Annex E

Report of the Standing Working Group on the Aboriginal Whaling Management Procedure (AWMP)

Members: Donovan (Convenor), Allison, DeMaster, Brandão, Brierley, Butterworth, de Moor, DeMaster, Double, Feindt-Herr, George, Givens, Gunnlaugsson, Holm, Iñíguez, Ketele, Lang, Litovka, Lundquist, Manley, Mduduzi Seakamela, Mikhno, Monnahan, Moronuki, Muraki, Paniego, Prewitt, Punt, Rendell, Rodriguez-Fonseca, Roel, Ryan, Santos, Scordino, Sironi, Sitar, Suydam, Thuok, Walløe, Witting, Yoshida, Zeh, Zharikov.

1. INTRODUCTORY ITEMS

1.1 Convenor's opening remarks

As Convenor, Donovan welcomed the participants. He noted that the primary aims of the Standing Working Group (SWG) this year were to continue the development of *Strike Limit Algorithms* (*SLA*s) for the Greenlandic hunt and to provide management advice for the aboriginal hunts. He also noted that the SWG would continue to discuss aspects of the Aboriginal Whaling Scheme following discussions at the intersessional Workshop.

1.2 Election of Chair

Donovan was elected Chair.

1.3 Appointment of rapporteurs

Allison, Butterworth, Givens and Punt acted as rapporteurs with assistance from the Chair.

1.4 Adoption of agenda

The adopted Agenda is shown in Appendix 1.

1.5 Documents available

The primary documents considered by the sub-committee were SC/66a/AWMP01-04 and SC/66a/Rep03. After initial consideration, SC/66a/AWMP02 was referred to the Working Group on Stock Definition and is discussed there (see Annex I, item 3.2.1).

2. DEVELOPMENT OF A *SLA* FOR THE GREENLANDIC BOWHEAD WHALE HUNT

2.1 Report of the intersessional Workshop

Donovan summarised the work undertaken at the February 2015 AWMP Intersessional Workshop on Developing *SLA*s for the Greenlandic hunt (SC/66a/Rep03, item 2). The objective with respect to bowhead whales was to follow up on the progress made at the 2014 Annual Meeting (IWC, 2015e), to review the performance statistics and plots for revised candidate *SLA*s for the Greenland bowhead whale hunt and to progress work to ensure that an *SLA* can be recommended to the Committee at its 2015 Annual Meeting. As for previous *SLA* selections, this process involved examining the results for the broad range of trials, determining which *SLA*s achieved acceptable conservation performance (the primary objective agreed by the Commission) and then identifying from those the *SLA*s that achieve the best need satisfaction within the set of such *SLA*s.

The Workshop received the results from two developing teams (Witting; Brandão and Butterworth) for several candidate *SLA*s. Based upon the different properties of these *SLA*s and their performance, the Workshop developed three new 'combined' *SLA*s that performed better than the individual components. Two of the candidates (*SLA-Trans* and *SLA-Av*) met the Commission's conservation objectives and one of these (*SLA-Trans*) slightly outperformed the other with respect to need satisfaction. Based upon these results[1], the Workshop recommended that *SLA* to the Scientific Committee as '*WG-SLA'*.

2.2 New information

The SWG thanked the Workshop for the excellent progress made and its recommendation. However, Donovan noted that new information received after the Workshop about an increase in the quota for Canada (a non-member nation) in 2015 to seven (Appendix 2) warranted further consideration by the SWG. The trials conducted at the Workshop to evaluate *SLA*s considered three scenarios regarding future Canadian catches (five constant over 100 years; two to eight over 100 years; two constant over 100 years). The SWG also noted that the catch off Canada during 2014 was two whales, against a quota of five (SC/66a/BRG08). The SWG was pleased to note that in recent years, Canada provides information associated with the catch, strikes and quota.

2.3 Implications of the new information

Of course, any *SLA* recommended by the Committee must be robust to reasonable assumptions made regarding future Canadian catches, recognising that as Canada is a non-member nation the IWC does not influence its quota setting. In considering the Canadian catches when developing the original scenarios, IWC (2015b) selected the initial value of two for two of the catch scenarios (B and D in SC/66a/Rep03) to be equivalent to the then current annual take of three bowheads in Canada. This was done because it was agreed to be unrealistic to include all Canadian catches in the catch series whilst using only the abundance estimates for the West Greenland component of the stock. The rationale for this was that:

(1) the abundance estimate from the Prince Regent area of Canada in 2002 (a best estimate of over 6,300) is appreciably larger than for West Greenland;
(2) whilst telemetry data have shown that some whales tagged off West Greenland do move to the east and west of Baffin Island (Heide-Jørgensen *et al.*, 2003; Heide-Jørgensen, pers. comm.), none of the whales tagged in Canada (from settlements where whaling occurs) in summer have subsequently been seen in West Greenland in spring (Ferguson *et al.*, 2010); and
(3) the sex ratio in the Canadian catches has been close to equal whereas the percentage of females off West Greenland is 80%.

[1]The full set of results are available from the Secretariat.

Thus whilst the larger catch limit for Canada for 2015 of seven could lead to catches/strikes in excess of those in recent years, there is uncertainty concerning the relationship of those catches to the abundance estimate off West Greenland alone. The SWG evaluated two options for addressing this uncertainty:

(1) adding a catch scenario in which the Canadian catch is seven annually and ensuring that the recommended *SLA* provides adequate conservation performance for this scenario whilst continuing to base this information on the conservative assumption that the abundance estimate for West Greenland alone is appropriate; or
(2) continuing to monitor the situation further and conducting an *Implementation Review* if future Canadian catches exceed five annually for a specified period.

The SWG noted that should a major *Implementation Review* be deemed necessary in the future under (2) above, then the simplified approach agreed up until now (i.e. assume that the West Greenland abundance estimate was applicable to the entire eastern Arctic) would no longer be applicable and a new simulation framework accounting for the full eastern Arctic would be required. As noted in IWC (2015b), this will be a major exercise given that as Canada is a non-member nation, determining plausible assumptions about the availability of abundance estimates as well as catches is problematic. Under scenario (1) it is clear from the existing results (SC/66a/Rep03) that this new framework would also be required to be developed in order to meet the need objectives for the Greenlandic hunt if the Canadian catch was seven or more into the future. This is discussed further below.

The SWG evaluated the conservation implications of the second of the options by conducting trials in which the proposed *WG-Bowhead SLA* is used to provide strike limits and the Canadian catch is seven annually. It agreed that assuming that all seven animals for the Canadian catch were taken from the animals represented by the West Greenland estimate was a worst-case scenario for the reasons provided above; following the already agreed logic that a Canadian catch of three should be considered two with respect to the West Greenland abundance estimate, a quota of seven would be reduced to just under five. In Table 1, the results of these trials with a constant annual Canadian catch of seven are compared to those in which the annual Canadian catch is five by using the standard performance statistics as well as the distribution for the ratio of the population size when the Canadian catch is seven and when it is five for periods of six, 12 and 18 years.

Given the results above, the SWG agreed that option (2) was appropriate. It noted that it under this worst case scenario, there was negligible conservation risk in using the proposed *WG-Bowhead SLA* for a period of 12 years (e.g. for the 2.5% MSYR trials, the lower 5th percentile of the 1+ population for constant catch 7 was never less than around 94% of the value for constant catch 5) or 18 years (the equivalent percentage was around 92%). The SWG also noted that *Implementation Reviews* will occur every six years. If the *WG-Bowhead SLA* is adopted by the Committee this year and by the Commission at its 2016 Annual Meeting, then an *Implementation Review* would take place in 2021. By this time there will have been: (a) six more years of Canadian catch data; (b) further information on any Canadian abundance surveys; and (c) potentially further information on stock structure and movements. It also noted that the West Greenland hunt had not taken bowhead whales since 2011. The SWG **recommends** that as part of the 2021 *Implementation Review*, the Committee should consider whether it appears likely that a new framework would need to be developed. If so, then work should be initiated to do that recognising that it will be a complex task and may take several years. If not, then a similar instruction should be provided for the 2027 *Implementation Review.* The SWG also noted that the Committee undertakes an annual review of management advice each year and has the ability to call for an early *Implementation Review* should it so wish.

2.4 Conclusions and recommendations

The SWG **recommends** the *WG-Bowhead SLA* developed in SC/66a/Rep03 to the Committee as the best approach to providing management advice for the Greenland hunt. It also **recommends** that information on Canadian catches be an important component of the 2021 *Implementation Review.* The SWG thanked the developers for their hard work during the process.

3. DEVELOPMENT OF A *SLA* FOR THE GREENLANDIC FIN WHALE HUNT

3.1 Report of the intersessional Workshop (SC/66a/Rep03)

With respect to work on an *SLA* for the Greenland fin whale hunt, the Workshop agreed that from a conservation perspective, it was acceptable to try to develop an *SLA* for this hunt assuming that the animals off West Greenland comprised a single population represented by the abundance estimates from that area. This was based upon a careful review of the available stock structure and other information discussed during the development of trials for the RMP *Implementation Review* for fin whales (SC/66a/Rep03, item 3.1). This was recognised to be a conservative assumption, as the alternative that these whales belonged to a larger more widely distributed stock would mean that strikes off West Greenland would have a lesser impact on the abundance of that stock. In doing so, the Workshop recognised that this may make achieving need satisfaction more difficult. This decision will be reviewed in light of initial results of candidate *SLA*s at the 2015 Scientific Committee meeting based on an agreed initial set of *Evaluation Trials* (see Table 2). Details of the trial structure agreed, including biological parameters, abundance estimates, need and all trials can be found in SC/66a/Rep03, item 3.2.

3.2 Intersessional progress

The SWG noted that the program to implement the *Evaluation Trials* agreed at the Workshop had been coded by Punt and thanked him for his usual excellent and tireless work. As agreed, all these trials assumed that fin whales taken off West Greenland belonged to a single independent stock. With these trials as a basis, two sets of developers had initiated development of candidate *SLA*s.

3.3 Initial exploratory *SLA*s

Brandão introduced SC/66a/AWMP04 which investigated six possible *SLA*s which were run for the evaluation trials developed at the AWMP Intersessional Workshop. Candidate *SLA*s were presented ranging in performance from complete satisfaction of the conservation performance criterion for all evaluation trials, to alternatives that sacrificed performance on this count for improved need satisfaction. Need was better satisfied over the first 20 years than over 100 years for these *SLA*s in these trials.

Table 1

Percentage ratio of the 1+ population size of the *SLA* with a constant Canadian catch of seven years and that of a constant five year catch after 6, 12 and 18 years. Trials are summarised here. Apart from Trial B01C where MYSL=0.80, MSYL=0.60. Survey frequency is 10 years except for Trials B02 where it is five years and Trials B03 where it is 15 years.

		6 years	12 years	18 years
B01A: $MSYR_{1+}$=2.5%; survey frequency 10 years	5%	97.0	94.2	91.8
	Median	98.9	98.0	97.2
	95%	99.4	98.9	98.5
B01B: $MSYR_{1+}$=1%; survey frequency 10 years	5%	96.4	92.1	86.8
	Median	98.7	97.4	96.1
	95%	99.3	98.5	97.8
B01C: $MSYR_{1+}$=4%; survey frequency 10 years	5%	97.4	94.5	91.7
	Median	98.7	97.5	96.2
	95%	99.3	98.5	97.7
B02A: $MSYR_{1+}$=2.5%; survey frequency 15 years	5%	97.0	94.9	92.5
	Median	98.9	98.0	97.4
	95%	99.4	98.9	98.6
B02B: $MSYR_{1+}$=1%	5%	96.4	92.5	88.6
	Median	98.7	97.4	96.2
	95%	99.3	98.5	97.8
B03A: $MSYR_{1+}$=2.5%	5%	97.0	94.2	91.4
	Median	98.9	98.0	97.1
	95%	99.4	98.9	98.5
B03B: $MSYR_{1+}$=1%	5%	96.4	92.1	85.9
	Median	98.7	97.4	96.0
	95%	99.3	98.5	97.8
B04A: $MSYR_{1+}$=2.5%; survey bias=0.5	5%	98.8	98.0	97.3
	Median	99.5	99.1	98.7
	95%	99.7	99.5	99.3
B04B: $MSYR_{1+}$=1%; survey bias=0.5	5%	98.1	96.3	94.5
	Median	99.4	98.7	98.1
	95%	99.7	99.3	99.0
B05A: $MSYR_{1+}$=2.5%; 3 episodic events	5%	97.2	94.7	92.6
	Median	98.9	97.9	97.3
	95%	99.5	98.9	98.5
B05B: $MSYR_{1+}$=1%; 3 episodic events	5%	96.6	93.9	88.9
	Median	98.8	97.7	96.6
	95%	99.3	98.6	98.1
B06A: $MSYR_{1+}$=2.5%; stochastic events every 5 years	5%	97.0	94.6	91.8
	Median	98.9	98.0	97.5
	95%	99.4	98.9	98.6
B06B: $MSYR_{1+}$=1%; stochastic events every 5 years	5%	96.5	93.6	88.9
	Median	98.8	97.8	96.9
	95%	99.4	98.7	98.1
B10A: $MSYR_{1+}$=2.5%; asymmetric environmental stochasticity	5%	97.7	94.9	93.7
	Median	99.0	98.2	97.4
	95%	99.5	99.1	98.7
B10B: $MSYR_{1+}$=1%; asymmetric environmental stochasticity	5%	97.5	94.7	92.0
	Median	98.9	97.9	97.0
	95%	99.4	98.8	98.5

Table 2

The *Evaluation Trials* for fin whales. Values given in **bold** type show differences from the base trial.

Trial	Description	$MSYR_{1+}$	Need scenarios	Survey frequency	Historic survey bias	Conditioning option
1A	$MSYR_{1+}$=4%	4%	A, B, C	12	1	Y
1B	$MSYR_{1+}$=2.5%	2.5%	A, B, C	12	1	Y
1C	$MSYR_{1+}$=1%	**1%**	A, B, C	12	1	Y
1D	$MSYR_{1+}$=7%	**7%**	A, B, C	12	1	Y
2A	6 year surveys	4%	A, B	**6**	1	1A
2B	6 year surveys; $MSYR_{1+}$=2.5%	2.5%	A, B, C	**6**	1	1B
3A	18 year surveys	4%	A, B	**18**	1	1A
3B	18 year surveys; $MSYR_{1+}$=2.5%	2.5%	A, B, C	**18**	1	1B
3C	18 year surveys; $MSYR_{1+}$=1%	**1%**	A, B, C	**18**	1	1C
4A	Survey bias=0.8	4%	A, B	12	**0.8**	Y
4B	Survey bias=0.8; $MSYR_{1+}$ =2.5%	2.5%	A, B	12	**0.8**	Y
5A	Survey bias=1.2	4%	A, B	12	**1.2**	Y
5B	Survey bias=1.2; $MSYR_{1+}$=2.5%	2.5%	A, B	12	**1.2**	Y
6A	3 episodic events	4%	A, B	12	1	1A
6B	3 episodic events; $MSYR_{1+}$=2.5%	2.5%	A, B, C	12	1	1B
6C	3 episodic events; $MSYR_{1+}$=1%	**1%**	A, B, C	12	1	1C
7A	Stochastic events every five years	4%	A, B	12	1	1A
7B	Stochastic events every five years; $MSYR_{1+}$=2.5%	2.5%	A,B	12	1	1B
8A	Asymmetric environmental stochasticity	4%	A, B	12	1	1A
8B	Asymmetric env. stochasticity; $MSYR_{1+}$=2.5%	2.5%	A, B, C	12	1	1B
8C	Asymmetric env. stochasticity; $MSYR_{1+}$=1%	**1%**	A, B, C	12	1	1C

In SC/66a/AWMP03 Witting reported on four initial *SLA* variants that had been run on the *Evaluation Trials*. All were simple data procedures that take a growth rate fraction of a lower percentile of an abundance measure, covering the growth rates of 1% (*SLA* p2r1), 2% (p2r2), 3% (p2r3) and 4% (p2r4), with the last of these *SLA*s being the *SLA* that had been accepted for West Greenland humpback whales. The $MSYR_{1+}$ values for the evaluation trials are 1%, 2.5%, 4% and 7%; only the p2r1 *SLA* ensured an increasing abundance for the lower 5th percentile of the 1% trials. This procedure had an average need satisfaction of 80%, while the other procedures attained an average need satisfaction above 93%.

3.4 Final trial structure (*Evaluation Trials* and *Robustness Trials*)

Witting introduced SC/66a/AWMP01 which used Bayesian modelling to analyse the density dependent growth of fin whales across four areas in the North Atlantic, ranging from West Greenland through East Greenland and West Iceland to East Iceland/Faroese waters. In each of these areas there are only three or four abundance estimates for each of these areas, but nevertheless the point estimates for $MSYR_{1+}$ were similar across the four areas, ranging from 5.7% to 6.7%. This small range indicates that fin whales may have similar growth across the North Atlantic, and averaging across the four areas the $MSYR_{1+}$ was estimated to be 6.1% (90% CI:2.1-9.6%). This estimate was examined for robustness to uncertainty in the priors for 1+ survival, fecundity and the MSYR. The paper's conclusion was that there is an approximately 95% probability that $MSYR_{1+}$ is higher than 2% for North Atlantic fin whales.

There was considerable discussion of this paper and the rationale provided by Witting (see Appendix 3) that elaborated further the view that $MSYR_{1+}$=1% was unnecessarily conservative. As part of that discussion, it was noted that after the MSYR review was completed (IWC, 2014b, p.9), the Committee had agreed that a lower bound for $MSYR_{1+}$=1% was appropriate for trials using the RMP. There was further considerable discussion as to whether the lower bound value used for the generic RMP (and being used in the current RMP North Atlantic fin whale *Implementation Review*; IWC, 2015c) necessarily had to be used in the case specific AWMP, particularly since *inter alia* the objectives of the RMP and AWMP differed. Although not all members of the SWG shared the same rationale, it was finally agreed that:

(a) the available information for North Atlantic fin whales indicated that trials based on $MSYR_{1+}$ of 1% were of relatively low plausibility, but that the evidence to choose a specific higher value was as yet based on relatively few data;
(b) this is reflected in the *Evaluation Trial* structure in the balance of trials amongst 1%, 2.5%, 4% and 7%; and
(c) as in previous *Implementations* and *SLA* development cases (IWC, 2002, pp.151-152), when reviewing the results of trials, there will be an integrated examination of the results of all trials, not simply the most challenging, taking into account plausibility.

3.5 Conditioning

The SWG reviewed the results of the conditioning (see Appendix 4) and **agreed** that this had been achieved satisfactorily.

3.6 Conclusions

The SWG reviewed the initial results from the developers (see Appendix 5). The purpose of this review was not to choose an *SLA* but rather to review the results as a whole to determine whether it was likely that an *SLA* that met both the Commission's conservation objective and user objectives could be met under the conservative assumption that the animals off West Greenland comprised a single population represented by the abundance estimates from that area. Based upon these results, the SWG **agreed** that while further work was needed with *SLA* development, it was clear that it would be possible to develop an *SLA* that met the Commission's objectives. Provided that sufficient resources are available and an intersessional workshop is held, the SWG **agreed** that it should be in a position to recommend a fin whale *SLA* at next year's meeting.

4. DEVELOPMENT OF A *SLA* FOR THE GREENLANDIC COMMON MINKE WHALE HUNT

The complexity of the stock structure situation for common minke whales combined with the level of need mean that the simple yet conservative approach adopted for fin whales (see Item 3) cannot be applied. As noted previously (IWC, 2015b, pp.447-449), testing of candidate *SLA*s for this hunt will require examination of the RMP *Implementation* process and adaptation of the code used. That *Implementation* process had involved joint AWMP/RMP work to consider stock structure hypotheses (IWC, 2015b, pp.545-557). This work was taken further this year.

The intersessional Workshop (SC/66a/Rep03) had noted that the code developed to implement the RMP trials structure now includes the facility to base catches of common minke whales off West Greenland on the outputs of an *SLA* or alternative *SLA*s. Depending on progress with the RMP *Implementation Review* at the present meeting, it may be possible to begin preliminary testing of initial candidate *SLA*s during the proposed forthcoming intersessional workshop (see Item 8). The SWG will allocate highest priority to developing an *SLA* for this hunt in time for its recommendation to the Commission by 2018 at the latest.

5. ANNUAL REVIEW OF MANAGEMENT ADVICE[2]

The SWG noted that the Commission had reached agreement on strike limits for Greenland at the 2014 Annual Meeting (IWC, 2014d), and the SWG based its management advice on the same need requests considered last year. In providing this advice, the SWG noted that the Commission had endorsed the humpback *SLA* last year (IWC, 2014d), and the interim safe approach (based on the lower 5th percentile for the most recent estimate of abundance) for providing advice for the Greenland hunts developed by the Committee in 2008 (IWC, 2009, p.16). It was agreed that that the interim approach should be considered appropriate for two blocks, i.e. up to the 2018 Annual Meeting. The SWG **emphasised** that the results of the full simulation exercise being undertaken as part of the development process for *SLA*s for the Greenland humpback and bowhead whales reconfirmed the Committee's original advice with respect to the *Interim SLA*.

[2]Note that this section only includes the hunts for which this SWG provides annual advice; advice with respect to Bering-Chukchi-Beaufort Seas bowhead whale and eastern North Pacific gray whale hunts can be found in Annex F.

Table 3
Most recent estimates of abundance for common minke whales in the Central North Atlantic by RMP *Small Area*.

Small Area(s)	Year(s)	Abundance and CV
CM	2010	10,990 (CV=0.29)
CIC	2007	10,680 (CV=0.29)
CG	2007	1,048 (CV=0.60)
CIP	2007	1,350 (CV=0.38)

Allison reported that the IWC have recently received individual catch data for Greenland for the 2010 to 2014 seasons. Allison has been collaborating with Nette Levermann to facilitate transfer and validation of these data and the SWG expressed its thanks for the work Levermann has done in this regard.

5.1 Common minke whales off West Greenland

5.1.1 New information (including catch data)

In the 2014 season, 144 common minke whales were landed in West Greenland and two were struck and lost. Of the landed whales, there were 115 females, 27 males and two of unknown sex. Genetic samples were obtained from 118 of these minke whales in 2014, and SWG was pleased to note that samples from the West Greenland hunt are included in ongoing genetic analyses of common minke whales in the North Atlantic. The SWG **encouraged** the continued collection of samples.

5.1.2 Management advice

In 2009, the Committee was able to provide management advice for this stock for the first time. This year, using the agreed interim approach and last year's revised estimate of abundance (16,100; CV=0.43), the SWG **advised** that an annual strike limit of 164 will not harm the stock.

5.2 Common minke whales off East Greenland

5.2.1 New information (including catch data)

In the 2014 season, 11 common minke whales were landed in East Greenland, and none were struck and lost. Of the landed whales, there were nine females, one male and one of unknown sex. The SWG was pleased to note that samples were collected from eight landed whales, and that samples from the East Greenland hunt are included in ongoing genetic analyses of common minke whales in the North Atlantic. The SWG **encouraged** the continued collection of samples.

5.2.2 Management advice

Catches of minke whales off East Greenland are believed to come from the large Central stock of minke whales. The most recent strike limit of 12 represents a very small proportion of the Central stock (see Table 3). The SWG **repeats** its advice of last year that the strike limit of 12 will not harm the stock.

5.3 Fin whales off West Greenland

5.3.1 New information (including catch data)

A total of 11 fin whales (five females and six males) were landed, and one was struck and lost, off West Greenland during 2014. The SWG was pleased to note that genetic samples were obtained from nine of these, and that the genetic samples of fin whales off West Greenland are being analysed together with the genetic samples from the hunt in Iceland. It **encouraged** the continued collection of samples.

5.3.2 Management advice

Based on the agreed 2007 estimate of abundance for fin whales (4,500 95% CI 1,900-10,100), and using the agreed interim approach, the SWG **repeated** its advice that an annual strike limit of 19 whales will not harm the stock.

5.4 Humpback whales off West Greenland

5.4.1 New information (including catch data)

A total of six (two males and four females) humpback whales were landed, and one was struck and lost, in West Greenland during 2014. The SWG was pleased to learn that genetic samples were obtained from six of these whales and that Greenland was contributing fluke photographs to the North Atlantic catalogue, both from captured whales and other field studies. The SWG again **emphasised** the importance of collecting genetic samples and photographs of the flukes from these whales.

5.4.2 Management advice

Based on the *Humpback SLA* that was agreed by the Commission last year, the SWG **agreed** that an annual strike limit of 10 whales will not harm the stock.

5.5 Humpback whales off St Vincent and The Grenadines

5.5.1 New information (including catch data)

No humpback whales were landed in St Vincent and The Grenadines in 2014, but two whales were struck and lost. One male humpback whale, 35.8ft long, was caught on 4 April 2015. Skin and/or blubber samples were collected from this whale, and they will be analysed in collaboration with the USA.

The SWG **welcomed** this information from St Vincent and The Grenadines and **strongly encourages** continued tissue sampling and collection of fluke photographs where possible. Data should be shared with the appropriate databases and catalogues for the North Atlantic.

5.5.2 Management advice

The SWG has agreed that the animals found off St Vincent and The Grenadines are part of the large West Indies breeding population (abundance estimate 11,570 95%CI 10,290-13,390). The Commission adopted a total block catch limit of 24 for the period 2013-18 for Bequians of St Vincent and The Grenadines. The SWG **repeated** its advice that this block catch limit will not harm the stock.

5.6 Bowhead whales off West Greenland

5.6.1 New information (including catch data)

No bowhead whales were taken in West Greenland in 2014. Two bowhead whales were taken in northeast Canada in 2014. Samples were reported to have been collected from one of the whales taken in Canadian waters and 45 biopsy samples had been collected from West Greenland bowhead whales in 2014. The SWG **welcomed** this information and **recommended** continuation of the work. It also **strongly encouraged** collaboration with Canada on genetic work.

The SWG **recalled** the following two abundance estimates for 2012 (IWC, 2015b): (i) a fully-corrected sighting survey abundance estimate of 744 (CV=0.34, 95% CI: 357-1,461); and (ii) a mark-recapture estimate of 1,274 (CV=0.12). It **agreed** that the mark-recapture estimate provides the best estimate of abundance for the number of whales visiting West Greenland.

5.6.2 Management advice

Based on the agreed best 2012 estimates of abundance for bowhead whales (1,274 CV=0.12), and using the agreed interim approach, the SWG **repeated** its advice that an annual strike limit of two whales will not harm the stock.

The SWG **agreed** that the new *WG-Bowhead SLA* agreed above (see Item 2) should be used to confirm the strike limit, following completion of the validation/checking process at next year's meeting.

6. ABORIGINAL SUBSISTENCE WHALING SCHEME

For more than a decade the Commission has been unable to agree on an *Aboriginal Whaling Scheme* (AWS). The 2003 AWS proposal (IWC, 2003, pp.161-166), includes the following:

(1) new abundance information expected at least once every 10 years, and hopefully more frequently - this criterion requires more precise specification for simulation purposes (Item 6.2);
(2) if abundance information is overdue, then a 'grace period' is invoked for the first whole quota block that follows - this block may begin as early as the 11th year after the last estimate or as late as the 14th;
(3) during the grace period, the *SLA* block quota recommendation is reduced by 50% to the previous block and hunters are allowed the flexibility as to how to allocate this throughout the block – a new *SLA* calculation can be carried out within the grace period if a new abundance estimate is accepted and a revised block quota set; and
(4) the grace period is only for one block - without a new abundance estimate, the Scientific Committee would be unable to give scientific advice on strike limits after the grace period expired, and an *Implementation Review* would likely be initiated.

Further information on the proposed rules about the grace period and the carryover of strikes are given in IWC (2003), along with examples of various scenarios.

The lack of acceptance by the Commission appears partly due to objections from hunters regarding potential strike limit reductions (the 'grace period' approach) when a recent whale abundance estimate has not been obtained due to factors outside their control despite researchers' concerted effort and planning ahead. These might include:

(1) several consecutive years of bad weather and/or poor or unsafe ice conditions;
(2) lack of sufficient funding, e.g. it costs more than $1 million USD over 2-4 seasons to produce a successful ice-based Bering-Chukchi-Beaufort Seas bowhead abundance estimate (including analysis); and
(3) domestic or international political paralysis.

Although such situations would probably trigger an *Implementation Review*, given the lack of progress at Commission level with an AWS, it is clear that there is a need to develop further advice on how to proceed in such cases.

6.1 Progress at the intersessional Workshop

The intersessional Workshop (SC/66a/Rep03) focussed on the B-C-B bowhead whale hunt. It recognised the hunters' concern but reiterated that it is important to consider aboriginal whaling quota reductions in the long term absence of data as well as when there is evidence of conservation risk. It was also noted that the status of the Beaufort-Chukchi-Beaufort (B-C-B) Seas stock of bowheads has changed substantially since the *Bowhead SLA* was developed and tested. On the basis of two recent, independent surveys, estimated abundance is 60% larger and the rate of population increase has been revised upward. Therefore, from a scientific viewpoint there may be more room to develop defensible, responsible management approaches for this stock that appeal to a wider range of stakeholders.

At the intersessional Workshop, the SWG began considering a different AWS proposal for use with B-C-B bowhead whales, focussing on what may occur during the grace period.

The new suggestion is that the grace period reduction should be replaced by an 'interim allowance'. Specifically the 50% phase-out during the grace period would not apply. Instead the block quota for the grace period would be equal to the strike limit produced by the *Bowhead SLA*, without reduction, for a single block. This proposal might be broadly applicable to other aboriginal hunts as well.

To determine whether such an approach satisfactorily meets the conservation and need satisfaction goals of the Commission, the Workshop had agreed that it was appropriate to test such a procedure using the same general framework as was used to test the *Bowhead SLA* in 2003. The Workshop had emphasised that the approach is intended only to be applied in the unlikely event that exceptional unforeseen circumstances delayed obtaining an agreed abundance estimate beyond the end of the second quota block. It should not be interpreted as a routine approach for extending quotas for a third block without a concerted effort to obtain a successful survey prior to then.

The Workshop had also stressed that as soon as it becomes apparent that there is a likelihood that an abundance estimate may not become available in time, researchers should immediately begin to develop alternative approaches to obtaining abundance estimates (or at least indices of abundance) that do not depend on the problematic conditions. It had noted that in the case of B-C-B bowhead whales, alternative methods of abundance or indices of abundance are already being developed.

6.2 AWS specifications and testing

Carrying forward the work from the Workshop, the SWG began by developing precise operational specifications for the new AWS proposal. Particular initial attention was given to the timing of block quotas, carryover, surveys, abundance estimates and grace periods. The SWG then developed a simulation testing framework to evaluate the conservation and need satisfaction performance of the new AWS proposal.

6.2.1 Strike limit block lengths

The SWG also noted that the *Bowhead SLA* was developed and evaluated in the context of five-year block quotas. After the *Bowhead SLA* was adopted, the Commission began meeting biennially and aboriginal hunting quotas have been set in six-year blocks (the Scientific Committee had stated that there was no conservation risk in either four- or six-year blocks). The SWG **agreed** that the *Bowhead SLA* should be adjusted to operate with six-year blocks.

6.2.2 The timing of grace periods

The 10-year criterion mentioned under Item 6.1 is more complex than it first appears because there will be a delay between when the survey is conducted and when the resulting abundance estimate is agreed by the Committee, and because surveys and quotas need not be synchronised, as recognised in IWC (2003). For the sake of counting years in this situation, a survey is not considered to have occurred until the resulting abundance estimate is agreed.

At that point, the 10-year time window is deemed to have begun in the year during which the survey was conducted.

Table 4

Examples of how carryover, phase-out, and interim allowances during grace period might occur. For simplicity in this table, it is assumed that there is a one year lag between the time that a successful survey occurs and the time that a final abundance estimate is completed. Blocks are six years. See the text for further explanation.

Year	Example 1	Example 2	Example 3	Example 4
1	SL=402	SL=402	SL=402	SL=402
2				
3	Survey	Survey	Survey	Survey
4	Estimate	Estimate	Estimate	Estimate
5				
6	Used=389	Used=389	Used=389	Used=389
7	SL=402+13	SL=402+13	SL=402+13	SL=402+13
8				
9				
10				
11				
12	Used=332	Used=332	Used=332	Used=332
13	Survey SL=402+50	SL=402+50	SL=402+50	SL=402+50
14	Estimate	Survey overdue	Survey overdue	Survey overdue
15				
16				
17		Survey		
18	Used=430	Used=430 estimate	Used=430	Used=430
19	SL=402+22	SL=402+22	Grace; SL=201+22; Used=67	Interim; SL=402+22; used=67
20			Used=134	Used=134
21			Used=201	Survey; used=201
22			Used=223	Estimate; SL=402-201+22; used=268
23	Survey		Depleted	Used=335
24	Estimate used=402	Used=402	Depleted survey	Used=402
25	SL=402+22	SL=402+22	Estimate SL=402	SL=402+22

Then, ideally, the next survey would be conducted and the estimate approved within 10 years of the previous survey. However, one can envisage other scenarios. For example, the next survey might have occurred eight years after the previous one, but the corresponding abundance estimate not agreed until 13 years after the survey was conducted ('the 13th year'). In this case, a survey would be considered overdue during the 11th and 12th years. If the start of a new block occurred during that time, the grace period would be triggered. Otherwise, when the abundance estimate is agreed in the 13th year after the last survey was conducted, the fact that the survey actually took place eight years after the last agreed estimate would reset the clock so that the next deadline would be the 18th year, and a grace period would have been averted.

Table 4 illustrates several scenarios about how strike limits might evolve in the presence of phase-out and carryover. In this table, it is assumed for simplicity that the *Bowhead SLA* would output a six-year block strike limit (SL) of 402 each time (this assumes that all 67 strikes available per year are used during the block regardless of how many whales are landed), and carryover is allowed in the manner previously proposed by the SWG. In the table, carryover is indicated as an addition to SL, such as 'SL=402+13'. Need is assumed to be 67 strikes per year. The quantity 'Used' refers to the *cumulative* number of strikes assumed to be used during the block up to and including the indicated year. The Commission's current limit on the bowhead hunt is 336 whales landed using no more than 67 strikes per year, with a provision of carryover of some unused strikes from previous years.

Four different scenarios are shown in Table 4. The first column illustrates a situation with regular 10-year survey intervals. The second column illustrates that it is possible that surveys could be more than 10 years apart (in this case, 14 years) without triggering the grace period. The next two columns illustrate cases where the grace period is invoked and phase-out is applied. In column 3, the hunters are assumed to expend the quota to fully satisfy need for as long as possible, leading to quotas of zero for the final several years of the grace period or until a new abundance estimate is obtained. In 2003, the SWG envisioned that, during the grace period block, a new strike limit would be established immediately when a new abundance estimate was agreed, rather than waiting until the end of the grace period block. Thus in Table 4 for the scenario that includes a grace period with phaseout (column 3), immediate revision of strike limit advice is assumed. The final column of Table 4 illustrates a case where the interim allowance approach is used and a new abundance estimate is obtained partway through the grace period block. It also corresponds to the situation in column 3 when the new estimate is obtained during the block.

6.3 Performance evaluation

During development of the *Bowhead SLA*, the SWG did not formally test its performance in the presence of phase-out but inferred it from the trials that had included a 15-year survey interval. No formal testing of carryover rules was undertaken, either, as the acceptability of that approach was inferred from the fact that it was assumed that all strikes resulted in kills and were taken during each simulation block. Since the SWG now intends to compare performance of two grace period policies (phase-out *vs* interim allowance), the *SLA* and simulation testing framework must be elaborated to include grace period options.

In most respects, the SWG **agreed** to apply the same general simulation testing framework used during the testing of the *Bowhead SLA* itself. This will include (mostly) the same assumptions, trials, and performance statistics, as detailed in IWC (2003). Appendix 6 lists changes to the computer code for the *Bowhead SLA*, its component programs, the simulation testing software, trials and statistics that would be required to examine management performance under both AWS grace period proposals and with six-year blocks. Some trials used for evaluation of the *Bowhead SLA* will

Table 5

Summary of survey abundance estimates by species and area. Relative indices of abundance for use in the trials are given in IWC (2015b, Annex D).

Area	Year	Corr*	Estimate and approx. 95% CI and CV	IWC reference	Original reference
Common minke whale					
West Greenland	2007	A+P	16,610 (7,170-38,400) (CV: 0.43)	IWC (2010); IWC (2014b)	Heide-Jørgensen *et al*. (2010b)
West Greenland	2005	A+P	10,790 (3,400-34,300) (CV: 0.59)	IWC (2008)	Heide-Jørgensen *et al.* (2008)
West Greenland	1993	A	8,370 (3,600-19,440) (CV: 0.43)	IWC (1995)	Larsen (1995)
Fin whale					
West Greenland	2007		4,360 (1,810-10,530) (CV: 0.45)	IWC (2009)	Heide-Jørgensen *et al.* (2010a)
West Greenland	2005	P	3,230 (1,360-7,650) (CV: 0.44)	IWC (2008)	Heide-Jørgensen *et al.* (2008)
West Greenland	1988	A	1,100 (554-2,180) (CV:0.35)	IWC (1993)	IWC (1993)
Humpback whale					
West Greenland	2007	A+P	4,090 (1,620-10,324); (CV: 0.50) MRDS	IWC (2009); IWC (2014b)	Heide-Jørgensen *et al.* (2012); Heide-Jørgensen and Laidre (2013)
West Greenland	2007*	A+P	2,700 (1,402-5,215) (CV: 0.34) strip census	IWC (2009); IWC (2014b)	Heide-Jørgensen *et al.* (2012); Heide-Jørgensen and Laidre (2013)
Bowhead whale					
Prince Regent Inlet	2002	A+P	6,340 (3,119-12,906) (CV: 0.36)	IWC (2009)	IWC (2009)
Foxe Basin/Hudson Bay	2003	A+P	1,525 (333-6,990) (CV: 0.78)	IWC (2009)	IWC (2009)
West Greenland[1]	2007	A+P	1,229 (489-3,090) (CV: 0.47)	IWC (2008)	Heide-Jørgensen *et al.* (2007)
Isabella Bay	2009	A+P?	1,105 (515-2,370) (CV: 0.39)	IWC (2014a)	Hansen *et al.* (2012)
West Greenland	2012	A+P	744 (357-1,461) (CV: 0.34)	IWC (2015b)	Rekdal *et al.* (2015)
B-C-B bowhead whale					
	1978		4,765 (CV: 0.305)		Zeh and Punt (2005)
	1980		3,885 (CV: 0.343)		Zeh and Punt (2005)
	1981		4,467 (CV: 0.273)		Zeh and Punt (2005)
	1982		7,395 (CV: 0.281)		Zeh and Punt (2005)
	1983		6,573 (CV: 0.345)		Zeh and Punt (2005)
	1985		5,762 (CV: 0.253)		Zeh and Punt (2005)
	1986		8,917 (CV: 0.215)		Zeh and Punt (2005)
	1987		5,298 (CV: 0.327)		Zeh and Punt (2005)
	1988		6,928 (CV: 0.12)		Zeh and Punt (2005)
	1993		8,167 (CV: 0.071)		Zeh and Punt (2005)
	2001		10,545 (CV: 0.128)		Zeh and Punt (2005)
	2004		12,631 (CV: 0.244)		Koski *et al.* (2010)
	2011		16,892 (CV: 0.058)		Givens *et al.* (2013)
ENP gray whale					
	1968		13,426 (CV: 0.094)		Laake *et al.* (2012)
	1969		14,548 (CV: 0.08)		Laake *et al.* (2012)
	1970		14,553 (CV: 0.083)		Laake *et al.* (2012)
	1971		12,771 (CV: 0.081)		Laake *et al.* (2012)
	1972		11,079 (CV: 0.092)		Laake *et al.* (2012)
	1973		17,365 (CV: 0.079)		Laake *et al.* (2012)
	1974		17,375 (CV: 0.082)		Laake *et al.* (2012)
	1975		15,290 (CV: 0.084)		Laake *et al.* (2012)
	1976		17,564 (CV: 0.086)		Laake *et al.* (2012)
	1977		18,377 (CV: 0.08)		Laake *et al.* (2012)
	1978		19,538 (CV: 0.088)		Laake *et al.* (2012)
	1979		15,384 (CV: 0.08)		Laake *et al.* (2012)
	1980		19,763 (CV: 0.083)		Laake *et al.* (2012)
	1985		23,499 (CV: 0.089)		Laake *et al.* (2012)
	1986		22,921 (CV: 0.081)		Laake *et al.* (2012)
	1988		26,916 (CV: 0.058)		Laake *et al.* (2012)
	1993		15,762 (CV: 0.067)		Laake *et al.* (2012)
	1994		20,103 (CV: 0.055)		Laake *et al.* (2012)
	1996		20,944 (CV: 0.061)		Laake *et al.* (2012)
	1998		21,135 (CV: 0.068)		Laake *et al.* (2012)
	2001		16,369 (CV: 0.061)		Laake *et al.* (2012)
	2002		16,033 (CV: 0.069)		Laake *et al.* (2012)
	2007		19,126 (CV: 0.071)		Laake *et al.* (2012)
	2007		20,750 (18,860-23,320) (CV: 0.06)		Durban *et al.* (in press)
	2008		17,820 (16,150-19,920) (CV: 0.054)		Durban *et al.* (in press)
	2010		21,210 (19,420-23,250) (CV: 0.046)		Durban *et al.* (in press)
	2011		20,990 (19,230-22,900) (CV: 0.044)		Durban *et al.* (in press)

*Indicates whether the estimate has been corrected for availability bias (A) and/or perception bias (P).

[1]The mark-recapture abundance estimate of 1,274 (CV=0.12; 95% CI: 967-1,581) constitutes the best available estimate of abundance for the number of bowhead whales visiting West Greenland - Rekdal *et al.* (2015); for a discussion as to why this estimate is not suitable for use within the present trial structure see IWC (2015b, Item 3.1).

Table 6
Summary of progress and work plan.

Topic	SC/66a	Intersessional (2015-16)	SC/66b (June 2016)
Validate *Humpback SLA*	Completed	No	No
Development of *SLA* for bowhead whales	Completed	No	Review Canadian catch information
Development of *SLA* for common minke whales	Little progress, awaiting results of RMP *Implementation Review*	Workshop; begin to develop framework and trial structure	Review progress; developers' work
Development of *SLA* for fin whales	Agreed trial structure	Workshop; review results	Expect to finalise *SLA*
Aboriginal Whaling Scheme	Trial testing approach developed	Workshop; review results	Expect to complete
Annual review of catch limits	Completed	No	To be completed
Implementation Reviews	None scheduled	No	Prepare for gray whale *Implementation Review*

not be needed for the present investigations; these are listed in Appendix. Each simulation trial chosen for analysis will be run three times: once with surveys every 10 years, once with overdue surveys and phase-out, and once with overdue surveys and an *Interim SLA* allowance.

6.4 Conclusions, recommendations and work plan

The SWG **agreed** that it should be possible to fully test the above proposal and determine whether it can be recommended by the 2016 Scientific Committee meeting. To meet this goal, Punt and Allison agreed to try to finish the necessary computer programming, to run the trials and to summarise results in advance of an anticipated intersessional meeting of the SWG in winter 2016. A steering group consisting of Allison, Brandão, Donovan, Givens (Chair), Punt and Witting was formed to help guide development between meetings.

7. UPDATE LIST OF ACCEPTED ABUNDANCE ESTIMATES

The SWG noted that it had no new abundance estimates to consider at this meeting. The full list of abundance estimates is thus that provided in IWC (2015). It is repeated here as Table 5.

8. WORK PLAN AND PRIORITISED BUDGET REQUESTS

The SWG developed two budget proposals per year that are integrally related, one for an intersessional Workshop to progress the work on *SLA* development, and the other to maintain the existing Developers' Fund (IWC, 2014c). Without funding of these two items, experience has shown that the SWG will not achieve its work plan and that the Committee will not be able to achieve the target of completing long-term *SLA*s for all of the Greenland hunts to the Commission to replace the *Interim SLA* in time for the 2018 Commission meeting. This is essential for the Committee to provide advice on the next block of subsistence whaling limits.

Last year the SWG had **strongly recommended** that both budget proposals were funded and given equal priority. This required some £7,000 each year for the Developers' fund and £7,000 for each Workshop (i.e. a total of £14,000 in 2016). This request was accepted by the Committee (IWC, 2015d, p.75) and the Commission. The SWG **reaffirms** the need for these requests in 2016. Without this, the SWG cannot achieve its two-year work plan and the Committee is unlikely to be able to meet the Commission's requirement to have long-term *SLA*s ready for the 2018 meeting at the latest. It requests that the Workshop allowance be increased to £11,000 to reflect true costs.

The Work Plan is summarised in Table 6.

9. ADOPTION OF REPORT

The report was adopted at 11.02 on 30 May 2015 subject to final editorial changes. The Chair thanked the participants for their co-operation and the quality of the debate. In particular he thanked the rapporteurs and especially Witting, Brandão and Punt for their exceptionally hard work to progress *SLA* development for the Greenlandic hunts for bowhead and fin whales.

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Appendix 1

AGENDA

1. Introductory items
   - 1.1 Convenor's opening remarks
   - 1.2 Election of Chair
   - 1.3 Appointment of rapporteurs
   - 1.4 Adoption of Agenda
   - 1.5 Documents available
2. Development of *SLA* for the Greenlandic bowhead whale hunt
   - 2.1 Report of the intersessional Workshop
   - 2.2 New information
   - 2.3 Conclusions and recommendations
3. Development of *SLA* for the Greenlandic fin whale hunt
   - 3.1 Report of the intersessional Workshop
   - 3.2 Intersessional progress
   - 3.3 Candidate *SLA*s
   - 3.4 Final trial structure (*Evaluation Trials* and *Robustness Trials)*
   - 3.5 Conditioning
   - 3.6 Trial results
   - 3.7 Conclusions and recommendations
4. Development of *SLA* for the Greenlandic common minke whale hunt
   - 4.1 Report of the intersessional Workshop
   - 4.2 Development of work plan
5. Annual review of management advice
   - 5.1 Common minke whales off West Greenland
     - 5.1.1 New information (including catch data)
     - 5.1.2 Management advice
   - 5.2 Common minke whales off East Greenland
     - 5.2.1 New information (including catch data)
     - 5.2.2 Management advice
   - 5.3 Fin whales off West Greenland
     - 5.3.1 New information (including catch data)
     - 5.3.2 Management advice
   - 5.4 Humpback whales off West Greenland
     - 5.4.1 New information (including catch data)
     - 5.4.2 Management advice
   - 5.5 Humpback whales off St Vincent and The Grenadines
     - 5.5.1 New information (including catch data)
     - 5.5.2 Management advice
6. Aboriginal Subsistence Whaling Scheme
   - 6.1 Report of the intersessional Workshop
   - 6.2 Intersessional progress
   - 6.3 Conclusions and recommendations
7. Update list of accepted abundance estimates
8. Work plan and prioritised budget requests
9. Adoption of Report

Appendix 2

INFORMATION ON CANADIAN CATCHES

Cherry Allison

INFORMATION FOR 2015

The Total Allowable Harvest for Nunavut is currently five bowhead whales (two for Baffin region, two for Keewatin region, and one for Kitikmeot region). This assumes that the increase from three to five was approved by the Minister of Fisheries and Oceans. The Total Allowable Take for the Nunavik Marine Region is currently two and thus the total quota=seven.

The annual take is usually less than the quota because Nunavik has not been taking bowhead whales recently but there are apparently plans for a bowhead hunt this year in Nunavik.

The IWC has received the following information on the bowhead whale catch by Canada in 2014. The 2014 quota set by Canada was five bowhead whales for the eastern Canada-west Greenland bowhead population.

CATCH INFORMATION FOR 2014

Year	Community	Date	Struck	Landed	Sex	Length (m)	Comment
2014	Clyde River, Nunavut	3 August	1	1	F	16.15	Taken at approximately 70.5170°N, 68.2800°W. Some biological information and samples were collected (to be analysed by DFO).
2014	Kugaaruk, Nunavut	31 August	1	1	M	9.75	Taken at approximately 68.9041°N, 89.8560°W. No biological samples were collected.

Note: poor weather prevented the hunt from taking place in Chesterfield Inlet, Nunavut.

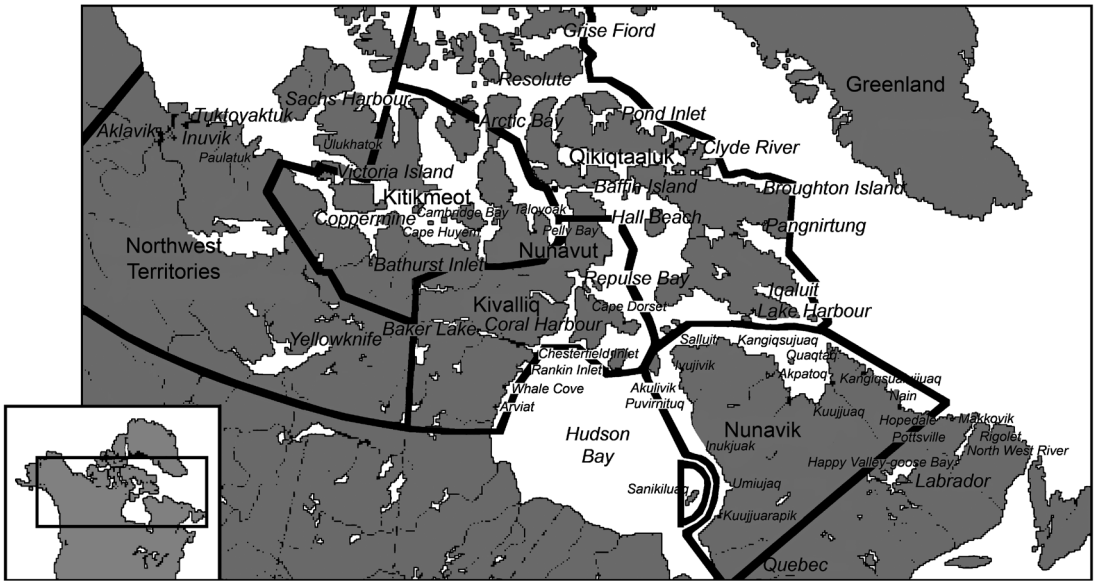


Fig. 1. Areas Canadian catches are taken from.

Appendix 3

THOUGHTS ON THE LOWER BOUND FOR MSYR$_{1+}$ FOR WEST GREENLAND FIN WHALE TRIALS

Lars Witting

In addition to the results of the assessment in SC/66a/AWMP01, a more detailed discussion of the rationale regarding the lower MSYR$_{1+}$ value to be used in the *Evaluation Trials* for West Greenland fin whales is presented here.

(1) Of the three *SLA*s accepted thus far (bowhead whale, gray whale, humpback whale), 1% was only used in *Evaluation Trials* for bowhead whales and *Robustness Trials* for West Greenland humpback whales (IWC, 2015a, p.435). Trials with 1% are thus not a default lower bound in AWMP *Evaluation Trials*.

(2) Trials with 1% MSYR$_{1+}$ are now part of the generic RMP trials (and *cf* the MSYR review; IWC, 2015b). Consistency in 'biology' amongst AWMP and RMP is not considered to be a valid argument for 1% AWMP trials, and this is because the lower bound on the MSYR is based not primarily on biology, but on the balancing of an estimated parameter against the conservation objective for the actual management regime. In the AWMP, the emphasis has always been on giving higher weight towards more plausible trials; as reflected to some degree in past trials structures where 1% occurs only in the *Evaluation Trials* for the species with the slowest dynamics – the bowhead whale.

(3) There has been no formal way of deciding the lower MSYR in AWMP *Evaluation Trials*, but it has been chosen based on information (especially trend information) for the appropriate species/stocks. In some of the Greenlandic hunts, there is less free 'conservation space' that will allow for satisfactory need satisfaction, and a balanced discussion on the conservation limit is prudent. This is why in SC/66a/AWMP01 a lower MSYR$_{1+}$ of 2% is proposed for the *Evaluation Trials* for West Greenland fin whales; this estimate corresponds with the often applied 5% significance level in the sense that our current best estimate suggests that there is only a 5% probability that the actual MSYR is lower than 2%.

(4) The suggested 2% value is based not only on the three abundance estimates from West Greenland, but on 14 abundance estimates across the North Atlantic where fin whales have point estimates of growth that are similar in four different areas. Given this consistency, it is reasonable to use all of the data in our judgement of a plausible lower bound, whatever technique is used to achieve this.

REFERENCES

International Whaling Commission. 2015a. Report of the AWMP Intersessional Workshop on Developing SLAs for the Greenland hunts, 8-11 January 2014, Copenhagen, Denmark. *J. Cetacean Res. Manage. (Suppl.)* 16:433-58.

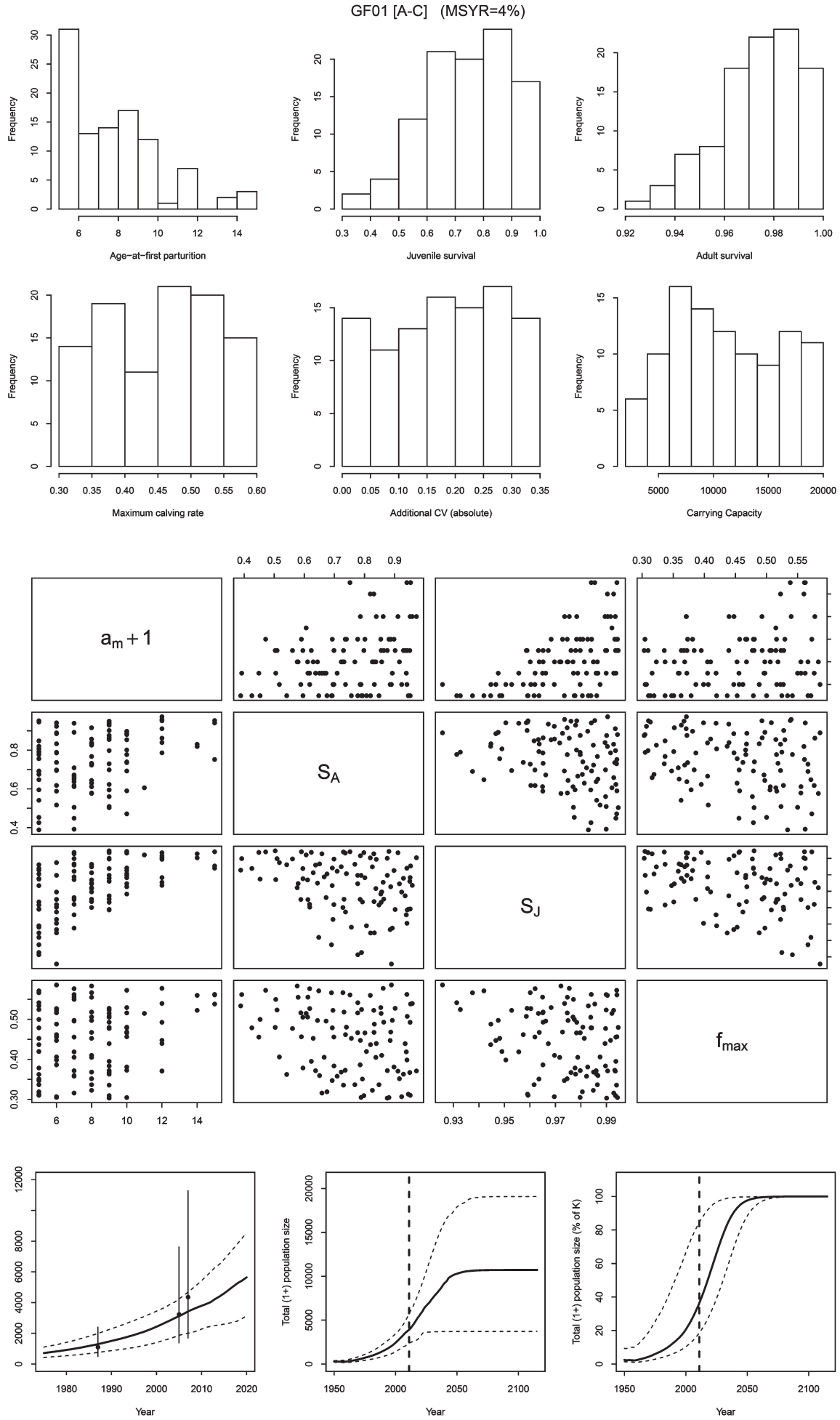
International Whaling Commission. 2015b. Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 16:1-87.

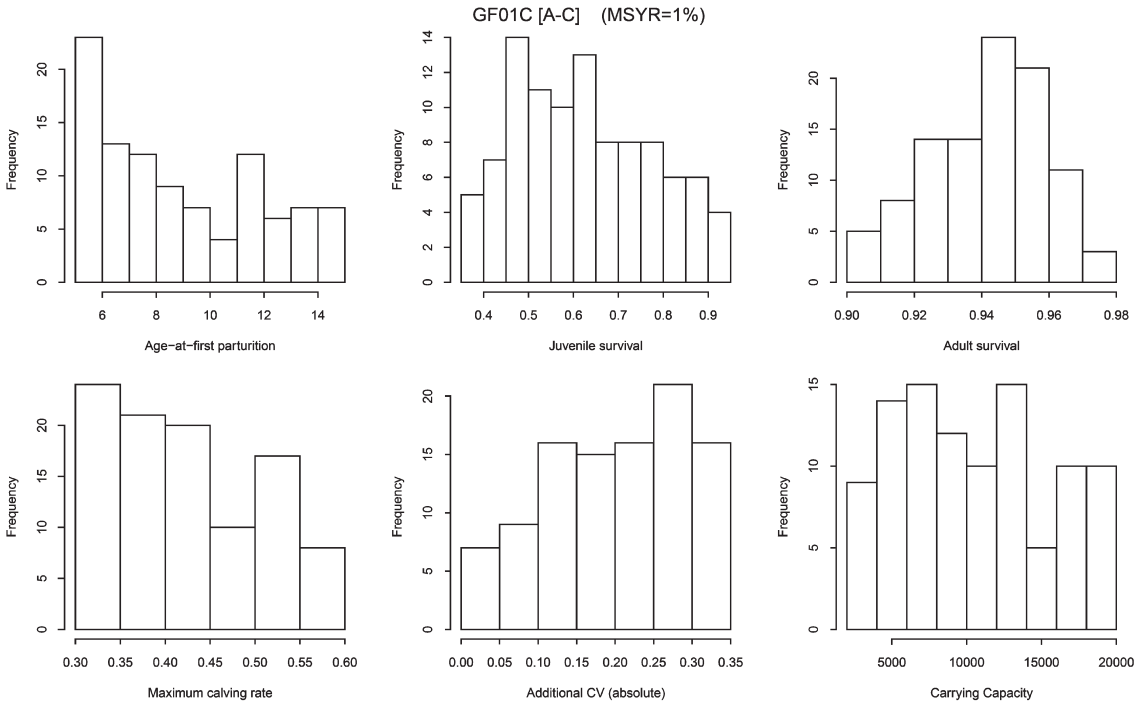
Appendix 4

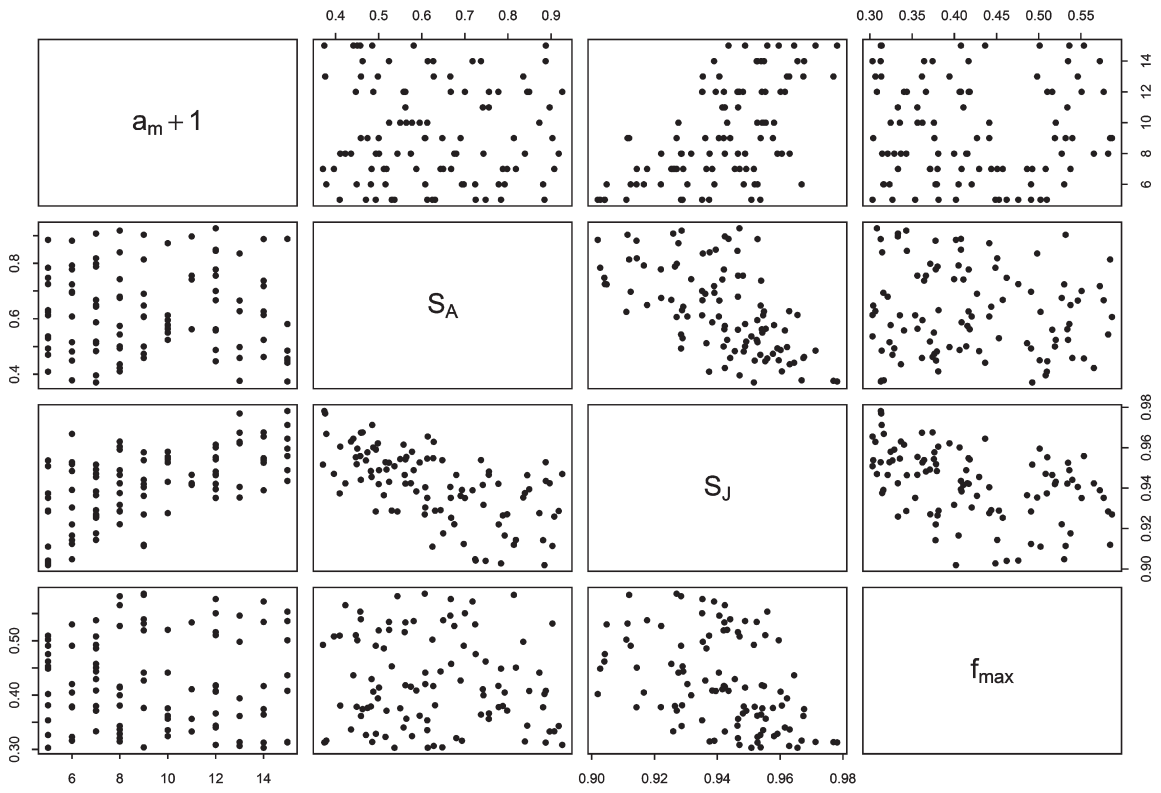
RESULTS OF THE CONDITIONING FOR WEST GREENLAND FIN WHALES

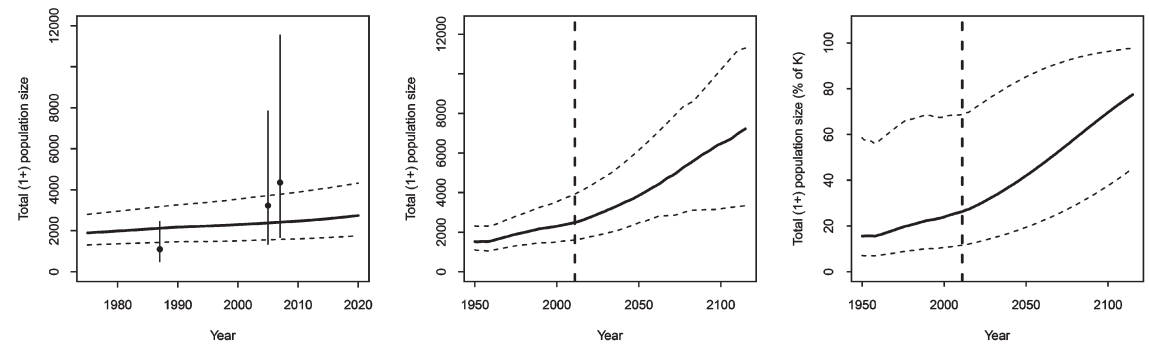
Sample plots for the GF01A (MSYR=4%) and GF01C (MSYR=1%) trials are shown. The full set of conditioning results is given at: *https://archive.iwc.int/?c=29.*

(Figures on next two pages)


GF01 [A-C] (MSYR=4%)
Frequency
Age−at−first parturition
Juvenile survival
Adult survival
Maximum calving rate
Additional CV (absolute)
Carrying Capacity
$a_m + 1$
S_A
S_J
f_{max}
Total (1+) population size
Total (1+) population size (% of K)
Year


GF01C [A-C] (MSYR=1%)
Frequency
Age−at−first parturition
Juvenile survival
Adult survival
Maximum calving rate
Additional CV (absolute)
Carrying Capacity

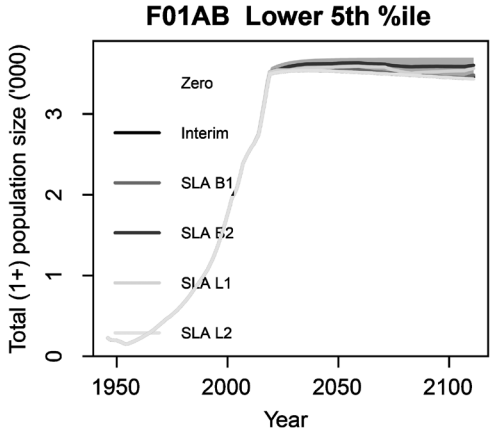

$a_m + 1$
S_A
S_J
f_{max}

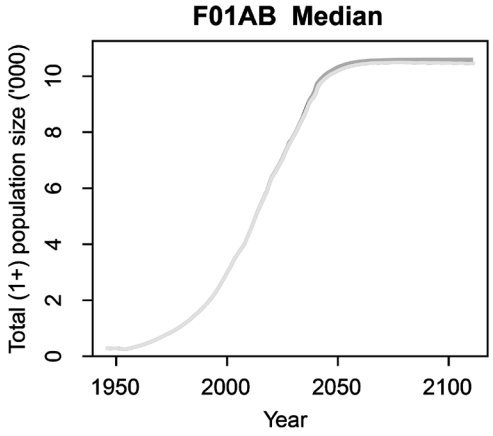

Total (1+) population size
Year
Total (1+) population size (% of K)

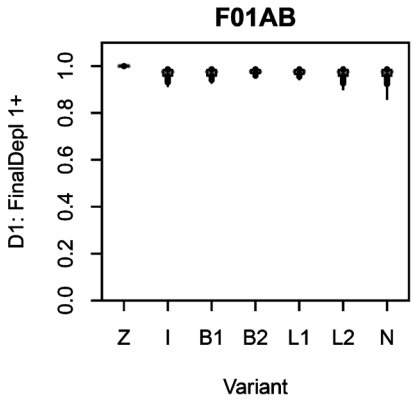
Appendix 5

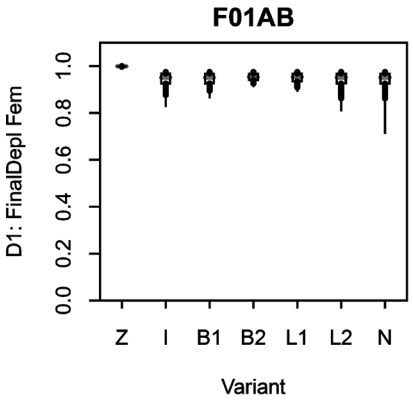
SUMMARY RESULTS FOR THE PRELIMINARY *SLA*S FOR WEST GREENLAND FIN WHALES

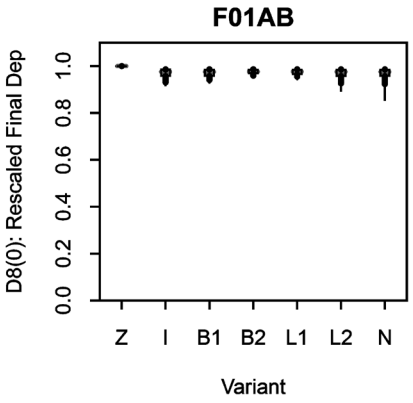
Sample plots are shown for trials GF01AB (MSYR=4%, need scenario B), and GF01CB (MSYR=1%, need scenario B). The full set of *SLA* results is given at: *https://archive.iwc.int/?c=29.*

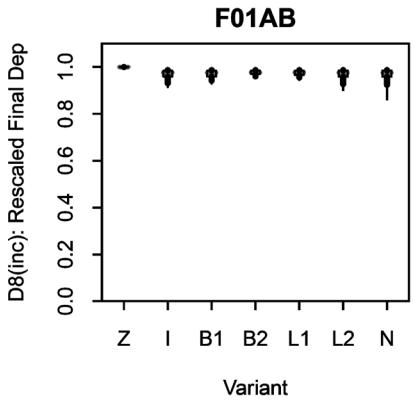


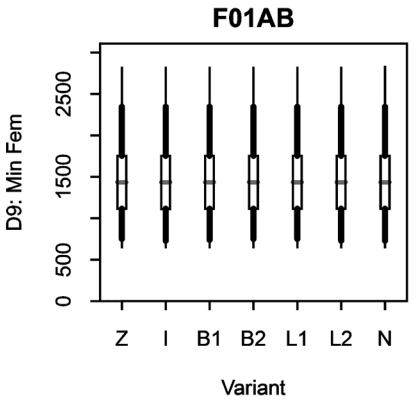


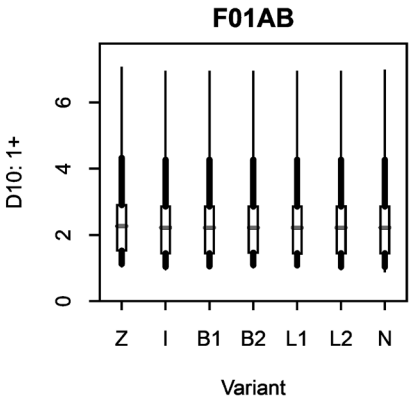


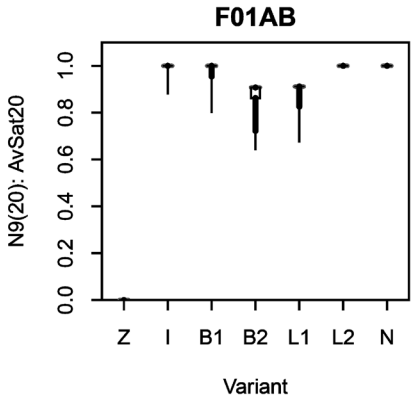


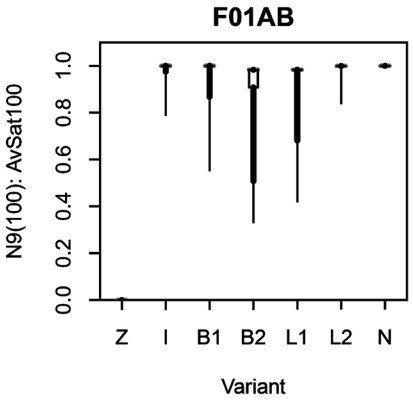


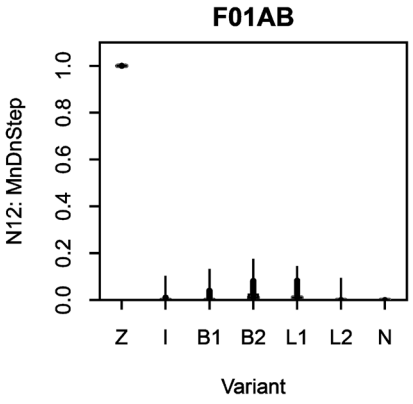


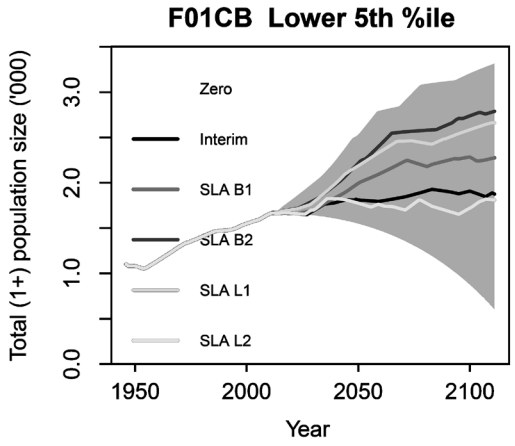


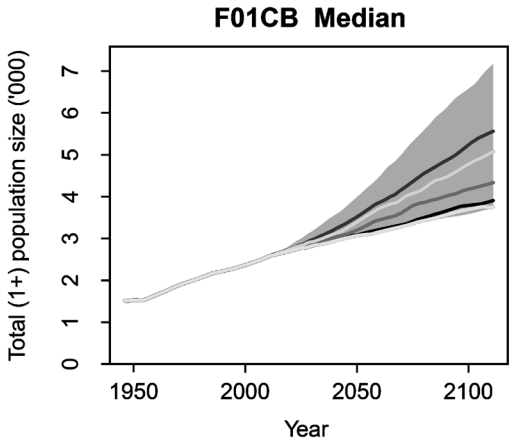


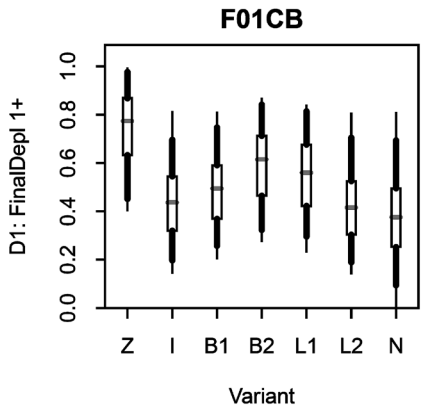


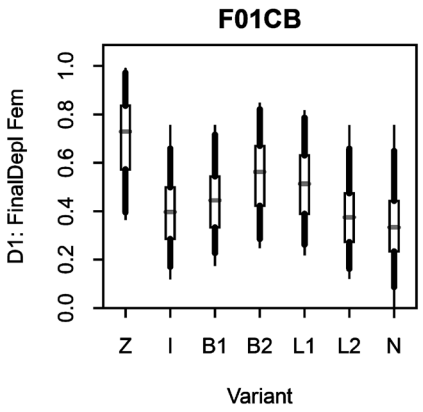


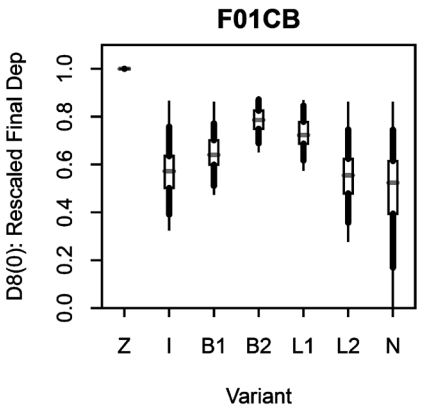



F01CB Lower 5th %ile
Total (1+) population size ('000)
0.0
1.0
2.0
3.0
Zero
Interim
SLA B1
SLA B2
SLA L1
SLA L2
1950
2000
2050
2100
Year


F01CB Median
Total (1+) population size ('000)
0
1
2
3
4
5
6
7
1950
2000
2050
2100
Year


F01CB
D1: FinalDepl 1+
0.0
0.2
0.4
0.6
0.8
1.0
Z
I
B1
B2
L1
L2
N
Variant


F01CB
D1: FinalDepl Fem
0.0
0.2
0.4
0.6
0.8
1.0
Z
I
B1
B2
L1
L2
N
Variant


F01CB
D8(0): Rescaled Final Dep
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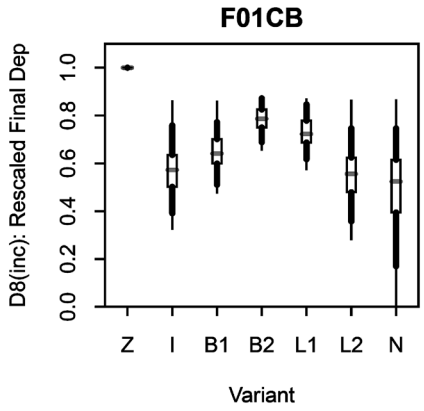
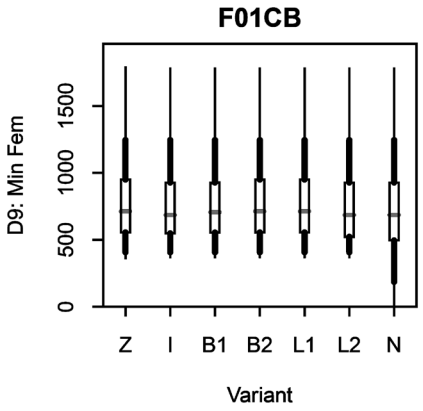
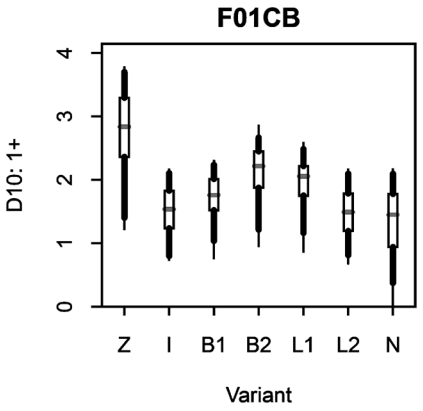
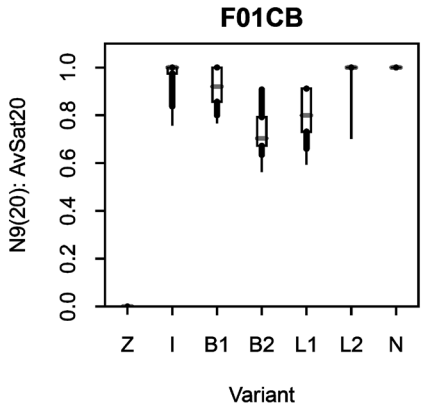
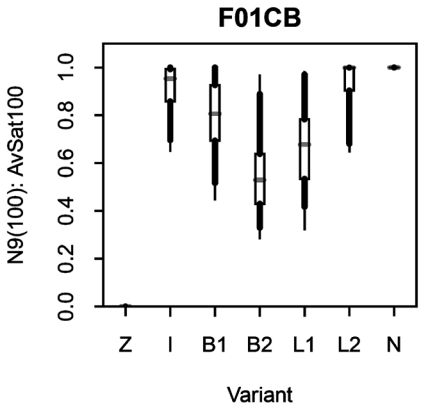
0.4
0.6
0.8
1.0
Z
I
B1
B2
L1
L2
N
Variant


F01CB
D8(inc): Rescaled Final Dep
0.0
0.2
0.4
0.6
0.8
1.0
Z
I
B1
B2
L1
L2
N
Variant


F01CB
D9: Min Fem
0
500
1000
1500
Z
I
B1
B2
L1
L2
N
Variant


F01CB
D10: 1+
0
1
2
3
4
Z
I
B1
B2
L1
L2
N
Variant


F01CB
N9(20): AvSat20
0.0
0.2
0.4
0.6
0.8
1.0
Z
I
B1
B2
L1
L2
N
Variant


F01CB
N9(100): AvSat100
0.0
0.2
0.4
0.6
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1.0
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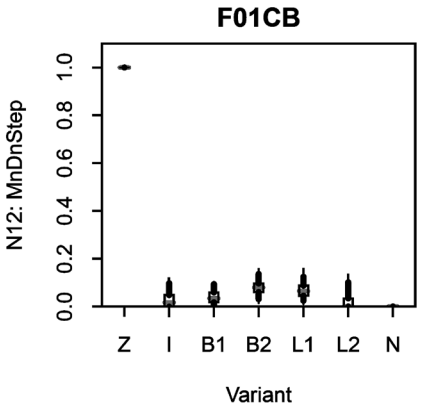
I
B1
B2
L1
L2
N
Variant


F01CB
N12: MnDnStep
0.0
0.2
0.4
0.6
0.8
1.0
Z
I
B1
B2
L1
L2
N
Variant

Appendix 6

TRIAL STRUCTURE FOR PROPOSED TESTING OF SOME AWS PROVISIONS FOR THE *BOWHEAD SLA*

Generally, the testing of the *Interim SLA* allowance strategy as an alternative to phase-out in the case of overdue abundance estimation will follow the methods used during the testing of the *Bowhead SLA*. The following are some needed modifications.

(1) Simulations start in 2019 (when the next block quota begins) and end after 100 years.
(2) Annual strikes for years from the present through 2018 should be determined by dividing the number of strikes remaining in the current block by the number of remaining years.
(3) Population trajectories begin in 1940; catch data before then are ignored.
(4) Strike limits are calculated for six-year blocks.
(5) The new abundance estimates for 2004 and 2011 are included.
(6) The biological model is unchanged.
(7) A new prior for K should be used for conditioning. Tentatively, a Unif(15000, 50000) prior will be used, but this choice will be subject to revision if preliminary investigations indicate that it creates biases or inefficiencies.
(8) The code should decouple survey years from block timing so that the two may be controlled independently.
(9) The code should decouple phase-out quota levels from calculated *SLA* quota levels so that instances where the *SLA* self-references will refer to the quota that would have been allowed before the external impact of phase-out.
(10) The lag between the survey year and the year that the corresponding abundance estimate is accepted by the Scientific Committee should be set to three years so that, e.g., a survey conducted in 2011 produces an estimate agreed in 2014. In this case, a new *SLA* quota could be calculated and applied as early as 2014 (if it was the start of a new block or the cancelation of a grace period), even though in fact Commission meetings are held partway through the hunting year. Related specifications about the timing of surveys, abundance estimates, grace period initiation and block timing are given in Annex E, item 6.2.2.

All these changes to the simulation and testing code, except for (7) and those in (10) have been completed by Punt. Changing the prior for K is easily done by changing the specifications in the appropriate input file.

TRIALS:

(1) The *Evaluation Trial* specifications for the *Bowhead SLA* are given in Table 2. In this table, some trials have been crossed out. The SWG agreed that these could be ignored for the current purpose. In particular:
  (a) BE02 should be deleted because it involves low need so would not provide a challenge to an *SLA* in terms of both conservation performance and need satisfaction;
  (b) BE04a, BE08, BE09a, BE10a, and BE12a should be deleted because fixing 5 and 15 year survey intervals is unnecessary when the grace period scenarios are used to specify survey intervals;
  (c) BE05 has not provided an effective test of *SLA*s in the past and will therefore be deleted;
  (d) BE07 will be deleted because the abundance data for the Bering-Chukchi-Beaufort Seas bowhead whales do not exhibit any evidence for density-dependence;
  (e) BE23 should be deleted for simplicity and because strategic survey scenarios can be replaced by the grace period scenarios now to be examined;
  (f) BE24 should be deleted for simplicity. Trials based on the inertia model are difficult to interpret; and
  (g) the SWG agreed that trial BE09 might be dropped once the results of the conditioning are available.
(2) All *Evaluation Trials* except those noted above must be rerun due to the change to six-year block quotas.
(3) The SWG anticipates running no *Robustness Trials* although this decision may be revised at the proposed 2016 intersessional Workshop.
(4) Each trial will be run with three different assumptions about surveys: no overdue surveys, overdue surveys with phase-out, and overdue surveys with *Interim SLA* allowance. See the next section.
(5) A new *Evaluation Trial* will be designed to mimic the situation when researchers quickly obtain an imprecise abundance estimate in order to avert a grace period. In this case, the abundance estimate will be available in the 10th year from the previous survey, and it will have a CV of 0.75. (Note: the base case CV for bowhead *Evaluation Trials* is 0.25).

CARRYOVER, PHASE-OUT, AND *INTERIM SLA* ALLOWANCE:

Many of the related specifications are given under Annex E, item 6.2.2. Some key points are as follows.

(1) Carryover will be ignored (because all strikes will be assumed taken), as was done when originally testing the *Bowhead SLA*.
(2) The baseline will be that surveys and abundance estimates are obtained every 10 years, thereby never presenting the need for invoking the grace period. Every trial will be run with this baseline.
(3) Every trial will also be run with two alternative assumptions about overdue surveys. These alternative scenarios will specify that the grace period is invoked and *either*: (i) phase-out; or (ii) *Interim SLA* allowance is applied. The SWG did not have time to fully consider aspects of the trials relating to the relative timing of surveys, abundance estimates, grace periods, etc. The details will be determined by the intersessional steering group.
(4) Simulated surveys will be scheduled to ensure that no grace period is immediately followed by another grace period. Aside from this, the SWG will adopt the most conservative approach that simulated surveys will be scheduled to incur the maximum number of grace periods, although this decision may be revised by the intersessional steering group.

Table 1

Examples of how carryover, phase-out, and interim allowances during grace period might occur. For simplicity in this table, it is assumed that there is a one year lag between the time that a successful survey occurs and the time that a final abundance estimate is completed. Blocks are 6 years. See the text for further explanation.

Year	Example 1	Example 2	Example 3	Example 4
1	SL=402	SL=402	SL=402	SL=402
2				
3	Survey	Survey	Survey	Survey
4	Estimate	Estimate	Estimate	Estimate
5				
6	Used=389	Used=389	Used=389	Used=389
7	SL=402+13	SL=402+13	SL=402+13	SL=402+13
8				
9				
10				
11				
12	Used=332	Used=332	Used=332	Used=332
13	Survey SL=402+50	SL=402+50	SL=402+50	SL=402+50
14	Estimate	Survey overdue	Survey overdue	Survey overdue
15				
16				
17		Survey		
18	Used=430	Used=430 estimate	Used=430	Used=430
19	SL=402+22	SL=402+22	Grace; SL=201+22; Used=67	Interim; SL=402+22; used=67
20			Used=134	Used=134
21			Used=201	Survey; used=201
22			Used=223	Estimate; SL=402-201+22; used=268
23	Survey		Depleted	Used=335
24	Estimate used=402	Used=402	Depleted survey	Used=402
25	SL=402+22	SL=402+22	Estimate SL=402	SL=402+22

Table 2

The *Evaluation Trials* used in 2003 for testing the *Bowhead SLA*. (Differences from the base case are shown in **bold**). Trials to be ignored for testing AWS grace period options are crossed out. Each trial will be run with three grace period scenarios: no grace period, grace period with phase-out, and grace period with *Interim SLA* allowance. See the text for more details and specifications regarding survey intervals.

Trial no.	Description	Model	$MSYR_{1+}$	$MSYL_{1+}$	Final need	Historical survey bias	Future survey bias	Survey CV (true, est)	Age data[#]	Other
BE01*	Base case	D, S_E	2.5%	0.6	134	1	1	0.25, 0.25	Good	
~~BE02~~	~~Constant need~~	~~D~~	~~2.5%~~	~~0.6~~	~~67~~	1	1	~~0.25, 0.25~~	~~Good~~	
BE03	Future +ve bias	D, S_E	2.5%	0.6	134	1	**1 · 1.5 in yr 25**	0.25, 0.25	Good	
BE04	Future –ve bias	D	2.5%	0.6	134	1	**1 · .67 in yr 25**	0.25, 0.25	Good	
~~BE04a~~	~~Future –ve bias~~	~~D~~	~~2.5%~~	~~0.6~~	~~134~~	1	~~**1 · .67 in yr 25**~~	~~0.25, 0.25~~	~~Good~~	~~**5yr surveys**~~
~~BE05~~	~~Underestimated CVs~~	~~D~~	~~2.5%~~	~~0.6~~	~~134~~	1	1	~~**0.25, 0.10**~~	~~Good~~	
~~BE07*~~	~~$MSYL1+ = 0.8$~~	~~D, SE~~	~~2.5%~~	~~**0.8**~~	~~134~~	1	1	~~0.25, 0.25~~	~~Good~~	
~~BE08~~	~~5 yr surveys~~	~~D~~	~~2.5%~~	~~0.6~~	~~134~~	1	1	~~0.25, 0.25~~	~~Good~~	~~**5yr surveys**~~
BE09*	$MSYR_{1+}$ = 1%	D, S_E	**1%**	0.6	134	**0.67 · 1**	1	0.25, 0.25	Good	
~~BE09a~~	~~$MSYR_{1+}$ = 1%~~	~~D~~	~~**1%**~~	~~0.6~~	~~134~~	~~**0.67 · 1**~~	1	~~0.25, 0.25~~	~~Good~~	~~**5yr surveys**~~
BE10*	$MSYR_{1+}$ = 4%	D	**4%**	**0.8**	134	1	1	0.25, 0.25	Good	
~~BE10a~~	~~$MSYR_{1+}$ = 4%~~	~~D~~	~~**4%**~~	~~**0.8**~~	~~134~~	1	1	~~0.25, 0.25~~	~~Good~~	~~**5yr surveys**~~
BE11	Bad data	D	2.5%	0.6	134	1	**1 · 1.5 in yr 25**	**0.25, 0.10**	**Poor**	
BE12*	Difficult 1%	D, S_E	**1%**	0.6	134	**1 · 1.5**	**1.5**	**0.25, 0.10**	**Poor**	
~~BE12a~~	~~Difficult 1%~~	~~D~~	~~**1%**~~	~~0.6~~	~~134~~	~~**1 · 1.5**~~	~~**1.5**~~	~~**0.25, 0.10**~~	~~**Poor**~~	~~**5yr surveys**~~
BE13	Difficult 1%; constant need	D	**1%**	0.6	**67**	**1 · 1.5**	**1.5**	**0.25, 0.10**	**Poor**	
BE14	Need increases to 201	D	2.5%	0.6	**201**	1	1	0.25, 0.25	Good	
BE16	$MSYR_{1+}$ = 1%; 201 need	D, S_E	**1%**	0.6	**201**	**0.67 · 1**	1	0.25, 0.25	Good	
BE20	$MSYR_{1+}$ = 4%; 201 need	D	**4%**	**0.8**	**201**	1	1	0.25, 0.25	Good	
BE21*	Integrated	D	U[1,4%]	**U[.4-.8]**	134	1	1	0.25, 0.25	Good	
BE22*	20yr time lag (see i)	D, S_E	2.5%	0.6	134	1	1	0.25, 0.25	Good	**20yr lag**
~~BE23~~	~~Strategic surveys; (see ii)~~	~~D~~	~~2.5%~~	~~0.6~~	~~**201**~~	~~**1**~~	~~**1**~~	~~0.25, 0.25~~	~~Good~~	~~**Strategic surveys**~~
~~BE24*~~	~~Inertia Model (see iii)~~	~~D~~	~~**0.6%**~~[§]	~~0.6~~	~~134~~	~~**1**~~	~~**1**~~	~~0.25, 0.25~~	~~Good~~	~~**Inertia model**~~

Table 3

Performance statistics used in 2003 to evaluate performance of the *Bowhead SLA*.

ID	Name	Mandatory	Optional	Time periods	Details
D1	Final depletion	1+, mature		100	P_T/K
D2	Lowest depletion		Mature	100	$\min(P_t/K)$: t=0,1,...,T
D6	Trajectories 1 and 2		1+, mature	100	
D7	Pointwise quantile trajectories		1+, mature	100	
D8	Rescaled final depletion	Yes		100	P_T/P^*_T
D9	Minimum number of whales		1+, mature	100	$\min(P_t)$: t=0,1,...,T
D10	Relative increase	Yes		100	P_T/P_0
N1	Total need satisfaction		Yes	20, 100	$\sum_{t=0}^{T-1} C_t / \sum_{t=0}^{T-1} Q_t$
N2	Longest shortfall		Yes	20, 100	(negative of the greatest number of consecutive years in which $C_t < Q_t/T$)
N4	Fraction of years in which catch=quota		Yes	20, 100	
N7	Percent need satisfaction pointwise quantile trajectory plot		Yes	100	
N8	Percent need satisfaction trajectories 1 and 2 plot		Yes	100	
N9	Average need satisfaction	Yes		20, 100	$\frac{1}{T}\sum_{t=0}^{T-1}\frac{C_t}{Q_t}$
N10	Average annual variation in catch		Yes	100	
N11	Anti-curvature catch variation statistic		Yes	100	
N12	Mean downstep	Yes			
R1	Relative recovery	1+, mature		100	$P_{t_r^*} / P^*_{t_r^*}$ 1st year in which P passes through *MSYL*
R3	Time frequency in recovered state after recovery		1+, mature	100	
R4	Relative time to recovery		1+,mature	100	

PERFORMANCE STATISTICS:

The performance evaluation statistics will be the same as those used previously (IWC, 2003, p.156), see Table 3. Exceptions are as follows.

(1) The definition of P^*_t will be changed slightly (so it is defined as the population size assuming zero strikes from 2019 onwards).

(2) The SWG will want to compare some performance statistics' values for phase-out (PO) versus *Interim SLA* allowance (SLAIA). Therefore ratios such as D1(SLAIA)/D1(PO) and D1(SLAIA)/D1(PO) will be computed, where D1 is the final depletion statistic.

(3) Analogous ratios will be calculated for statistics D10, N1 and N9. Along with item (2), this comprises eight new statistics. These calculations can be done in the R program for summarising results; modification of the Fortran common control program is unnecessary.

REFERENCE

International Whaling Commission. 2003. Report of the Scientific Committee. Annex E. Report of the Standing Working Group on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP). *J. Cetacean Res. Manage. (Suppl.)* 5:154-255.