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Correcting mis-calculated values of J_{target} for use in the Greenland halibut HCR

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Abstract

One parameter value underlying the harvest control rule (HCR) used for Greenland halibut in Subarea 2+Div. 3KLMNO was mis-specified in the TAC computations for the past two years. Here we describe the error and show that it had a negligible impact on TAC values computed from the HCR.

Introduction

An HCR for Greenland halibut in Subarea 2+Div. 3KLMNO was adopted by the Commission in 2017. The HCR has a target and slope component. As part of the target component, survey-specific targets were defined as the average of each index (mean weight per tow) from 2011 to 2015 multiplied by a tuning parameter, α, which was set to 0.972. Discrepancies were noticed between J_{target} values used in the calculation of the TAC for 2019 and 2020 from those that were used to test the HCR in 2017. A typo when inputting the value of α meant that 0.927 was applied in the calculation of the TAC for 2019 and 2020 instead of the correct value of 0.972, resulting in incorrect J_{target} values (Table 1).

Methods

To assess the impact of this error, TACs for 2019-2021 were calculated from the HCR using both the mis-calculated and the correctly calculated J_{target} values. See **Appendix A** for the equations and data used in these calculations.

Results and Discussion

Past TACs differed by less than 1% following the correction of α (Table 2). The mis-calculation of J_{target} thus had a negligible impact on advice. The corrected J_{target} values should be used to calculate the TAC for 2021 and subsequent years.

Tables

Table 1. Target values (J_{target}) used in the 2017 MSE simulations and those used to calculate the TAC for 2019 and 2020.

Survey	Used in 2017 in the MSE	Used to calculate TAC for 2019 and 2020
Canada Fall 2J3K	26.34	25.12
Canada Fall 3LNO	1.79	1.71
Canada Spring 3LNO	1.06	1.02
EU 3M 0-1400m	26.42	25.20
EU 3NO	6.93	6.61

Table 2. TACs calculated from the HCR when applying J_{target} values based on α values of 0.927 and the correct value of 0.972.

	TAC based on α of 0.927	TAC based on α of 0.972	Percent difference
2019	16496	16434	0.38 %
2020	16927	16867	0.36 %
2021	16559	16498	0.37 %

Appendix A: HCR description and data

An HCR for Greenland halibut in Subarea 2+Div. 3KLMNO was adopted by the Commission in 2017. The HCR has two components: target based and slope based.

*Target based (**t**)*

The target harvest control rule (HCR) is:

$$TAC_{y+1}^{target} = TAC_y(1 + \gamma(J_y - 1)) \qquad (1)$$

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 Fall 2J3K, EU 3M 0-1400m, Canada Spring 3LNO, EU 3NO and Canada Fall 3LNO:

$$J_y = \sum_{i=1}^{5} \frac{1}{\sigma^{i2}} \frac{J_{current}^i}{J_{target}^i} / \sum_{i=1}^{5} \frac{1}{\sigma^{i2}} \qquad (2)$$

with $(\sigma^i)^2$ being the estimated variance for index *i* (estimated in the SCAA model fitting procedure, see **Table i.3**)

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

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

with q indicating the period of years used to determine current status. 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 harvest control rule (HCR) is:

$$TAC_{y+1}^{slope} = TAC_y[1 + \lambda_{up/down}(s_y - X)] \qquad (5)$$

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 $y' = y - 5$ to $y' = y - 1$, for each of the five surveys considered, with

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

with the standard error of the residuals of the observed compared to model-predicted logarithm of survey index i (σ^i) estimated in the SCAA base case operating model (**Table i.3**).

*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) $\quad TAC_{y+1} = (TAC_{y+1}^{target} + TAC_{y+1}^{slope})/2$

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

$$\text{if} \quad TAC_{y+1} > TAC_y(1 + \Delta_{up}) \quad \text{then} \quad TAC_{y+1} = TAC_y(1 + \Delta_{up}) \quad (7)$$
$$\text{and}$$
$$\text{if} \quad TAC_{y+1} < TAC_y(1 - \Delta_{down}) \quad \text{then} \quad TAC_{y+1} = TAC_y(1 - \Delta_{down}) \quad (8)$$

During the MSE process, this inter-annual constraint was set at 10%, for both TAC increases and decreases.

The control parameters for the adopted HCR are shown in **Table i.4** with a starting TAC of 16 500 t in 2018. Missing survey values are treated as missing in the calculation of the rule, as was done in the MSE. In such cases, q in equation (3) is reduced accordingly.

Table 3. The weights given to each survey in obtaining composite indices of abundance (target rule) and composite trends (slope rule) 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 4. Control parameter values for the adopted HCR. 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 t
γ	0.15
q	3
α	0.972
λ_{up}	1
λ_{down}	2
X	-0.0056
Δ_{up}	0.1
Δ_{up}	0.1

Table 5.   Stratified estimates of mean weight per tow (kg) from Canadian and EU research vessel surveys. These data are used in the calculation of the TAC.

Year	Canada Fall 2J3K	Canada Fall 3LNO	Canada Spring 3LNO	EU 3M 0-1400m	EU 3NO
2011	26.74	2.21	1.05	26.15	7.09
2012	23.50	1.71	1.94	19.20	7.37
2013	29.65	2.59	0.73	19.11	5.46
2014	33.34		0.66	23.92	6.24
2015	22.29	0.87		47.52	9.49
2016	18.54	1.31	0.66	28.30	8.80
2017	15.10	1.25		42.66	16.63
2018	17.05	1.89	1.88	29.80	7.88
2019	16.28	1.87	1.45	16.89	8.82