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Effect of missing values from the Canadian spring and fall surveys of NAFO Divisions 3LNO on the calculation of the TAC using the Greenland halibut HCR

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Abstract

To test the impact of ignoring recent missing abundance indices for Greenland Halibut in NAFO divisions 2+3KLMNO on applying the accepted HCR for this population to provide a TAC recommendation for 2023, the impact of similar exclusions in the past is examined and found to be small. To further test of the impact of the missing 2021 index from the Canada Fall 3LNO survey, a range of pessimistic to optimistic abundance index values were assumed to assess the plausible range of impact this one value might have on the TAC computation. The range of the resultant TACs is small, and the difference of the impact of TACs at either end of this range on exploitable biomass projections for the next year is found to be negligible. Hence, it is argued, the minimalist and straightforward approach of simply ignoring the missing 2021 Canadian Fall 3LNO result in the four-survey version of the HCR agreed last year would be a defensible and appropriate approach to the required adjustment of the implementation of this HCR to provide a TAC recommendation for 2023.

Introduction

The number of survey points missing in the 2022 assessment year for Greenland Halibut in NAFO divisions 2+3KLMNO is sufficient to meet the criterion for Exceptional Circumstances to be declared. Specifically, the disruption of the Canadian spring 3LNO and EU-Spain 3NO surveys in 2020, due to COVID-19 pandemic, and the Canadian spring survey of 3LNO in 2021, due to survey vessel issues, results in more than two missing values from amongst the lower weighted surveys in the HCR (Annex I.G; **NAFO, 2022**). In anticipation of this issue arising this year, sensitivity tests were conducted during the June 2021 meeting of NAFO Scientific Council to assess the impact of excluding the Canadian spring 3LNO index from the HCR (Table i.3; **NAFO,**

2021). The SC advised that "adjusting the TAC advised for 2022 using the HCR informed by four survey indices only (Canadian Fall 2J3K, Canadian Fall 3LNO, EU 3M 0-1400m, and EU-Spain 3NO surveys) may serve as a reasonable option for providing TAC advice for 2023 with minimal deviation from the agreed Management Procedure" (Page 41; NAFO, 2021). The Commission subsequently requested that SC advise a TAC for 2023 using the suggested approach, but "conditional on the absence of other reasons for Exceptional Circumstances arising (other than the missing Canadian spring 3LNO survey)." Specific to missing survey values and ignoring the Canadian spring 3LNO series, Exceptional Circumstances are not occurring; however, vessel issues disrupted the Canadian Fall survey of 3LNO in 2021. Though only one value is missing from this highly weighted survey, additional sensitivity tests are presented here to evaluate the combined impact of excluding the Canadian Spring 3LNO survey and missing the terminal value from the Canadian Fall 3LNO survey.

The overall objective behind this study relates to the fact that the absence of some recent survey results obligates the SC, under the Exceptional Circumstances provisions of the HCR, to consider the possibility of an alternative (and possibly markedly different) approach to recommending the TAC for 2023. The analyses following examine whether, at least for the 2023 TAC recommendation, the minimalist and straightforward approach of simply ignoring the missing 2021 Canadian Fall 3LNO result in the four-survey approach (see above) agreed last year would be a defensible and appropriate way forward.

Methods

Following the HCR equations in Annex I.F of COM Doc. 22-01, the TACs for 2019-2022 were calculated using:

1) all available survey data ("Baseline"),
2) all values from the Canadian Spring 3LNO survey excluded ("Excluding Canadian Spring 3LNO"),
3) dropping the terminal value from the Canadian Fall 3LNO survey ("Partial Canadian Fall 3LNO"), and
4) applying both 2 and 3 ("Excluding Spring and partial Fall").

The impact of a range of values from optimistic to pessimistic for the missing Canadian fall 2021 survey of 3LNO on the TAC for 2023 was also assessed by assuming the 2021 index equals the following values:

1) the 2020 index,
2) the 2020 index less the largest inter-annual decline, and
3) the 2020 index plus the largest inter-annual increase.

These values are compared to a TAC obtained from the HCR lacking a value for the 2021 Canadian Fall survey of 3LNO. The objective of this additional test is to assess the plausible range of impact this one value might have on the TAC computation. This test does not represent an attempt to evaluate options for imputing the missing value. All available data for use in these sensitivity tests are presented in **Table 1**.

Results and Discussion

A summary of differences in the TACs computed under the four missing data scenarios are shown in **Table 2**. Excluding all the Canadian Spring 3LNO survey data resulted in less than a 3% change in the TAC. Likewise, excluding the terminal value from the Canadian Fall 3LNO survey resulted in less than a 3% change in the TAC. The combined effects of both interventions resulted in marginally higher changes, but still relatively minor (<4% change). The influence of the Canadian Spring 3LNO survey was expected to be relatively small because of its low weight. The Canadian Fall 3LNO survey has a relatively high weighting; however, missing one of five years had a minimal impact.

Focusing on the plausible range of impacts that the missing (and unknown) 2021 Canadian Fall 3LNO survey index might have on the TAC advised for 2023, a range of values were assumed for the missing 2021 index (**Table 3**). All scenarios resulted in relatively minor changes in the TAC (<5% change) compared to the

default approach of calculating the TAC without imputing a value for the missing index. This result suggests that if an index for 2021 from this survey was available, its potential contribution to the TAC calculation would not result in a drastically different TAC recommendation for 2023.

Projections have been carried out using the SCAA 2020 Base Case update (**Rademeyer and Butterworth, 2020**) and the actual catch data for 2020 and 2021, the TAC for 2022 and the minimum and maximum TACs in **Table 3** for 2023. The resulting estimated exploitable biomass trajectories (relative to the 1960 level) are plotted in **Figure 1**. The two trajectories, which differ only from 2023 to 2024, are basically indistinguishable. This test indicates that the range of possible TACs resulting from the input to the HCR of a 2021 Canadian Fall 3LNO survey result, if it was available, would not have a substantial (indeed only a very small) impact on exploitable biomass.

In summary, these results indicate that excluding the Canadian Spring 3LNO survey and ignoring the terminal value from the Canadian Fall 3LNO survey have a limited effect on the TAC calculated. Percent differences across all sensitivity tests were less than the implementation error for 2021, when the TAC was 16 498 t and the catch was 15 039 t (~9% difference). The estimated effect on the 2024 exploitable biomass of a TAC in the range given in **Table 3** is negligible; relative to the 1960 level, this biomass increases from 0.436 in 2023 to between 0.483 and 0.486 in 2024. Hence this would seem to be a defensible and appropriate basis to recommend the TAC for 2023.

Acknowledgements

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References

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Rademeyer, R., and Butterworth, D. (2020). Updated SCAA Base Case Assessment for Greenland Halibut. . *NAFO SCR Doc*, *20/30*. **https://www.nafo.int/Portals/0/PDFs/sc/2020/scr20-030REV.pdf**

Tables

Table 1. Survey indices available for use in the HCR.

	Canada Fall 2J3K	Canada Fall 3LNO	Canada Spring 3LNO	EU-Spain 3NO	EU 3M 0-1400m
2011	26.736	2.206	1.046	7.093	26.152
2012	23.504	1.712	1.941	7.373	19.198
2013	29.645	2.589	0.730	5.463	19.110
2014	33.336		0.664	6.239	23.921
2015	22.290	0.869		9.486	47.517
2016	18.541	1.314	0.658	8.796	28.298
2017	15.104	1.246		16.627	42.665
2018	17.054	1.887	1.884	7.875	29.803
2019	16.285	1.872	1.446	8.824	16.887
2020	15.840	2.714			13.230
2021	21.153			8.090	16.310

Table 2. Effect of excluding the Canadian spring survey of NAFO Divisions 3LNO ("Excluding Canadian Spring 3LNO") and/or missing the terminal index from the Canadian fall survey of 3LNO ("Partial Canadian Fall 3LNO") on the calculation of the TAC using the Greenland halibut HCR. Percentage differences are indicated in parentheses.

TAC Year	Baseline	Excluding Canadian Spring 3LNO	Partial Canadian Fall 3LNO	Excluding Spring and partial Fall
2019	16 434	16 486 (0.3%)	16 079 (-2.2%)	16 108 (-2%)
2020	16 867	16 733 (-0.8%)	16 754 (-0.7%)	16 612 (-1.5%)
2021	16 498	16 094 (-2.5%)	16 618 (0.7%)	16 222 (-1.7%)
2022	15 864	15 456 (-2.6%)	15 688 (-1.1%)	15 269 (-3.8%)

Table 3. Effect of alternate assumed values for the missing Canadian fall 2021 survey of NAFO divisions 3LNO on the calculation of the TAC for 2023 using the Greenland halibut HCR. The scenarios use the 2020 index (2.71) and the largest inter-annual decline (1.29) or increase (1.22). All scenarios exclude the Canadian spring survey of 3LNO from the HCR.

Scenario	TAC	Percent difference
Missing terminal value	15 156	
2021 index = 2020 index	15 030	-0.8%
2021 index = 2020 index - largest decline	14 503	-4.4%
2021 index = 2020 index + largest increase	15 359	1.3%

Figures

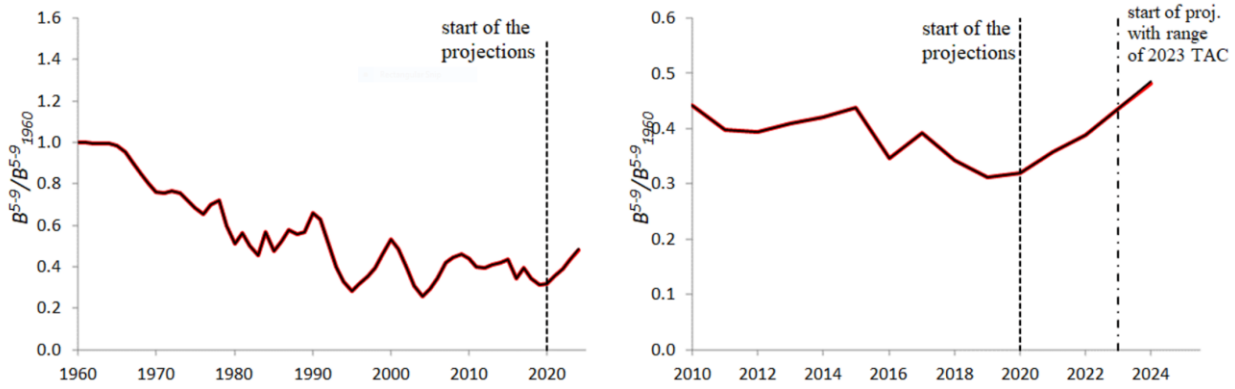

Figure 1. Trajectories of estimated exploitable biomass (relative to the 1960 level) for the 2020 SCAA Base Case update, and projected forward from 2020 under the actual catch data for 2020 and 2021, the TAC for 2022 and the minimum and maximum possible TACs in **Table 3** for 2023. The two trajectories therefore differ only from 2023 to 2024, but are virtually indistinguishable.

Colophon

This version of the document was generated on 2022-06-03 16:34:55 using the R markdown template for SCR documents from **NAFOdown**.

The computational environment that was used to generate this version is as follows:

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