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Performance metrics based on the state-space stock assessment model for Greenland halibut stock in NAFO Subarea 2 and Divisions 3KLMNO

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Introduction

This document presents a recalculation of the performance metrics (F_{MSY} , B_{MSY}) based on the state-space stock assessment model for the same stock for the Greenland halibut stock in NAFO Subarea 2 and Divisions 3KLMNO. The recalculation was done because documentation of values used in the earlier presentation of the SSM based MSE for the same stock were not available at the time of the review of the MSE (scwp20-008).

Methods

The parameters from the SSM model (2016 run) were used to project the population forward for 100 years. The performance metrics from this projection were applicable to the base operating model (OM) in the MSE. Additional projections were done to calculate performance metrics for the OM where there is no fishery on the plus group ages (10+).

$$Fbar = \frac{\sum_{a=5}^9 F_a}{5}$$

Note that the Fbar outputs reported from the SSM model are population weighted Fbar values.

$$Fbar_{SSM} = \frac{\sum_{a=5}^9 N_a F_a}{\sum_{a=5}^9 N_a}$$

Decisions and steps of carrying out the projections:

1. Recruitment: average of the recruitment estimates from the SSM model

$$R = \frac{\sum_{t=1975:2016} R_t}{42}$$



2. Weight-at-age: average of the catch weights-at-age for last 10 years
3. Selectivity: average of last three years where selectivity for each year is obtained as:

$$Sel_{a,y} = \frac{F_{a,y}}{\frac{\sum_{a=5}^9 F_{a,y}}{5}}$$

4. Start projection from 2016 Numbers-at-age from the SSM
5. From second year to end of simulation

$$N_{a,t} = \begin{cases} \text{if } a = 1 & N_{1,t} = R \\ \text{if } 10 > a > 1 & N_{a,t} = N_{a-1,t-1} e^{(-Z_{a-1,t-1})} \\ \text{if } a \geq 9 & N_{10+,t} = \sum_{a=9}^{10} N_{a,t-1} e^{(-Z_{a,t-1})} \end{cases}$$

6. Projected yield is tracked using the Baranov catch equation

$$C_{a,t} = \frac{F_{a,t}}{Z_{a,t}} (1 - e^{-Z_t}) N_{a,t}$$

$$Y_t = \sum_{a=1}^{10} C_{a,t} * w_{a,t}$$

The maximum equilibrium yield was optimized.

Results and Discussion

Similar to the previous exercise (Regular et al 2017), we found that the peak for F at maximum yield is not well defined. The $F_{0.1}$ is calculated as the F value where the increase in yield per unit of F (a change of 0.1) is a tenth of the increase in yield at the origin (Fig 1; table 1). A more appropriate approach at this time is considered to be to use $F_{0.1}$ as a proxy for F_{MSY} , in part to make some allowance for the present SSM model assuming that recruitment is independent of spawning stock size.

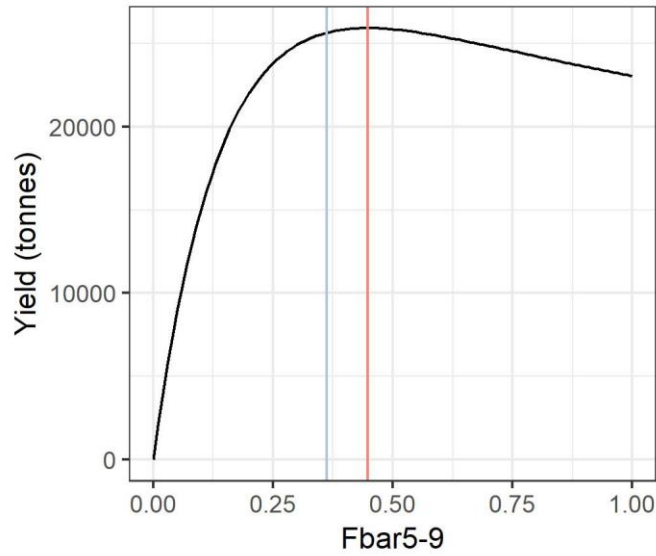


Figure 1. Yields and yield proportions across range of Fbar5-9 for the base case of SSM. The red line shows the value of F at maximum yield and the blue line is F0.1.

In the no plus catch scenario, age 10 plus fish were not selected to the fishery (Fig. 3). The yield is very similar to the base case as some (approximately 10% of total), but not a lot of 10+ fish are caught commercially (Fig 2, Table 1).

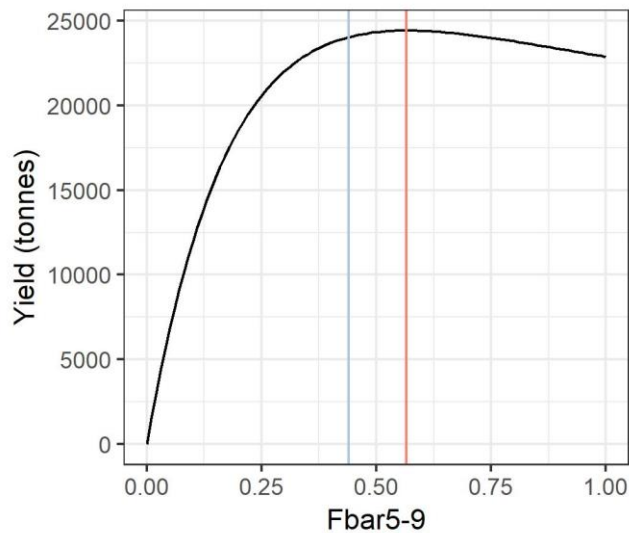


Figure 2. Yields and yield proportions across range of Fbar5-9 for the base case of SSM. The red line shows the value of F at maximum yield and the blue line is F0.1.

Table 1. Performance metrics

OM	type	Fbar5-9	Yield	Biomass	B5to9	B10p	Fbar5-9 population weighted
base	F01	0.363	25649	168619	84464	63536	0.274
lorec	F01	0.363	25649	168619	84464	63536	0.274
nopluscatch	F01	0.439	24027	155320	77794	56923	0.319
tacplus	F01	0.363	25649	168619	84464	63536	0.274
base	Fmax	0.447	25926	137087	77164	39321	0.323
lorec	Fmax	0.447	25926	137087	77164	39321	0.323
nopluscatch	Fmax	0.566	24419	119502	68992	29933	0.385
tacplus	Fmax	0.447	25926	137087	77164	39321	0.323

*lorec and tacplus OMs use the same values as the base OM

Acknowledgements

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References

Regular, Paul M, Noel G Cadigan, Christoph Konrad, M Joanne Morgan, and Brian P Healey. 2017. (2019). Approximating F_{MSY} using the State-Space Stock Assessment Model developed for Greenland Halibut in NAFO Subarea 2 and Divisions 3KLMNO. *NAFO SCR 17/048*.