



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

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 assess 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 2014, 2015, 2016, 2017 and 2018 used this new procedure (DFO 2015, 2016, 2017, 2018, 2019a). 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 will continue to be fished for at least three years (2017–2019) to calibrate the Stratified Random Survey with the Fixed Station Survey and provide TAC advice.

Resource Management 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 Science Response Process of December 4, 2019, on the Stock Status Update of 3NOPs4VWX5c Atlantic Halibut.

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

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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 faster 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 3200 tonnes (t) was first established in 1988 and in response to an eight 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 4789 t in 2019 (Table 1; Figure 2).

The NAFO statistics are used to describe removals up to 2018 because landings occur in two DFO regions (Maritimes Region and Newfoundland and Labrador Region), and other countries including Portugal, Spain, France, and the US take Halibut within the stock area but outside Canada's Exclusive Economic Zone (EEZ). Only the Canadian landings (MARFIS) are reported for 2019, and these numbers are preliminary. The majority of landings in 2018 occurred on the Scotian Shelf (NAFO Divs. 4VWX) and were 27% greater than in 2017. Foreign catches for 2018 were less than those reported in 2017, with a decrease of approximately 43%. In some years, Canadian quota carry forward provisions and foreign catches result in total landings above the TAC.

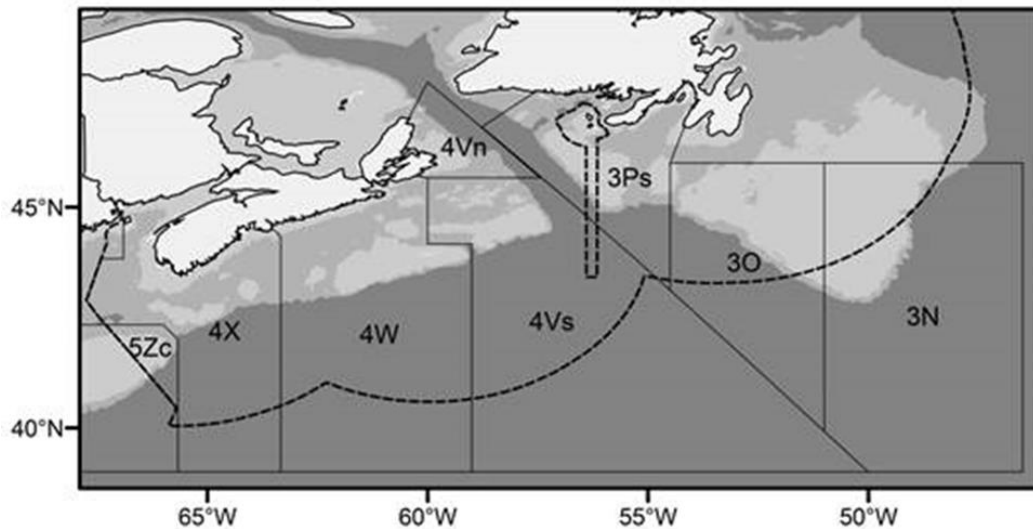


Figure 1. Management unit Northwest Atlantic Fisheries Organization Divisions 3NOPs4VWX5Zc.

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of Atlantic Halibut**

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Table 1. Total reported Canadian and foreign landings (tonnes) of Atlantic Halibut from Northwest Atlantic Fisheries Organization Divisions 3NOPs4VWX5Zc¹. 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 are from the September 13, 2019, update of the NAFO 21A database. 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	1	132	1892	1850
Annual	2011	373	1346	1719	218	1	219	1938	1850
Annual	2012	531	1491	2022	200	1	201	2223	2128
Annual	2013	562	1836	2398	205	1	206	2604	2447
Annual	2014	839	1811	2650	312	1	313	2963	2563
Annual	2015	693	2174	2867	395	1	396	3263	2738
Annual	2016	626	2186	2812	393	1	394	3206	3149
Annual	2017	759	2353	3112	403	1	404	3562	3621 ⁴
Annual	2018	699	3241	3939	231	0	231	4170	4164 ⁴
Annual	2019	356	3415	3771 ⁵	-	-	-	-	4789 ⁴

¹Canadian 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.

²Landings were first listed in 5Zc in 1986; 5Zc and 5Ze are used to indicate same area.

³Prior to 1988, the Atlantic Halibut catch was unregulated.

⁴For 2017, 2018 and 2019, 100 t of the Canadian TAC were set aside to cover catches by US and France within the stock area.

⁵Landings from the Maritimes Fisheries Information System (MARFIS) for 2019 are preliminary, as of November 27, 2019.

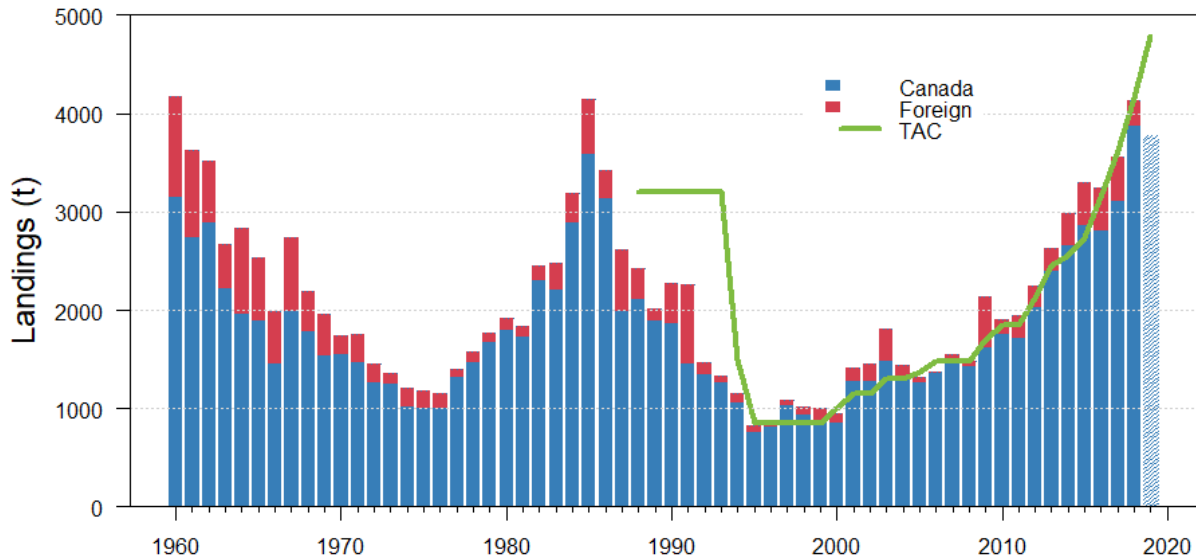


Figure 2. Northwest Atlantic Fisheries Organization (NAFO) reported Canadian (blue) and foreign (red) landings (tonnes) for 3NOPs4VWX5Zc Atlantic Halibut. Landings for 2019 (hashed bar) are preliminary, and taken from the Maritimes Fisheries Information System (MARFIS) as of November 27, 2019. The solid 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 2020. However, if the DFO Summer RV Survey (NAFO Divs. 4VWX) index falls below the long-term mean in three of the most recent five years, an earlier than anticipated framework review could be triggered. 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 2019 were lower than it has 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 the second highest level in the time series (DFO 2019b), reflecting the greater number of large fish in the survey. Although the 2017 RV survey did not catch halibut less than 38 cm, roughly 6% of the 2019 catch was under 38 cm (DFO 2019b), indicating that some of the youngest cohorts are still present in the survey.

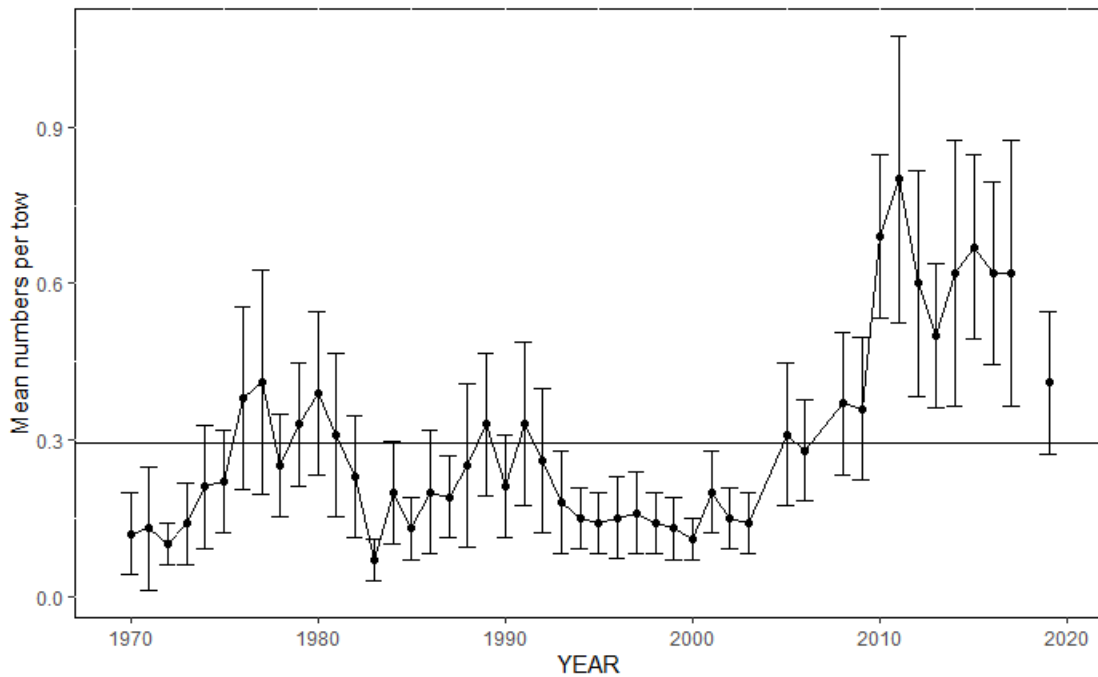


Figure 3. Plot of mean number of Atlantic Halibut per tow for DFO Summer Ecosystem Survey sets in 4VWX from 1970 to 2019. The solid black horizontal line is the long-term (1970–2018) mean (0.30 per tow). The vertical bars indicate 95% confidence intervals.

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. 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 to both provide 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 2019 standardized catch rate from the GLM fit to the 100 Index Stations is the third greatest in the 22-year time series (Figure 4). The 2019 three-year mean of exploitable biomass from the Halibut Survey is 13% higher than 2018, and twice the value from 2014, the last year the stock was assessed (Figure 5). 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 2019 SSB is above the USR point, putting the stock in the Healthy Zone.

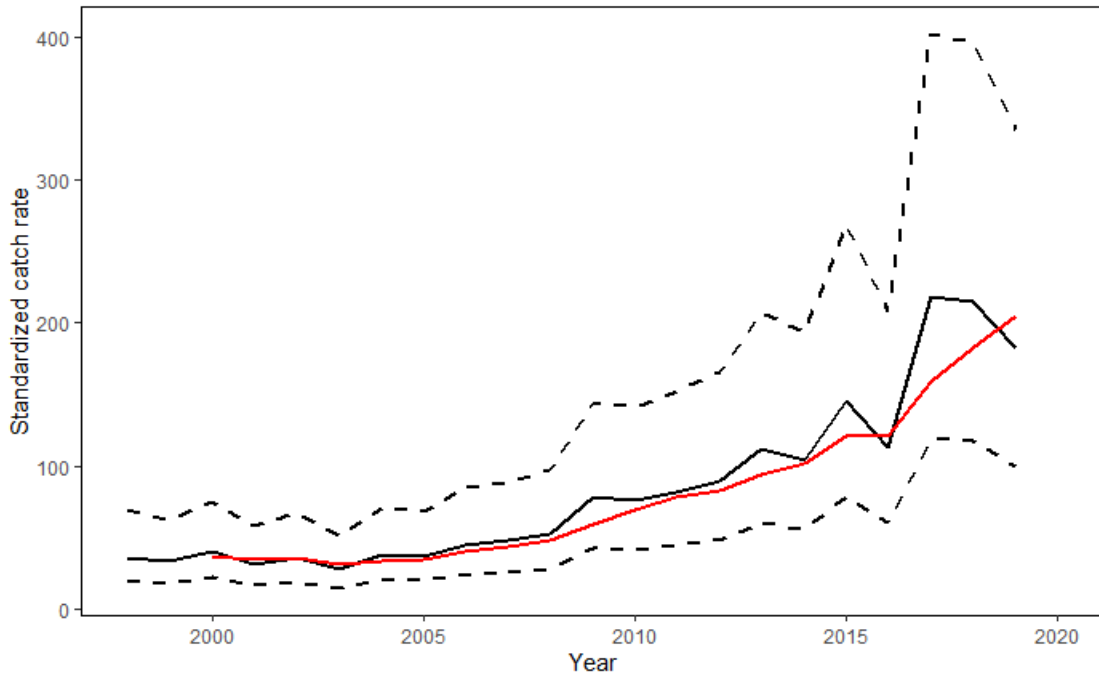


Figure 4. Plot of standardized catch rate of Atlantic Halibut (kg/1000 hooks/10 hrs) from the Generalized Linear Model (GLM) of 3NOPs4VWX Halibut Survey 100 Index Stations. The solid black line is predicted catch rate; the dashed lines indicate the 95% confidence interval. The 3-year mean of the index (solid red line) is also plotted.

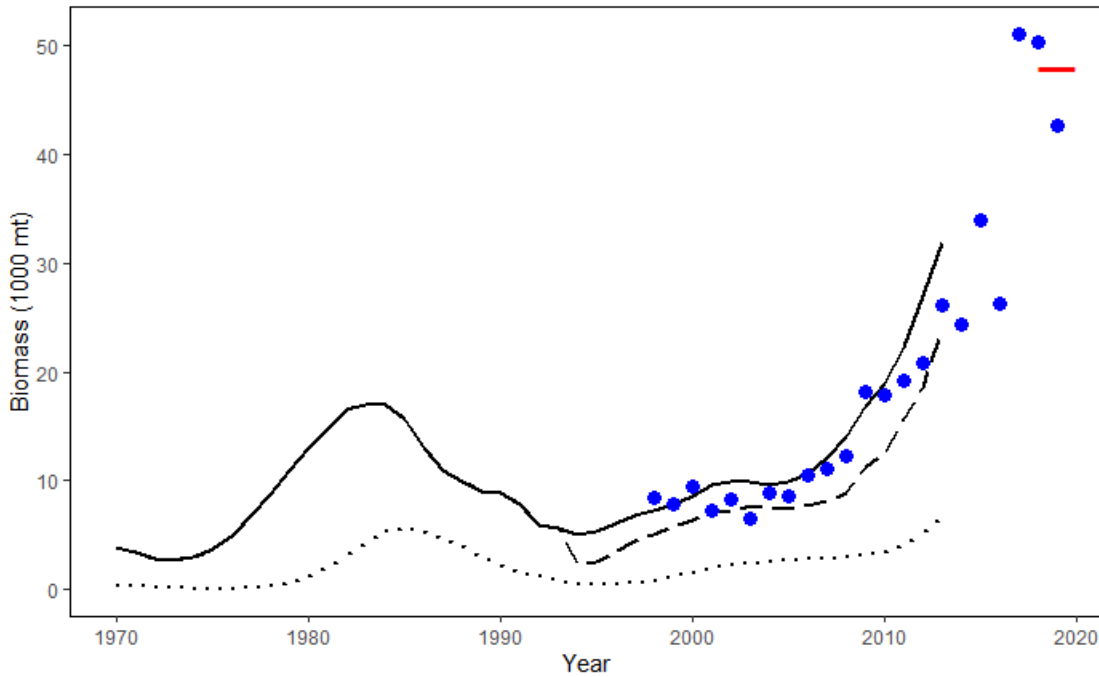


Figure 5. Plot of Atlantic Halibut biomass between 1970 and 2013 estimated from the stock assessment model (black lines) and the Halibut Survey 100 Index Stations (blue circles). The solid black line is total biomass, the dashed line is exploitable biomass (>81 cm), and the dotted line is spawning stock 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 (4789 t), would result in a 2020–2021 TAC to 5507 t. This application of the harvest control rule, and the projections from the HAL model (Cox et al. 2016), assume all removals from Canadian and international fisheries are included.

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 2018, 5034 Halibut were double tagged with T-bar anchor tags. As of January 1, 2019, 912 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, F is declining from a high of 0.18 in 2008 to 0.035 for 2018 (Figure 6). The absolute estimates of F from the tagging model are not directly comparable to the assessment model, but they provide an indication of trend in interim assessment years.

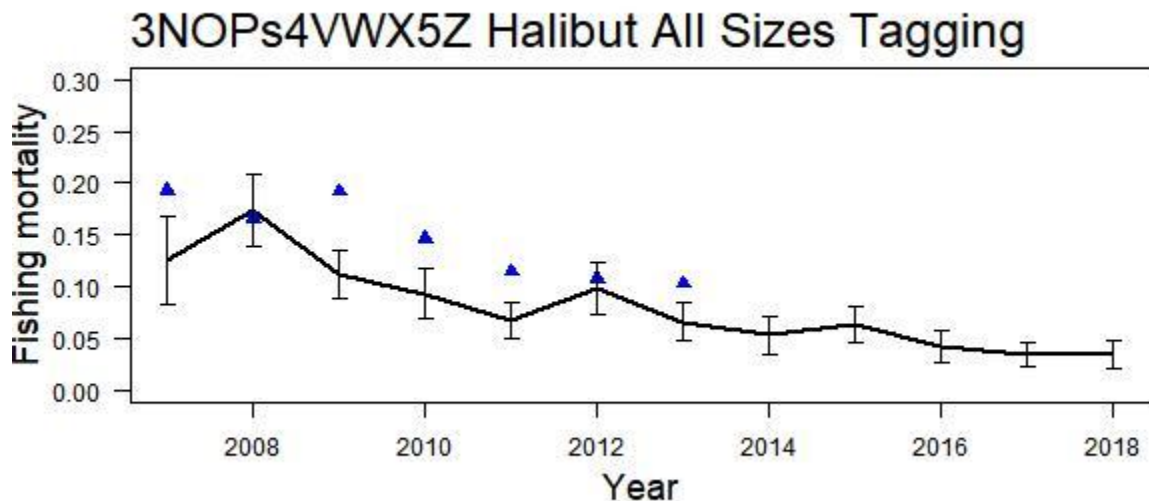


Figure 6. Plot of instantaneous fishing mortality for Atlantic Halibut estimated from the multi-year tagging model (solid black line) and the assessment model (blue triangles). The vertical bars indicate 95% confidence intervals.

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 2019 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 third highest in the 22-year time series. Consistent with the rapid increase in biomass and a capped increase in TAC, the fishing mortality estimated

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from the multi-year mark-recapture model has remained at low levels. The 3-year mean index of exploitable biomass for 2019 is 13% higher than last year. A 2020/21 TAC consistent with the Harvest Strategy adopted by the SFGAC is 5507 t, which is the maximum yearly change in TAC of 15% (718 t).

Contributors

Name	Affiliation
Brad Hubley (Lead)	DFO Science, Maritimes Region
Donald Clark	DFO Science, Maritimes Region
Allan Debertin	DFO Science, Maritimes Region
Heath Stone	DFO Science, Maritimes Region
Monica Finley	DFO Science, Maritimes Region
Fonya Irvine	DFO Science, Maritimes Region
Daphne Themelis	DFO Science, Maritimes Region
Dave Hebert	DFO Science, Maritimes Region
Michelle Greenlaw	DFO Science, Maritimes Region
Tara McIntyre	DFO Science, Maritimes Region
Ellen MacEachern	DFO Science, Maritimes Region
Melanie Barrett	DFO Science, Maritimes Region
Jamie Emberley	DFO Science, Maritimes Region
Catalina Gomez	DFO Science, Maritimes Region
Quinn McCurdy	DFO Science, Maritimes Region
Virginia Noble	DFO Science, Maritimes Region
Ryan Martin	DFO Science, Maritimes Region
Danielle Deonarine	DFO Science, Maritimes Region
Rabindra Singh	DFO Science, Maritimes Region
Danielle Dempsey	DFO Science, Maritimes Region
Phil Greyson	DFO Science, Maritimes Region
Brad Hubley	DFO Science, Maritimes Region
Godana Lazin	DFO Science, Maritimes Region
Tania Davignon	DFO Science, Maritimes Region
Sara Deller	DFO Resource Management, Maritimes Region
Jennifer Saunders	DFO Resource Management, Maritimes Region
Penny Doherty	DFO Resource Management, Maritimes Region

Approved by

Alain Vézina
Regional Director of Science
DFO Maritimes Region
Dartmouth, Nova Scotia
Ph. 902-426-3490

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Sources of Information

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Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive, PO Box 1006
Dartmouth, Nova Scotia B2Y 4A2
Canada

Telephone: 902-426-7070

E-Mail: MaritimesRAP.XMAR@dfo-mpo.gc.ca

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

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