Report of the Fourth Workshop on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP)

SC/54/Rep2

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Members: Donovan (Chair), Allison, Borodin, Breiwick, Butterworth, Dereksdottir, Etylina (I), Fay (local scientist), George, Givens, Magnússon, Mikhno, Punt, Wade, Witting, Zeh.

1. INTRODUCTORY ITEMS

1.1 Convenor's opening remarks

The Workshop took place in Seattle from 23-26 January 2002. Donovan convened the meeting and thanked the National Marine Mammal Laboratory, Jeff Breiwick and Doug DeMaster for hosting the meeting. He noted that the primary objectives of this meeting were to: complete discussions of the gray whale trial structure; review progress on the process to determine a recommended *SLA* for the bowhead whale; consider how to present the recommended *SLA* to the Scientific Committee and the Commission; continue discussion of scientific aspects of an aboriginal subsistence whaling scheme in the light of comments received from the Commission at the 2001 Commission meeting; and determine a work plan for the intersessional period up to the 2002 Scientific Committee meeting.

1.2 Election of Chair

Donovan was elected as Chair.

1.3 Appointment of rapporteurs

Allison, George and Givens were appointed as rapporteurs.

1.4 Adoption of agenda

The agenda adopted is given in Annex A.

1.5 Review of documents

SC/J02/AWMP1-3 (Annex B), Witting (2001), Punt and Breiwick (2002) and a collection of past reports were available for discussion and review.

2. GRAY WHALE TRIALS STRUCTURE

2.1 Review of trial specifications

The SWG reviewed the specifications for the gray whale trials. The revised specifications are given as Annex C. Details and rationale for changes are given below.

2.1.1 Model related issues

Witting (2001) noted that the density-regulated BALEEN II model (Punt, 1999), which forms the basis for the bowhead trials, cannot reconcile the catch history and the abundance data for the eastern North Pacific gray whales unless the catches are assumed to be have been severely under-reported or the carrying capacity is assumed to have increased substantially (Butterworth *et al*., 2002). Witting (2001) used an alternative model based on inertial dynamics to calculate population trajectories over the past 150 years that are able to reconcile all of the data and that are also consistent with an independent abundance estimate for 1885. The inertia model predicts over-compensation and that the population has increased steadily above the equilibrium abundance level for the last three to four decades.

The SWG welcomed this work, particularly as it incorporates regime shifts, which have been postulated. Oscillations in population size, which are damped over time, are a feature of the inertia model and are caused by the assumption that there is an 'intrinsic' birth rate which is determined at birth and does not change over time.

Moore summarised the current information on the productivity of gray whale feeding areas as it relates to possible changes in gray whale carrying capacity. Gray whales migrate north towards the Cherkov Basin of the Bering Sea. Benthic sampling in this area indicates that prey density was decreasing in the 1980s (Highsmith and Coyle, 1990; 1992) and decreases in prey density were also noted along the Bering Sea Shelf (Grebmeier and Harrison, 1992). Additional sampling will be conducted in the same areas by the same researchers this year. The Arctic Oscillation (which is computed from the relative strength of barometric pressure fields near Arctic North America), was considered as a possible cause for the changes in prey density. The North Pacific region may be shifting out of the warmer, less productive regime, to a cooler, more productive regime. In the favourable phase of the Arctic Oscillation, a larger proportion of the production from along the shelf break is advected north into the Cherkov Basin and Bering Strait which may improve feeding opportunities for gray whales. During the last few years, several hundred gray whales have been noted to feed near Kodiak Island in the Gulf of Alaska. This appears to be a new phenomenon, and suggests that gray whales can feed in a more opportunistic way than previously thought.

The oscillatory population trajectories from the inertia model are due to the structure of how birth rate is modelled. Hence they differ from variation in population size due to external factors such as environmental change. The latter can be mimicked in the trials by imposing sinusoidal time trajectories for carrying capacity. It will be difficult to find empirical support for the inertia model, however, because there are few large mammals, the dynamics of which have not been profoundly impacted by human activities. It was suggested, however, that there might be value in examining data for Canadian Arctic caribou as there are few human-related constraints on them, data are available for many years and there is evidence for large oscillations in population size.

The SWG **agreed** that the different dynamics provided by the inertia model meant that this model should be included in the trials but that the model needed to be examined in more detail before it was used as the basis for many trials. A fundamental assumption to the inertia model is that fecundity is stable for the whole life of an animal. A possible extension to the model might be to add a factor allowing the fecundity memory to decay over time. This is, however, likely to be a second-order effect. In addition, the fecundity rate and juvenile survival rate could be separated so that survival rather than fecundity are considered intrinsic.

The robustness of the future predictions of the inertia model was questioned, *inter alia* because the model may be sensitive to perturbations to its initial conditions. For example, Witting (2001) assumes that the population was at its equilibrium level in 1846; starting the population projections in 1600 and including the aboriginal catches from that date might lead to different future trajectories of population size. Many of the population trajectories in Witting (2001) show steep declines in population size in the future. The SWG **agreed** that such declines in population size were not implausible and agreed to include some inertia model based trials to ensure that the full range of plausible hypotheses was included in the trials.

The SWG noted that the statistics used to evaluate the performance of candidate *SLA*s may need to be revised for use with the inertia model. However, it was **agreed** that the present statistics that compare the population levels with and without catch might be suitable and should continue to be used. This matter will be reviewed at the next meeting of the SWG.

The current control program incorporates a version of the inertia model and this has been used in some of the bowhead trials. This implementation uses the traditional Pella-Tomlinson form of density-dependence in combination with the inertia model. It was noted that the formulation of the Pella-Tomlinson model in the control program does not constrain the birth rate to be larger than zero when the population is above *K*, which can lead to time trajectories of population size that exhibit rapid short-term fluctuations. It was agreed to modify the behaviour of the model at high population levels to eliminate this problem. Initial runs of the inertia model indicate that it was possible to obtain good fits to the recent abundance data, but with population trajectories that are at very high levels in the late 1800s. To overcome this problem, a constraint would be added to the population size during this period.

2.1.1.1 NEW TRIALS

The SWG **agreed** to add three trials using the inertia model to the previously agreed set of trials (see Table 1). The three trials can be classified as having fast, medium and slow dynamics. The inertia model would be that used in the bowhead BE24 trial (i.e. including a Pella-Tomlinson density-dependence function) but with a restriction on the birth rate at population levels above *K* and with an additional constraint to ensure that the population between 1880 and 1920 is less than 5,000. There is no obvious definition of 'fast, medium and slow' dynamics. The SWG **agreed** therefore that Allison should conduct analyses based on defining 'fast, medium and slow' according to five alternatives:

(1) Slope: the slope from the first maximum population size after year 0 (= actual year 2003) to the first minimum population size or the slope from year 0 to year 50 if the population size increases monotonically over the entire 50 year period.
(2) F_{MSY}: the constant exploitation rate that, over the next 1,000 years, maximises the average future catch (range 0 to 10% in steps of 0.5%).
(3) F_{ext}: the constant exploitation rate that, over the next 1,000 years, keeps the 1+ population size above 1,000 animals.
(4) Population change: the ratio of the population size in year 50 to that in year 0.
(5) High Low ratio: the ratio of the lowest to the highest population size over years 0 to 50.

The 'slope', 'population change' and 'high low ratio' statistics are based on population projections after 2003 in which the catch is assumed to be zero. To select parameter sets for a simulation trial, the draws from the prior distributions will be divided into three groups based on the values for each of these statistics, a subset of draws for each group will be selected by sampling with replacement and proportional to the likelihood within each group, and the resulting trajectories will be plotted for each group. The e-mail correspondence group will examine the trajectory plots to see which of the five statistics can be best used to define 'fast, medium and slow' dynamics.

2.1.2 CVs

The last two historic estimates of abundance (1995/6 and 1997/8) have both incorporated allowance for covariance between errors in school size estimation and correction for mixed groups. Last year (IWC, 2002b), the SWG agreed that the overall CV associated with the abundance estimates of gray whales would be modelled as the sum of three components: estimation error from factors considered historically (CV_{est}); estimation error in mean school size estimation (CV_{sch}); and additional variance (CV_{add}). As for the bowhead trials, CV_{est} is modelled as a chi square distribution with 19 degrees of freedom, and it was suggested that CV_{sch} also be modelled as a chi square distribution with 10 degrees of freedom. The SWG reviewed the intention of the specifications and agreed that: (1) the expectation of the distribution should match the average observed value; and (2) that the CV of the CVs should be constant and match the observed value of the CV of the CVs. Some concern was expressed that the equation for likelihood assumed independence between the observed estimates and the CV_{sch} but as only two estimates have incorporated this allowance, it was **agreed** that the approximation was sufficient for the trials.

2.1.3 Other

The trials agreed previously use a value of 124 whales for the lowest need value, based on the present catch limits (a total of 620 landed during the five-year period 1998-2002, with a maximum of 140 in any one year). However, it was noted that (a) the *Schedule* referred to takes not strikes; and (b) it was also noted that when the Russian Federation had submitted its need statement in 1997 it had noted that its real need was for up to 340 gray whales but that at that time only up to 140 per year could be realistically harvested (IWC, 1998, p.28). In addition, the USA had at that time submitted a request for up to five gray whales. The Workshop therefore

Table 1

Revised GE trials.

Trial	Description	Model	$MSYR_{1+}$	$MSYL_{1+}$	Final Need	Survey frequency	Historical survey bias	Future survey bias	Future Survey CV
GE01	Base case	D	3.5%	0.6	340	10	1	1	Base
GE02	Low need i.e. constant need	D	3.5%	0.6	150	10	1	1	Base
GE03	Future +ve bias	D	3.5%	0.6	340	6	1	1→1.5 in yr 25	Base
GE04	Future -ve bias	D	3.5%	0.6	340	6	1	1→0.5 in yr 25	Base
GE05	Underestimated CVs	D	3.5%	0.6	340	10	1	1	½ CV_{est}
GE07	$MSYL_{1+}$ = 0.8	D	3.5%	0.8	340	10	1	1	Base
GE08	6 year surveys	D	3.5%	0.6	340	6	1	1	Base
GE09	$MSYR_{1+}$ = 1.5%	D	1.5%	0.6	340	10	0.5 -> 1	1	Base
GE10	$MSYR_{1+}$ = 5.5%	D	5.5%	0.6	340	10	1	1	Base
GE11	Bad data	D	3.5%	0.6	340	10	1	1→1.5 in yr 25	½ CV_{est}
GE12	Difficult 1.5%	D	1.5%	0.6	340	10	0.5 -> 1	1→1.5 in yr 25	½ CV_{est}
GE12a	Difficult 1.5%	D	1.5%	0.6	340	6	0.5 -> 1	1→1.5 in yr 25	½ CV_{est}
GE14	High need	D	3.5%	0.6	530	10	1	1	Base
GE14a	High need	D	3.5%	0.6	530	6	1	1	Base
GE16	$MSYR_{1+}$ = 1.5%; high need	D	1.5%	0.6	530	10	0.5 -> 1	1	Base
GE20	$MSYR_{1+}$ = 5.5%; high need	D	5.5%	0.6	530	6	1	1	Base
GE21	Integrated	D	U [1.5,5.5%]	U [.4-.8]	340	10	1	1	Base
GE21a	Integrated	D	U [1.5,5.5%]	U [.4-.8]	340	6	1	1	Base
GE23	Strategic surveys; high need	D	3.5%	0.6	530	5	1	1	CV_{true}=0.1+ base case value
GE24	Inertia Model – medium	I		0.6	340	10	1	1	Base
GE25	Inertia Model – slow	I		0.6	340	10	1	1	Base
GE26	Inertia Model – fast	I		0.6	340	10	1	1	Base

agreed that it was appropriate to increase the lower value to 150 whales for the purposes of the trials; the base case value is 340.

The previous specifications for the gray whale trials (IWC, 2002b) have assumed that the *SLA* is provided with estimates of abundance every five years. However, the group recognised that 5-yearly estimates may not be available in practise. Surveys have been performed regularly over the past 30 years, but as surveys are costly this pattern may change once the Aboriginal Whaling Scheme is in place. In addition, circumstances may prevent completion of a successful survey. For example, weather and ice conditions have frequently prevented the completion of a successful bowhead abundance survey. In the light of this, the SWG agreed that a base-case value of 10-yearly survey intervals would be used. However, the SWG recognised that there might be a trade off between data availability and need satisfaction so it agreed that a few trials (GE12, 14, 20 and 21) be tested with 6-year surveys for comparison. Trials with future biased data (GE03 and GE04) would be performed with 6-yearly surveys as more data may cause the *SLA* more problems in these cases. The revised list of trials is given in Table 1. The robustness trials should continue to include some 15-year surveys.

3. BOWHEAD WHALES AND THE SELECTION OF AN *SLA*

3.1 Review of trial structure

In light of considerations discussed under Item 4, the Workshop **agreed** that the bowhead *Evaluation Trials* should be changed to assume a 10-year survey frequency. Trial BE08 should be changed to a 5-year interval, and trials BE04, BE09, BE10 and BE12 should be run with both 5-year and 10-year survey intervals. It was **agreed** that Allison should adjust the *Robustness Trials* to account for this. The Workshop **agreed** that the strategic survey trials (BE23 and BR05) should retain a 5-year nominal survey interval.

Punt noted that there were two trials not run in Hammersmith due to lack of time (BR16e-9s and BR11a), and two were revised (BR06b-1 and BR11a). The SWG **agreed** that these should be run and the results circulated to the group via e-mail.

Item 5.4 of IWC (2002a, p.154) describes a trial designed to test sensitivity of *SLA*s to a sharp decline in abundance (to 2,000 whales). The Workshop reviewed this scenario and **agreed** that it should be implemented for trials BE01 and BE16. It reiterated, however, that such a scenario is not even remotely plausible and should not be considered an *Evaluation* or *Robustness Trial.* It is rather being used to assess the relative speed at which the *SLA*s react to large changes in population size. However, it recognised that the interpretation of the results will be difficult since there are both positive and negative aspects of reacting quickly to such a change.

The G-G and D-M *SLA*s were subjected to these trials but a technical problem (underflow error) prevented the results of some of the trials being available during the meeting. The Workshop **agreed** that these trials should be run and all the results considered at the 2002 Committee meeting.

Magnússon reviewed the roles of the *Cross-validation* and *Robustness* trials, and considered whether extrapolatory cross-validation of *SLA*s had been sufficient. The SWG noted that it had increased the number of *Cross-validation* trials last year and that the roughly 100 *Robustness Trials* had been designed to constitute a diverse and challenging set of extrapolatory *Cross-validation Trials*. The SWG **agreed** that all necessary trials should be set at the present meeting. After further consideration, Magnússon indicated that his concerns were sufficiently addressed by the existing trial structure and the long-standing agreement that *Implementation Reviews* must be carried out if any implementation appeared to move outside the scenario space tested by the SWG.

Tables 2 and 3 show the agreed set of bowhead *Evaluation* and *Robustness Trials.*

3.2 Intersessional progress

SC/J02/AWMP1 presented some further developments and explorations of the D-M procedure. The following changes were investigated.

Table 2

The *Evaluation Trials* for the Bering-Chukchi-Beaufort Seas stock of bowhead whales (10 year surveys unless specified).

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 *CV*s	D	2.5%	0.6	134	1	1	**0.25, 0.10**	Good	
BE07*	$MSYL_{1+}$ = 0.8	D, S_E	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	D, S_E	2.5%	0.6	134	1	1	0.25, 0.25	Good	20yr lag
BE23	Strategic surveys;	D	2.5%	0.6	**201**	1	1	0.25, 0.25	Good	Strategic surveys
BE24*	Inertia Model	D	**0.6%**§	0.6	134	1	1	0.25, 0.25	Good	Inertia model

* Requires conditioning. # Age data: Good (no bias or extra variance): $\gamma_{12.9} = 0$, $\lambda_{12.9} = 1$; poor: $\gamma_{12.9} = 2$, $\lambda_{12.9} = 1.5$.

§ $MSYR_{1+}$ here refers to *MSYR* in the absence of inertia dynamics. The value of 0.6% was set intersessionally by the E-mail correspondence group following inspection of trajectories.

Incorporation of the snap-to-need feature: this feature, employed in the G-G procedure, adjusts the strike limit upwards to meet 100% of need if it is nominally above 95% of need.

Using of a finer grid of MSYR values: the previous version of the D-M *SLA* had four different MSYR values which gave a cumulative distribution function for strike limits that is a step function with four levels corresponding to the four MSYR values. In order to reduce the heights of the steps and produce a smoother cumulative distribution, a finer grid of MSYR filters was used. The seven values of 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4% MSYR were used. Adopting an even finer grid is desirable but was not done in this instance for computational reasons. A retuning of the *SLA* is required if a finer grid is used.

Exploring a variety of different catch control laws: the previous version of the D-M *SLA* used the 'H' rule given in IWC (2001, p.150) to determine strike limits, conditional on values of (*K*, *MSYR*). The variants considered in SC/J02/AWMP1 replaced the 'H' strike limit of 0.8RY for stocks between 2,000 whales and MSYL with several intermediate steps so that a lower percentage of *RY* is caught for low stock sizes. These results showed some promise, in particular they showed increased ability to protect the stock in low MSYR trials without severely lowering need satisfaction in trials where productivity is higher. Furthermore, the tunability of the procedure was increased.

In discussion, it was noted that the tuning parameter in the D-M procedure was sensitive to the number of filters chosen. While sensitivity is to be expected, the view was expressed that similar sensitivity was considered problematic during the development of the RMP. If the number of filters was adjusted *post hoc* (e.g. to 'improve the integration over MSYR'), performance of the procedure might be affected sufficiently to require new tuning. However, it was argued that the estimation technique in the D-M procedure should be viewed as a weighting of a discrete list of choices, rather than as a Monte Carlo approximation to an integral. From that viewpoint, there is little justification for *post hoc* improvements such as those required for the RMP.

The filters used in the D-M procedure are evenly spaced over 131 values of K and 4 or 7 values of MSYR. Some suggestions for changing the array of filters were made in discussion. These included: reducing the number of K filters to allow a greater number of MSYR filters; spacing the K filters unevenly; and eliminating some filters whose (K, MSYR) combinations virtually always assured simulated population extinction. The developers of the D-M procedure noted these ideas and indicated that they might investigate several options.

SC/J02/AWMP2 presented results from several pilot studies implementing suggestions the SWG offered for the G-G *SLA* last year. First, transitions to 30% and 50% protection levels (i.e. reductions of the strike limit by those amounts) were made continuous with respect to surveyed abundance. This was done by estimating the range spanned by the quantity triggering such protections when surveyed abundance changed by four standard deviations. The transitions between protection levels were then continuously interpolated over this range. Other SWG suggestions involved removing certain discontinuities with respect to time. SC/J02/AWMP2 noted that *SLA*s are inherently discontinuous with respect to time and that there were practical barriers related to survey timing that prevented meaningful discrete intermediate steps. Furthermore, these discontinuities were internal to the *SLA*; they did not cause a situation where any quantity estimated by the hunters (e.g. survey abundance) would change the strike limit discontinuously. Nevertheless, one discontinuity with respect to time was changed from a single step to six smoother steps, to investigate this SWG concern. All these

Table 3

The *Robustness Trials* for the Bering-Chukchi-Beaufort Seas stock of bowhead whales.

Trial	Factor	Basic trials (Table 2)	Factor Level
BR01	A: Density-dependence	1, 1^S, 9, 9^S	Density-dependence on mature (BE trials use 1+).
BR02	B1: Stochastic dynamics	8^S, 13^S	Stochastic dynamics (with serially-correlated environmental variation).
BR04	E: Survey frequency	9, 13, 14, 16, 20 16, 20	a) 15 yrs b) 5 yrs
BR05	F: Strategic surveys	9 9	a) Yes + CV = (0.25, 0.25) b) Yes + CV = (0.34, 0.25)
BR06	G: Survey bias time dependence	1 1 9, 9^S 12, 12^S 14	a) Historic bias (1978-2002): 1.5 constant; Future bias: decreasing (1.5→1) b) Historic bias (1978-2002): 0.67 constant; Future bias: increasing (0.67→1) c) Future bias: sinusoidal from base value in yr 0 to maximum of 150% in yr 40 d) Future bias: decreasing (1.5→1) from year 0 to 100 e) Future bias: increasing from 1→1.5 in year 25 and constant thereafter
BR07	H: Future survey *CV*	1 1^S 9	a) CV = (0.1, 0.1) b) CV = (0.34, 0.25) c) (0.1, 0.1) + sinusoidal survey bias
BR08	I: Historic catch bias	14, 16^S 14, 16, 16^S	a) 0.5 bias from 1848-1914 b) 1.5 bias from 1848-1914
BR09	K: Time dependence in *K*	1, 9, 10 1, 9, 10 1 1, 21 1, 9	a) *K* halves linearly over 100 years b) *K* doubles linearly over 100 years c) *K* sinusoidal from base value in year 0 to maximum of 150% in year 40 d) Tent *K: K* doubles linearly from years-50 to 0 and halves from years 0 to 50 e) *K* halves linearly over 100 years + strategic surveys
BR10	L: Time dependence in *MSYR*	10 9 1, 8 1, 8 1 1, 21	a) Resilience (*A*) halves linearly over 100 years, b) Resilience (*A*) doubles linearly over 100 years c) Resilience steps 2½%→1%→2½% every 33 yrs over 100 years d) Resilience steps 2½%→1%→2½% every 33 yrs over 100 years in sync with *M* (compute *MSYR* first) – if it is practical halve *M* for each age class e) *K* and *A* halve linearly over 100 years f) *K* and *A* vary as tent (see BR09)
BR11	M: Time dependence in *M*	1, 9, 10 1, 9, 10	a) Natural mortality *M* halves linearly over 100 years (and calculate resulting MSYR) b) *M* doubles linearly over 100 years
BR12	N: Episodic events	1, 1^S, 9, 9^S	2 events occur, between years 1-50, in which 20% of animals die
BR13	O: Integrated	1, 11, 14 11, 14 1, 1^S, 11, 11^S, 14 1^S, 11^S	a) $MSYR_{1+}$~U[0.01, 0.04]; fixed $MSYL_{1+}$=0.6 b) $MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8] c) $MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8]; historical catch bias ~U[0.5, 1.5]; Serial correlation ~ U[0.47, 0.95] d) $MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8]; historical catch bias ~U[0.5, 1.5]; Serial correlation ρ~ U[0.47, 0.95], time delay in density-dependence ~U[0, 30]
BR14	P: 1st year of population projection	1, 9	1940 (reference or base case level is 1848 or 1748 for stochastic trials)
BR15	$MSYL_{1+}$=0.9	1, 9, 10	
BR16	B2: Different stochastic parameters	1^S 1^S 1^S, 9^S, 10^S 1^S 9^S	a) Negative correlation in recruitment $\rho = -0.75$ b) High correlation in recruitment $\rho = 0.9$ c) High correlation in recruitment $\rho = 0.9$; + Episodic events d) Change σ_ε^2 to give 3* variation in population size at equilibrium e) $\rho = 0.9$ + change σ_ε^2 to give 3*equilibrium variation +episodic events

experimental changes described in SC/J02/AWMP2 resulted in very small and predictable effects on strike limits and performance.

The Workshop discussed a number of technical points regarding the design of the G-G *SLA* and the discontinuities therein. It believed the approaches illustrated in SC/J02/AWMP2 were suitable strategies for responding to SWG suggestions. It **agreed** with the author that discontinuities with respect to survey abundance were qualitatively different and of much greater concern than discontinuities with respect to time or similar quantities. The SWG also endorsed the choice of roughly 100 whales as the span over which continuous protection level transitions were made in SC/J02/AWMP2 to address the discontinuity with respect to survey abundance. The SWG believed that the removal of other discontinuities might be investigated to the extent that this does not deteriorate performance of the algorithm, but did not view this to be essential.

3.2.1 Selection of preferred SLA(s)

The difficulty in selecting a final *SLA* from the two excellent procedures had been noted at the last meeting.

During the Workshop, Givens suggested that a candidate *SLA* that took the simple mean of the G-G and D-M block strike limits would perform extremely well. Furthermore, this would provide a procedure with a built-in check-and-balance system because if one *SLA* behaved somewhat erratically in one instance, the effect would likely be muted by the better performance of the other *SLA*. Adoption of this averaged *SLA* (hereafter termed GUP – the

Grand Unified Procedure) would prevent the SWG from being forced to select between two very different yet highly desirable *SLA*s on the basis of small performance differences that are partially obscured by random variation. The Workshop **agreed** that such an approach was extremely desirable and should be pursued. It was noted that it would be possible to overlay a snap-to-need feature on such an averaged *SLA* in order to retain this feature, which would otherwise be eliminated by averaging. A number of snap-to-need overlay methods were discussed, and the SWG **agreed** that a suitable choice could easily be made.

The developers agreed to separate out the snap-to-need features in their *SLAs* so that the raw catch limits from each would be available to the GUP *SLA*; the snap-to-need feature can then be applied after the averaging.

3.2.2 Review of Guidelines for Developers after the 2001 meeting

Last year, the SWG developed a list of instructions about the changes to each *SLA* either sought or forbidden by the SWG (see Annex D). After reviewing these decisions, the SWG **agreed** that those instructions were still relevant, although its interest in time-continuity had weakened. Magnússon sought clarification regarding what constituted a substantial change in a *SLA*. The SWG **agreed** that changes which compelled a re-examination of most trial results would be substantial. For example, adding bias filters to the D-M procedure would probably comprise a substantial change. The SWG noted that in SC/J02/AWMP1 the changed catch control law ‘H’ was at the upper end of what would be considered an acceptable change; any greater change would be a matter of concern. The Workshop **instructed** the *SLA* developers that if they were in doubt about whether any planned change would be acceptable or not, they should contact the SWG via e-mail to seek advice before proceeding.

3.3 Presentation of results for the SWG

In consideration of its concerns about avoiding substantial modifications to *SLA*s at this point, the Workshop requested that developers provide the following scatter plot to compare new and old versions of their procedures. The horizontal axis should show the original block strike limits. The vertical axis should show the new block strike limits. The figure should contain 2,000 points (100 replicates with 20 block quotas each) if it is based on one trial (e.g. BE01). The selection of trials to examine was left to the developers to provide. The possible advantage of pooling the results from several trials in one scatter plot should be considered. The $x = y$ line should be added for reference. Supplemental plots designed by developers to aid in the comparison of their original and revised *SLA*s are also welcome.

Next, the SWG considered how to organise the voluminous tabular and graphical results that would be generated to compare the G-G, D-M and GUP (Grand Unified Procedure) *SLA*s. The SWG was satisfied overall with the presentation of results last year. Revisions and additions suggested by the SWG were as follows. The plots of 100 strike limit trajectories for each trial (*Evaluation* and *Robustness*) should be constructed. The plots in figure 6i-iii of IWC (2002a, p.171) should be constructed by Allison. The plots in figures 7i and 7ii of IWC (2002a, pp.172-173) are unnecessary.

All tables and results will be compiled in a ‘book’ to be made available to the SWG. All tables and results for *Evaluation Trials*, and selected tables and results for *Robustness Trials*, will be distributed to each SWG member. The SWG **agreed** that a small group consisting of Dereksdottir, Givens, Magnússon and Punt would sort through the complete tables and results in order to select which *Robustness Trial* results should be distributed. The standard for selection would be whether any member of that small group believed that the item conveyed useful information. The small group might also construct a summary of which items from the *Evaluation Trials* are most important, based on the same standard. In addition to this summary, all *Evaluation Trial* results should be distributed.

3.4 Presentation of results to the Scientific Committee

The SWG **agreed** that its presentation of results to the Scientific Committee should not differ substantially from that for the Commission. For reasons of clarity, results from procedures not preferred by the SWG should not be provided to the Scientific Committee.

3.5 Tuning

SC/J02/AWMP2 discussed several issues related to potential tuning of *SLA*s. In the most plausible trials, the G-G and D-M *SLA*s do an excellent job in satisfying nearly all aboriginal need while leaving the stock above MSYL. To seek an alternate tuning with higher catch might risk severely diminishing returns because fulfilling the last few percentage points of need satisfaction on plausible trials would probably require significant performance sacrifices on other trials. Conversely, it is also unreasonable to seek an alternate tuning with lower risk because this amounts to asking the developer to create an *SLA* that is inferior to the original tuning in the sense that it provides less catch at equal practical risk to the stock (namely none).

Furthermore, SC/J02/AWMP2 noted that the SWG has received explicit and precise performance goals from the Commission, and – on plausible trials – meeting these goals allows very little room for tuning freedom. It is only on less plausible trials where a range of tunings can provide a range of catch/risk tradeoffs.

The SWG also noted that the GUP *SLA* (see Item 3.2) reduces the relevance of equivalence tuning. It would no longer be necessary to tune two competing *SLA*s for a fair comparison by matching their performances on some key statistic.

The SWG **agreed** that it was not necessary to establish precise tuning goals to which *SLA* developers must adhere. After reviewing some simulation results for various tunings of the G-G and D-M *SLA*s from last year and for alternative tunings of D-M given in SC/J02/AWMP1, the SWG **agreed** that the range of tunings seen thus far was not outside the range of trade-offs it deemed reasonable. The SWG **agreed** that each developer should bring between two and three tunings of their procedure. It advised that at least one tuning should provide median D_{10} value on BE12 of 1.0 or greater.

Given that there is essentially no tuning freedom if an *SLA* is to best meet the Commission’s objectives on plausible trials, the SWG **agreed** that it would consider presenting only a single tuning of the preferred procedure to the Commission and the Scientific Committee. Along with this, it would present illustrative data on how performance would suffer on plausible trials if the procedure were retuned to alter the catch/risk trade-off on less plausible trials.

It was **agreed** that the GUP *SLA* will be based on the developers preferred tunings only.

4. ABORIGINAL WHALING MANAGEMENT SCHEME

4.1 Rules

4.1.1 Carry-over

The concept of carry-over is intended to address the problems associated with variability in hunting conditions in a harsh environment. Last year, the Committee presented the Commission with the following illustration:

> For the purposes of illustration only it is assumed that the block is 5 years, that the total strike limit over the 5 year period is 500, and that an inter-annual carry over allowance of 50% is permitted. The block length and the percentage inter-annual carryover allowance are numbers for which explicit advice is require from the Commission. The total block quota is then divided by the number of years to provide an average annual quota.

In response the Commission agreed:

> …that blocks of five years with an inter-annual variation for fifty percent were satisfactory in terms of allowing for the likely variability in hunting conditions. It therefore agreed that these values are appropriate for use in trials. It was recognised that this does not commit the Commission to these values in any final aboriginal whaling management procedure.

In order to allow the Commission to consider this further, the Workshop notes that if under a recommended *SLA*, current need is met (and there is no indication from the present results that this will not be the case), then a revised *Schedule* paragraph for bowhead whales might look something like:

> *For the years* ***[2003-2007]*** *inclusive, the total number of strikes shall not exceed* ***[330]****. The Strike Limit in any one year shall not exceed [100].*

4.1.2 Survey interval and related issues

Phase-out is the process by which catch limits are reduced in the absence of new abundance data. Donovan noted that when he presented the Committee's discussion of this to the Commission (and representatives of the AEWC – the Alaska Eskimo Whaling Commission) at the Commission meeting last year, this concept was the most contentious.

George presented a brief summary of the AEWC concerns regarding phase-out. In essence, the AEWC felt that the phase-out concept should apply only to commercial whaling and is overly harsh, and even suggests mistrust of aboriginal whalers and hunters. The AEWC further stated that the AWMP 'rules' should provide hunters with as much freedom as possible to cope with environmental variability, since it has such a significant effect on surveys and hunting success.

The Workshop noted the concerns of the AEWC. It referred to its earlier discussions of the difficulties in carrying out successful censuses[1] (and hunting) in the Arctic environment and its efforts to take this into account both by using a survey interval of 10 years and in the carryover provision described above. However, it noted that it was not possible to successfully manage in the absence of data; the Workshop did not believe that it was acceptable for catches to be allowed to continue at level of need if there was no new abundance information for long periods. This does not imply mistrust of hunters and the cooperation of the AEWC in the census effort is well recognised and greatly appreciated. Whilst it is hoped and expected that any phase-out rule will never need to be utilised, it is important that any comprehensive management procedure includes rules for such an eventuality.

There was substantial discussion of what form any decrease in catches might take. After discussing a number of approaches, the Workshop **agreed** to the following principles to be applied to any 'grace period':

(1) the grace period should not exceed five years (after which time, catches will be reduced to zero);
(2) over the 5-year period, the block limit shall be reduced by 50% (analogous to a linear reduction);
(3) carryover from the last block is permissible (the same conditions that can render a survey unusable can also preclude the hunt);
(4) the distribution of strikes over the time period is the responsibility of the hunter (they may for example decide to place no restrictions at the beginning of the period – but in the absence of an estimate in that period the catch will be reduced to zero in less than the five years;
(5) when a survey is successfully conducted, the *SLA* is applied and a quota generated – the quota is then applied retroactively to the current block and the 'used' strikes subtracted from the resultant block limit.

Concern had been expressed about the possibility that should sequential annual surveys be conducted, only the 'best' survey might be submitted. The 'strategic survey' trials examine this situation. It was also noted that survey plans will be submitted in advance to the Committee and that regardless of how many surveys are conducted, all resultant estimates are included in the survey database and used by the *SLA*.

The Workshop noted the need to consider how the application of the *SLA* in 5-year blocks, variable survey times and application of a 'grace period' might occur in practice. It briefly considered this subject and Donovan **agreed** to develop a paper for consideration at the next meeting.

4.1.3 Guidelines for surveys

The Workshop reviewed and reconfirmed the principles for surveys developed at last year's meeting agreed by the Commission regarding: survey/census methodology and design; Committee oversight; and data analysis. The Workshop **agreed** that it was not necessary to develop these into a formal document for inclusion in the overall AWS at the present time. It noted that if the *SLA* was to be adopted at the next meeting, some consideration would be needed of the fact that some of the criteria (e.g. submission of data by a particular time) may need to be relaxed.

4.1.3.1 SURVEY/CENSUS METHODOLOGY AND DESIGN

The SWG had **agreed** that plans for undertaking a survey/census should be submitted to the Scientific Committee in advance of them being carried out, although prior approval by the Committee is not a requirement. This should normally be at the Annual Meeting before the survey/census is to be carried out. Sufficient detail should be provided to allow the Committee to review the field and estimation methodology. Considerably more detail would be expected if novel methods are planned.

4.1.3.2 COMMITTEE OVERSIGHT

The SWG had **agreed** that it was appropriate that should it desire, the Scientific Committee could nominate one of its members to observe the survey/census to ensure that proposed methods were adequately followed. This would be more important if novel methods were being used.

[1] Weather and ice conditions often prevent the completion of a successful bowhead abundance survey even when all the best efforts are made. Since 1988, three successful censuses have been made (1988, 1993, 2001) in six attempts.

Table 4

Work plan.

Task	To be undertaken by:	Timetable
Modify gray whale trials, including the inertia model.	Allison	
Complete modifications of *SLAs* and submit to Secretariat.	Givens; Dereksdottir and Magnusson	
Prepare RMP version.		
Run trials for G-G, D-M and GUP and prepare new 'book'.	Allison	Shimonoseki
Develop discussion document on survey interval and 'grace period'.	Donovan	Shimonoseki

4.1.3.3 DATA ANALYSIS AND AVAILABILITY

The SWG had **agreed** that it was appropriate that all data to be used in the estimation of abundance were made available to the Scientific Committee suitably in advance of the Annual Meeting at which an estimate was to be presented. If new estimation methods are used, the Committee may require that computer programs (including documentation to allow such programs to be validated) shall be provided to the Secretariat for eventual validation by them.

4.1.4 Guidelines for data/sample collection

The SWG had **agreed** that data from each harvested animal should be collected and made available to the IWC. The following information should normally be provided for each whale: species; number of animals; sex; season; position of catch (to the nearest village); and length of catch (to 0.1m). It further requested that information/samples on reproductive status and samples for genetic studies be collected where possible. The Workshop noted the value of traditional knowledge in its discussions and agreed that any such information will be valuable when conducting *Implementation Reviews*.

5. PRESENTATION OF RESULTS TO THE COMMISSION

The SWG **agreed** that its presentation to the Commission should resemble that to the Scientific Committee.

The SWG considered how best to compare the performance of the preferred *SLA* to performance that might be achieved using the current management regime, and to that achieved with management conducted according to an implementation of the RMP. For the former comparison, the SWG **agreed** that it would be counterproductive and probably infeasible to make an accurate comparison via simulation. Instead, the SWG **agreed** to develop a qualitative list of reasons why the AWMP represents a better approach to management than the existing approach. Donovan **agreed** to provide a draft for discussion at the next meeting of the SWG.

For comparison with the RMP, the SWG **agreed** to implement the RMP on trials BE01, BE09 and BE10. These results will be summarised by the SWG for presentation to the Commission.

6. WORKPLAN AND PRIORITY TASKS

The Workshop agreed to the following work plan given in Table 4.

7. TYPE THREE FISHERIES

Punt and Breiwick (2002) provides the specifications for a generic framework within which operating models for Type 3 fisheries can be developed. This framework is founded on an individual-based model that includes temporally correlated environmental variation in births and survival as well as the possibility of occasional catastrophic reductions in survival. Methods are developed to specify the value of the parameter that determines the productivity of the resource from that for *MSYR*, to enable simulation trials based on this framework to be parameterised in terms of *MSYR*. Three potential candidate *Strike Limit Algorithms* are evaluated using 14 'generic' simulation trials that capture a range of factors pertinent to Type 3 fishery situations.

SC/J02/AWMP3 examined the question of whether it is necessary to use an individual-based operating model for Type 3 fisheries or whether a framework based on an operating model that is age- and stage-structured but also considers demographic uncertainty, environmental variability in births and survival and catastrophes would be adequate. The stages considered in SC/J02/AWMP3 were males, immature females, mature females that can give birth this year and mature females that gave birth last year. This stochastic age- and stage-structured model leads to qualitatively, and also largely quantitatively, identical results to the individual-based model described in Punt and Breiwick (2002). SC/J02/AWMP3 argued that an age- and stage-structured model would be appropriate as the basis for operating models for Type 3 fisheries.

In discussion, it was noted that the approach of SC/J02/AWMP3 was based on the assumption of homogeneity in the values for biological parameters such as fecundity and survival among animals of the same age and stage while the individual-based model of Punt and Breiwick (2002) could allow for heterogeneity in these parameters. The Workshop suggested that further work related to developing operating models for Type 3 fisheries might be to apply the approaches of Punt and Breiwick (2002) and SC/J02/AWMP3 to the data for North Atlantic right whales to assess whether they are capable of replicating the dynamics of this well-studied population. It was also suggested that the approach in SC/J02/AWMP3 could be compared with an extension of the SE model that underlies the trials for the Bering-Chukchi-Beaufort Seas stock of bowhead whales to assess whether the complications of integer-based dynamics inherent in SC/J02/AWMP3 are necessary.

8. ADOPTION OF REPORT

The draft report was adopted at the end of the meeting. The final sections were completed intersessionally. The Workshop thanked the Chair for his excellent chairmanship. The Chair thanked the participants for: not mentioning North Pacific common minke whales; for their hard work and cooperative spirit; and most of all for the proposed GUP solution which seemed to him both elegant and fair, and in the best interests of both the Commission and the hunters. Finally, he thanked NMML for its usual hospitality, kindness and efficiency in hosting the meeting.

REFERENCES

Butterworth, D.S., Korrûbel, J.L. and Punt, A.E. 2002. What is needed to make a simple density-dependent response population model consistent with data for the eastern North Pacific gray whales? *J. Cetacean Res. Manage.* 4(1):63-76.

Grebmeier, J.M. and Harrison, N.M. 1992. Seabird feeding on benthic amphipods facilitated by gray whale activity in the northern Bering Sea. *Mar. Ecol. Prog. Ser.* 80(2-3):125-33.

Highsmith, R.C. and Coyle, K.O. 1990. High productivity of northern Bering Sea benthic amphipods. *Nature, Lond.* 6269:862-4.

Highsmith, R.C. and Coyle, K.O. 1992. Productivity of Arctic amphipods relative to gray whale energy requirements. *Mar. Ecol. Prog. Ser.* 83(2-3):141-50.

International Whaling Commission. 1998. Chairman's Report of the Forty-Ninth Annual Meeting. *Rep. int. Whal. Commn* 48:17-52.

International Whaling Commission. 2001. Report of the Scientific Committee, Annex E. Report of the Standing Working Group (SWG) on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP). Appendix 3B. Fishery type 2: Implementation for Bering-Chukchi-Beaufort bowhead whales. *J. Cetacean Res. Manage. (Suppl.)* 3:142-52.

International Whaling Commission. 2002a. Report of the Scientific Committee. Annex E. Report of the Standing Working Group (SWG) on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP). *J. Cetacean Res. Manage. (Suppl.)* 4:148-77.

International Whaling Commission. 2002b. Report of the Third Workshop on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP). *J. Cetacean Res. Manage. (Suppl.)* 4:415-53.

Punt, A.E. 1999. Report of the Scientific Committee. Annex R. A full description of the standard BALEEN II model and some variants thereof. *J. Cetacean Res. Manage. (Suppl.)* 1:267-76.

Punt, A.E. and Breiwick, J.M. 2002. A framework for evaluating *Strike Limit Algorithms* for population reduced to small numbers. *J. Cetacean Res. Manage.* 4(2):165-77.

Witting, L. 2001. On inertial dynamics in whale populations. The case of the eastern North Pacific gray whale. Paper SC/53/AWMP6 presented to the IWC Scientific Committee, July 2001, London (unpublished). [Paper available from the Office of this Journal].

Annex A
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
   - 1.4 Review of documents
2. Gray whale trials structure
   - 2.1 Review of trial specifications
     - 2.1.1 Model related issues
       - 2.1.1.1 New trials
     - 2.1.2 CVs
     - 2.1.3 Other
3. Bowhead whales and the selection of an *SLA*
   - 3.1 Review of trial structure
   - 3.2 Intersessional progress
     - 3.2.1 Selection of preferred *SLA*(s)
     - 3.2.2 Review of Appendix 4 of Annex E
   - 3.3 Presentation of results for the SWG
   - 3.4 Presentation of results to the Scientific Committee
   - 3.5 Tuning
4. Aboriginal whaling management scheme
   - 4.1 Rules
     - 4.1.1 Carry-over
     - 4.1.2 Survey interval and related issues
     - 4.1.3 Guidelines for surveys
       - 4.1.3.1 Survey/census methodology and design
       - 4.1.3.2 Committee oversight
       - 4.1.3.3 Data analysis and availability
     - 4.1.4 Guidelines for data/sample collection
5. Presentation of results to the Commission
6. Work plan and priority tasks
7. Type three fisheries
8. Adoption of report

Annex B
List of Documents

SC/J02/AWMP

1. DEREKSDÓTTIR, E.H. and MAGNÚSSON, K.G. Further developments of a *Strike Limit Algorithm* for the BCB Seas stock of bowhead whales based on Adaptive Kalman Filtering.
2. GIVENS, G. Pilot studies and discussion of potential revisions to a *Strike Limit Algorithm* for managing aboriginal hunting of bowhead whales.
3. PUNT, A.E. On the basis for evaluating *Strike Limit Algorithms* for Type 3 fisheries.

Annex C
Fishery Type 2: Implementation for Eastern Gray Whales

[See Appendix 3ii of Scientific Committee Report, Annex E, this volume, pp.183-190]

Annex D
Instructions for *SLA* Developers Regarding Intersessional *SLA* Alterations

Geof Givens

Three different issues were raised with respect to discontinuities in procedures. First, both procedures could produce strike limits that were discontinuous with respect to abundance at a given time. In the case of the D-M procedure, this would arise if, for example, the distributions of quotas corresponding to the MSYR = 1% filters and the MSYR = 2% filters were mostly disjoint. Then, when the 70^{th} percentile of the catch control law output shifted from belonging in one distribution to the other due to a negligible change in the abundance estimate, the strike limit would jump discontinuously. In the case of the G-G procedure, the discontinuities were explicit: if an estimator depending on abundance was less than, for example, 6,700 whales, the strike limit is reduced by 30%.

For the G-G procedure, it was agreed that Givens should examine the quantity that triggers the intermediate protection level effects to determine how much variation in it is induced by a +/- 2 standard error variation in the current abundance estimate. Then, he should interpolate the desired protection level (e.g. reduction from 100% to 70% of the nominal strike limit) over this range of the estimator. This approach was only a SWG suggestion to indicate the degree of smoothness desired; if Givens developed a better approach the SWG would welcome it. For the D-M procedure, the SWG believed it could be beneficial (but not required) to increase the fineness of the mesh in the grid of parameter values used, as this might increase smoothness.

The developers of both procedures were instructed not to change the aspect of either procedure that sets the strike limit to zero when the *SLA* estimates that the stock has fallen below 2,000 whales.

The second issue was that some protection levels in the G-G procedure were introduced only at fixed times (e.g. after 35 years) during the 100-year period. The SWG agreed that it was not necessary for protection levels to be invoked from year zero; however it believed that their invocation might be phased in gradually rather than instantaneously. It asked Givens to investigate this idea.

The third discontinuity issue was that the relationship between the strike limit and one of the predictors in the G-G procedure had a different slope after year 35. Again it invited Givens to investigate whether the *SLA* could be altered to phase in the change in slope more gradually.

The G-G procedure also included a 'snap-to-need' feature that made small, discontinuous increases in need satisfaction in cases where this was sure to have negligible management consequences. The SWG agreed that this feature was not a cause for concern, and could be a useful component of a good *SLA*. Butterworth cautioned that such features could lead to practical implementation problems, as with the discontinuities discussed above. The SWG believed that the D-M procedure might be improved if this feature were added to it.

The SWG agreed that the D-M procedure could be retuned by changing the values of the parameters of the catch control law (eg. changing permissible catch from 80% to 90% of replacement yield for moderately depleted stocks). However, the SWG also agreed that the functional form of this catch control law should not be altered.

The SWG agreed that each developer should provide a low, central, and high tuning of their procedure to the next meeting. There was not time to specify sufficiently what range these tunings should cover; however the group believed that examination of the 5^{th} percentile of D_{10}, for zero catch or ideal catch, in one or more trials where $MSYR_{1+} = 0.01$ might be helpful in this regard. The group agreed to continue discussions intersessionally with the aim of providing some general guidance while avoiding the pitfalls of overspecificity it encountered with its previous attempts to define a tuning.

One potential improvement that might be made to the G-G *SLA* would be if it incorporated the D-M *SLA* in its H-optimisation step. The developer had noted that the G-G procedure had been built using only predictors from the A-P and J-B procedures, which had inferior performance to the D-M procedure, yet it had built from these a procedure with performance similar to that of the D-M *SLA*. It was unclear to what extent performance could be improved further through incorporation of the D-M *SLA* predictors. The SWG agreed that it would be interesting to investigate this question, but also had some concerns about maintaining recognizable evolution of the G-G procedure. It decided that this investigation had a very low priority.

Concerned about maintaining comparability to this year's *SLA* candidates, the SWG agreed that unless the G-G *SLA* was expanded to incorporate predictors from the D-M *SLA*, the developers of the D-M procedure should not add any new filters to their procedure (including bias filters). The SWG asked Givens to notify the D-M developers if he decided to incorporate D-M predictors in G-G; and it instructed the

D-M developers not to make substantial changes to their procedure unless so notified. An exception to this is that the SWG believed it would be appropriate for the developers to alter their existing grid of filters to have a finer mesh, if they believed this to be necessary. The SWG also agreed that the D-M *SLA* should not be altered to rely on fewer values of MSYR than at present.

In general, the SWG held the view that the remaining development period was intended for modest changes to procedures in direct response to SWG concerns. It intended that developers should not engage in further, open-ended efforts to improve the performance of their procedures. The SWG wanted the *SLA*s at the next meeting to remain as similar as possible to those it had examined at this meeting. It was also noted that if substantially improved *SLA*s were eventually developed, they could be considered after adoption of an AWMP via the mechanism of an *Implementation Review*. For the D-M procedure, the SWG had identified very few design features it wished to see improved. Because the SWG had identified more design features to improve for the G-G procedure, and since these changes were more likely to impact performance, the SWG agreed that Givens would need some latitude to change the G-G *SLA* design to meet the SWG's design priorities while maintaining its high level of performance.

Finally, the SWG emphasised that there was an important distinction to be drawn between the 'design' features and the 'performance' features. The SWG was very pleased with the performance of both procedures and did not intend for this discussion to negate its belief that either procedure would provide performance that adequately meets the IWC's aboriginal whaling management goals. The intent is facilitate the development of procedures that have equally suitable design features.