Northwest Atlantic  Fisheries Organization

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[Adopted]

**39th ANNUAL MEETING OF NAFO - SEPTEMBER 2017**

**Recommendations arising from WG-RBMS meetings in 2017 relating to the Greenland Halibut Management Strategy Evaluation (MSE)**

## 1. Selection of the Management Procedure (MP) and associated Harvest Control Rule (HCR)

The set of management objectives specified for the Greenland halibut MSE by the RBMS WG, contains elements to ensure a profitable fishery (maximize catches and ensure low inter-annual variability) and to protect the productivity of the stock (low risk of breaching Blim and high probability of rebuilding to Bmsy). These objectives cannot be maximized simultaneously, and the task for the WG was therefore to seek a HCR that strikes the best balance between utilization and conservation.

The proposed Management Procedure with its associated Harvest Control Rule provides a high probability of reaching Bmsy in the longer term (10-20 years) and a very low risk of going below 30%Bmsy (which can be considered a proxy for Blim). At the same time catches should remain relatively stable.

## 2. Recommendation to be forwarded to the Fisheries Commission.

### i) Management procedure

WG RBMS recommends that the Commission should implement a model-free management procedure (MP), i.e. the MP does not include any assessment model, but instead calculates TACs to be implemented in the future directly from the abundance indices provided each year by five different surveys.

WG RBMS further recommends that the harvest control rule (HCR) component of this MP should be a combination of a "target based" and a "slope based" rule. The "target-based" rule increases or decreases the TAC depending on whether an abundance index averaged over the 5 available surveys is above or below a specified multiple (α) of its immediate past (in this case 5 years average) level. A "slope-based" rule considers the recent trend in this averaged abundance index, and increases or decreases the TAC depending on whether the overall trend is up or down.

The full formulation of the MP is set out in Annex I. A number control parameter values (such as α above) were selected so that the MP achieves an appropriate trade-off amongst the various objectives for the fishery and resource that were pre-specified by WG-RBMS (ref) to be desirable. The values recommended for these control parameters are set out in Tables 1 and 2 of Annex I. These selections include that the TAC for the first year (2018) of application of the MP will be 16 500 t, and that TACs may change by no more than 10% (either up or down) from one year to the next.

### ii) Implementation

The management strategy should be implemented initially for 6 years. It should be annually monitored by the Scientific Council to determine whether exceptional circumstances are occurring. Scientific Council should perform an "update assessment" after 3 years. If either the annual monitoring or the update assessment indicates that exceptional circumstances are occurring, the exceptional circumstances protocol will provide guidance on what steps should be taken.

### iii) Exceptional circumstances

The exceptional circumstances protocol should consist of two elements: 1. a technical description that identifies when exceptional circumstances have occurred and 2. What actions should then be taken.

Ad. 1. To support the development of an exceptional circumstances protocol by WG-RBMS, the Commission should request the Scientific Council in June 2018 to develop criteria for the identification of exceptional circumstances, taking account *inter alia* of the following issues raised by the WG:

- Clear determination of how missing data points required for input to the HCR should be filled and specification of the number of missing surveys that would trigger exceptional circumstances
- Note elements that are based on data that are available to SC as part of its annual monitoring (survey results) as well as others that are based on less frequent update assessments e.g. recruitment
- Identify the indices that the MSE indicated to be more important to monitor in regard to the determination of exceptional circumstances e.g. the factors that were indicated to have greater influence in the robustness trials. This links to the consideration of the suite of primary and secondary indicators
- Consider an appropriate balance between specificity *vs* flexibility in defining exceptional circumstances
- The robustness of the exceptional circumstances protocol should ensure that their application is triggered only when necessary.
- Evaluation of recruitment signals should be a key consideration, given some concern within the WG over poorer performance of the proposed rule under a low recruitment scenario.

Ad.2. WG-RBMS will meet in August 2018 to finalize the exceptional circumstances protocol.

## ANNEX I.

## A detailed technical specification of the MP recommended

As indicated in the main text of the report, the MP recommended is a combination of a target- and a slope-based approach. This Annex describes each of these approaches in turn, and then how the outputs from the two are combined to provide the final TAC recommendation.

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*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 $y$,

$\gamma$ is the "response strength" tuning parameter

$J_y$ 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 five series have been 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:

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

with

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

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

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

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 $y$.

*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

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

with the standard error of the residuals of the observed compared to model-predicted logarithm of survey index *i* ($\sigma^i$) 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 MP: CMP16.5_s+t are shown in Table 2.

**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 $\sigma^i$ listed below.

| Survey | $\sigma^i$ |
|---|---|
| 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 $\alpha$ 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 |
| $\gamma$ | 0.15 |
| $q$ | 3 |
| $\alpha$ | 0.972 |
| $\lambda_{up}$ | 1.00 |
| $\lambda_{down}$ | 2.00 |
| $X$ | -0.0056 |
| $\Delta_{up}$ | 0.10 |
| $\Delta_{down}$ | 0.10 |