HARVEST CONTROL RULE UPDATE FOR WESTERN COMPONENT POLLOCK (*POLLACHIUS VIRENS*) IN NAFO DIVISIONS 4XOPQRS5

Context

Pollock (*Pollachius virens*) in Northwest Atlantic Fisheries Organization (NAFO) Divisions 4VWX5 comprise two population components: a slower-growing Eastern Component including Divisions 4V and 4W, as well as Subdivisions 4Xm and 4Xn, and a faster-growing Western Component (WC) including 4Xopqrs and Canadian portions of Area 5. The WC has been the main focus of past analytical assessments, but scientific advice on stock status and catch limits using Virtual Population Analysis (VPA) modeling has been highly variable, especially since the mid-2000s. For example, the 2008 assessment indicated that Age 4+ population biomass was at 27,000 tonnes (t) (Stone et al. 2009) while the 2010 assessment update indicated Age 4+ population biomass was either 23,000 t or 17,000 t, depending on whether the very low 2010 Fisheries and Oceans Canada (DFO) Research Vessel (RV) Summer Survey indices were excluded or included in the analysis (Stone 2011). Consequently, the Canadian fishing industry recommended exploration of alternative approaches, which would provide more stability in future catch limits to allow for better business planning and a more stable fishery.

In 2011, fisheries managers and the fishing industry decided to manage WC Pollock using a risk-management approach and embarked on a Management Strategy Evaluation (MSE) process, with the help of government scientists and outside experts (DFO 2011). MSE is a technique to explicitly consider the uncertainty in stock assessment assumptions and models, and to compare the likely consequences to Management Objectives when a predetermined Management Procedure (MP) incorporating a Harvest Control Rule (HCR) is applied. The Pollock MP was selected on the basis of satisfying three medium-term objectives agreed upon for management of the resource, which relate to sustainability, catch levels and the extent of annual catch changes. The MP model was built around a HCR that either increased or decreased future catch limits based on results from ongoing monitoring from the annual DFO Summer RV Survey. An Exceptional Circumstances Protocol was put in place to cover situations that fall outside the range for which the MP was simulation tested and, if necessary, to allow for some form of intervention.

The 2015 Science Response Process recommended a catch limit of 2,225 t for WC Pollock for fishing year (FY) 2016-2017 (DFO 2016). Discussions following the process centered around an irregularity in the 2015 DFO Summer RV Survey, increases in Pollock indices from the U.S. National Marine Fisheries Service (NMFS) Spring and Fall surveys in Canadian waters since 2013, and an increasing proportion of commercial catch coming from 5Z, an area without consistent coverage by the DFO Summer RV Survey. Given all of these concerns, Resource Management implemented a 9% increase in the quota and temporarily suspended the use of the HCR with the intent to review and consider other sources of information when generating catch advice for 2017/2018. The 2016 Science Response Report (DFO 2017) provides a review of additional indices of WC Pollock biomass from the NMFS Spring and Fall Surveys, and

recent DFO Summer RV Survey coverage of eastern Georges Bank. Updated information on commercial catch at age, fish condition and mean lengths at age were also examined.

In January 2017, Resource Management and Industry asked that the 2015 RV Survey index value be considered a missing value to reflect concerns that the point was not representative of the state of the stock. Further, as the HCR uses the previous year's quota as a starting point for the following year, the actual 2016/17 quota of 3,081 t was used in the HCR to generate advice for 2107/18. This approach was supported by members of the Scotia Fundy Groundfish Advisory Committee as it stayed as close as possible to the HCR for this stock, while reflecting the increasing trends seen in the DFO Summer RV Survey index, the fishery, and U.S. surveys. Following this approach, the HCR quota for FY 2017/2018 was set at 3,697 t.

This report provides an update to the 2016 analysis (DFO 2017) of the Western Component Pollock Harvest Control Rule and provides advice on the FY 2018/2019 catch limit generated by the Pollock MP and HCR using updated information from the 2017 DFO Summer RV Survey. It also describes current status with respect to the provisions in the Exceptional Circumstances Protocol. Following the approach accepted at the 2016 Science Response Process, the HCR with updated monitoring data for 2017 generated a catch limit of 4,437 t for FY 2018/2019, up 20% from 3,697 t for FY 2017/2018. The DFO Summer RV Survey biomass index decreased from 28.15 kg/tow in 2016 to 13.16 kg/tow in 2017 and did not trigger the exceptional circumstance provision of the DFO Summer RV Survey biomass index being < 6 kg/tow for two consecutive years and the Survey Index Ratio being < 0.2.

This Science Response Report results from the Science Response Process of December 4, 2017, on the Status Update of the Western Component Pollock Management Strategy Evaluation.

Analysis and Response

DFO Summer Survey Index

The DFO Summer RV Survey time series for the WC Pollock biomass index (kg/tow) extends from 1984-2017, a period when the same survey design and bottom trawl (Western IIA) have been used annually (Figure 1). The index is based on survey strata representing unit areas 4Xopqrs+5Yb and does not include 5Zc (eastern Georges Bank). The biomass index exhibits strong year-effects, which reflect the semi-pelagic schooling behaviour of Pollock and changes in availability arising from differing distributions in the water column at the times of the survey. In general, there has been a declining trend in the index since the late 1980s, an increasing trend from 2003-2007, followed by another decline to 2012. Since 2012, the survey biomass index has generally remained low. Although the index is highly variable, the long term trends are informative. The RV series using a three-year geometric mean (GM) (three-year moving average) provides a clearer indication of long-term trends by smoothing year effects and provides the monitoring data used in the HCR for calculating future catch limits (Figure 1).

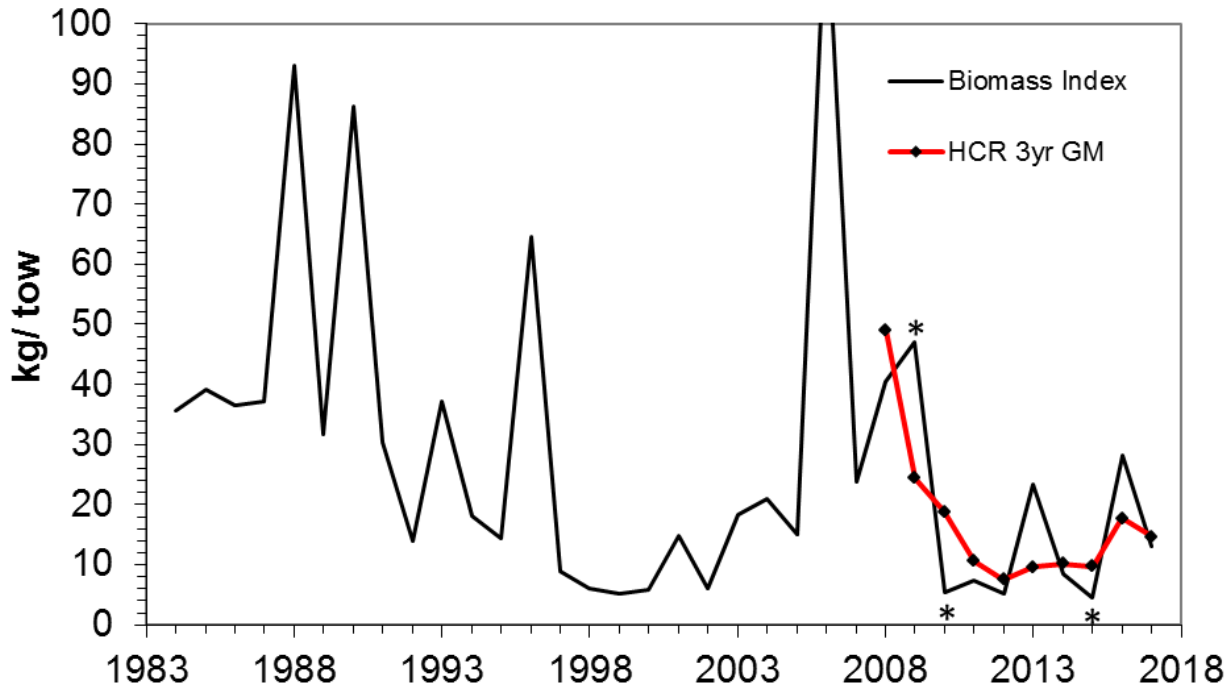

Figure 1. DFO Summer RV Survey biomass index (black line) and three-year geometric mean (GM) index used in the HCR (red line) based on survey strata representing unit areas 4Xopqrs+5Yb, 1984-2017. Survey biomass indices marked by asterisks were modified (2009 and 2010) or excluded (2015) for the calculation of the three-year geometric mean.

Harvest Control Rule

The Pollock MP is linked to the HCR to calculate catch limits based on results from ongoing monitoring (DFO Summer RV Survey). The catch limit either increases or decreases by up to 20% annually (with increases capped at 20% or 500 t, whichever is the greatest) depending on the value of the GM biomass index for the most recent 3 years as a proportion of the GM of the index for 1984-1994, a period of high productivity (also referred to as the Survey Index Ratio). The catch limit was initially set at 6,000 t in 2011 for the Pollock MP Model and the maximum permitted decrease limit (20%) was applied every year from FY 2011/2012 to FY 2014/2015 and in FY 2016/2017. In response to the request to treat the 2015 survey biomass index as a missing value, the HCR calculated catch limit for FY 2018/2019 is based on the 3-year GM survey biomass index for 2014, 2016 and 2017. The survey biomass index decreased from 28.15 kg/tow in 2016 to 13.16 kg/tow in 2017. The 3-year GM value for 2014, 2016, and 2017 decreased to 14.67 kg/tow from 17.79 kg/tow (3-year GM value for 2013, 2014, and 2016) and the resultant Survey Index Ratio is now at 0.41. Due to the formulation of the HCR, the increase in the 3-year GM seen in 2016 leads to an increasing calculated catch limit of 4,437 t for 2017/2018, which is the maximum permitted increase. Technical details of the Pollock MP and HCR are described in Rademeyer and Butterworth (2011).

Exceptional Circumstances Protocol

There are provisions to cover situations outside the range for which the Pollock MP model was simulation tested or beyond situations that the management procedure was designed to handle.

These provisions can be applied by decision-makers to amend the catch limits set by the Pollock MP or to revise the MP itself but application should not be a frequent occurrence.

Results that would trigger an exceptional circumstance based on the protocol established in DFO 2011 include:

1. When the Survey Index Ratio Falls below 0.2 or is beyond the 90% probability level from model predictions.

The current Survey Index Ratio (based on the three-year GM survey index for 2014, 2016-2017 as a proportion of the index for 1984-1994) is 0.41, which is above the exceptional circumstance value of 0.2.

2. When the RV survey biomass index is < 6.0 kg/tow for two consecutive years.

The DFO Summer RV Survey index was 28.15 kg/tow in 2016 and 13.16 kg/tow in 2017, which does not trigger an exceptional circumstance.

3. Additional situations.

Research Vessel survey age-specific indices are monitored for changes in age structure, which could also trigger an exceptional circumstance (i.e. when extremely compressed/expanded). There has been a period of diminished numbers at age for older ages from 1995-2005, with some modest improvement since then (Figure 2). The recent age structure indicates some improvements in the numbers of fish in the population older than Age 7, but the number of older fish remains low.

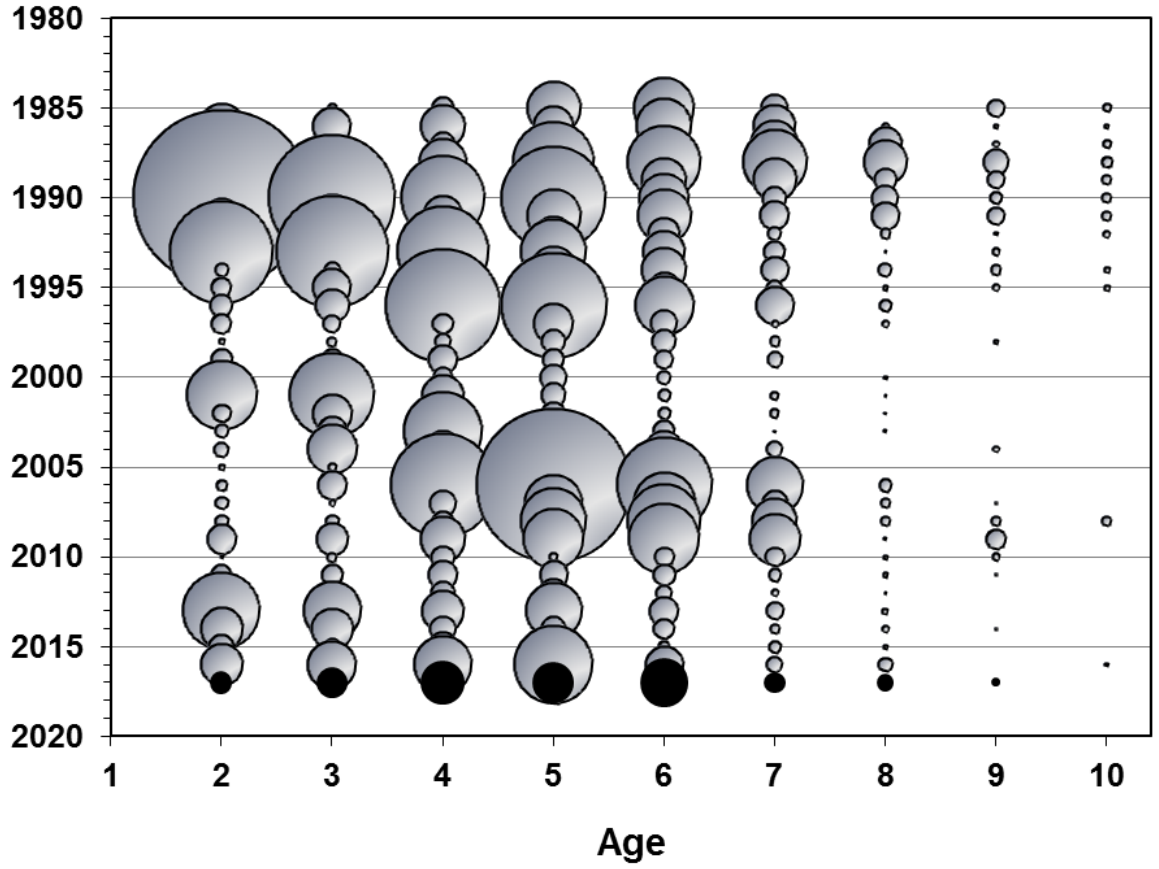

Figure 2. Stratified mean number per tow at age for Pollock from the DFO Summer RV Survey based on strata representing unit areas 4Xopqrs+5Yb for ages 2-10, 1985-2017. The index values for the 2017 survey are shown in black. Bubble size is proportional to the stratified mean number per tow at age.

Review of Additional Biomass Indices

In 2016, Resource Management requested a review of additional biomass indices for WC Pollock from the NMFS Spring and Fall Surveys, and recent DFO Summer RV Survey coverage of eastern Georges Bank. This report provides updated survey biomass indices for NMFS Spring and Fall Surveys, as well as DFO Summer RV Survey coverage of eastern Georges Bank up to 2017.

The DFO Summer RV Survey biomass index is based on survey strata representing unit areas 4Xopqrs+5Yb and does not include 5Zc (eastern Georges Bank). Recently, members of the fishing industry have raised concerns regarding the lack of survey coverage on Georges Bank, an area with an increasing proportion of WC Pollock landings in recent years. NMFS carries out bottom trawl groundfish surveys that cover part of the Western Component management unit and includes eastern Georges Bank but, unlike the DFO Summer RV Survey, the NMFS Surveys occur in the Spring and Fall. All three surveys are subject to high inter-annual variability in Pollock abundance (Figure 3). NMFS survey biomass indices were scaled to the DFO Summer RV Survey. Scaling was achieved by taking an average of the indices for 1984-1994 (the same reference period used for the DFO survey index in the HCR) and each NMFS survey index from 1984-2017 was divided by its reference period average then multiplied by the DFO

survey average index. It should be noted that the 2017 NMFS Fall Survey was not completed at the time of the update report and is therefore not included in the calculations.

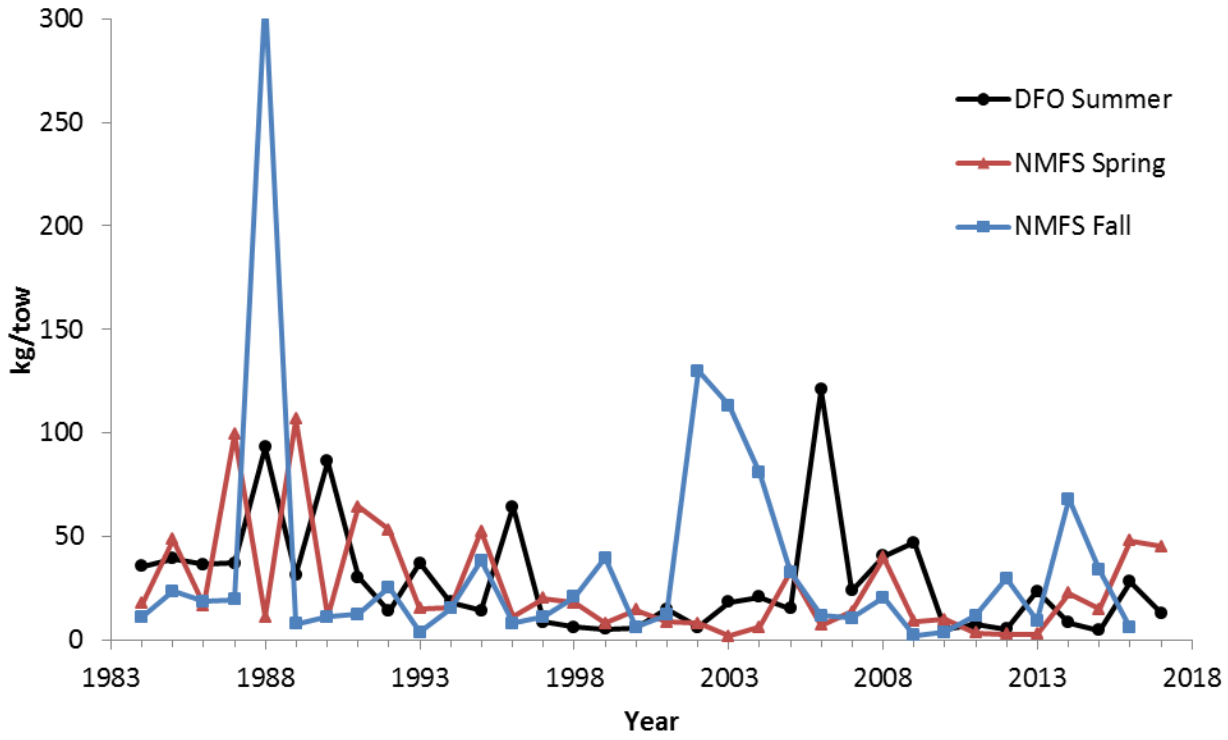

Figure 3. Western Component Pollock biomass indices, scaled to the DFO Summer RV Survey mean (1984-1994) for the DFO Summer (black line), NMFS Spring (red line), and NMFS Fall (blue line) surveys from 1984-2017.

In recent years, the DFO Summer RV Survey has included some coverage of eastern Georges Bank including strata 5Z9 (2011-2017), 5Z1 (2011-2013, 2016-2017) and 5Z2 (2016-2017). With the exception of 2016 and 2017, the survey coverage on Georges Bank has been minimal and the indices from these data are likely a poor representation of Pollock biomass in unit area 5Zc. In most years, including survey coverage from eastern Georges Bank generates a very similar biomass index to the current survey coverage in 4Xopqrs+5Yb with the exception of 2011 and 2016 where the index is higher when Georges Bank data are incorporated (Figure 4).

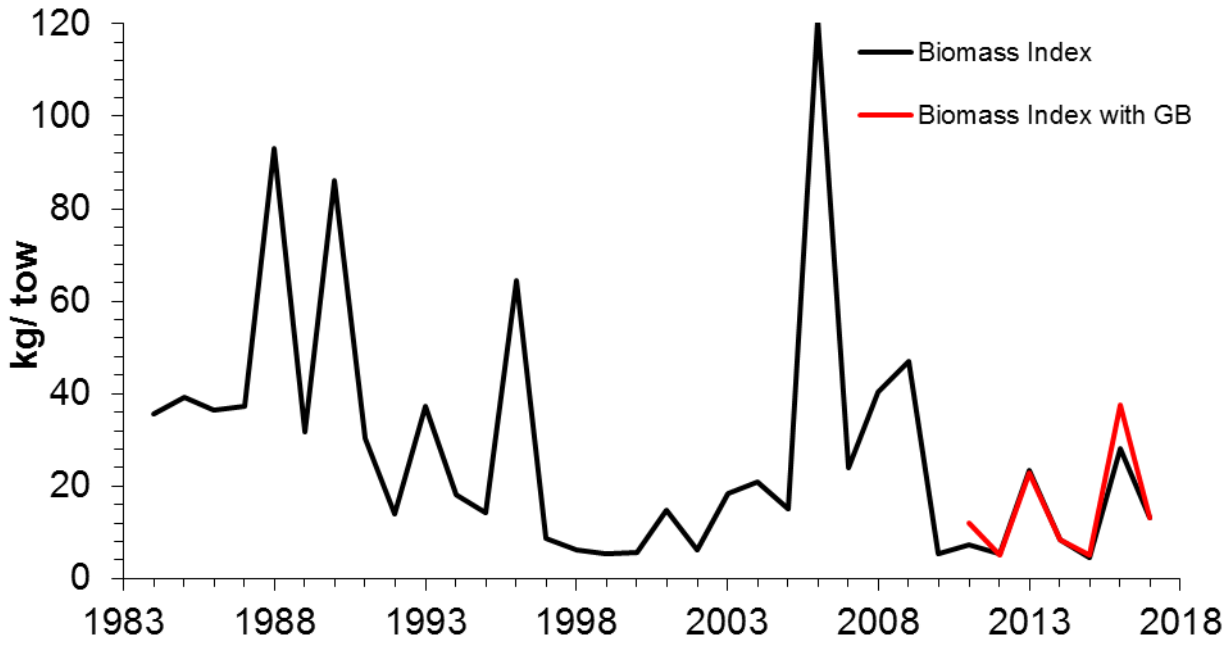

Figure 4. DFO Summer RV Survey biomass index based on strata representing Subdivisions 4Xopqrs+5Yb (black line), 1984-2017, and the DFO Summer survey biomass index for strata representing 4Xopqrs+5Yb+5Zc (red line), 2011-2017.

Conclusions

Using updated monitoring data from the 2017 DFO Summer RV Survey, the HCR calculates a catch limit of 4,437 t for WC Pollock for FY 2018/2019 up the maximum of 20% from the catch limit of the previous year.

The Pollock MP and its HCR have responded to declining trends in the RV survey biomass index for WC Pollock by decreasing the catch limits. Increases in the DFO Summer survey biomass index in recent years has resulted in an increase in the catch limit reported in the current update. Since the inception of the HCR in 2011, no exceptional circumstance has been triggered.

This update report provides an updated review of additional biomass indices of WC Pollock from the NMFS Spring and Fall surveys and recent DFO Summer RV Survey coverage of Georges Bank. Incorporating a new data input time series within the current HCR framework would require a detailed analysis involving comparisons with the original operating models used in the Pollock MSE, which is beyond the scope of this update. Regardless of the data source, indices of Pollock biomass continue to be highly variable further emphasizing the need for exploration of improved indices of abundance and the importance of a HCR designed to reduce erratic changes in catch limits.

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