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Northwest Atlantic Fisheries Organization

Report of the NAFO Joint Commission-Scientific Council Working Group on Risk-Based Management Strategies (WG-RBMS) Meeting

11-13 July 2017
Dartmouth, Nova Scotia, Canada

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2017

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1. Opening by the co-Chairs, Jacqueline Perry (Canada) and Carsten Hvingel (Norway)

The meeting was opened at 10:10 hours on 11 July 2017 at the NAFO Headquarters in Dartmouth, Nova Scotia, Canada. The co-Chairs, Jacqueline Perry (Canada) and Carsten Hvingel (Norway), welcomed representatives from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union, Japan, Russian Federation and United States of America. The presence of an observer from the Ecology Action Centre was acknowledged (Annex 1).

Japan made an opening statement expressing its sincere appreciation of the hard work of this Working Group (WG) and of the Scientific Council (SC) particularly on the Greenland halibut Management Strategy Evaluation (GHL- MSE).

Co-Chair, Carsten Hvingel, reported on the status of the GHL-MSE work being undertaken in relation to the adopted workplan. He referred to the previous meetings of this WG and of the SC this year. The selections of management objectives, performance statistics, and operating models have been completed. Candidate Harvest Control Rules (HCRs) have been identified. He also reminded WG that in accordance with the timeline agreed at the London meeting in February 2017, the WG is expected at this meeting to: review initial Candidate Management Procedures and/or Harvest Control results, finalize objectives and their quantification and advise direction for further Candidate Management Procedure and/or HCR development.

2. Appointment of Rapporteur

The Senior Fisheries Management Coordinator and Scientific Council Coordinator (NAFO Secretariat) were appointed co-Rapporteurs of this meeting.

3. Adoption of Agenda

The co-Chairs indicated this meeting would focus on the GHL-MSE. The provisional agenda previously circulated was adopted without any changes (Annex 2).

4. Review of the report from the WG-RBMS Meeting, 25-27 April 2017

Kathy Sosebee (SC Chair), the presiding Chair of the April 2017 meeting, presented the meeting report (FC-SC Doc. 17-03). Highlights of the meeting, as reflected in the report, include:

- a presentation of a generalized form of target-based HCR, in addition to the existing slope-based HCR, which served as a basis for further development of a suite of Candidate Management Procedures (CMPs),
- progress towards the finalization of management objectives and their corresponding performance targets and associated performance statistics (PS), as well as the identification of “required” and “desirable” targets (Tables 1 and 2 of FC-SC Doc. 17-03),
- specific steps in a paring down exercise to limit the number of CMPs, e.g. determination of the reference set of Operating Models (OMs) and tuning CMPs to a specified criterion.

5. Greenland Halibut Management Strategy Evaluation (GHL-MSE) and other related matters arising from the Scientific Council Meeting, 01-15 June 2017

There were discussions about the great difficulties the SC has encountered due to its heavy agenda and the demanding work on the Greenland halibut MSE. The busy schedules of meeting both the SC and the different WGs did not allow the final reports of the meetings to be finalized in time, making deliberations and decision-making difficult.

Due to the short time between the SC June meeting and this meeting, the SC meeting report was not available to this WG for discussion. Instead, Brian Healey (SC vice-Chair) gave a presentation outlining the progress of SC on the GHL-MSE work. In accordance with the GHL-MSE timeline developed in London, UK in February 2017, SC had the following agenda items to address at the June meeting:

- Tabling of developers (SCAA and SSM) results
- Review of operating model fits
- Review of initial CMPs results
- Initial discussion on trial plausibility
- Possibly add further trials and then finalize operating models and trials
- Cull initial CMPs to a smaller set and summarize results.

Work on the above was initiated with the exception of discussion on trial plausibility. Considerations in conducting the MSE trials were related to, among others, target- and slope-based HCRs, alpha and gamma parameters, weighting of the different surveys used in the assessment, number of years (3) to average for composite stock size index, starting TAC, a 30% over-catch scenario, and maximum inter-annual TAC changes of 10% and 20%.

SC agreed that the following elements would be included in future Candidate Management Procedures trials:

- Target based procedure ($TAC_{y+1} = TAC_y \left(1 + \gamma_{up/down}(J_y - 1)\right)$)
- Test γ = c(0.5, 1)
- Previous slope based rule would also be tested in as comparative a manner as possible with survey weighting.
  Points were raised in discussion of the above related to the variance estimates for J, and that some surveys are better monitors of certain age ranges (generally younger) given the depth of those surveys. It was noted that there was very little difference in performance statistics between inverse variance and equal weighting of surveys, and a decision to keep inverse variance weighting had been made.
- Number of years to average for composite stock size index: the agreed decision was 3
- Starting TAC in 2018 to initiate HCR: 15000 and 20000 t.
- Alpha parameter: tuned to baseline (median exploitable (5-9) biomass in 2037 = B_{msy}), and an alternative (tuned to overcatch scenario 30%, med B (5-9)=B_{msy} in 2037)
- Max interannual TAC change: 10% and 20%

Table 1 below summarizes the operating model variants that were agreed upon as basis for MSE trials going forward.

Table 1. Operating Model variants as basis for MSE trials going forward.

Retained Operating models (shown after the first entry as variants to baseline)	SSM	SCAA
Baseline: uses data including 2016 and the O3 set of surveys	X	X
Hockey-stick with flex point at 25% quantile of SSB (or as reasonably approximated)	X	X
Post-hoc fitting of Beverton Holt curve, with h = 0.8.	X	
Continue development of internally fitted stock recruitment model	X	
Recruitment for the first 8 years at 0.5 of the level predicted by the recruitment method (mean recruitment or SR function)	X	X
Larger recruitment variability σ_R=0.6	X	X
SSM future dynamics, and with SSM numbers-at-age		X
Senescence: increase natural mortality from 0.12 to 0.5 in 10+	X	X
Future catches =130% TAC	X	X

Additional variants discussed by SC but not included in the above table included an option for zero selectivity in the plus group.

Following the SC June 2017 meeting, issues were discovered in the computer code used to produce some of the SCAA results considered at that meeting. Consequently, some SC members have expressed concerns that decisions taken by the SC regarding the selection of trials to go forward may have been unsound. Due to the short time interval between the SC June meeting and the present meeting, it had not been yet possible to assess the potential implications of the corrected model fully. This analysis will be performed by the model developers after this meeting and any decisions made at the present meeting are conditional upon the SC receiving adequate demonstration that the model results have not significantly altered the basis for OMs or CMP selection.

SCAA operating model

Japan (Doug Butterworth) presented the results of the trials agreed at the June SC meeting using the SCAA based suite of operating models. Results are presented in COM-SC RBMS-WP 17-11. At the request of the WG, further trials were run with the number of survey series used by the HCRs increased from three to five (COM-SC RBMS-WP 17-12). A broader range of trails was explored, e.g. additional runs were requested and presented including a variation of starting TAC (15 000t and 17 500t); time to B_{msy} (ie 2030); and varying Δ (5, 7.5 and 15%). Additional trials were requested and ran for the target based model with γ=0.5 and γ=1.0 and for the slope based model with Δ=0.1, 2018 TAC=17 500t (COM-SC RBMS-WP 17-14).

SSM operating model

Canada (Christoph Konrad) presented preliminary results of operating models based on the SAM style model (SSM). Operating model variants trialed included the base case, hockey stick recruitment, Beverton-Holt recruitment, catches of 130%TAC, plus-group senescence, low recruitment (under constant recruitment and Beverton Holt recruitment), and no fishing on the plus group. At present, only a limited number of CMPs have been trialed so that further work will be required before the September 2017 meeting.

The operating model failed to converge (ie, had not attained stability after numerous iterations) for some of the tests (e.g. those with high recruitment variability); the reason for this is not currently understood. Furthermore, some of the tests produced results that were different from equivalent tests performed during

the June SC meeting. The model developers will work together before September to understand and resolve these problems.

Next Steps

Decisions concerning next steps were based mainly on the results of the SCAA because the SMM results were considered preliminary.

It was agreed that both target and slope based HCRs should remain under consideration (see Annex 3). It was also agreed to use the O3 set of surveys as the basis for computing TACs in both HCRs (see Annex 4). Candidate HCRs will be developed based on the following agreed upon parameters for future testing for both SCAA and SSM operating models. Each of the variants will be applied as an individual variation on the base HCR Additional runs incorporating two or more variations may be tested in combination.

Target based rule:

- Tuning: for 0M1, $med\ B_{(5-9)} = B_{msy}$ by 2037
- γ = 0.15
- Δ = 0.1
- Starting TAC of 17 500t and 15 000t

Slope based rule:

- Δ = 0.1
- λ_{up} = 1.0, λ_{down} = 2.0 or 1.25
- Tuning: for 0M1, $med\ B_{(5-9)} = B_{msy}$ by 2037
- Starting TAC of 17 500 t and 15 000 t

An additional CMP with catch = 0 would be included to indicate the bound on the extent of recovery possible.

It was further noted that starting TAC eventually selected may lie within the range of 15 000 and 17 500 t rather than be one of those two explicit values.

It was acknowledged that there may be a need to revisit these parameters in the event that performance targets cannot be achieved under these circumstances within the SSM suite of OMs.

The SCAA-based results had used the same random number seed for runs for different CMPs for a given OM to provide results that were comparable in relative terms. It was agreed that the final trials should be ran for more than 100 replicates to achieve better precision of results in absolute terms.

Output Figures should include ones of the same form as be the same as Figure 1 in COM-SC RBMS- WP 17-16 with the addition of a plot for the probability that $B_{2022}^{5-9} < B_{2018}^{5-9}$.

It was noted that OMs including 30% TAC overharvest resulted in very low biomass in the SCAA trials, and the WG discussed whether such a high level of overharvesting would be plausible in the context of current management and surveillance. It was agreed that future runs should instead include an overharvest scenario of 10% which is considered to be more realistic. It was noted that the exceptional circumstances protocol, which will be developed following the adoption of the agreed management procedure, could be used to address possible situations in which higher levels of overharvest are known to be occurring.

Consultants for SCAA and SSM were requested to make the results of the MSE runs available at least one week prior to the next meeting. OM considerations for the MSE trials are summarized in Table 2.

Table 2. Operating Models for further review.

Retained Operating models (shown after the first entry as variants to baseline)	**SSM**	**SCAA**
Baseline: uses data including 2016 and the O3 set of surveys	X	X
Recruitment for the first 8 years at 0.5 of the level predicted by the recruitment method (mean recruitment or SR function)	X	X
Larger recruitment variability e_{rr}=0.6	X	X
Zero selectivity for the + group	X	X
Future catches =110% TAC	X	X
Operating models still required for validation of the SSM model.		
Hockey-stick with flex point at 25% quantile of SSB (or as reasonably approximated)	X	
Post-hoc fitting of Beverton Holt curve, with h = 0.8.	X	
Continue development of internally fitted stock recruitment model	X	
SSM future dynamics, and with SSM numbers-at-age		
Senescence: increase natural mortality from 0.12 to 0.5 in 10+	X	

6. Recommendations to forward to the Commission and Scientific Council

This agenda item was deferred to the next Working Group meeting.

7. Other Matters

The WG noted SC's indication that the assessment of Greenland halibut will be completed during the first day of the NAFO Annual Meeting in September 2017.

It was decided to have another meeting on 15-16 September 2017 in Montréal, Québec, Canada to finalize the GHL-MSE, i.e. the selection of the Management Procedure, which will be forwarded to the Commission with a recommendation for adoption.

8. Adoption of Report

The report was adopted via correspondence.

9. Adjournment

The meeting was adjourned the meeting at 18:00 hours on 13 July 2017.

Annex 1. List of Participants

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Annex 2. Agenda

1. Opening by the co-Chairs, Jacqueline Perry (Canada) and Carsten Hvingel (Norway)
2. Appointment of Rapporteur
3. Adoption of Agenda
4. Review of the report from the WG-RBMS Meeting, 25-27 April 2017
5. Greenland Halibut Management Strategy Evaluation (GHL-MSE) and other related matters arising from the Scientific Council Meeting, 01-15 June 2017
6. Recommendations to forward to the Commission and Scientific Council
7. Other Matters
8. Adoption of Report
9. Adjournment

Annex 3. Formulation of candidate management plans

Target based CMPs:

$$TAC_{y+1} = TAC_y\left(1 + \gamma_{up/down}\left(J_y - 1\right)\right) \quad (1)$$

where

TAC_y is the TAC recommended for year *y*,

γ_{up} and γ_{down} are "response strength" tuning parameters (γ_{down} if $J_y < 1$ and γ_{up} if $J_y \geq 1$), and

J_y is a composite measure of the immediate past level in the abundance indices that are available to use for calculations for year *y*; for this base case CMP three series have been used, with *i* = 1, 2 and 3 corresponding respectively to Canada Fall 2J3K, EU 3M 0-1400m and Canada Spring 3LNO:

$$J_y = \sum_{i=1}^{3} \frac{1}{(\sigma^i)^2} \frac{J^i_{curr}}{J^i_{target}} \Big/ \sum_{i=1}^{3} \frac{1}{(\sigma^i)^2} \quad (2)$$

with

$(\sigma^i)^2$ being the estimated variance for index *i* (estimated in the model fitting procedure for OM1)

$$J^i_{curr} = \frac{1}{q}\sum_{y'=y-q}^{y-1} I^i_{y'} \quad (3)$$

$$J^i_{target} = \alpha\frac{1}{5}\sum_{y'=2011}^{2015} I^i_{y'} \quad \text{(where α is a control/tuning parameter of the CMP)} \quad (4)$$

Note the assumption that when a TAC is set in year *y* for year *y*+1, indices will not at that time yet be available for the current year *y* though they will be for the preceding year *y*-1.

Constraints on the maximum allowable annual change in TAC can be applied, viz.:

$$\text{if } TAC_{y+1} > TAC_y\left(1 + \Delta_{up}\right) \text{ then } TAC_{y+1} = TAC_y\left(1 + \Delta_{up}\right) \quad (5)$$

and

$$\text{if } TAC_{y+1} < TAC_y(1 - \Delta_{down}) \text{ then } TAC_{y+1} = TAC_y(1 - \Delta_{down}) \quad (6)$$

Slope-based CMPs:

$$TAC_{y+1} = TAC_y\left(1 + \lambda s_y\right) \quad (7)$$

where

λ = 1.0 if $s_y > 0$ and λ = 2.0 if $s_y < 0$, and

s_y is a measure of the recent (over the five most recent years) trend in survey biomass, taken as the unweighted arithmetic average over the three surveys.

Annex 4. Survey data sets

Table 1. Data sets agreed by SC April 2017 meeting (NAFO SCS Doc. 17-15) to be considered for use in operating models. The O3 set will be used as the basis for computation of TACs in all CMPs.

	Base	**O1**	**O2**	**O3**
Fall 2J3K	1996-2015	1996-2015	1996-2015	1996-2015
Spring 3LNO	1996-2014	1996-2014	1996-2014	1996-2014
EU 3M 0-700	1995-2003	1995-2015	1995-2015	1995-2003
EU 3M 0-1400	2004-2015			2004-2015
EU 3M 700-1400		2004-2015	2004-2015	
EU Spain 3L		2006-2015		
EU Spain 3NO		1997-2015	1997-2015	1997-2015
Fall 3LNO		1996-2015	1996-2015	1996-2015