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DRAFT MEMORANDUM

DATE: August 7, 2017 (DRAFT)

TO: Scientific and Statistical Committee (SSC)

FROM: SSC Sub-Group on Quantifying Substantial Change in the Georges Bank yellowtail flounder empirical assessment

SUBJECT: **Progress Report**

In 2016, the Scientific and Statistical Committee (SSC) made the following recommendation regarding Georges Bank (GB) yellowtail flounder:

> *An SSC sub-group should be formed to develop alternatives for quantitative metrics that would trigger an upward or downward adjustment of the ABC. We expect that the SSC will request time at an upcoming meeting to review the work of the sub-group and develop recommendations, as appropriate.*

The SSC Sub-Group met by conference call on July 17 and on August 1, 2017 to 1) discuss the purpose of the sub-group, 2) discuss possible approaches to define what constitutes substantial change, 3) review available analysis, and 4) develop a strawman proposal to the SSC. All sub-group members participated in both calls. Members include Dr. John Wiedenmann (group spokesperson), Dr. Steve Cadrin, Dr. Christopher Legault, Dr. Kevin Friedland, and Dr. Patrick Sullivan, supported by Council staff, Dr. Jamie Cournane.

Background

This excerpt is from the 2016 SSC Report[1] on GB yellowtail flounder:

> *Finally, because the SSC was limited by the absence of clear metrics that would constitute "substantial" changes in the stock and trigger a change in the ABC, we have decided to form a sub- group that will develop a list of potential metrics and the pros and cons of each. These might include, but would not necessarily be limited to:*
>
> - *A threshold (i.e., percentage) change in the average biomass estimate.*

[1] 2017-2018 SSC ABC and OFL recommendations for GB yellowtail flounder (August 22, 2016 Memo from SSC to Tom Nies).

- *Use of the three-year moving average of biomass estimates, rather than a single year estimate, with or without a threshold that would trigger a change.*
- *The trend in biomass estimates instead of or in addition to single year or multi-year estimates.*
- *Use of the 95% confidence interval or other measures of spread to determine whether inter- annual changes are significant and warrant a change.*
- *Changes in other relevant metrics beyond the biomass estimates and trends, e.g.:*
    - *Characteristics of the population structure (e.g., proportion of fish in older age classes).*
    - *Magnitude and trends in condition indices.*
    - *Changes in the ratio of catch:ABC.*
    - *Other biological, ecological or socio-economic indicators (e.g., price trends).*

We will likely request time on the agenda at an upcoming SSC meeting to review the work of the sub-group and develop recommendations as appropriate. This process will be important in establishing greater transparency in future development of catch advice for the Georges Bank yellowtail flounder stock.

Discussion Summary

- The sub-group discussed the pros and cons of each approach. In general, using a single metric to defining substantial change was not proposed (e.g., rubble strip approach by SSC/MAFMC 2013).
- Some group members raised concerns regarding the mismatch in precision of the surveys and the precision that management needs. Others felt the surveys were fairly precise (20-30% CVs in most years). The group recognized that variability in the surveys could result in large changes in catch advice from year to year. For these reasons, the group found value in applying some additional smoothing/averaging on to the empirical approach to determining catch advice. The group did not support a single approach at present, but did acknowledge simulation work done by Perretti et al. (2017) for the 2017 TRAC and other related work (e.g., ICES 2012) on this topic.
- The group conducted a change point analysis (see Attachment 1). A change point analysis is designed to determine when a change occurred. Three change points were identified in the early 1970s, late 1990s, and 2007. However, these results are not particular useful for defining what constitutes a "substantial change" for GB yellowtail flounder because change is not being detected in recent years. Alternatively, the results may indicate that in recent years the survey biomass estimates are within the range of variation of each other, and therefore the analysis would support no change in catch advice – because a "substantial change" was not detected. The group notes that change point analysis can be subjective, with respect to how the model is specified so these findings should be considered preliminary and subject to further modification and testing.
- Rather than looking a significance differences in the survey biomass estimates year-to-year, the group felt it would be important to define a "control rule" for this stock. One example provided was fixing the exploitation rate. The group noted that additional analysis would be needed to examine a range of exploitation rates and their consequences. The group also recognized that this work could eventually be applied to other stocks with similar assessments.

- Additionally, the group recognized the importance of continuing to examine the fishery and survey data alongside any approach considered to determine catch advice. The group also felt that information on the groundfish and scallop fisheries would be beneficial.
- The group suggested developing a "Road Map" documenting all recommendations since the 2014 empirical benchmark from the TRAC/TMGC, and PDT/SSC/Council.

Strawman Proposal to the SSC for Application to Georges Bank Yellowtail Flounder

Given this discussion, the group developed a strawman proposal for the SSC to consider. However, the group did not have the opportunity to fully test the approach and does not support applying the approach for FY2018 catch advice, without additional evaluation.

Strawman Proposal:

- Constant quota in the interim is not a good long-term approach
- Need a "control rule", e.g., the terminal year, or more generally some averaging/smoothing in the biomass index or some other approach
- Constant exploitation rate application [2, 6%, 16%?]
- If necessary, provide table with range of survey metrics representing alternative states (with and without outliners- different states of nature) and corresponding quotas
- Define some threshold minimum level – accounting for fisheries bycatch – cannot go below
- Include alternative metrics to consider in decision process (i.e., size at age, demographics, fecundity, temperature, etc.)

References

ICES. 2012. ICES Implementation of Advice for Data-limited Stocks in 2012 in its 2012 Advice. ICES CM 2012/ACOM 68. 42 pp.

Perretti, C. T., M. J. Fogarty, and C. M. Legault. 2017. Sensitivity analysis of terminal year versus three year moving average estimation of survey biomass using an empirical model and state-space model. DRAFT 2017 TRAC Working Paper. 14 pp.

Scientific and Statistical Committee (SSC) of the Mid-Atlantic Fishery Management Council (MAFMC). 2013. Ruble Strips for Assessing the Performance of Multi-year Acceptable Biological Catch Limits. Report of the Scientific Uncertainty Subcommittee of the SSC, August 20, 2013. 10 pp.

Attachment 1: Preliminary Change-Point Analysis

The subgroup considered the general class of change point statistics as a means of formalizing the decision as to whether a substantial change has occurred in a stock parameter. Two methods were considered. First, a sequential F test was used by applying the R library "strucchange" to yellowtail flounder survey catch per unit effort for spring and fall NEFSC surveys (Andersen et al. 2009). The sequential F test identified three potential structural changes in both the spring and fall data, but the contemporary changes relevant to the issues with the fishery were not significant. Hence, this approach was not considered useful; noting however that an attractive feature of this method is that there is no need to set fitting parameters making its application straight forward. Furthermore, the catch series from the DFO survey was not included in the analysis since it appears to be driven by outliers and thus was not coherent to the NEFSC survey for yellowtail flounder. The second approach evaluated was the sequential averaging algorithm called STARS or "sequential t-test analysis of regime shifts" (Rodionov 2004; 2006). The STARS algorithm was parameterized with the default setting of alpha level used to test for a change in the mean of $\alpha = 0.1$; the length criteria, the number of time steps to use when calculating the mean level of a new regime, which was set to 10; and, the Huber weight parameter, which determines the relative weighting of outliers in the calculation of the regime mean, which was set to 1. Under these parameters, change points were identified in 1985, 1995, and 2013 in the spring data (Figure 1) and in 1975, 1997, and 2010 in the fall data (Figure 2). This analysis suggests a regime change in the yellowtail occurred sometime during the period of 2010 to 2013 and the stock has undergone a substantial change. But, what is problematic is that the number and position of change points in a time series can be influenced by the parameter settings for STARS. The subgroup sees the potential value of this sort of statistical tool when questions of substantial change arise, but suggests the effect and standardization of STARS parameter settings for fisheries applications needs to be studied before it can be taken up in the formulation of advice.

References

Andersen, T., Carstensen, J., Hernandez-Garcia, E., Duarte, C.M., 2009. Ecological thresholds and regime shifts: approaches to identification. Trends Ecol. Evol. 24, 49–57.

Rodionov, S.N. 2004. A sequential algorithm for testing climate regime shifts. Geophysical Research Letters 31(9):Doi 10.1029/2004gl019448.

Rodionov, S.N. 2006. Use of prewhitening in climate regime shift detection. Geophysical Research Letters 33(12): Doi 10.1029/2006gl025904.

Figure 1-Results of spring survey STARS analysis.

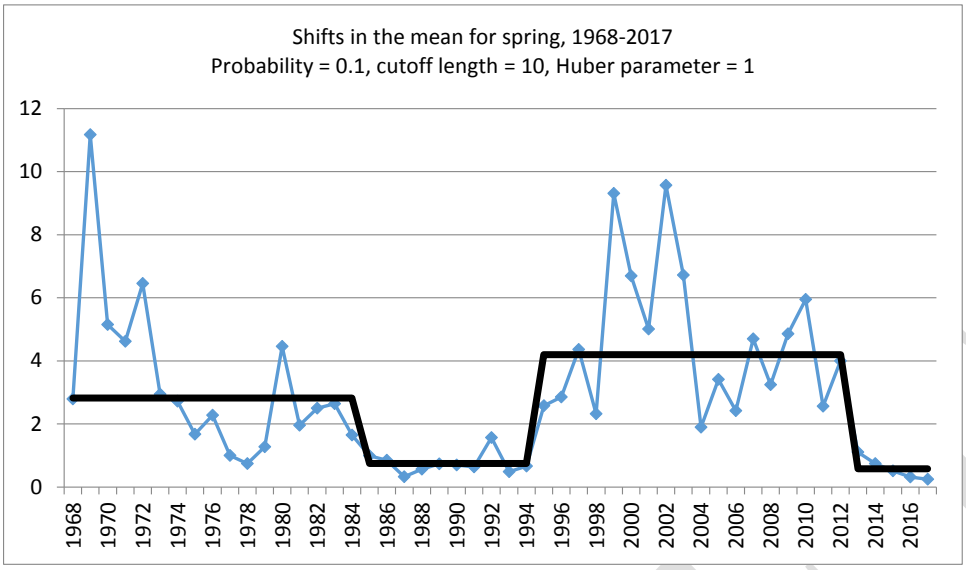

Figure 2- Results of fall survey STARS analysis.