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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

13-15 August 2018
London, United Kingdom

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Dartmouth, Nova Scotia, Canada
2018

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1. Opening by the co-Chair, Jacqueline Perry (Canada) 3
2. Appointment of co-Chair 3
3. Appointment of Rapporteur 3
4. Adoption of Agenda 3
5. Development of Exceptional Circumstances Protocol for 2+3KLMNO Greenland halibut management strategy 3
6. Work plan for 3M Cod Management Strategy Evaluation 4
   a. Development of Harvest Control Rule for Cod in Div. 3M 4
   b. Development of Management Objectives, Performance Statistics and associated Risk Thresholds for Cod in Div. 3M 4
   c. Revised Calendar for the development of the 3M Cod Management Strategy Evaluation (MSE) 6
7. Progress on the Review of the NAFO Precautionary Approach (PA) Framework 6
8. Other Business 7
9. Recommendations to forward to the Commission and Scientific Council 7
10. Adoption of Report 7
11. Adjournment 7

Annex 1. List of Participants 8
Annex 2. Agenda 10
Annex 3. Draft Exceptional Circumstances Protocol for the Greenland halibut Management Procedure 11
Annex 4. Revised calendar for the development of 3M Cod MSE 12
Annex 5. Changes in Greenland halibut Harvest Control Rule in Annex I.F of the NCEM 14

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

13-15 August 2018
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1. Opening by the co-Chair, Jacqueline Perry (Canada)

The meeting was opened at 09:30 hours on 13 August 2018 at the North-East Atlantic Fisheries Commission (NEAFC) Secretariat in London, United Kingdom. The co-Chair, Jacqueline Perry (Canada), welcomed representatives from Canada, Denmark (in respect of Faroe Islands and Greenland), the European Union, Japan, and the United States of America (Annex 1). The Chair also acknowledged the presence of Darius Campbell, the Secretary of NEAFC. The Scientific Council (SC) Chair, Brian Healey (Canada), acted as a co-Chair of this meeting.

2. Appointment of co-Chair

It was noted that the SC co-Chair position, previously held by Carsten Hvingel (Norway) was vacant. The appointment of a new SC co-Chair was deferred to the Annual Meeting in September 2018.

3. Appointment of Rapporteur

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

4. Adoption of Agenda

Sub-agenda item 6.c "*Revised calendar for the development of 3M Cod Management Strategy Evaluation (MSE)*" was inserted (Annex 2).

5. Development of Exceptional Circumstances Protocol for 2+3KLMNO Greenland halibut management strategy

The WG-RBMS noted that in 2017, the Commission adopted a new Management Procedure (MP) for the Greenland halibut stock (GHL) in Subarea 2 + Divisions 3KLMNO, which shall be in force from 2018 to 2023 inclusive. This MP includes a harvest control rule (HCR) applied annually to adjust the Total Allowable Catch (TAC) based on biomass indices provided each year by five different surveys.

Exceptional Circumstances provisions are intended to respond to an event or observation that is outside of the range of possibilities considered within the Management Strategy Evaluation (MSE). An Exceptional Circumstances Protocol should consist of two elements: 1) a technical description of what constitutes Exceptional Circumstances, and 2) actions to be taken should Exceptional Circumstances exist.

The Commission has tasked the NAFO Joint Commission-Scientific Council Working Group on Risk-Based Management Strategies (WG-RBMS) with finalizing the Exceptional Circumstances Protocol for adoption at the NAFO Annual Meeting in September 2018. To support the development of an Exceptional Circumstances Protocol, the Scientific Council developed criteria in June 2018 for the identification of Exceptional Circumstances, as requested by the Commission and taking into account the issues noted by the WG-RBMS (COM-SC Doc. 17-11).

Further, the WG-RBMS noted that the SC has provided specific guidance on some of the issues raised by the WG-RBMS (see SCS Doc. 18-19), while other issues will require expert judgement on a case-by-case basis to determine whether Exceptional Circumstances are occurring. Indicators that would be annually monitored by the SC were considered separately from assessment-based indicators, which would be based on less frequent update assessments.

SC advice identified four roles for the SC when Exceptional Circumstances have been declared to apply:

1. To comment on the severity of the Exceptional Circumstance identified
2. To advise on options with respect to the Management Procedure (MP) and TAC
3. If required and, if possible, to provide updated TAC advice (i.e. not using the MP)
4. If necessary, to advise on an earlier review of the MP

WG-RBMS endorsed the guidance provided by the SC. On the basis of this advice, WG-RBMS developed an Exceptional Circumstances Protocol (Annex 3).

WG-RBMS discussed its the role when Exceptional Circumstances are considered to apply. It is expected that WG-RBMS would convene between the annual SC June meeting and the Annual Meeting to consider the SC advice and the options. WG-RBMS would not be expected to propose alternative TACs but would review options provided by SC, if available, and develop recommendations in relation to the review or revision of the management procedure.

6. Work plan for 3M Cod Management Strategy Evaluation

SC held a benchmark assessment meeting for 3M Cod in Lisbon, Portugal in April 2018. The report of this meeting has not yet been finalized but the outcomes of the meeting were presented to the SC June meeting and (with some modifications to the prior distribution proposed at the end of the benchmark) formed the basis of SC's response to item 5 in the Commission's request for advice in 2018. The final model agreed in the benchmark, including the modification to the prior distribution proposed at the end of the benchmark, was agreed by the SC in June and used for the 2018 assessment of 3M cod.

The data used in the SC June 2018 Cod 3M assessment (over the time frame 1988-2017) will be used to conduct the MSE. Further, the assessment model approved in the 2018 June SC meeting will be used as the base case reference operating model (OM) in the MSE. SC proposed guidelines for the development of other OMs, the period over which the simulations will be carried out and the development of MSE performance statistics.

a. Development of Harvest Control Rule for Cod in Div. 3M

It was agreed that index-based rules were preferred, but the WG would consider model-based HCRs if required.

Within the management strategy evaluation, the performance of a variety of candidate Management Procedures should be considered. The eventual selection amongst candidates will be based on the most robust results in terms of a set of agreed performance statistics.

Restrictions to maximum changes in the TAC in terms of percentages and absolute numbers should be considered either as part of the HCR or as part of a suite of performance statistics (there is an initial preference for the former because it provides a degree of certainty for the industry). These restrictions may differ depending on the direction of the change and/or status of the stock.

b. Development of Management Objectives, Performance Statistics and associated Risk Thresholds for Cod in Div. 3M

Performance Statistics and Criteria agreed as required/desirable during the development of the Greenland halibut MSE in 2017 (FC-SC Doc. 17-03, Table 2) were taken as a starting point for the development of equivalent objectives for the 3M Cod MSE. The WG-RBMS agreed that the Greenland halibut MSE elements were not being endorsed as a template. However, it was accepted they could inform the 3M Cod process recognizing there may be specific considerations for the management of each species and therefore may be considered individually.

The required performance statistic, performance criterion and relevant management objectives were provisionally adapted. They are included in Table 1 below. There was no agreement on the content highlighted in grey and it was recognized that further discussion on these aspects is required before they serve as the basis of any evaluation. These details have been left in the table for illustrative purpose only.

Table 1. Performance Statistics and Criteria development for 3M Cod MSE.

This table was adapted from one developed during the Greenland halibut MSE. Content highlighted in grey has not been agreed to apply to 3M Cod but has been left in for illustrative purposes.

REQUIRED PERFORMANCE STATISTICS/CRITERIA		
Performance statistic	**Performance criterion**	**Relevant management objective**
$P(B_{20YY} < B_{MSY})$	$P \leq 0.5$	Restore to within a prescribed period of time or maintain at B_{MSY}
To be determined	Count	Low risk of exceeding F_{lim} (currently F_{MSY})
To be determined	$P \leq 0.1$ Count	Very low risk of going below an established threshold [e.g. B_{lim} or B_{lim} proxy].
DESIRABLE SECONDARY PERFORMANCE STATISTICS/CRITERIA		
Performance statistic	**Performance criterion**	**Relevant management objective**
$P(B_{2022} < B_{2018})$	$P \leq \alpha$ Where; α = 0.10 if $B_{2018} < 0.3B_{\mathrm{MSY}}$; 0.25 if $0.3 B_{\mathrm{MSY}} < B_{2018}$	The risk of failure to meet the B_{msy} target and interim biomass targets within a prescribed period of time should be kept moderately low
C_{2019} C_{2020} $\sum_{y=2018}^{2022} C_y / 5$ $\sum_{y=2018}^{2027} C_y/10$ $\sum_{y=2018}^{2037} C_y/20$		Maximize yield in the short, medium and long term
For each year, y $P\left(\frac{\lvert C_y - C_{y-1}\rvert}{C_{y-1}} > 0.15\right)$ $AAV_{2018-2022} = \frac{1}{5}\sum_{y=2018}^{2022} \frac{\lvert C_y - C_{y-1}\rvert}{C_{y-1}}$ and $AAV_{2018-2037} = \frac{1}{20}\sum_{y=2018}^{2037} \frac{\lvert C_y - C_{y-1}\rvert}{C_{y-1}}$	P≤0.15	Keep inter annual TAC variation below "an established threshold"

It was agreed that short medium and long-term objectives will be evaluated over 5, 10 and 20-year periods but that this may vary to some extent depending on the specific statistic.

c. Revised Calendar for the development of the 3M Cod Management Strategy Evaluation (MSE)

Drawing from the lessons and experience in the development of the Greenland halibut MSE that was recently adopted by the Commission in 2017, the Working Group started to develop the workplan for 3M Cod MSE. The Working Group discussed the calendar developed during the Working Group meeting in February 2017 in London, United Kingdom (FC-SC Doc. 17-02).

- *Elements considered to be currently available/achieved are:* Finalization of past data to be used
- Partial list of Management Objectives (MO)
- Partial list of Performance Statistics (PS) and associated risk thresholds
- Base Case Operating Model (OM)
- Guidance from SC on considerations for Operating Models
- Progress on Development of Operating Models
- Initiation of development of projection specifications
- Guidance from WG-RBMS on development of HCRs

Outstanding work includes:

- Finalize MO
- Finalize PS and associated risk thresholds
- Finalize initial set of OMs
- Approve final set of OMs, including the acceptability of their conditioning
- Specify tuning to be used to compare across HCRs (if agreed)
- Develop and update Trials Specifications (OM details, basis for projections, data used) in SCR document
- Make arrangements for code and trial results to be archived
- Finalize data used in HCR calculation and associated projection specifications
- Agree plausibility weightings for OMs
- Test a range of candidate HCRs
- Review performance of HCRs on all OMs
- Add new HCRs if desired; compile results

With the goal of having the 3M Cod MSE ready for presentation to the Commission in September 2019, the calendar for the development of 3M Cod MSE was revised (Annex 4). It will be presented to the Commission for endorsement as it requires an unexpected intersessional meeting.

7. Progress on the Review of the NAFO Precautionary Approach (PA) Framework

The Chair of the PA Framework Working Group, Kathy Sosebee (USA) reported that there has been no progress in the work of the NAFO PA Framework since January 2017. There was a plan to have a workshop on the PA framework but that did not happen.

The Working Group discussed the reasons contributing to the lack of progress, in particular the SC experts on the PA involved in the work that have moved on or retired and the prioritization of the Greenland halibut MSE and Cod 3M benchmark assessment.

Also, it was noted that among Contracting Parties, there has been no agreement whether to consider F_{msy} as the target or limit reference point. In some cases, this is written into national legislation making it very difficult to reach a common position. The PA will be raised during the joint SC/Commission session in September in order to discuss a plan for the way forward. The SC vice-Chair, Carmen Fernandez (EU) is working toward preparing a summary of the ICES PA review which may inform future NAFO work on this matter.

8. Other Business

At its June 2018 Meeting, SC brought to the attention of the Secretariat an error in formula six (6) in the Annex I.F "*Greenland halibut Management Strategy*" of the NAFO Conservation and Enforcement Measures (NCEM). COM-SC RBMS-WP 18-01 shows the correction in Annex I.F to reflect the original intention of the Greenland halibut Management Strategy adopted by the Commission in 2017 (Annex 5). It is recommended that the Commission approve the changes.

9. Recommendations to forward to the Commission and Scientific Council

The WG-RBMS recommends that:

- **The Commission adopt the Exceptional Circumstances Protocol for 2+3KLMNO Greenland halibut management strategy as reflected in Annex 3. The Protocol would be inserted as Annex I.G in the NAFO Conservation and Enforcement Measures.**
- **The Commission and Scientific Council consider and endorse the revised calendar for the development of the 3M Cod MSE as reflected in Annex 4 of this report (COM-SC Doc. 18-02).**
- **The Commission and the Scientific Council continue their work on the NAFO PA Framework.**
- **The Commission approve the corrections in Annex I.F of the NCEM as reflected in Annex 5 of this report (COM-SC Doc. 18-02).**

10. Adoption of Report

The report was adopted via correspondence.

11. Adjournment

The meeting was adjourned at 12:30 hours on 15 August 2018.

Annex 1. List of Participants

CO-CHAIRS

Healey, Brian (SC Chair and Acting Interim co-Chair). Science Advisor, Fisheries and Oceans Canada, Northwest Atlantic Fisheries Centre, 80 East White Hills Road, St. John's, NL, A1C 5X1
Tel: +1 709 772 8674 – Email: brian.healey@dfo-mpo.gc.ca

Perry, Jacqueline. Acting Regional Director General, Fisheries and Ocean Canada, 80 East White Hills Rd., St John's, NL, A1C 5X1
Tel: + 1 709 772 4417 – Email: jacqueline.perry@dfo-mpo.gc.ca

CANADA

Chapman, Bruce. President. Groundfish Enterprise Allocation Council, 1362 Revell Dr., Manotick, ON K4M 1K8
Tel: +1 613 692 8249 – Email: bchapman@sympatico.ca

Fagan, Robert. Senior Resource Manager. Fisheries Management, Fisheries and Oceans Canada, Northwest Atlantic Fisheries Centre, 80 East White Hills Road, St. John's, NL, A1C 5X1
Tel: +1 709 772 7627 – Email: Robert.Fagan@dfo-mpo.gc.ca

Walsh, Ray. Regional Manager, Fisheries Management, Fisheries and Oceans Canada, 80 East White Hills Road, St. John's, NL A1C 5X1
Tel: +1 709 772 4472 – Email: ray.walsh@dfo-mpo.gc.ca

DENMARK (IN RESPECT OF FAROE ISLANDS + GREENLAND)

Ridao Cruz, Luis. Faroe Marine Research Institute, P. O. Box 305, Nóatún 1, FO-100 Tórshavn, Faroe Islands
Tel: (+298) 353 900 – Email: luisr@hav.fo

EUROPEAN UNION

Alpoim, Ricardo. Instituto Portugues do Mar e da Atmosfera, Rua Alfredo Magalhães Ramalho, nº6, 1495-006 Lisbon, Portugal
Tel: +351 213 02 70 00 - Email: ralpoim@ipma.pt

Fernández, Carmen. Instituto Español de Oceanografía (IEO). Avenida Príncipe de Asturias, 70 bis. 33212 Gijón, Spain
Tel: +34 985 308 672 – Email: carmen.fernandez@ieo.es

González, Diana. Instituto Español de Oceanografía (IEO), Aptdo 1552, E-36280 Vigo, Spain
Tel: +34 986 492111 – Email: diana.gonzalez@ieo.es

González Costas, Fernando. Instituto Español de Oceanografía (IEO), Aptdo 1552, E-36280 Vigo, Spain
Tel: +34 986 49 22 39 – Email: fernando.gonzalez@ieo.es

Ivanescu, Raluca. NAFO Desk Officer, European Commission, Directorate General for Fisheries and Maritime Affairs (DG MARE B2), Rue Joseph II, 99, B-1049, Brussels, Belgium
Email: raluca.ivanescu@ec.europa.eu

Lopes, Luis. Direção Geral de Recursos Naturais, Segurança e Serviços Marítimos. Avenida Brasilia, 1449-030 Lisboa, Portugal
Email: llopes@dgrm.mam.gov.pt

Mancebo Robledo, C. Margarita. Jefa de Area de Relaciones Pesqueras Internacionales, Ministerio de Agricultura Pesca y Alimentacion, S. G. de Acuerdos y Organizaciones Regionales de Pesca, Direccion General de Recursos Pesueros y Acuicultura, Secretaria General de PESCA, C/Velázquez, 144, 28006 Madrid, Spain
Tel: +34 91 347 61 29 – Email: cmancebo@mapama.es

Tuvi, Aare. Fishery Resources Department, Ministry of the Environment, Narva mnt 7ª, 15172 Tallinn, Estonia
Tel: +372 626 0712- Email: aare.tuvi@envir.ee

JAPAN

Butterworth, Doug S. Emeritus Professor, Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch 7701 South Africa
Tel: +27 21 650 2343 – E-mail: doug.butterworth@uct.ac.za

Nishida, Tsutomu (Tom). Associate Scientist, National Research Institute of Far Seas Fisheries, 5-7-1, Orido Shimizu-Ward, Shizuoka-City, Shizuoka, 424-8633, Japan
Tel: +81(54)3365834 – E-mail: aco20320@par.odn.ne.jp

UNITED STATES OF AMERICA

Gamble, Robert. Northeast Fisheries Science Centre (NOAA), 166 Water Street, Woods Hole, MA 02543
Tel: +1 508 495 2202 – E-mail: Robert.Gamble@noaa.gov

Mencher, Elizabethann. International Policy Advisor, Office of International Affairs and Seafood Inspection, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, (NOAA), 1315 East-West Hwy., Silver Spring, MD 20910, USA
Tel: +1 301 427 8362 – Email: elizabethann.mencher@noaa.gov

Sosebee, Katherine. Research Fisheries Biologist, National Marine Fisheries Service, Northeast Fisheries Science Centre (NOAA), 166 Water Street, Woods Hole, MA 02543
Tel: +1 508 495 2372 – Email: katherine.sosebee@noaa.gov

Warner-Kramer. Deirdre. Acting Deputy Director, Bureau of Oceans, International Environmental and Scientific Affairs, Office of Marine Conservation (OES/OMC), Department of State, Washington, DC 20520 USA
Tel: +1 202 647 2883 – Email: warner-kramerdm@fan.gov

OBSERVER

NORTH-EAST ATLANTIC FISHERIES COMMISSION

Campbell, Darius. Secretary, North-East Atlantic Fisheries Commission. 44 Baker Street, London, W1U 7AL – UK
Tel: +44 (0)20 7631 0016 – E-mail: Darius@neafc.org

NAFO SECRETARIAT

2 Morris Drive, Suite 100, Dartmouth, Nova Scotia, Canada – Tel: +1 902 468-5590

Kingston, Fred. Executive Secretary.	Email: fkingston@nafo.int
Blasdale, Tom. Scientific Council Coordinator.	Email: tblasdale@nafo.int
Federizon, Ricardo. Senior Fisheries Management Coordinator	Email: rfederizon@nafo.int
LeFort, Lisa. Senior Executive Assistant to the Executive Secretary	Email: llefort@nafo.int

Annex 2. Agenda

1. Opening by the co-Chair, Jacqueline Perry (Canada)
2. Appointment of co-Chair
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5. Development of Exceptional Circumstances Protocol for 2+3KLMNO Greenland halibut management strategy
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Annex 3. Draft Exceptional Circumstances Protocol for the Greenland halibut Management Procedure

The following criteria constitute Exceptional Circumstances:

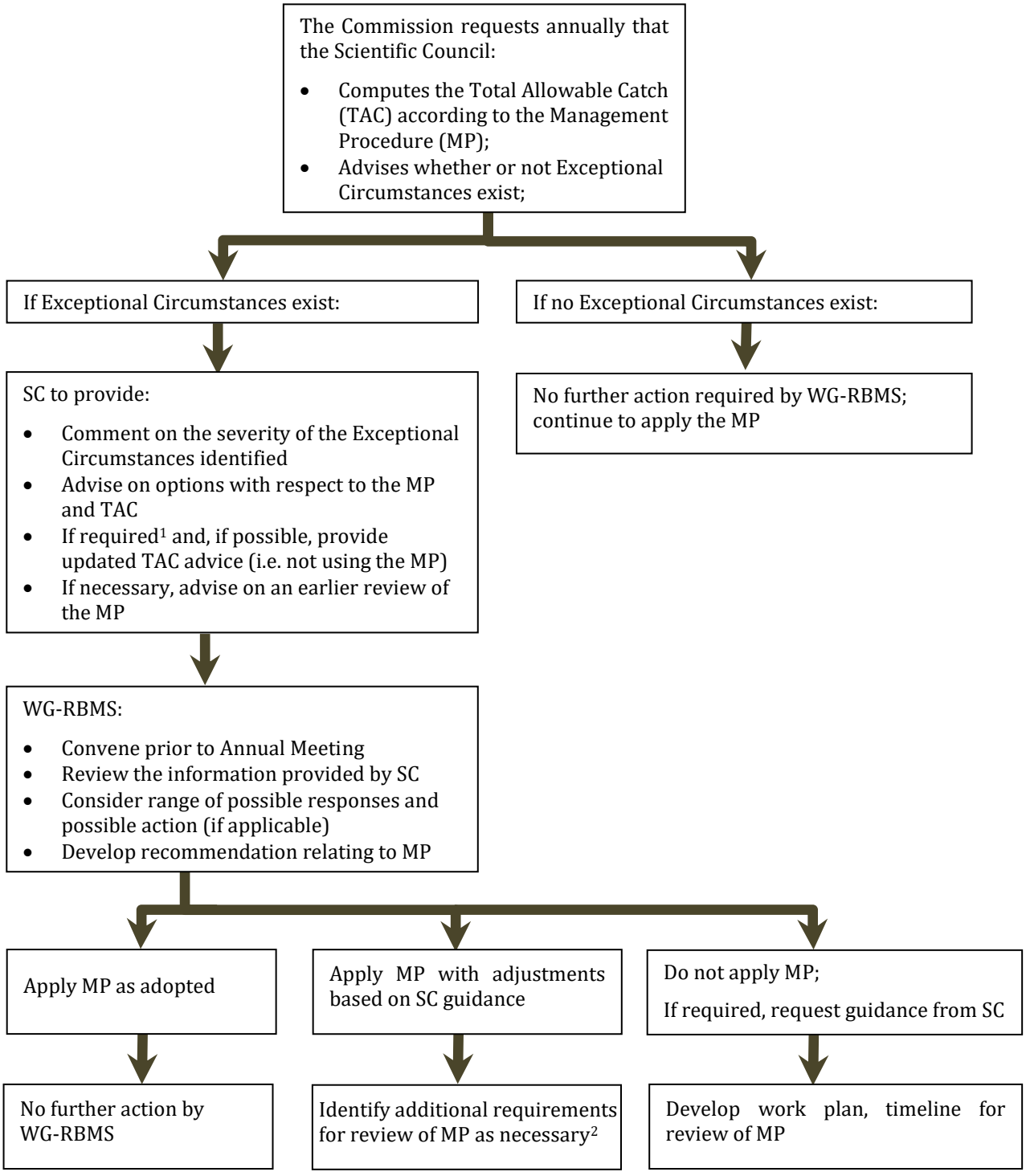
1. Missing survey data:
    - More than one value missing, in a five-year period, from a survey with relatively high weighting in the HCR (Canadian Fall 2J3K, Canadian Fall 3LNO, and EU 3M surveys);
    - More than two values missing, in a five-year period, from a survey with relatively low weighting in the HCR (Canadian Spring 3LNO and EU-Spain 3NO surveys);
2. The composite survey index used in the HCR, in a given year, is above or below the 90 percent probability envelopes projected by the base case operating models from SSM and SCAA under the MS; and
3. TACs established that are not generated from the MP

The following elements will require application of expert judgment to determine whether Exceptional Circumstances are occurring:

1. the five survey indices relative to the 80, 90, and 95 percent probability envelopes projected by the base case operating models (SSM and SCAA) for each survey;
2. survey data at age four (age before recruitment to the fishery) compared to its series mean to monitor the status of recruitment; and
3. discrepancies between catches and the TAC calculated using the MP.[1]

Figure 1 illustrates the actions to be taken in Exceptional circumstances.

[1] Noting that 10% exceedance of TAC was tested during MSE.



[1] For example, where the SC determines that, in the light of identified exceptional circumstances, the application of the TAC generated by the MP may not be appropriate.

[2] This review may include updated assessment, sensitivity analysis, etc.

Figure 1. Decision tree illustrating actions to be taken in the event of Exceptional Circumstances.

Annex 4. Revised calendar for the development of 3M Cod MSE

The table below shows actions required to complete the MSE process, the parties responsible for their completion, and indicative dates that would enable the process to be completed by September 2019.

Validation of code by independent analysts was initially suggested as a separate step towards the end of the process. It is considered to be unlikely that this could be done in the time available although this will remain under consideration. An alternative option would be that external validation could be achieved through some sort of continuous external review throughout the process.

Dates	Action	Responsibility
Fall 2018	Development of OMs	Analysts
	Testing of HCRs	Analysts
	Development of Projection Specifications	Analysts
	Proposals for full set of MO/PS/Risks	Analysts
	Develop Trials Specification document (to be updated as the process continues)	Analysts
	Arrange repository for code and results	Secretariat
January 2019	Review OMs and approve initial set of OMs, including the acceptability of their conditioning, and/or suggest further refinements	SC
	Approve Projection Specifications	SC
	Comments on initial set of HCR (if required)	SC
Feb-March 2019	Test initial/refined HCRs using initial/refined set of OMs	Analysts
March 2019	Review initial MSE results	WG-RBMS
	Update and possibly finalize PS and associated risk levels	WG-RBMS
	Indicate where improvements in performance are most required to guide analysts in revising HCRs	WG-RBMS
April – May 2019	Implement HCR improvements	Analysts
	Propose plausibility weightings for OMs (if required)	Analysts
June 2019 SC Meeting	Review refined OMs and approve final set of OMs, including the acceptability of their conditioning	SC
	Review results from refined HCRs and cull those HCRs not needing further consideration	SC
	Agree plausibility weightings of OMs (though subject to endorsement by RBMS)	SC
Summer 2019. (potentially an additional day on the end of the SC June meeting or separate July meeting, possibly by Webex)	Finalize PS and associated risk levels –	WG-RBMS
	Endorse plausibility weightings of OMs	WG-RBMS
August-early September 2019	Run tests of a final set of HCRs on finalized OMs and prepare consolidated results –	Analysts
preceding NAFO AM 2019	Review results of MSE for revised HCRs & recommendation to Commission –	WG-RBMS

Annex 5. Changes in Greenland halibut Harvest Control Rule in Annex I.F of the NCEM

Revision of NCEM Annex I.F
Greenland halibut Management ~~Strategy~~Procedure

Proposed changes to Annex I.F to reflect the original intention in the Greenland halibut management strategy adopted by the Commission in 2017.

Annex I.F
Greenland halibut Management ~~Strategy~~Procedure

The harvest control rule (HCR) will adjust the total allowable catch (TAC) from year (y) to year (y+1), according to:

a combination of a "target based" and a "slope based" rule detailed below.

*Target based (**t**)*

The basic harvest control rule (HCR) is:

$$TAC_{y+1} = TAC_y\left(1 + \gamma\left(J_y - 1\right)\right) \quad (1)$$

where

TAC_y is the TAC recommended for year y,

γ is the "response strength" tuning parameter,

J_y is a composite measure of the immediate past level in the mean weight per tow from surveys (I^i_y) ~~abundance indices~~ that are available to use for calculations for year y; ~~for this base case CMP~~ five series ~~have been~~ are used, with i = 1, 2, 3, 4 and 5 corresponding respectively to Canada Fall 2J3K, EU 3M 0-1400m, Canada Spring 3LNO, EU 3NO and Canada Fall 3LNO:

$$J_y = \sum_{i=1}^{5} \frac{1}{(\sigma^i)^2} \frac{J^i_{current\,~~curr~~,y}}{J^i_{target}} \Big/ \sum_{i=1}^{5} \frac{1}{(\sigma^i)^2} \quad (2)$$

with

$(\sigma^i)^2$ being the estimated variance for index i (estimated in the SCAA model fitting procedure, see Table 1)

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

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

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.

*Slope based (**s**)*

The basic harvest control rule (HCR) is:

$$TAC_{y+1} = TAC_y\left[1 + \lambda_{up/down}\left(s_y - X\right)\right] \quad (5)$$

where

$\lambda_{up/down}$ and X are tuning parameters,

s_y is a measure of the immediate past trend in the survey-based abundance indices, computed by linearly regressing $lnI^i_{y'}$ vs year y' for $y' = y - 5$ to $y' = y - 1$, for each of the five surveys considered, with

$$s_y = \sum_{i=1}^{5} \frac{1}{(\sigma^i)^2} s^i_y \Big/ \sum_{i=1}^{5} \frac{1}{(\sigma^i)^2} \quad (6)$$

with the standard error of the residuals of the observed compared to model-predicted logarithm of survey index *i* (σ^i) estimated in the SCAA base case operating model.

*Combination Target and Slope based (**s+t**)*

For the target and slope-based combination:

1) TAC_{y+1}^{target} is computed from equation (1),
2) TAC_{y+1}^{slope} is computed from equation (5), and
3) $TAC_{y+1} = \left(TAC_{y+1}^{target} + TAC_{y+1}^{slope}\right)/2$

Finally, constraints on the maximum allowable annual change in TAC are applied, viz.:

$$\text{if } TAC_{y+1} > TAC_y\left(1 + \Delta_{up}\right) \text{ then } TAC_{y+1} = TAC_y\left(1 + \Delta_{up}\right) \quad (7)$$

and

$$\text{if } TAC_{y+1} < TAC_y(1 - \Delta_{down}) \text{ then } TAC_{y+1} = TAC_y(1 - \Delta_{down}) \quad (8)$$

The control parameters for the ~~recommended~~ adopted MP ~~MP: CMP16.5_s+t~~are shown in Table 2 with a starting TAC of 16 500 t in 2018. Missing survey values are treated as missing in the calculation of the rule as in the MSE.

Table 1. The weights given to each survey in obtaining composite indices of abundance are proportional to the inverse squared values of the survey error standard deviations σ^i listed below.

Survey	σ^i
Canada Fall 2J3K	0.22
EU 3M 0-1400m	0.21
Canada Spring 3LNO	0.49
EU 3NO	0.38
Canada Fall 3LNO	0.26

Table 2. Control parameter values for the MPs recommended. The parameters α and X were adjusted to achieve a median biomass equal to B_{msy} for the exploitable component of the resource biomass in 2037.

TAC_{2018}	16 500 tonnes
γ	0.15
q	3
α	0.972
λ_{up}	1.00
λ_{down}	2.00
X	-0.0056
Δ_{up}	0.10
Δ_{down}	0.10