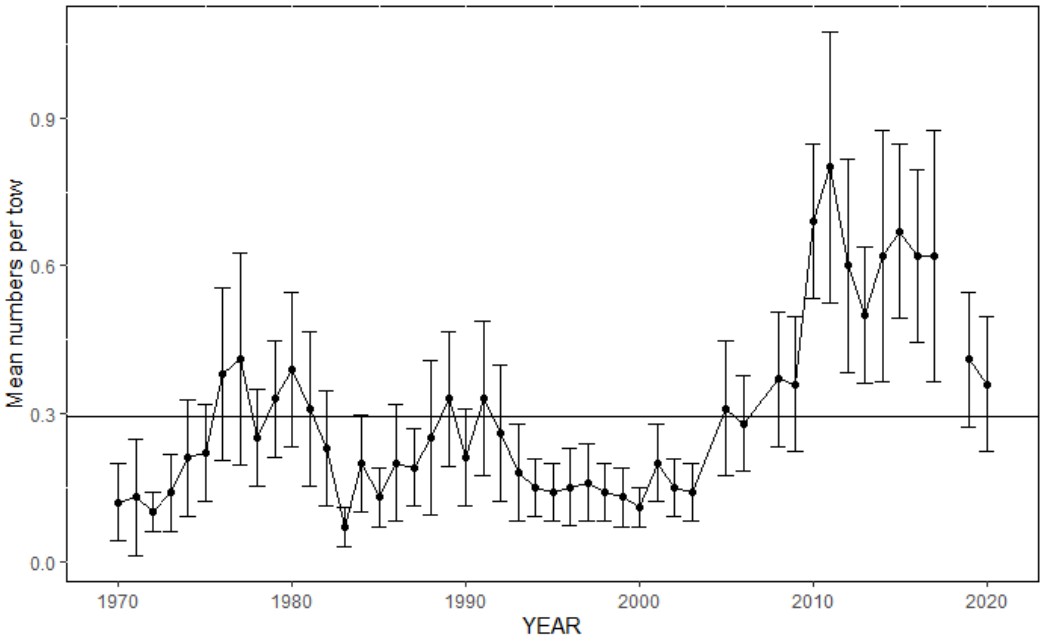

Figure 3. Plot of mean number of Atlantic Halibut per tow for DFO Summer Ecosystem Survey sets in 4VWX from 1970 to 2020. The solid black horizontal line is the long-term (1970–2019) mean (0.30 per tow). The vertical bars indicate 95% confidence intervals.

Fixed Station Halibut Survey

The Fixed Station Halibut Survey provides an index of abundance of Atlantic Halibut ranging in size between 50 and 220 cm (den Heyer et al. 2015). The survey is completed by commercial fishermen with onboard observers between May and August. Halibut Survey catch rates were standardized using a Generalized Linear Model (GLM) including both station and year effects. It should be noted that because a year effect is included in the GLM, values for previous years are re-estimated when the model is updated with a new year of data, and this may cause discrepancies between previously reported abundance indices. In 2017, the number of stations surveyed during the Fixed Station Halibut Survey was reduced from the approximately 232 consistently fished stations to 100 Index Stations. This allowed more effort to be directed towards the new Stratified Random Survey, while providing adequate sampling for an index of exploitable biomass and to calibrate the Stratified Random stations to the Fixed Stations. The catch rate has increased since 2004, and the 2020 standardized catch rate from the GLM fit to the 100 Index Stations is the second greatest in the 23-year time-series (Figure 4). The 2020 three-year mean index from the Halibut Survey shows little change in exploitable biomass from 2019. The GLM estimates that the 2020 index of abundance is 2% higher than in 2019. However, the three-year mean estimated by the updated GLM is 4% lower than the three-year mean index estimated for 2019 in the last Science Response and used for the 2020 TAC advice (DFO 2020). The Upper Stock Reference (USR) point was set in the 2014 assessment as the highest Spawning Stock Biomass (SSB) in the 1982 to 2013 time-series, which was the SSB in 2013 (Figure 5). Given that the total biomass has increased since 2013, unless the relationship between total biomass and SSB has changed markedly, the 2020 SSB is above the USR point, putting the stock in the Healthy Zone.

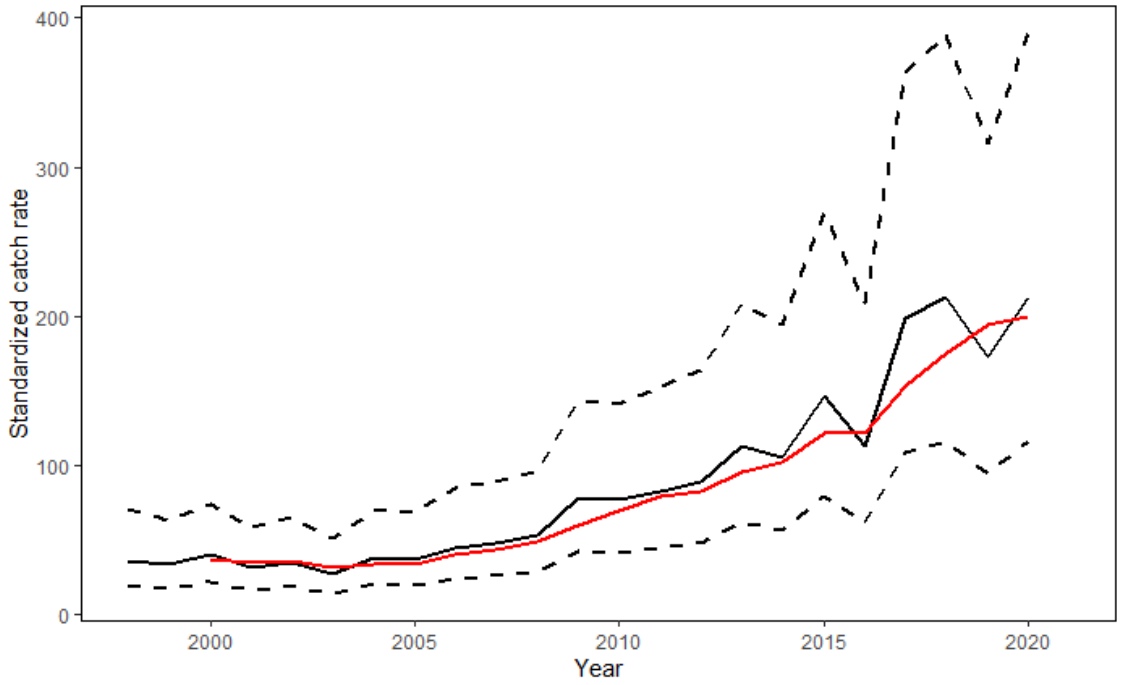

Figure 4. Plot of standardized catch rate of Atlantic Halibut (kg/1000 hooks/10 hrs) from the Generalized Linear Model (GLM) of 3NOPs4VWX5Zc Halibut Survey 100 Index Stations. The solid black line is predicted catch rate; the dashed lines indicate the 95% confidence interval. The 3-year mean of the index (solid red line) is also plotted.

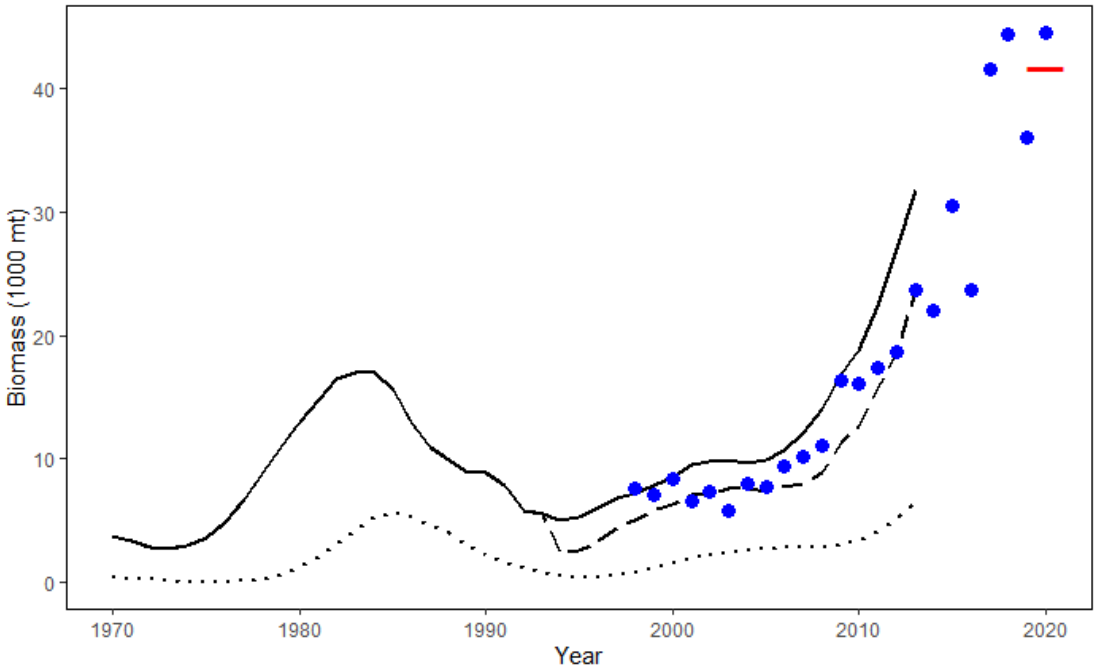

Figure 5. Plot of Atlantic Halibut biomass between 1970 and 2013 estimated from the stock assessment model (black lines) and the Halibut Survey 100 Index Stations (blue circles). The solid black line is total biomass, the dashed line is exploitable biomass (> 81 cm), and the dotted line is spawning stock biomass. The solid red bar is the current 3-year mean of the Halibut Survey biomass index.

Harvest Control Rule

Applying the F = 0.14 strategy, with a maximum annual change of 15% from the 2019–2020 TAC (5,507 t), would result in a 2021–2022 TAC of 5,445 t. This TAC advice is based on the 3-year mean of the standardized Halibut Survey index of exploitable biomass and was tested against simulations from the HAL model at the last assessment (Cox et al. 2016). This application of the harvest control rule, and the projections from the HAL model (DFO 2015), assume all removals from Canadian and international fisheries are included. Note that the slight (1%) decline in TAC despite a slight (2%) increase in the 3-year mean of the standardized Halibut Survey index is the result of the re-estimation of the 2019 index by the updated model.

Multi-year Mark-recapture Tagging Model

In 2006, DFO and the Atlantic Halibut Council (AHC) began the Halibut All Sizes Tagging (HAST) program to estimate population size, exploitation rate and evaluate the distribution of Atlantic Halibut within the Scotian Shelf southern Grand Banks management unit (den Heyer et al. 2015). Between 2006 and 2019, 5,434 Halibut were double tagged with T-bar anchor tags. As of January 1, 2020, 945 tagged Halibut were recaptured and reported with sufficient information to be used in the multi-year mark-recapture model. Assuming 80% tag reporting and 100% survival from tagging, the F in 2019 is estimated to be 0.030 (Standard Error [SE] = 0.006) (Figure 6). This is a small decline from 2018 (F = 0.036, SE = 0.007). Overall the mark-recapture estimate of fishing mortality has been declining since 2008 but has been fairly stable in recent years. The absolute estimates of F from the tagging model are not directly comparable to the assessment model but provide an indication of the trend in interim assessment years.

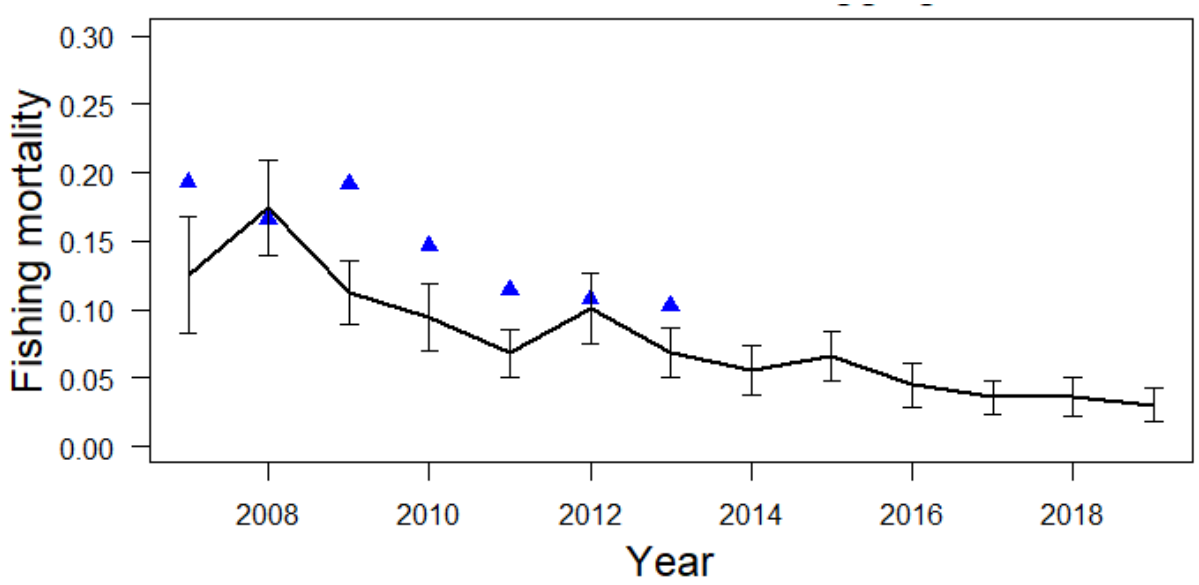

Figure 6. Plot of instantaneous fishing mortality for Atlantic Halibut estimated from the multi-year tagging model (solid black line) and the assessment model (blue triangles). The vertical bars indicate 95% confidence intervals.

Conclusions

The 3NOPs4VWX5Zc Atlantic Halibut stock has a history of overfishing that predates the time-series used in the stock assessment model (i.e., prior to 1970). The assessment model indicates that the stock has increased from the depleted state observed in the early 1990s. The updated DFO Summer RV (4VWX) survey and the 3NOPs4VWX5Zc Halibut Survey indices show that abundance of both pre-recruits and recruits continue to be high. The 2020 DFO Summer RV (4VWX) index remains above the long-term mean and suggests that the fishery will continue to benefit from high recruitment in the next couple of years. The index of exploitable (> 81 cm) Atlantic Halibut biomass is the second highest in the 23-year time-series. Consistent with the rapid increase in biomass and a capped increase in TAC, the fishing mortality estimated from the multi-year mark-recapture model has remained at low levels. The 3-year mean index of exploitable biomass for 2020 is essentially the same as last year. A 2021–2022 TAC consistent with the Harvest Strategy adopted by the SFGAC is 5,445 t, 62 t (1%) less than last year.

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Sources of Information

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