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Changes to the NAFO CEM resulting from the Revised Management Strategy for 2+3KLMNO Greenland halibut

The following edits to Article 10, Annex I.F and Annex I.G of the NAFO CEM reflect the proposed adoption of a revised management procedure and exceptional circumstances protocol.

Article 10 – Greenland Halibut

Rebuilding Program

1. The current Management Strategy (MS) for Greenland halibut stock in Subarea 2 + Divisions 3KLMNO adopted by NAFO in 2024 shall be in force from 2025 to 2034 inclusive, or until such a time that the Commission adopts a revision.

2. The total allowable catch (TAC) shall be adjusted annually according to the harvest control rule (HCR) specified in Annex I.F.

The text for Annex I.F below will replace the entirety of the current text of Annex I.F.

Annex I.F
Greenland Halibut Management Procedure

The MP combines a "target based" and "slope based" rule, which was tuned to reach B_{msy} by 2044 under OM1 using the SCAA framework. The full set of control parameters are shown in Table 1.

*Target based (**t**)*

The target rule is:

$$\mathrm{TAC}_{y+1}^{target} = \mathrm{TAC}_y \left(1 + \gamma\left(J_y - 1\right)\right) \qquad (1)$$

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_y^i) that are available to use for calculations for year y; five survey series are used, with i = 1, 2, 3, 4, and 5 corresponding respectively to Canada Autumn 2J3K, Canada Autumn 3LNO, EU-Spain 3L, EU-Spain 3NO and EU 3M 0-1400m:

$$J_y = \sum_{i=1}^{5} \frac{1}{(\sigma^i)^2} \frac{J_{current,y}^i}{J_{target}^i} \Big/ \sum_{i=1}^{5} \frac{1}{(\sigma^i)^2} \qquad (2)$$

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

$$J_{current,y}^i = \frac{1}{q^i} \sum_{y' \in \mathrm{Q}^i}^{y-1} I_{y'}^i \qquad (3)$$

$$J_{target}^i = \alpha \frac{1}{5} \sum_{y'=2011}^{2015} I_{y'}^i, \quad \text{(where } \alpha \text{ is a control/tuning parameter for the MP)} \qquad (4)$$

where q^i indicates the number of years in Q^i, and Q^i the years in the period $y' = y - 5$ to $y' = y - 1$ used to determine current status for survey series i (i.e. missing survey values are treated as missing in the calculation using the rule, as was done in the MSE testing). 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 slope rule is:

$$\mathrm{TAC}_{y+1}^{slope} = \mathrm{TAC}_y \left[1 + \lambda_{up/down}\left(s_y - X\right)\right] \qquad (5)$$

where $\lambda_{up/down}$ and X are tuning parameters, s_y^i is a measure of the immediate past trend in the survey-based mean weight per tow indices, computed by linearly regressing lnI_y^i, vs year y' for $y' \in Q^i$ (as defined above) for each survey series i considered, with:

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

with the standard error of the residuals of the observed compared to model-predicted logarithm of survey index i (σ^i) as estimated in the SCAA base case operating model. Missing survey values are treated as missing in the calculation using the rule, as was done in the MSE. In such cases, the slope for each index, s_y^i, in equation (6) is calculated from the available values within the last five years.

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

For the target and slope based combination:

1) $\mathrm{TAC}_{y+1}^{target}$ is computed from equation (1),

2) $\mathrm{TAC}_{y+1}^{slope}$ is computed from equation (5), and

3) $\mathrm{TAC}_{y+1} = \mu\left(\mathrm{TAC}_{y+1}^{target} + \mathrm{TAC}_{y+1}^{slope}\right)/2$, where μ is a tuning parameter.

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

$$\text{if} \quad \mathrm{TAC}_{y+1} > \mathrm{TAC}_y\left(1+\Delta_{up}\right) \quad \text{then} \quad \mathrm{TAC}_{y+1} = \mathrm{TAC}_y\left(1+\Delta_{up}\right) \qquad (7)$$

and

$$\text{if} \quad \mathrm{TAC}_{y+1} < \mathrm{TAC}_y(1-\Delta_{\mathrm{down}}) \quad \text{then} \quad \mathrm{TAC}_{y+1} = \mathrm{TAC}_y(1-\Delta_{\mathrm{down}}) \qquad (8)$$

During the MSE process, this inter-annual constraint was set at 10%, for both TAC increases and decreases, and these constraints were adopted as part of the adopted MP.

Table 1. Control parameter values for the adopted MP. The parameters μ, α, and X were adjusted to achieve a median biomass equal to B_{msy} for the exploitable component of the resource biomass in 2044 for the Base Case SCAA Operating Model.

μ	0.963
γ	0.15
q	3
α	0.972
λ_{up}	1
λ_{down}	2
X	-0.0056
Δ_{up}	0.1
Δ_{down}	0.1

Annex I.G
Exceptional Circumstances Protocol

The following criteria constitute Exceptional Circumstances:

1. Missing survey data:

    - More than two values missing, in a five-year period, from a survey used in the MP;

    - Missing more than two of the five survey indices from the terminal year.

2. The composite survey index used in the MP, 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;

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:

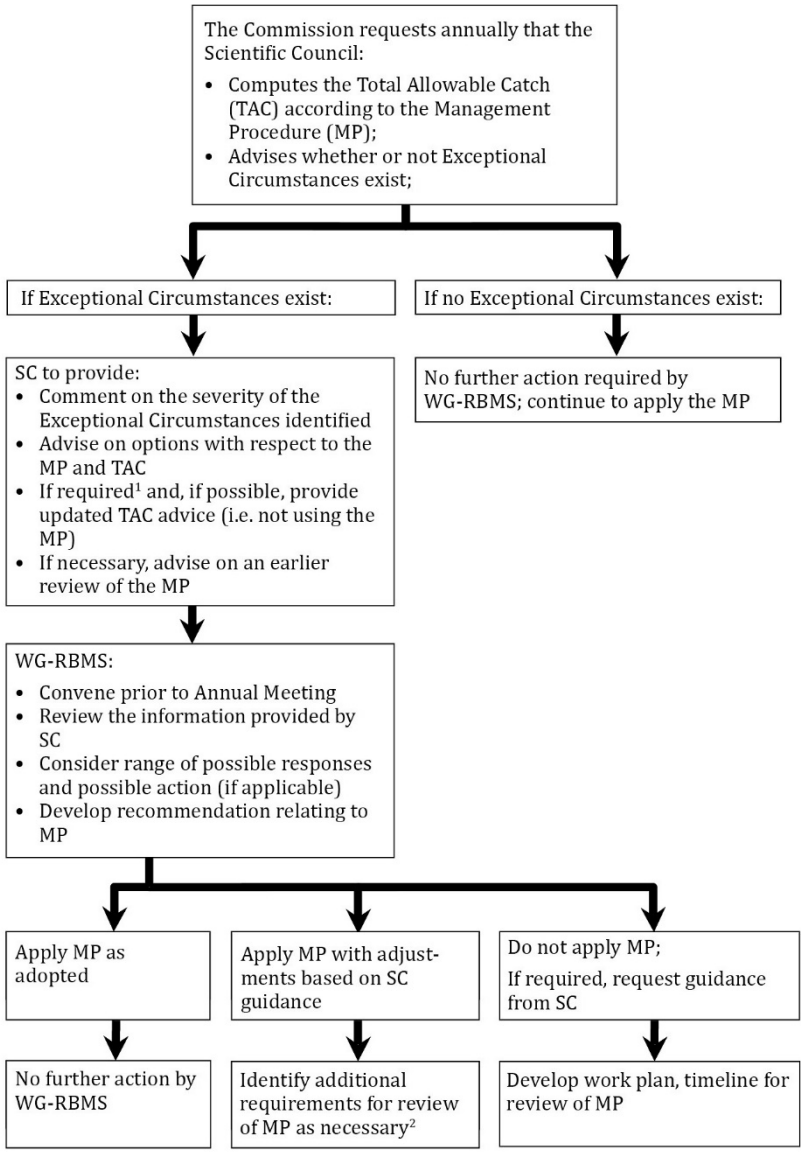
1. the five survey indices relative to the 80, 90, and 95 percent probability envelopes projected by the base case operating models (SSM and SCAA) for each survey;

2. survey data at age four (age before recruitment to the fishery) compared to its series mean to monitor the status of recruitment;

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.