

SC/68A/IST/01

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# Results of Carryover Analyses for West Greenland fin, minke and bowhead whales

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INTERNATIONAL  
WHALING COMMISSION

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## ABSTRACT

Projection results to evaluate carryover provisions for West Greenland fin, minke and bowhead whales are provided for the five carryover scenarios previously evaluated for the Bering-Chukchi-Beaufort Seas bowhead whales and humpback whales off West Greenland

## INTRODUCTION AND METHODS

The Scientific Committee of the International Whaling Committee has been discussing the scientific aspects of carryover provisions. At its March 2018, meeting, the AWMP Working Group received a joint request from the US Acting Commissioner and the Danish Commissioner for assessment by the Scientific Committee of the conservation performance and other scientific issues associated with a specific carryover scheme. The request related to a period of accumulation (three blocks), a time until expiration (greater than three blocks), and a limit on usage (total strikes not exceeding 150% of the annual strike limit). During the March 2018 AWMP Workshop, Witting reported that Greenland was interested in having an evaluation that relates not only to the sustainability of non-accumulating and accumulating carryover systems, but also to the potential differences in the levels of sustainability of the different systems.

The March 2018 Workshop developed an approach using the simulation testing framework to compare alternative carryover schemes and applied it to the Bering-Chukchi-Beaufort Seas bowhead whales and humpback whales off West Greenland. The comparison was based on five cases in addition to “no carryover”:

- The “frontloaded” scheme assumes that strikes are taken as quickly as possible within a block, subject to the 150% limit. It serves as a bounding case for evaluating a non-accumulating scheme such as Greenland’s.
- The scheme “1@67%, 1@≤150%” alternates between carryover accumulation and usage blocks: first only 67% of the strike limit is taken, then up to 150% of the strike limit is used.
- The scheme “1@80%, 1@≤150%” resembles the previous, but it assumes that 80% of the strike limit is taken in the accumulation block.
- The scheme “3@67%, 2@≤150%” refers to a scheme with three accumulation blocks (with 67% strike limit usage) followed by two carryover usage blocks (using up to 150% of the baseline strike limit).
- The “3@80%, 2@≤150%” scheme resembles the previous one, but 80% of the strike limit is taken during the accumulation blocks.

Based on the analyses conducted, the Workshop agreed that the results showed that the conservation and recovery performances of the carryover schemes were virtually identical of that for the *Bowhead SLA* and *Humpback SLAs* without carryover. It also agreed that the carryover provision described in the US/Denmark request yields acceptable conservation and recovery performance with no greater risk than the *SLAs* themselves, and that the non-accumulating Greenland carryover scheme also yields acceptable performance.

The Scientific Committee recommended that trials to evaluate carryover provisions would need to be conducted for the remaining Greenland hunts (West Greenland common minke whales, bowhead whales and fin whales). This document provides the results of the requested analyses.

## RESULTS

Tables 1, 2 and 3 summarize the results of the projections requested for fin whales (Table 1), common minke whales (Table 2) and bowhead whales (Table 3) off West Greenland. The trials for which results are reported are base-case

trials that provide amongst the most severe challenges to the *SLAs* (e.g. 1% *MSY* rates) and the reported results should therefore not be considered to be representative of those of the full set of *Evaluation Trials*. The results should be interpreted in the context that the Scientific Committee has already agreed that the conservation performance of the “frontloaded” option is satisfactory (IWC, 2018). The results for West Greenland minke whales are based on need scenario A (a need of 164 over the 100-year projection period) as this was the basis for the accepted *SLA*.

#### **REFERENCES**

International Whaling Commission. 2018. Report of the Scientific Committee. *J. Cetacean Res. Manage.* 19 (Suppl.): 1-101.

Table 1: Simulation results comparing carryover schemes for West Greenland fin whales. The cases are no carryover, within-block frontloading, two cases with accumulation from one prior block, and two cases with accumulation from three prior blocks. The statistics, pertaining to the age 1+ population, are D1 (final depletion), and D10 (relative increase). For each statistic, the 5<sup>th</sup> percentile (.05) and median (.50) are given. These results are shown for four *Evaluation Trials*.

<b>Trial</b>	<b>Scheme</b>	<b>D1<sub>1+</sub> (0.05)</b>	<b>D1<sub>1+</sub> (0.5)</b>	<b>D10<sub>1+</sub> (0.05)</b>	<b>D10<sub>1+</sub> (0.5)</b>
GF01-1A	No carryover	0.288	0.620	1.26	3.03
	Frontloaded	0.287	0.619	1.26	3.02
	1@67%, 1@≤150%	0.288	0.619	1.26	3.03
	1@80%, 1@≤150%	0.288	0.619	1.26	3.03
	3@67%, 2@≤150%	0.288	0.620	1.26	3.02
	3@80%, 2@≤150%	0.288	0.620	1.26	3.02
GF01-1B	No carryover	0.277	0.604	1.23	2.95
	Frontloaded	0.276	0.604	1.23	2.95
	1@67%, 1@≤150%	0.278	0.604	1.24	2.95
	1@80%, 1@≤150%	0.277	0.603	1.24	2.95
	3@67%, 2@≤150%	0.277	0.604	1.24	2.95
	3@80%, 2@≤150%	0.277	0.604	1.24	2.95
GF34-1A	No carryover	0.404	0.709	0.93	1.67
	Frontloaded	0.396	0.709	0.92	1.66
	1@67%, 1@≤150%	0.402	0.712	0.92	1.67
	1@80%, 1@≤150%	0.398	0.708	0.92	1.66
	3@67%, 2@≤150%	0.403	0.707	0.93	1.67
	3@80%, 2@≤150%	0.401	0.709	0.93	1.67
GF34-1B	No carryover	0.310	0.599	0.8	1.43
	Frontloaded	0.306	0.601	0.81	1.44
	1@67%, 1@≤150%	0.316	0.614	0.81	1.46
	1@80%, 1@≤150%	0.304	0.606	0.81	1.44
	3@67%, 2@≤150%	0.316	0.607	0.80	1.45
	3@80%, 2@≤150%	0.308	0.603	0.81	1.45

Table 2: Simulation results comparing carryover schemes for West Greenland minke whales. The cases are no carryover, within-block frontloading, two cases with accumulation from one prior block, and two cases with accumulation from three prior blocks. The statistics, pertaining to the age 1+ population, are D1 (final depletion), and D10 (relative increase). For each statistic, the 5<sup>th</sup> percentile (.05) and median (.50) are given. These results are shown for four *Evaluation Trials*.

<b>Trial</b>	<b>Scheme</b>	<b>D1<sub>1+</sub> (0.05)</b>	<b>D1<sub>1+</sub> (0.5)</b>	<b>D10<sub>1+</sub> (0.05)</b>	<b>D10<sub>1+</sub> (0.5)</b>
M01-1A	No carryover	0.574	0.690	0.860	0.956
	Frontloaded	0.581	0.695	0.865	0.960
	1@67%, 1@≤150%	0.605	0.714	0.911	0.991
	1@80%, 1@≤150%	0.595	0.705	0.887	0.979
	3@67%, 2@≤150%	0.588	0.699	0.875	0.967
	3@80%, 2@≤150%	0.583	0.697	0.868	0.962
M02-1A	No carryover	0.729	0.834	0.970	1.011
	Frontloaded	0.732	0.837	0.978	1.017
	1@67%, 1@≤150%	0.750	0.848	1.001	1.032
	1@80%, 1@≤150%	0.743	0.843	0.994	1.026
	3@67%, 2@≤150%	0.735	0.838	0.985	1.017
	3@80%, 2@≤150%	0.730	0.836	0.982	1.016
M04-1A	No carryover	0.448	0.589	0.733	0.893
	Frontloaded	0.453	0.595	0.741	0.900
	1@67%, 1@≤150%	0.489	0.626	0.800	0.942
	1@80%, 1@≤150%	0.472	0.608	0.772	0.927
	3@67%, 2@≤150%	0.458	0.607	0.749	0.919
	3@80%, 2@≤150%	0.453	0.601	0.740	0.907
M08-1A	No carryover	0.693	0.823	0.961	1.006
	Frontloaded	0.701	0.824	0.964	1.011
	1@67%, 1@≤150%	0.716	0.837	0.994	1.032
	1@80%, 1@≤150%	0.715	0.831	0.986	1.021
	3@67%, 2@≤150%	0.706	0.826	0.968	1.012
	3@80%, 2@≤150%	0.704	0.824	0.966	1.010

Table 3: Simulation results comparing carryover schemes for West Greenland bowhead whales. The cases are no carryover, within-block frontloading, two cases with accumulation from one prior block, and two cases with accumulation from three prior blocks. The statistics, pertaining to the age 1+ population, are D1 (final depletion), and D10 (relative increase). For each statistic, the 5<sup>th</sup> percentile (.05) and median (.50) are given. These results are shown for eight *Evaluation Trials*.

<b>Trial</b>	<b>Scheme</b>	<b>D1<sub>1+</sub> (0.05)</b>	<b>D1<sub>1+</sub> (0.5)</b>	<b>D10<sub>1+</sub> (0.05)</b>	<b>D10<sub>1+</sub> (0.5)</b>
B01AA	No carryover	0.619	0.895	3.28	12.59
	Frontloaded	0.615	0.894	3.28	12.57
	1@67%, 1@≤150%	0.616	0.894	3.28	12.59
	1@80%, 1@≤150%	0.615	0.894	3.28	12.58
	3@67%, 2@≤150%	0.615	0.894	3.28	12.57
	3@80%, 2@≤150%	0.615	0.894	3.28	12.57
B02AA	No carryover	0.636	0.897	3.28	12.66
	Frontloaded	0.632	0.896	3.28	12.65
	1@67%, 1@≤150%	0.630	0.896	3.28	12.63
	1@80%, 1@≤150%	0.631	0.896	3.28	12.64
	3@67%, 2@≤150%	0.632	0.896	3.28	12.65
	3@80%, 2@≤150%	0.632	0.896	3.28	12.65
B03AA	No carryover	0.613	0.894	3.28	12.59
	Frontloaded	0.610	0.894	3.28	12.57
	1@67%, 1@≤150%	0.616	0.891	3.28	12.56
	1@80%, 1@≤150%	0.617	0.891	3.28	12.56
	3@67%, 2@≤150%	0.610	0.894	3.28	12.57
	3@80%, 2@≤150%	0.610	0.894	3.28	12.57
B04AA	No carryover	0.871	0.965	2.22	7.52
	Frontloaded	0.871	0.966	2.22	7.52
	1@67%, 1@≤150%	0.871	0.966	2.22	7.52
	1@80%, 1@≤150%	0.870	0.966	2.22	7.52
	3@67%, 2@≤150%	0.871	0.966	2.22	7.52
	3@80%, 2@≤150%	0.871	0.966	2.22	7.52

<b>Trial</b>	<b>Scheme</b>	<b>D1<sub>1+</sub> (0.05)</b>	<b>D1<sub>1+</sub> (0.5)</b>	<b>D10<sub>1+</sub> (0.05)</b>	<b>D10<sub>1+</sub> (0.5)</b>
B05AA	No carryover	0.801	1.020	3.52	14.22
	Frontloaded	0.797	1.020	3.52	14.22
	1@67%, 1@≤150%	0.799	1.020	3.52	14.22
	1@80%, 1@≤150%	0.797	1.020	3.52	14.22
	3@67%, 2@≤150%	0.797	1.020	3.52	14.22
	3@80%, 2@≤150%	0.797	1.020	3.52	14.22
B06AA	No carryover	0.650	0.889	3.09	12.40
	Frontloaded	0.649	0.889	3.09	12.40
	1@67%, 1@≤150%	0.647	0.888	3.09	12.40
	1@80%, 1@≤150%	0.649	0.889	3.09	12.39
	3@67%, 2@≤150%	0.649	0.889	3.09	12.40
	3@80%, 2@≤150%	0.649	0.889	3.09	12.40
B07AA	No carryover	0.642	0.898	3.26	12.68
	Frontloaded	0.639	0.898	3.27	12.67
	1@67%, 1@≤150%	0.639	0.898	3.26	12.66
	1@80%, 1@≤150%	0.639	0.897	3.27	12.66
	3@67%, 2@≤150%	0.639	0.898	3.27	12.67
	3@80%, 2@≤150%	0.639	0.898	3.27	12.67
B08AA	No carryover	0.691	0.917	3.31	12.91
	Frontloaded	0.689	0.917	3.31	12.90
	1@67%, 1@≤150%	0.689	0.916	3.31	12.90
	1@80%, 1@≤150%	0.690	0.916	3.31	12.90
	3@67%, 2@≤150%	0.689	0.917	3.31	12.90
	3@80%, 2@≤150%	0.689	0.917	3.31	12.90