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On the threshold of a XSA 2017 assessment of Greenland halibut on Div. 2J and Div. 3KLMNO: considerations on input framework and settings for an alternate approach to the 2010 assessment

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Introduction

Following the December 2016-January 2017 works on the consistency of (and between) Canadian and EU surveys on NAFO Div. 2J and Div. 3KLMNO, on the discrepancies found on ageing by otoliths between Canadian and Spanish readers along with uncertainty on ageing individuals older than age 9 (Joanne Morgan and Karen Dwyer (DFO, Canada), Fernando Gonzalez and Diana Gonzalez (IEO, Spain) *pers. comm.*) and the discussions held at a couple of WebEx conferences by the NAFO Scientific Council in preparation of the Greenland halibut MSE meeting (Vigo, 3-7 April 2017), several questions were raised related to the most appropriate array of input data and settings to be the base line of the candidate assessments, from which the operative models should be derived for this stock.

Such questions are here addressed in the scope of a candidate XSA assessment running with a broader set of survey series and at the same time delivering more consistent results, under all uncertainties and gaps conditioning any Greenland halibut assessment.

So the considerations bellow is the personal view of the author on several framework options, focused on the possibility to incorporate XSA based operative models on the ongoing MSE process, or even to perform an XSA assessment if short term advice is required by the Fisheries Commission (in the case that MSE is not concluded by September 2017). Therefore they may not necessarily match with the final base lines and selected assessment/operative models that will carry out the following Greenland halibut Management Strategy Evaluation.

Surveys

Should the Spanish 3NO and 3L surveys and the Canadian fall 3LNO 0-730m survey be included? And ages 1-5 on the EU 3M 1400m survey?

Since the beginning of a Greenland halibut fishery in the NRA by the end of the 1980's a major portion of commercial catch has been taken by otter trawl fleets on the northern slopes of Div. 3L and Flemish Pass (Div. 3L, 3M and Div. 3N) at depths >700m.

However, these bottoms are not swept by Canadian surveys since the fall of 2009 (Di. 3N) and 2010 (Div. 3L). On top of that, between 1996 and 2009-2010 the coverage of deeper strata has been occasional on Div. 3N and missing on 2004-2005 and 2008 on Div. 3L. With the exception of the fall survey on Div. 2J and 3K no other Canadian survey candidate to this assessment goes beyond the 730m depth contour from 2011 onwards.

That is why the ongoing EU 3M 1400m survey, and the spring and summer Spanish EU surveys on the NRA of Div. 3NO and Div. 3L, all of them down to 1400m depth contour, should be included in the present assessment work, regardless the quality of their internal consistency and relation with other surveys. The model (XSA at least) will deal by its own with different survivors at age estimates from more robust or more noisy surveys. After defining the input settings, a first exploratory assessment should run incorporating these surveys and, unless an obvious difficulty is found in the convergence process, all surveys should stay. Otherwise the "useless" survey (most likely the Spanish EU summer 3L survey, taking into account its poor internal consistency within several sequential ages and poor correlation with other surveys based on relative year class strength) should be removed in order to preserve an assessment run with a relatively short number of iterations to convergence.

Nevertheless there are three issues related with these surveys that still need to be addressed:

1. *How to deal with the two 3M series?* Taking into account recent results on internal consistency (*log* age correlated with *log* age before within the each cohort in each series) and year class strength/age correlation to others surveys, it seems that a 0-700m 1995-2015 survey for ages 1-5 (0-700m 3M survey) and a 700-1400m 2004-2015 survey for ages 6 and older (1400 3M survey) could be an appropriate option, avoiding opposite trends that have already shown up on several cohorts when the 0-700m strata are considered in both 3M survey series.
2. *When the Spanish spring 3NO survey should start, 1995, 1997 or 2003?* Due to changes on surveys catchability, reflected on more severe retrospective patterns, 1978-1995 Canadian surveys were excluded from the input survey data sets since the 2003 assessment. In 1995 EU-Spain started a new stratified-random bottom trawl spring (May-June) survey on NAFO Regulatory Area of Div. 3NO down to 730m depth contour and from 1997 onwards the Spanish survey was extended to 1464 m (with the exception of 2001, with an 1116m depth limit). From 1995 till 2000 the survey was carried out by the Spanish stern trawler *C/V Playa de Menduiña* using a *Pedreira* bottom trawl net. In 2001 the *R/V Vizconde de Eza*,with a *Campelen 1800* bottom trawl net, replaced the commercial stern trawler. Earlier survey indices from C/V *Playa de Menduíña* have been transformed to R/V *Vizconde de Eza* units. To be consistent with the Canadian single gear option the input Spanish spring 3NO survey series should have only true Campelen data and start in 2001. However the Spanish EU 3NO 1995-2015 survey shown a good internal and external consistency. And moreover it seems that this good consistency is positively related with the length of the survey time series. So

far there is no basis to suspect that shortening this series would stronger the assessment and therefore the assessment should include the full deeper series (1997-2016).

3. *And the Spanish EU summer survey on Div. 3L, 2003 or 2006?* This survey was initiated in 2003, already with the *"Vizconde de Eza"* and the entire series has used the same *Campelen 1800* gear. But it was only in 2006 that for the first time an adequate prospecting survey was conducted in Division 3L with over 100 valid hauls. So Spanish EU summer survey on Div. 3L should start at 2006.

Finally the Canadian fall 3LNO 0-730m survey, and again based on recent survey consistency analysis, has shown in general good internal consistency (though no ages older than 9 are available in this survey) and good year class strength correlation with other surveys. On top it is a long time series so should also be included in the new input framework.

Ageing criteria and ALK's –surveys match

For the time being no option but to accept a double ageing criteria for survey ALK's. Each survey should have its own annual ALK's based on an unique ageing criteria regardless the survey flag, but the wider length spectrum found on the Grand Bank Spanish surveys (and EU Flemish Cap as well) prevent any possible combination of Canadian survey ALK's with Spanish/EU abundance@length indices. So each survey is abided to its own ageing criteria.

As for the commercial catch at age, the Canadian annual trawl - gillnet ALK's will continue to be used over the catch@length of each fleet.

Age spectrum

The assessment should start at age 3: ages 1 and 2 have a very low consistency between surveys and don't show up in the commercial catch. In terms of assessment they depend straight on abundance at age indices from surveys and (assumed) natural mortality. Both have great associated uncertainty so their final estimates are also weak, as shown on retrospective recruitment. Evaluation from age 3 onwards would ignore this unavoidable uncertainty and should be harmless on the perception of total biomass or recommendations.

The previously adopted last true age at age 13 with a 14+ group should be kept despite the variable bias associated with ageing above age 9 (new reading of otoliths previously aged 9 or plus systematically end up with an assigned age older than the first one (Dwyer, K *pers. comm.*)). As long as the ageing process is kept constant, this is a handicap less harmful to the perception of the stock by the assessment results than the apparent removing of this source of error by compressing even further the abundance and biomass of older individuals within a larger black hole. Furthermore at times when analysis of surveys internal consistency indicate an increasing presence of older ages (Morgan, J *pers. comm.*) the actual under ageing – under representation of the adult component should not be aggravated by a plus group starting at a younger age.

Smaller number of true ages will downgrade the XSA performance (namely inflating the tuning iteration process) which, among other constraints, is conditioned by the number of estimates of the survivor last age group by the end of the terminal year from each of the previous ages within each cohort. And on the other hand, if ageing uncertainty increase on older ages one can always increase the CV's of the survivor estimates from the older age groups, weakening their contribution to the final survivor mean of each cohort.

Shortening the true age interval will also have a negative impact in the assessment, underestimating stock biomass and spawning stock biomass. And if F and SSB reference points are derived from an YPR analysis, fuelled with some average recruitment from the assessment but extending the number of true ages up to an older plus group, then most likely B reference point will be overestimated in relation with the current B from the assessment and F reference point underestimated in relation with the current F.

For the reasons above the 1-9 interval and 10plus group option should not be adopted without a prior comparison with the 3-13 interval and 14plus group based assessment. Among other diagnostics this comparison should be focused in the results of retrospective analysis for a medium term window (five years?). If assessment doesn't get worse when starting at an older pre recruited age and ending at an older plus group then the 3 to 13 true age interval with a 14+ age group should be more appropriate.

In either case one should stick to the same true age interval and plus group on both assessment and YPR analysis.

Natural mortality

A sensitivity analysis for a range o M's between 0.1 - 0.2 should be carried out similar to the analysis carried out prior to each 3M beaked redfish assessment since 2011(Ávila de Melo *et al.* 2015). M of =0.112, estimated for Greenland halibut from the northeastern Pacific Ocean (Cooper *et al.*, 2007), should be considered and adopted if within the range providing the better diagnostics.

For a predefined time window covering the more recent years (2006-2016?) select an M candidate that will minimize the $SS\log q_{age}$ residuals and maximize correlation between exploitable survey abundance (given by the "best" input survey, most likely Canadian fall 2J3K) and XSA abundance.

Framework

When comparing with the 2010 assessment framework the accepted 2017 formulation should have a first run free of any softeners. For the 3-13 true age and 14plus group scenario that would mean:

- Catchability independent of age for ages >= 10 (penultimate true age, mandatory): with the exception of the F2J3K series survey catchabilities at age present trends and remain unsettled until last true age. However, taking into account the higher uncertainty associated with ages older than 9, catchability should be assumed as a constant over last true ages.

- No shrinkage of terminal year survivors at age with mean F's at age for the last three years: they should depend on terminal year F's at age.

- No shrinkage of oldest age survivor estimates for the years 1975 to 2015: mean F of ages 10 - 12 presents a declining trend on several cohorts namely on recent years.

- Minimum standard error of final cohort estimates from each cohort age older than 9 = 0.50: prevent overweight of estimates from higher uncertain age groups.

References

Ávila de Melo, A., Dominguez-Petit R., Casas, M., González Troncoso D., González-Costas ,F., Fromin, K., Brites, N., Alpoim, R. and F. Saborido-Rey (2015) - An Assessment of Beaked Redfish (*S. mentella and S. fasciatus*) in NAFO Division 3M (*at times when natural mortality is driven stock dynamics and fishing mortality reference points are useless to scientific advice)*. NAFO SCR Doc. 15/028, Ser. No. N6452, 54pp.

Cooper, D. W., Maslenikov, K. p. and D. R. Gunderson (2007) – Natural mortality rate, annual fecundity, and maturity at length for Greenland halibut (*Reinhardtius hippoglossoides*) from northeastern Pacific Ocean. Fish. Bull. 105: 296-304 (2007).

Healey, B. P. e Mahé, J.C. (2010) – An Assessment of Greenland Halibut (Reinhardtius hippoglossoides) in NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR Doc. 10/40, Ser. No. N5799, 108pp.