Report of the Scientific Committee

Bled, Slovenia, 9-21 May 2017

Annex D: Report of the Sub-Committee on the Revised Management Procedure

**This report is presented as it was at SC/67a.
There may be further editorial changes (e.g. updated references, tables, figures) made before publication.**

International Whaling Commission

Bled, Slovenia, 2017

Annex D

Report of the Sub-Committee on the Revised Management Procedure

Members: Robbins (Convenor), Al Jabri, Allison, Baba, Baker, Bell, Bjørge, Brandão, Brownell, Butterworth, Cipriano, Cooke, de la Mare, de Moor, Diallo, Doherty, Donovan, Double, Enmynkau, Fortuna, Frey, Fruet, Fujise, Funahashi, Gonzalez, Goodman, Goto, Gunnlaugsson, Hakamada, Haug, Hoelzel, Hubbell, Iñíguez, Isoda, Johnson, Kim, Kitakado, Konan, Lang, Lundquist, Maeda, Mallette, Matsuoka, McKinley, Miyashita, Morishita, Morita, H., Morita, Y., Moronuki, Murase, Nakamura, Nelson, Øien, Palka, Pampoulie, Panigada, Park, Pastene, Phay, Punt, Redfern, Reeves, Santos, Simmonds, Skaug, Slugina, Solvang, Taguchi, Tamura, Tiedemann, Víkingsson, Wade, Walløe, Walters, Witting, Yasokawa, Yasunaga, Yoshida, Zerbini, Zharikov.

1. INTRODUCTORY ITEMS

1.1 Convenor's opening remarks

In the absence of Robbins, Donovan welcomed the participants.

1.2 Election of Chair and appointment of rapporteurs

Robbins was elected Chair. Punt acted as the rapporteur.

1.3 Adoption of Agenda

The adopted Agenda is shown in Appendix 1.

On behalf of Japan, Moronuki stated that:

> *Japan understands that one of the objectives of agenda items "2.3 General consideration of how to evaluate the effect of special permit catches on stocks" and "2.4 Improvements in SCAA or RMP performance by improved precision in biological parameters" is consideration of relevant guidelines proposed for incorporation into Annex P responding to the recommendations from the Expert Panel of NEWREP-NP (Rep 01).*
>
> *As Japan expressed in its response paper to the Panel (SP01), many of the requirements proposed by the Panel, including additional requirements of quantifications of the effect on stock and improvement in RMP performance impose unreasonably heavy burdens upon proponents. These are mainly unnecessary and reflect a misunderstanding of the review process which has the effect of making any implementation of Special Permit programs unreasonably difficult particularly for those Contracting Governments whose resources and capacities are limited. For this reason, Japan will oppose the proposed amendments of Annex P that reflect the noted recommendations of the Expert Panel.*
>
> *However, Japanese scientists may participate in discussions as far as it concerns purely scientific and technical perspectives associated with RMP.*

St. Lucia associated itself with the view expressed by Japan.

1.4 Available documents

The documents considered by the sub-committee were SC/67a/RMP01-04, SC/67a/NH05, SC/67a/Rep01, SC/67a/Rep05, SC/67a/Rep07, SC/67a/SCSP01-02, SC/67a/SCSP08 and SC/67a/SCSP13.

2. GENERAL ASSESSMENT ISSUES WITH A FOCUS ON THOSE RELATED TO THE REVISED MANAGEMENT PROCEDURE

2.1 Relationship between $MSYR_{mat}$ and $MSYR_{1+}$: evaluate energetics-based model

SC/67a/RMP02 illustrated some improvements in the parameterisation of the individual based energetics model (IBEM) for humpback whales. Some examples were given of the density-dependent relationships for a range of demographic parameters and how these are affected by variability in food supply. The results showed that the variability and correlation between demographic parameters is linked to variable food supply. A stage-based model was developed to use these parameter characteristics to emulate the results given by the full IBEM. Some illustrations showed that some features of the IBEM are emulated by the stage-based model, but some differences in dynamics are also evident. Further work is needed to develop and apply diagnostics to compare the properties of the IBEM model and its emulator in order to make improvements to the latter.

The sub-committee thanked de la Mare for continuing to develop the IBEM and to initiate development of an emulator model. An emulator model could form the basis for future *Implementation Simulation Trials* once it is fully developed. The sub-committee noted that this work was initiated to examine more fully the relationship between $MSYR_{1+}$ and $MSYR_{mat}$, but that a stochastic model could replace the current deterministic model as the basis for the operating models used in *Implementation Simulation Trials*.

The sub-committee identified priorities for the next steps for this work:

(1) continue to assess whether it is possible to represent the trajectories from the IBEM using the emulator model;
(2) compare the yield curves from the IEBM with those from the emulator model; and
(3) develop guidelines for how to use an emulator model as the basis for a multi-stock, multi-area population dynamics model and how such a model could be conditioned given available data.

The sub-committee noted that it would not be easy to use age data during conditioning if the operating model was based on a stage-structured population dynamics model, and suggested that de la Mare consider developing an emulator model based on an age-structured model. In addition, it recognised the importance of applying the IEBM and any emulator model to minke whales, given minke whales are the primary focus of the sub-committee.

2.2 Implications of *IST*$_5$ for consideration of 'status'

RMP and AWMP *Implementation Simulation Trials* are designed to provide robust management advice, but not 'status' in the traditional sense expected by the Commission (i.e. what is the present 'stock' level compared to the unexploited level and what are the likely future trends). Rather, they provide considerable output for a wide range of plausible scenarios that would need to be integrated and summarised to provide measures of status. The results of a set of *Implementation Simulation Trials* should be summarised by the following three statistics to provide information on status:

- current depletion (number of animals aged 1+ and older relative to 1+ carrying capacity);
- current 1+ abundance; and
- 1+ abundance in 2050 if all future RMP and AWMP catches (but not projected bycatches) are assumed to be zero.

Results should be provided for two values for the MSY rate (1% in terms of harvesting of the total (1+) component of the population and 4% in terms of harvesting of the mature component) unless the base-case trials are based on a higher value for the lowest plausible value for MSY rate or if MSY rate has been estimated and there is an agreed value. In addition, results should be summarised across simulations and trials (medians over simulations and averages across base-case trials).

Each base-case trial may have a different number of breeding stocks. Results should be reported by area, specifically for the Ocean Basin (i.e. 'Region'), and by 'Medium Area', rather than by the sub-areas on which the population model underlying the trials are based to avoid having a very large number of summary statistics. However, there needs to be flexibility in reporting. For example, the Committee may also wish to present results for individual biological stocks that it believes the Commission needs to be informed about, and hence that the default of reporting results by area provides a misleading impression. For future assessments, the choice of the stocks for which results are be reported needs to be decided during *Implementations* and *Implementation Reviews*. The sub-committee **recommends** that the Guidelines for Conducting *Implementations* and *Implementation Reviews* be updated to reflect the choice of the stocks for which results are be reported needs to be decided during *Implementations* and *Implementation Reviews*, and that the control programs used for *Implementation Simulation Trials* be modified to report the three measures of status. In addition, the results for all stocks should be calculated and made available to the Commission, but not included in the primary presentation.

2.3 General consideration of how to evaluate the effect of special permit catches on stocks

Evaluation of the effects of catches on stocks should be based on the best available information regarding the status and productivity of the stock or stocks in the area in which scientific permit catches are to occur. Conducting projections to evaluate the effects of catches will rely on a well-specified sampling plan that includes details on where within the study area and when catches are expected to occur (should this information be uncertain, it will be necessary to consider sensitivity to alternative plausible outcomes of the sampling plan).

Where possible, evaluation of scientific permit catches should be based on existing models and methods developed by the Scientific Committee. The draft guidelines consider the following scenarios:

(1) where either an AWMP or RMP *Implementation* has been completed for the species/region concerned;
(2) where an in-depth assessment has been completed; and
(3) other cases (i.e. where neither (1) nor (2) apply).

In all cases, projections should be conducted that consider a set of scenarios that aim to cover the core uncertainties for the region and species (although, not at the level of detail one would expect for an RMP/AWMP *Implementation*). In some cases, the amount of modelling work could be minimal if it is clear that effects of the catches will be minimal. Appendix 2 outlines a set of guidelines for the calculations to evaluate the effects of special permit catches on stocks.

2.4 Improvements in management performance (in relation to RMP and SCAA) by improved precision in biological parameters

SC/67a/SCSP02 outlined a potential approach for using the RMP *Implementation Simulation Trial* framework to inform quantification of the management-related benefits of research programs. The approach involves: (1) defining a metric to

quantify the benefits of scientific research (such as the improvement in catches given a fixed level of risk); (2) identifying a set of uncertainties that if addressed may improve management performance as indicated by that metric; (3) calculating the extent to which alternative research programmes will reduce those uncertainties; and (4) using simulations to relate the improved management performance to sample size. A simple example was provided for a case in which a lethal research programme occurs in coastal areas and there is uncertainty about productivity (as quantified using MSYR) and stock structure (one or two stocks).

General issues
Discussion focussed on general issues related to evaluating management-related benefits of scientific research programmes and special permit programmes, in particular. The sub-committee noted that the present situation has been frustrating to both proponents and reviewers as witnessed by comments in Panel reports and in responses to those by proponents. It was agreed that, in principle, it would be useful for both proponents and reviewers if there was general guidance on the level of information to be provided to show quantitatively that any proposed research will have management benefits. Whilst the sub-committee agreed that it is not reasonable to 'accept' either a general assertion that there will be benefits or to 'require' a formal demonstration with 100% certainty that there will be an improvement, it was recognised from the discussions of the papers at this meeting that developing consensus on what constitutes 'sufficient' information will be a difficult task. It was therefore:

(a) agreed that the topic should be given priority at next year's sub-committee meeting; and
(b) strongly encouraged members to develop discussion documents (and where possible potential guidelines) to address this issue well in advance of next year's meeting.

While it was not considered appropriate to form an intersessional correspondence group, it encouraged collaboration and sharing of ideas amongst interested scientists.

The sub-committee noted that Panel Reports have included many 'recommendations', some of which are actually suggestions for further analyses to help the proponents as they conduct future work, but that they do not reflect fundamental flaws with the programme. It **recommends** that future Panel Reports separate out more clearly types of 'recommendations' (either: (a) tasks that the Panel considers need to be completed (and reviewed where necessary) before the lethal component of a programme is initiated; or (b) tasks required for non-lethal components of the programme to be better achieved) and 'suggestions' (tasks that are desirable to enhance the value of the research, but are not considered essential for the programme).

Specific issues
SC/67a/SCSP13 (see Appendix 3 for a summary) contains information about: (i) the basis and analytical methods related to the selection of the sample size for common minke whales (Annex 11 and section 3.1.3 of the NEWREP-NP revised research plan); (ii) the basis and analytical methods related to the selection of the sample size for sei whales (Annex 16 and section 3.2.3 of the revised NEWREP-NP research plan); and (iii) assessments of the potential effect of catches on the stocks of minke and sei whales (sections 4.1 and 4.2 of the revised NEWREP-NP research plan).

Some members of the sub-committee asserted that there was not a link between the collection of age data and improvement in management performance in the proposal nor SC/67a/SCSP13, such as increased catches given pre-specified levels of risk. Other members responded that this level of analysis was not required for evaluation of a Scientific Permit proposal and that analyses presented to the 2016 meeting of the Scientific Committee (SC/66b/SP10) had provided initial indications that a revision to the *CLA* that uses age data will lead to improved management performance. They also noted that age data can be used to improve estimates of natural mortality (M) for North Pacific sei whales, which is related to the size of expected catches.

SC/67a/SCSP08 reported simulation analyses addressing a part of the report of the Expert Panel review of NEWREP-NP. The Panel provided some conclusions on the potential reliability of estimates of M using statistical catch at age (SCAA) models and the likely utility of such estimates in providing information relevant to trials for the RMP. However, the Panel also considered that verification of those conclusions would be advisable. Simulations tests of SCAA analyses verified that the Panel's conclusions are correct. The simulations also showed that the proposed sample size in NEWREP-NP is too small to lead to narrowing the plausible ranges of the parameters used in RMP simulation trials. Sample sizes sufficiently large to lead to reliable estimates entail a substantial risk of further declines in population abundance.

The sub-committee noted that MSYR and M were estimated with bias in SC/67a/SP08 even with large sample sizes. De la Mare stated that larger catches led to less bias, but the exact reasons for the bias were unclear, although were perhaps related to lack of contrast.

Appendix 4 provides a response to SC/67a/SP08 by providing an example for North Pacific sei whales showing that the level of transient catch depends on M, for a fixed value for MSYR. Appendix 5 gives a counter example to Appendix 4 based on the conclusions that might be drawn about the conservation performance of management using different values of M, with and without increasing natural mortality for older animals.

The sub-committee was unable to address all the implications raised in SC/67a/SCSP08, SC/67a/SCSP13 and Appendices 4 and 5. There are widely different opinions on the issues, which means that achieving consensus within the sub-committee would be impossible at this meeting.

2.5 Work plan

Item	***During the Intersessional period***	***During SC67b***
Item 2.1: Conduct work to evaluate the energetics-based model and hence the relationship between $MSYR_{1+}$ and $MSYR_{mat.}$	(a) Parameterise the individual-based model for 'minke-like' whales (de la Mare); (b) Further develop emulator models (de la Mare); and (c) Conduct simulations of the *CLA* for the energetics-based model (de la Mare).	Continue to work to evaluate the energetics-based model and hence the relationship between $MSYR_{1+}$ and $MSYR_{mat.}$
Item 2.2: Implications of *ISTs*, for consideration of status.	(a) Update the Guidelines for *Implementations* and *Implementation Reviews* to reflect decisions on evaluation status of stocks (Donovan); and (b) Modify the control programs used for *Implementation Simulation Trials* to report the three measures of status (Allison).	
Item 2.4: Improvements in management performance (in relation to RMP and SCAA) by improved precision in biological parameters.	Develop documents on guidance on the level of information to be provided to show quantitatively that any proposed research will have management benefits.	Review any proposals on guidance on the level of information to be provided to show quantitatively that any proposed research will have management benefits.

3. RMP – *IMPLEMENTATION*-RELATED MATTERS

3.1 North Atlantic common minke whales

3.1.1 Report of the intersessional Workshop

Donovan summarised the report of the Third RMP Intersessional Workshop on the *Implementation Review* for North Atlantic common minke whales (SC/67a/RMP07). The Workshop was held at the kind invitation of the Greenland Representation, Copenhagen, from 16-18 December 2016 with the objective of facilitating the completion of the *Implementation Review* at the 2017 Annual Meeting of the Scientific Committee.

Fig. 1 shows a map of the 11 sub-areas referred to in the text whilst Fig. 2 shows the stock structure hypotheses considered.

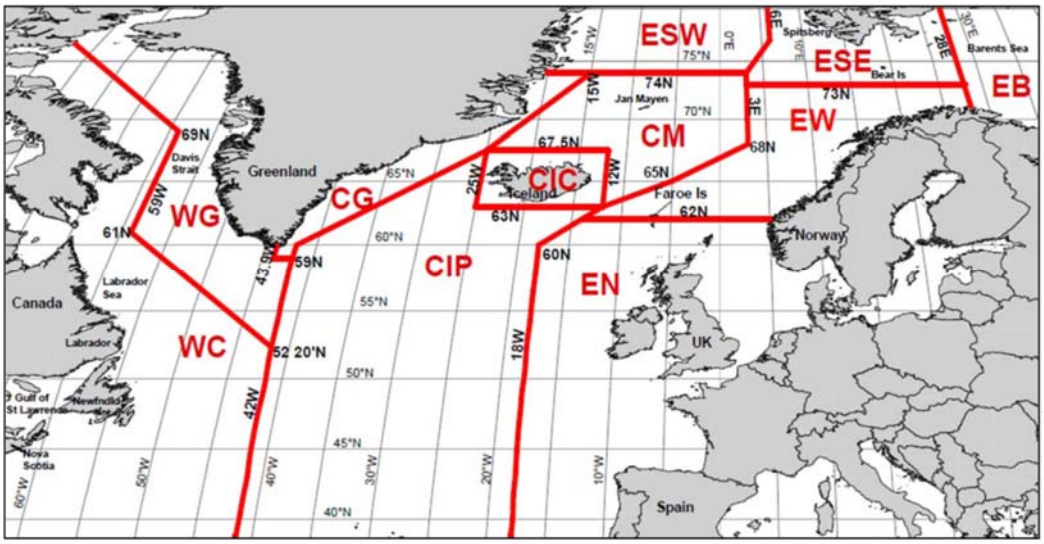

Fig. 1. Sub-areas used in the *Implementation Review* for the North Atlantic common minke whales.

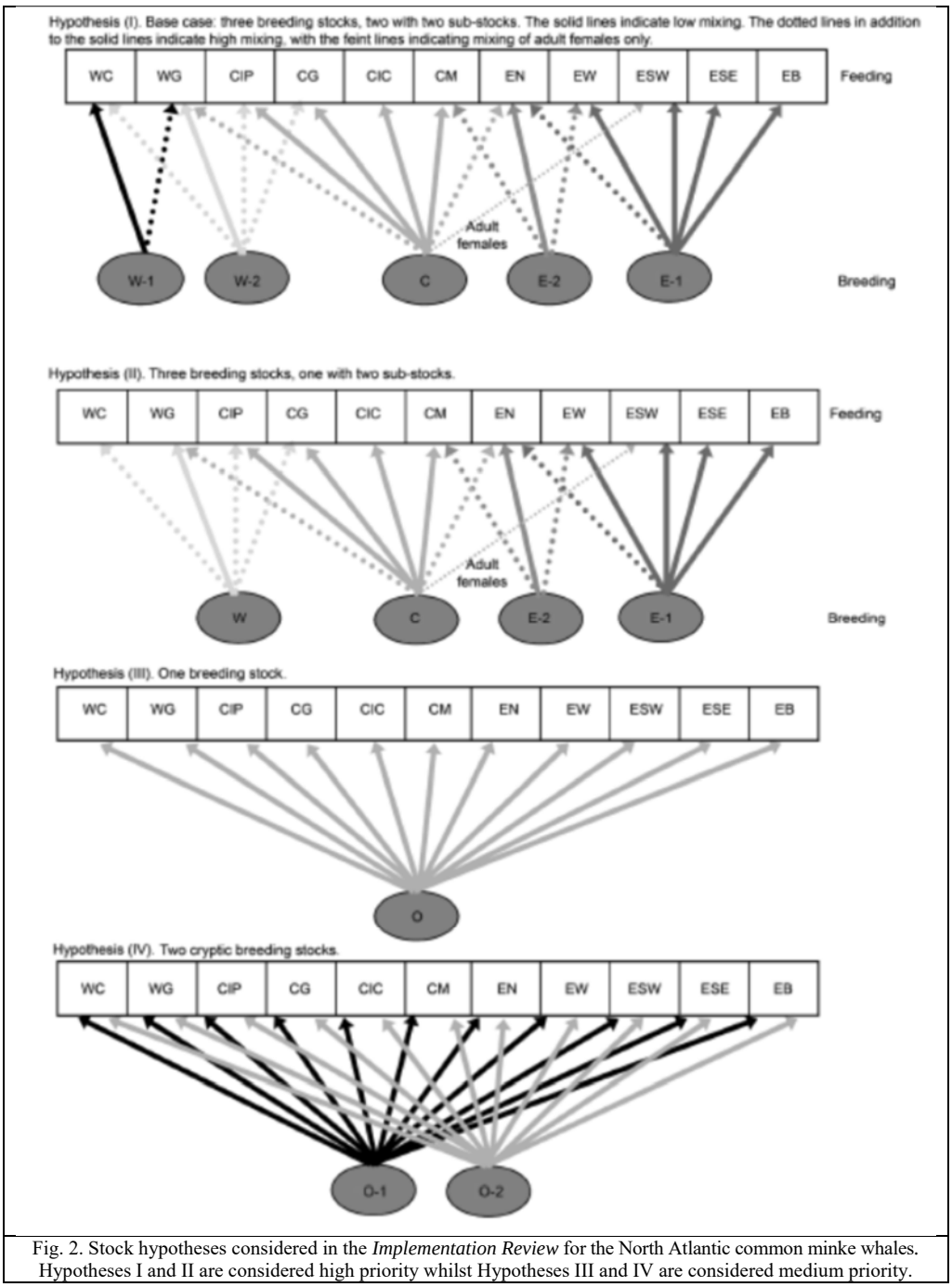

Fig. 2. Stock hypotheses considered in the *Implementation Review* for the North Atlantic common minke whales. Hypotheses I and II are considered high priority whilst Hypotheses III and IV are considered medium priority.

The Workshop focused on finalising the trial specifications to account for issues raised at the 2016 Annual Meeting and intersessionally. Changes were made to the specifications of the trials to account for the following issues:

(a) taking account process error in the CVs for the abundance estimates for the E sub-areas;
(b) modifying the mixing matrices to remove the possibility of unrealistically low values for the size of the W-2 stock prior to exploitation; and
(c) placing a maximum on the exploitation rates in the WG sub-area to avoid implausibly high values, especially when animals of only one stock (usually the W-2 stock) are in the WG sub-area.

The full set of trials are given in Table 1 and the Workshop confirmed the plausibility ratings agreed at the 2016 Annual Meeting and agreed those trials that needed reconditioning. Not all of those could be reconditioned at the Workshop and so the Workshop focussed on two of the more complex trials, NM01-1 and NM01-4. It agreed that these had been conditioned satisfactorily and that the rest of the trials should be conditioned prior to the 2017 Annual Meeting. The Workshop also updated the trial specifications to include the most recent catches and agreed abundance estimates. The Workshop agreed that the projections be based on the removals from the WG sub-area set to minimum of need and the output from the interim *SLA* (IWC, 2009), rather than assuming the catch equals the need. A Workplan was developed to enable the *Implementation Review* to be completed at the 2017 Annual Meeting.

In conclusion, Donovan thanked the participants for their dedicated work on such complex issues, particularly Punt and Allison.

The sub-committee thanked Donovan for chairing the meeting, which put the sub-committee in a position to complete the *Implementation Review* this year.

Table 1
The *Implementation Simulation Trials* for North Atlantic minke whales. The trials in strikeout were eliminated during this meeting.

Trial No.	Stock Hypothesis	*MSYR*	No. of Stocks	Boundaries	Catch sex-ratio for selectivity	Trial Weight	Notes
NM01-1	I	1%[1]	3	Baseline	2008-13	M	3 stocks, E and W with sub-stocks
NM01-4	I	4%[2]	3	Baseline	2008-13	H	3 stocks, E and W with sub-stocks
NM02-1	II	1%[1]	2	Baseline	2008-13	M	2 stocks, E with sub-stocks
NM02-4	II	4%[2]	2	Baseline	2008-13	H	2 stocks, E with sub-stocks
NM03-1	III	1%[1]	1	Baseline	2008-13	M	1 stock
NM03-4	III	4%[2]	1	Baseline	2008-13	M	1 stock
NM04-1	IV	1%[1]	2	Baseline	2008-13	M	2 cryptic stocks
NM04-4	IV	4%[2]	2	Baseline	2008-13	M	2 cryptic stocks
NM05-1	I	1%[1]	3	Stock C not in ESW	2008-13	M	3 stocks, E and W with sub-stocks
NM05-4	I	4%[2]	3	Stock C not in ESW	2008-13	M	3 stocks, E and W with sub-stocks
NM06-1	II	1%[1]	2	Stock C not in ESW	2008-13	M	2 stocks, E with sub-stocks
NM06-4	II	4%[2]	2	Stock C not in ESW	2008-13	M	2 stocks, E with sub-stocks
NM07-1	I	1%[1]	3	Baseline	**2002-07**	M	Alternative years to adjust selectivity-at-age
NM07-4	I	4%[2]	3	Baseline	**2002-07**	M	Alternative years to adjust selectivity-at-age
~~NM09-1~~	~~I~~	~~1%~~	~~3~~	~~Baseline~~	~~2008-13~~	~~M~~	~~E-2 stock in EN 10%~~
~~NM09-4~~	~~I~~	~~4%~~	~~3~~	~~Baseline~~	~~2008-13~~	~~M~~	~~E-2 stock in EN 10%~~
NM10-1	I	1%	3	Baseline	2008-13	M	E-2 stock in EN 90%
NM10-4	I	4%	3	Baseline	2008-13	M	E-2 stock in EN 90%
NM12-1	I	1%[1]	3	Stock E1 not in ESW	2008-13	M	3 stocks, E and W with sub-stocks
NM12-4	I	4%[2]	3	Stock E1 not in ESW	2008-13	M	3 stocks, E and W with sub-stocks
NM13-1	II	1%[1]	2	Stock E1 not in ESW	2008-13	M	2 stocks, E with sub-stocks
NM13-4	II	4%[2]	2	Stock E1 not in ESW	2008-13	M	2 stocks, E with sub-stocks
NM01-1v	I	1%[1]	3	Baseline	2008-13	M	CV of future abundance = ½ basecase value
NM01-4v	I	4%[2]	3	Baseline	2008-13	H	CV of future abundance = ½ basecase value
NM02-1v	II	1%[1]	2	Baseline	2008-13	M	CV of future abundance = ½ basecase value
NM02-4v	II	4%[2]	2	Baseline	2008-13	H	CV of future abundance = ½ basecase value
NM03-1v	III	1%[1]	1	Baseline	2008-13	M	CV of future abundance = ½ basecase value
NM03-4v	III	4%[2]	1	Baseline	2008-13	M	CV of future abundance = ½ basecase value
NM04-1v	IV	1%[1]	2	Baseline	2008-13	M	CV of future abundance = ½ basecase value
NM04-4v	IV	4%[2]	2	Baseline	2008-13	M	CV of future abundance = ½ basecase value

[1] – 1+; [2] –mature

3.1.2 Completion of Implementation Review

3.1.2.1 CONDITIONING OF TRIALS

3.1.2.1.1 TRIALS NM09-1 AND NM09-2

Stock structure hypotheses I and II include two 'sub-stocks[1]' of the E stock. The E-2 sub-stock is found in sub-areas CM, EN and EW. Unlike the C stock and the E-1 sub-stock, there is no sub-area in which only the E-2 sub-stock is found. Thus, there are no data that directly inform on the minimum value for the unexploited abundance of the E-2 sub-stock. To address this, the trials based on stock hypotheses I and II arbitrarily specify that 50% of the whales in the EN sub-area at equilibrium are from the E-2 sub-stock, with the entries in the mixing matrices for females in the E-2 sub-stock being pre-specified (80% of female E-2 animals are found in the EN sub-area). The unexploited and current abundances of the E-2 sub-stock are in effect determined by the arbitrarily specified proportion of the number of animals in the EN sub-area that are from the E-2 sub-stock.

The results of the conditioning show that the size of the E-2 sub-stock ranges between ~3,000 mature females (Trials NM10-1 and NM10-4) and 400 mature females (Trials NM09-1 and NM09-4); the base-case trials (trials NM01-1, NM01-4, NM02-1, and NM02-4) are intermediate between these. For the base case trials, this leads to a current abundance for the E-2 stock of 1,500 - 2,000 mature females. In contrast, the current abundance of the E-1 sub-stock is approximately ten times higher at 20,000 mature females. All trials suggest that the *current* abundance of the E-2 stock is increasing and well above MSYL. In addition, all of the trials mimic the abundance and sex-ratio data adequately.

There is no stochastic mixing prior to the start of the projection period. However, the results of projections of the size of the E-2 sub-stock will be impacted by stochastic mixing. For years in which few C and E-1 whales are in sub-area EN, the exploitation rate on the E-2 sub-stock will be high. This effect is exacerbated for trial NM09-1; there can be as many as ~12,000 whales in the EN sub-area in some years, but in years where there are few C and E-1 whales present, abundance

[1]Sub-stocks are modelled as stocks. The joint AWMP/RMP Workshop on stock structure had agreed that that there is a single EA stock and the previous sub-stocks need not to be maintained. Nonetheless, because there was some discontinuity in pollutant profiles, it had also agreed that the separate sub-stocks may be maintained in the trials.

could be as low as 1,500. The operating model assumes that the allocated catch limits are taken exactly, irrespective of how few whales there are in the EN sub-area. This is unreasonable.

The sub-committee noted that evidence for sub-stocks within the E stock was weak and that the support for retaining the EN sub-stock as a possibility was because of some differences in chemical concentrations in blubber (JCRM 16:559). Given the unexpected results in terms of unexploited size of the EN sub-stock and the weak evidence for existence of this sub-stock, the sub-committee **agrees** trials NM09-1 and NM09-4 are low plausibility.

3.1.2.1.2 MODIFICATIONS TO TRIALS

Allison reported that the changes to the trials since the 2016 Scientific Committee were:

(1) The 2015 abundance estimates and catches (as agreed at the December 2016 Workshop) are now included in the operating model. The first assessment is now in 2016 and it uses the new estimates. Any remaining abundance estimates for 2014-5 that are not yet available (for sub-areas ESW, ESE, EW and CM) are assumed to have occurred in 2016.

(2) The exploitation rate (catch as a proportion of the number of 1+ animals) in the WG sub-area is very high in a few years in the future when the catch for the WG sub-area is set to 164 whales, in particular when mixing is such that only animals of one stock (usually the W-2 stock) are in the WG sub-area. Given the nature of the hunt, it is implausible that aboriginal whalers could catch most of the whales in the WG sub-area in any one year. Therefore, a maximum annual exploitation rate was set for the WG sub-area. This maximum rate must be realistic given past exploitation rates achieved by aboriginal whalers, but not so low that the conservation performance of a candidate *SLA* would be impacted substantially. The maximum exploitation rate is set at twice the maximum historical exploitation rate achieved by aboriginal hunters; this level is sufficiently precautionary (exploitation rates can still be high enough that stocks can be depleted) and also more realistic given past exploitation rates.

(3) A minimum value for the mixing matrix parameter γ_{10} of 0.1 was imposed to eliminate the possibility of unrealistically low values for the size of the W-2 stock prior to exploitation, as agreed at the December 2016 Workshop.

(4) The new abundance estimates for the WG sub-area (in 2007 and 2015, see Table 2) led to implausibly low estimates of the pristine W-2 stock size, so the following additional restraints were imposed:

   (i) the ratio of the pristine sizes of sub-stocks W-2 and W-1 > 0.10; and
   (ii) the pristine size of sub-stock W-2 >2,000.

(5) The calculation of the final UAB statistics were revised so that they are based on comparison with projections with aboriginal catches in the WG and CG sub-areas set by the 'Interim SLA' (IWC, 2009), but no commercial catches.

(6) The CVs used by Norway when applying the RMP to the E *Medium Area* during the *catch cascading* process account for process error. However, the trials considered at the 2016 Scientific Committee ignored process error, which led to larger catch limits than would be expected in reality. The trials were therefore modified to multiply the CVs of abundance estimates for the E *Medium Area* by the slope of a regression of the CVs for the E *Medium Area* which took process error into account against the CVs for this Area when process error is ignored (1.43).

The sub-committee **endorses** these changes to the specifications. The final trial specifications are given as Appendix 5.

Table 2
New and revised abundance estimates for the North Atlantic common minke whales.

Year	Sub-Area	Abundance	CV
2007	WG	9,853[$]	0.430
2015	WG	5,241	0.490
2015	CIP	6,306	0.345
2015	CG	5,408	0.344
2015	CIC	12,710	0.530

[$]this replaces an earlier estimate of 16,609 (CV 0.428) as it takes into account improved information on availability bias (see SC/67a/Rep02).

3.1.2.1.3 CONDITIONING

Table 3 provides a summary of the diagnostic statistics used to evaluate whether conditioning has been achieved satisfactorily and Fig. 3 shows some example diagnostic plots – the full set of diagnostics will be available at the Secretariat. The sub-committee considered that conditioning had been achieved satisfactorily for all trials in Table 1.

Table 3
Summary of the diagnostic plots and statistics used to evaluate conditioning.

Plot/statistic	Description	Factors in the evaluation
Fit of the operating model by subarea to the estimates of abundance	The plot for each subarea shows the abundance estimates and their 90% confidence intervals, the fit of the model to the actual data ('deterministic'; solid red lines), and the median and 90% intervals from the 100 replicates (solid black and dashed lines respectively).	Adequate performance for these plots is that (i) the 'deterministic' trajectory passes through the centroid of the data points, (ii) the 'deterministic' and median trajectories are not markedly different, (iii) the 90% interval for the 1+ abundance in a year with data matches the sampling distribution for the data when there is only one data point, and (iv) the 90% intervals for 1+ abundance for years with data are narrower than the sampling distributions when there are multiple abundance estimates for a sub-area.
Fit of the operating model to the sex ratio types ('original' and 'fishery').	The plots for each sex ratio type show the data points by sub-area and their assumed (normal) sampling distributions, along with the model-predictions from the fit to actual data, and the median and the 90% intervals for the model predictions.	For these plots, the 'deterministic' estimates should match the data almost exactly, and the 95% intervals from the stochastic replicates should closely match the sampling distributions. The model should mimic the original sex ratios fairly closely, but should not match them as well as the fishery sex ratios because the model imposes relationships among the abundances by sub-area, in particular that the overall sex ratio is 1:1 across the spatial domain of the model.
Individual trajectories of mature female numbers by subarea	This plot shows 10 time-trajectories of mature female numbers by sub-area and the abundance estimates and their 90% confidence intervals	This plot is examined qualitatively to ensure that there are no 'unexpected' trajectories that would be missed by simply looking at overall 90% limits only.
Annual numbers of mature females.	This plot shows the median and 90% intervals for the annual numbers of mature females.	This plot is examined qualitatively to check that the model has not converged to an "unrealistic" situation (e.g. that one of the stocks never existed)

3.1.2.2 EVALUATION OF RMP VARIANTS: OVERVIEW OF PROCEDURE TO FOLLOW

The procedure for defining 'acceptable', 'borderline' and 'unacceptable' performance agreed by the Committee (IWC 2007) involves conducting the following steps for each stock (or sub-stock) in an *Implementation Simulation Trial*.

(1) Construct a single stock trial, which is 'equivalent' to the stock. For example, if a particular stock in the *Implementation Simulation Trial* involved carrying capacity halving over the 100-year projection period, the 'equivalent single stock trial' will also involve carrying capacity halving over the next 100 years.
(2) Conduct two sets of 100 simulations based on this single stock trial in which future catch limits are set by the *CLA*. The two sets of simulations correspond to the 0.60 and 0.72 tunings of the *CLA*. Rather than basing these calculations on a single initial depletion, the simulations for each stock shall be conducted for the distribution of initial depletions for the stock concerned in the *Implementation Simulation Trial* under consideration.
(3) The cumulative distributions for the final depletion and for the minimum depletion ratio (the minimum over each of the 100-year projections of a trial of the ratio of the population size to that when there are only incidental catches) shall be constructed for each of these two tunings of the *CLA*.
(4) The lower 5%-ile of these distributions shall form the basis for determining whether the performance of the RMP (i.e., the RMP variant under consideration) for the *Implementation Simulation Trial* is 'acceptable' - A, 'borderline' - B or 'unacceptable' - U, as follows:
    (a) if the 5%-ile of the final depletion or the 5%-ile of the minimum depletion ratio for the *Implementation Simulation Trial* is greater than for the equivalent single stock trial with the 0.72 tuning of the *CLA* (or the 5%-ile of the minimum depletion ratio for the *Implementation Simulation Trial* is greater than 0.999), the performance of the RMP variant shall be classified as 'acceptable';
    (b) if performance is not 'acceptable' and either the 5%-ile of the final depletion or the 5%-ile of the minimum depletion ratio for the *Implementation Simulation Trial* is greater than for the equivalent single stock trial with 0.60 tuning of the *CLA*, the performance of the RMP variant shall be classified as 'borderline'; and
    (c) if performance is neither 'acceptable' nor 'borderline' and if the 5%-ile of the final depletion and the 5%-ile of the minimum depletion ratio for the *Implementation Simulation Trial* are less than those for the equivalent single stock trial with 0.60 tuning of the *CLA*, then performance of the RMP variant shall be classified as 'unacceptable'.

If the performance for a small number of medium weight trials is 'borderline' but close to 'acceptable', then performance of the variant can be considered 'acceptable without research'. A flow chart summarising the decision process that should be followed is given as Fig. 4. The sub-committee reviewed the results of the *Implementation Simulation Trials* based on the experience gained during recent *Implementations* and *Implementation Reviews*. The purposes of the following tables range from providing a quick summary of conservation performance to listing many of performance statistics for each trial and RMP variant. The master set of plots and tables is archived by the Secretariat and available to members of the Scientific Committee on request.

(1) A table showing for each RMP variant: the average over the trials of the lower 5%-ile, median and upper 95%-ile of catch in the C and E *Medium Areas* for the first 10 years of the projection period and over the entire projection period and a summary of the application of the procedure for defining 'acceptable' - A, 'borderline' - B and 'unacceptable' - U performance. Results are shown separately for the 'high' and 'medium' plausibility trials (Table 4).

(2) A table showing the detailed results for each trial and RMP variant. The following information is included in this table:

   (a) median catch over the entire projection period and median, lower 5%-ile and upper 5%-ile over the first 10 years;
   (b) lower 5%-ile and median of the final depletion distribution (by stock);
   (c) lower 5%-ile and median of the minimum depletion ratio distribution (by stock); and
   (d) lower 5%-ile and median of the initial depletion distribution (by stock).

   This table also includes the values for the thresholds for each performance statistic and stock for the trials and the outcomes of the application of the procedure for defining 'acceptable', 'borderline' and 'unacceptable' performance.

3.1.2.3 EVALUATION OF RMP VARIANTS: REVIEW TRIAL RESULTS

The five management variants to be considered were as follows:

(1) Sub-areas CIC, CM, CG, CIP, EN, EB, ESW+ESE and EW are *Small Areas*, with the catch limits for these *Small Areas* based on catch cascading from the C and E *Combination Areas*. The catch from the ESW+ESE *Small Area* is all taken in sub-area ESE. The catch limits set for the CM, CG and CIP *Small Areas* are not taken (except that the Aboriginal catch is taken from CG);
(2) Sub-areas CIC, CM, CG, CIP, EN and EB+ESW+ESE+EW are *Small Areas*, with the catch limits for these *Small Areas* based on catch cascading from the C and E *Combination Areas*. The catch from the EB+ ESW+ESE +EW *Small Area* is all taken in sub-area EW. The catch limits set for the CM, CG and CIP *Small Areas* are not taken (except that the Aboriginal catch is taken from CG);
(3) Sub-areas CIC, CM, CG, CIP, EN, ESW+ESE, and EB+EW are *Small Areas*, with the catch limits for these *Small Areas* based on catch cascading from the C and E *Combination Areas*. The catch from the EB+ EW *Small Area* is all taken in sub-area EW and the catch from the ESW+ESE *Small Area* is taken in the ESE sub-area. The catch limits set for the CM, CG and CIP *Small Areas* are not taken (except that the Aboriginal catch is taken from CG);
(4) As for variant 1, except that sub-areas CIC+CIP+CM are a single *Small Area* and all of the catches from this *Small Area* are taken in sub-area CIC. The catch limits set for the CG *Small Area* are not taken (except that the Aboriginal catch is taken); and
(5) Sub-areas CIP+CIC+CG+CM, EN, EB, ESW+ESE and EW are *Small Areas*, with the catch limits for the E *Small Areas* based on catch cascading from the E *Combination Area*. All the catches from CIP+CIC+CG+CM *Small* Area are taken in sub-area CIC (after taking the Aboriginal catch from CG) and those for the ESW+ESE *Small Area* are taken in sub-area ESE.

There are a number of possible scenarios to consider when evaluating the trials, and it is at this stage that a degree of judgement is required, including consideration of the overall balance of the trials and the characteristics of the specific trials for which performance is questionable. Table 5 summarises the application of the rules for evaluating conservation performance:

(1) There is no RMP variant for which performance is 'acceptable' for all trials (step 1). However, none of the RMP variants performed 'unacceptably' on a 'high' weight trial so step 4 of the flowchart is applied.
(2) All of the RMP variants had 'borderline' performance for the same trials (NM01-1, NM02-1, NM05-1, NM06-1, NM12-1, NM13-1, and NM01-1v) and sub-stock (E-2). The sub-committee therefore considered the conservation performance for each RMP variant for these trials in detail (step 4a):

   (a) Variant 1. The performance statistics for this variant are just below the 'acceptable' threshold for trials NM06-1 and NM13-1 and closer to the 'acceptable' rather than the 'unacceptable' threshold for all but trial NM01-1v.
   (b) Variant 2. The conservation performance of the variant is poorer than for variant 1, with values for the performance statistics closer to the 'unacceptable' threshold, and close to the 'unacceptable' threshold for trial NM12-1.
   (c) Variant 3. The conservation performance for this variant is intermediate between those for variants 1 and 2
   (d) Variant 4. This variant achieved performance statistics for trials NM02-1, NM06-1 and NM13-1 that were marginally different from 'acceptable', and achieved performance statistics that were closer to the 'acceptable' rather than the 'unacceptable' threshold for all other trials for which performance was 'borderline'.
   (e) Variant 5. The performance of this variant was essentially identical to that for variant 4.

Overall, and taking into account that less than acceptable performance occurred only for one sub-stock when $MSYR_{1+}$ was 1%, that the evidence for sub-stock E-2 is very weak, and that the performance statistics for variants 1, 3, 4 and 5 were closer to 'acceptable' than 'unacceptable' even for this stock, the sub-committee **recommends** these variants to be considered be 'acceptable without research'. In terms of catch performance, all of the RMP variants achieve very similar catches (particularly when average catch over 100 years is considered) for the E *Medium Area* (Table 5). In contrast, RMP variants 4 and 5 lead to higher catches for the C *Medium Area*, with variant 5 leading to catches that are higher than those for variant 4. Given that variant 2 performs close to 'unacceptably' on several trials and does not outperform the other variants in terms of catch statistics, the sub-committee **concludes** that this variant is 'unacceptable'.

Table 4

Table of summary statistics for the *Implementation Simulation Trials* for the North Atlantic common minke whales.

Trial	Var	C Av Catch			C 1st 10yr			E Av Catch			E 1st 10yr			P final					P min										
		Med	5%	95%	Med	5%	95%	Med	5%	95%	Med	5%	95%	V1	2	3	4	5	V1	2	3	4	5	V1	2	3	4	5	
NM01-1	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM01-1	V1	130	86	190	154	145	164	371	252	522	410	359	473	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM01-1	V2	130	86	190	154	145	164	411	290	547	410	364	465	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM01-1	V3	130	86	190	154	145	164	388	261	529	411	362	472	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM01-1	V4	264	213	326	358	352	380	369	250	519	410	359	473	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM01-1	V5	275	223	342	389	384	409	368	250	518	410	359	473	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM01-4	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM01-4	V1	129	87	184	154	145	164	506	383	672	425	375	507	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM01-4	V2	129	87	184	154	145	164	517	395	669	425	382	493	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM01-4	V3	129	87	184	154	145	164	512	389	672	426	379	497	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM01-4	V4	277	221	341	359	352	380	505	382	671	425	375	507	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM01-4	V5	288	233	351	390	384	409	505	382	671	425	375	507	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM02-1	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM02-1	V1	138	91	202	154	144	165	368	253	511	409	357	485			A	A	A	B			A	A	B	B			A	A	A	B	B
NM02-1	V2	138	91	201	154	144	165	417	283	551	408	362	478			A	A	A	B			A	A	A	B			A	A	A	B	B
NM02-1	V3	138	91	202	154	144	165	385	263	530	410	361	483			A	A	A	B			A	A	A	B			A	A	A	B	B
NM02-1	V4	285	225	347	358	351	386	366	250	509	409	357	485			A	A	A	B			A	A	B	B			A	A	A	B	B
NM02-1	V5	293	236	365	389	384	414	366	249	508	409	357	485			A	A	A	B			A	A	B	B			A	A	A	B	B
NM02-4	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM02-4	V1	135	92	200	154	143	165	507	376	674	424	371	509			A	A	A	A			A	A	A	A			A	A	A	A	A
NM02-4	V2	135	92	200	154	143	165	523	400	663	423	379	488			A	A	A	A			A	A	A	A			A	A	A	A	A
NM02-4	V3	135	92	200	154	143	165	517	381	672	424	377	499			A	A	A	A			A	A	A	A			A	A	A	A	A
NM02-4	V4	282	229	350	358	351	387	506	375	671	424	371	509			A	A	A	A			A	A	A	A			A	A	A	A	A
NM02-4	V5	294	242	363	390	384	416	506	375	671	424	371	509			A	A	A	A			A	A	A	A			A	A	A	A	A
NM03-1	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM03-1	V1	133	99	195	155	149	166	506	369	653	427	381	500				A						A						A			A
NM03-1	V2	135	102	200	155	149	166	531	405	656	426	396	483				A						A						A			A
NM03-1	V3	134	100	197	155	149	166	513	380	650	428	389	493				A						A						A			A
NM03-1	V4	237	188	314	357	351	371	487	352	633	427	381	500				A						A						A			A
NM03-1	V5	235	186	318	389	383	401	486	351	632	427	381	500				A						A						A			A
NM03-4	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM03-4	V1	130	96	191	154	149	166	507	367	660	433	385	509				A						A						A			A
NM03-4	V2	130	97	193	154	149	166	515	369	640	431	403	492				A						A						A			A
NM03-4	V3	130	97	192	154	149	166	510	372	655	434	392	503				A						A						A			A
NM03-4	V4	234	186	303	358	351	371	497	359	648	433	385	509				A						A						A			A
NM03-4	V5	232	184	305	389	383	401	497	359	648	433	385	509				A						A						A			A
NM04-1	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM04-1	V1	119	87	170	156	149	167	571	438	722	434	387	511				A	A					A	A					A	A		A
NM04-1	V2	121	88	175	156	149	167	600	483	713	434	404	493				A	A					A	A					A	A		A
NM04-1	V3	120	87	173	156	149	167	578	452	719	435	397	501				A	A					A	A					A	A		A
NM04-1	V4	196	154	275	355	351	369	555	420	706	434	387	511				A	A					A	A					A	A		A
NM04-1	V5	195	149	274	387	383	399	554	420	705	434	387	511				A	A					A	A					A	A		A
NM04-4	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM04-4	V1	117	85	168	156	149	167	576	434	737	440	391	520				A	A					A	A					A	A		A
NM04-4	V2	117	85	169	156	149	167	589	454	702	438	410	500				A	A					A	A					A	A		A
NM04-4	V3	117	85	168	156	149	167	583	447	722	440	401	512				A	A					A	A					A	A		A
NM04-4	V4	195	154	267	356	351	368	568	426	729	440	391	520				A	A					A	A					A	A		A
NM04-4	V5	193	151	268	387	383	398	567	426	728	440	391	520				A	A					A	A					A	A		A
NM05-1	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM05-1	V1	132	85	190	154	145	164	372	256	525	410	360	481	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM05-1	V2	131	85	190	154	145	164	413	290	549	410	361	472	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM05-1	V3	131	85	190	154	145	164	391	264	534	411	362	476	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM05-1	V4	267	214	330	359	352	380	370	254	523	410	360	481	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM05-1	V5	275	223	346	390	384	409	370	254	523	410	360	481	A	U	A	A	B	A	A	A	A	B	A	A	A	A	B	B
NM05-4	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM05-4	V1	129	87	183	154	145	164	506	378	664	424	374	507	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM05-4	V2	129	87	184	154	145	164	518	390	664	423	380	487	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM05-4	V3	129	87	184	154	145	164	511	379	662	425	378	494	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM05-4	V4	276	223	341	359	352	380	505	378	664	424	374	507	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM05-4	V5	286	237	348	390	384	409	505	378	664	424	374	507	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NM06-1	V0	12	12	12	12	12	12	0	0	0	0	0	0																
NM06-1	V1	138	91	199	154	143	165	373	255	517	409	358	484			A	A	A	B			A	A	A	B			A	A	A	B	B
NM06-1	V2	138	91	199	154	143	165	418	290	558	409	361	472			A	A	A	B			A	A	A	B			A	A	A	B	B
NM06-1	V3	138	91	199	154	143	165	389	265	531	410	362	480			A	A	A	B			A	A	A	B			A	A	A	B	B
NM06-1	V4	284	226	343	358	352	387	371	253	512	409	358	484			A	A	A	B			A	A	A	B			A	A	A	B	B
NM06-1	V5	293	239	362	389	384	415	371	253	511	409	358	484			A	A	A	B			A	A	A	B			A	A	A	B	B

```
NM06-4 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM06-4 V1    135  90 198 154 143 165 508 374 672 424 371 508     A  A  A  A      A  A  A  A      A  A  A  A    A
NM06-4 V2    135  90 197 154 143 165 523 392 665 424 379 490     A  A  A  A      A  A  A  A      A  A  A  A    A
NM06-4 V3    135  90 197 154 143 165 516 378 671 425 377 496     A  A  A  A      A  A  A  A      A  A  A  A    A
NM06-4 V4    284 226 347 358 352 386 507 373 671 424 371 508     A  A  A  A      A  A  A  A      A  A  A  A    A
NM06-4 V5    295 241 360 390 384 414 506 373 670 424 371 508     A  A  A  A      A  A  A  A      A  A  A  A    A

NM07-1 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM07-1 V1    127  87 186 154 145 164 369 253 520 410 359 478  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM07-1 V2    127  87 186 154 145 164 402 283 540 409 364 470  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM07-1 V3    127  87 186 154 145 164 381 259 521 411 362 475  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM07-1 V4    248 198 311 358 352 380 365 249 516 410 359 478  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM07-1 V5    254 205 316 390 384 409 365 249 516 410 359 478  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A

NM07-4 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM07-4 V1    129  87 182 154 145 165 506 377 661 424 374 509  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM07-4 V2    129  87 182 154 145 165 518 390 657 424 379 488  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM07-4 V3    129  87 182 154 145 165 513 379 658 425 378 494  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM07-4 V4    272 218 334 359 352 380 504 376 660 424 374 509  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM07-4 V5    279 230 340 390 384 409 504 376 659 424 374 509  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A

NM10-1 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM10-1 V1    134  96 193 153 144 163 370 258 511 409 361 478  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM10-1 V2    134  96 193 153 144 163 410 300 543 410 374 466  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM10-1 V3    134  96 193 153 144 163 384 274 518 412 368 473  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM10-1 V4    266 220 340 360 352 383 369 258 510 409 361 478  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM10-1 V5    277 231 352 391 384 412 369 258 510 409 361 478  A  U  A  A  A   A  A  A  A  A   A  A  A  A  A    A

NM10-4 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM10-4 V1    134  96 190 153 144 164 506 388 652 424 371 501  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM10-4 V2    134  96 189 153 144 164 521 407 642 427 387 482  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM10-4 V3    134  96 189 153 144 164 513 394 644 426 378 489  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM10-4 V4    280 232 358 360 352 383 505 387 652 424 371 501  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM10-4 V5    291 244 369 391 384 412 505 387 651 424 371 501  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A

NM12-1 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM12-1 V1    130  87 187 154 144 164 363 250 513 407 353 476  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B
NM12-1 V2    130  87 187 154 144 164 407 279 541 408 361 470  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B
NM12-1 V3    130  87 187 154 144 164 380 253 515 409 359 476  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B
NM12-1 V4    265 211 322 358 352 382 360 247 511 407 353 476  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B
NM12-1 V5    275 224 340 389 384 411 360 247 511 407 353 476  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B

NM12-4 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM12-4 V1    127  86 189 154 144 164 509 382 672 423 371 505  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM12-4 V2    127  86 189 154 144 164 522 411 665 424 381 490  A  B  A  A  A   A  A  A  A  B   A  A  A  A  A    A
NM12-4 V3    127  86 189 154 144 164 516 390 670 425 375 495  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM12-4 V4    273 219 328 358 352 382 507 381 670 423 371 505  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM12-4 V5    281 232 340 389 384 411 507 380 670 423 371 505  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A

NM13-1 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM13-1 V1    136  91 200 154 143 165 363 244 505 408 356 486     A  A  A  B      A  A  B  B      A  A  A  B    B
NM13-1 V2    136  91 200 154 143 165 407 281 539 410 361 479     A  A  A  B      A  A  A  B      A  A  A  B    B
NM13-1 V3    136  91 200 154 143 165 380 257 522 409 360 485     A  A  A  B      A  A  A  B      A  A  A  B    B
NM13-1 V4    283 226 353 358 351 386 358 241 502 408 356 486     A  A  A  B      A  A  B  B      A  A  A  B    B
NM13-1 V5    293 232 366 389 383 414 358 241 502 408 356 486     A  A  A  B      A  A  B  B      A  A  A  B    B

NM13-4 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM13-4 V1    134  91 198 154 143 166 514 386 675 424 372 515     A  A  A  A      A  A  A  A      A  A  A  A    A
NM13-4 V2    134  91 198 154 143 166 530 410 659 424 382 497     A  A  A  A      A  A  A  A      A  A  A  A    A
NM13-4 V3    134  91 198 154 143 166 520 396 668 425 375 503     A  A  A  A      A  A  A  A      A  A  A  A    A
NM13-4 V4    283 229 353 358 351 387 511 384 672 424 372 514     A  A  A  A      A  A  A  A      A  A  A  A    A
NM13-4 V5    293 239 366 389 383 415 511 384 671 424 372 514     A  A  A  A      A  A  A  A      A  A  A  A    A

NM21-1 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM21-1 V1    155 114 213 153 147 159 383 263 517 414 368 478  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B
NM21-1 V2    155 114 213 153 147 159 427 311 541 413 373 461  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B
NM21-1 V3    155 114 213 153 147 159 399 279 513 413 370 469  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B
NM21-1 V4    284 228 350 360 354 374 381 261 514 414 368 478  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B
NM21-1 V5    288 235 353 390 386 403 381 261 514 414 368 478  A  U  A  A  B   A  A  A  A  B   A  A  A  A  B    B

NM21-4 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM21-4 V1    129  87 184 154 145 164 506 383 672 425 375 507  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
NM21-4 V2    129  87 184 154 145 164 517 395 669 425 382 493  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
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NM21-4 V4    277 221 341 359 352 380 505 382 671 425 375 507  A  B  A  A  A   A  A  A  A  A   A  A  A  A  A    A
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NM22-1 V4    285 225 347 358 351 386 366 250 509 409 357 485     A  A  A  B      A  A  B  B      A  A  A  B    B
NM22-1 V5    293 236 365 389 384 414 366 249 508 409 357 485     A  A  A  B      A  A  B  B      A  A  A  B    B
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NM22-4 V1    135  92 200 154 143 165 507 376 674 424 371 509      A  A  A  A      A  A  A  A      A  A  A  A  A
NM22-4 V2    135  92 200 154 143 165 523 400 663 423 379 488      A  A  A  A      A  A  A  A      A  A  A  A  A
NM22-4 V3    135  92 200 154 143 165 517 381 672 424 377 499      A  A  A  A      A  A  A  A      A  A  A  A  A
NM22-4 V4    282 229 350 358 351 387 506 375 671 424 371 509      A  A  A  A      A  A  A  A      A  A  A  A  A
NM22-4 V5    294 242 363 390 384 416 506 375 671 424 371 509      A  A  A  A      A  A  A  A      A  A  A  A  A

NM23-1 V0     12  12  12  12  12  12   0   0   0   0   0   0
NM23-1 V1    151 122 219 154 149 162 445 318 586 423 381 486         A               A               A            A
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NM23-1 V4    283 237 368 359 352 369 425 302 559 423 381 486         A               A               A            A
NM23-1 V5    284 236 377 390 384 399 425 301 557 423 381 486         A               A               A            A

NM23-4 V0     12  12  12  12  12  12   0   0   0   0   0   0
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NM23-4 V4    279 236 363 359 352 369 436 299 569 429 387 496         A               A               A            A
NM23-4 V5    279 235 371 390 384 399 436 298 568 429 387 496         A               A               A            A
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Table 5
Summary of the conservation and catch performance of the five RMP variants for the North Atlantic common minke whales.

					C Medium Area				E Medium Area			
					Catch first ten years		Catch average		Catch first ten years		Catch average	
Variant	Trial weight	Acceptable	Border-line	Unacceptable	Mean med	Mean 5%	Mean med	Mean 5%	Mean med	Mean 5%	Mean med	Mean 5%
1	H	9	0	0	132	90	154	144	506	380	424	373
2	H	9	0	0	132	90	154	144	520	398	424	380
3	H	9	0	0	132	90	154	144	514	385	425	378
4	H	9	0	0	280	225	358	352	506	378	424	373
5	H	9	0	0	291	238	390	384	506	378	424	373
1	M	82	9	0	134	94	154	145	451	326	420	370
2	M	82	9	0	134	94	154	145	477	352	420	379
3	M	82	9	0	134	94	154	145	461	334	421	375
4	M	82	9	0	266	214	358	352	446	321	420	370
5	M	82	9	0	273	222	389	384	445	321	420	370

3.1.3 New information

SC/67a/NH05 reported estimates of abundance for the CIC area based on an aerial survey conducted during July 2016. The estimates were reviewed by the ASI Working Group (see Item 3 of Annex Q), which focused on the incomplete coverage of several of the survey blocks and how to perhaps obtain a minimum estimate of abundance for future use in an *Implementation Review*. The ASI Working Group also reviewed the report of the 2016 survey in Small Management Area CM (SC/67a/RMP01) and the progress towards the next estimate of abundance for the E *Medium Area* (SC/67a/RMP03).

3.1.4 Conclusions and recommendations

Based on the results of the I*mplementation Simulation Trials*, variants 1, 3, 4 and 5 are acceptable in terms of conservation performance. Of these variants, variant 5 achieves the best performance in terms of catch.

The sub-committee noted the considerable work that has been undertaken to complete the *Implementation Review*, which involved revising the stock structure hypotheses and hence the *Implementation Simulation Trials*. The sub-committee particularly acknowledged the work of Allison and de Moor who coded and ran the trials and Donovan who led this *Implementation Review*.

This completes the *Implementation Review*.

3.2 North Pacific common minke whales

3.2.1 Review of new information

Allison and de Moor informed the sub-committee that a minor error had been detected in the code implementing the *Implementation Simulation Trials* for the western North Pacific minke whales. The error has been corrected, with no substantial changes to the conclusions from the *Implementation Review* that was completed in 2013.

The sub-committee noted that the discussions in the Working Group on Stock Definition and DNA related to stock structure for the western North Pacific minke whales (Item 2.2 of Annex I). The SDDNA WG agreed that the results of the kinship analysis are inconsistent with the mixing matrices associated with stock structure hypothesis C as currently implemented in the *Implementation Simulation Trials* among sub-areas 7CS, 7CN, 8 and 9. The implications of these discussions will need to be accounted for during the upcoming *Implementation Review*.

3.2.2 Prepare for the next Implementation Review

The sub-committee noted that considerable amounts of new information, in particular genetics data, has been collected since the last *Implementation Review* in 2013. In particular, that *Implementation Review* had been based on genetics data to 2006 and many samples had been collected and analysed since then.

The sub-committee recognised that the most difficult aspect of the last *Implementation Review* had been selecting, modelling and assigning plausibility to stock structure hypotheses. Although considerable new data and analyses had been become available since 2013, it was likely that resolving how to handle stock structure uncertainty in the next *Implementation Review* will again be challenging. Much progress on complex topics such as addressing stock structure uncertainty can be accomplished during focused Workshops. The sub-committee therefore **recommends** that a preparatory meeting be held prior to SC67b focused on stock structure for western North Pacific minke whales. This meeting can be held immediately before or after the second Intersessional Workshop for the western North Pacific Bryde's whales.

3.3 Western North Pacific Bryde's whales

3.3.1 Report of the intersessional Workshop

Donovan summarised the report of the First Intersessional Workshop on the *Implementation Review* of western North Pacific Bryde's whales (SC/67a/Rep07). This Workshop, chaired by Donovan, was held in Tokyo from 21-24 March 2017 at the excellent facilities in the Ministry of Agriculture, Forestry and Fisheries Sanbancho Branch Office.

The Workshop made considerable progress with this being the first *Implementation Review* since the completion of the *Implementation* in 2007 as summarised below.

(1) The Workshop reviewed the new information relevant to stock structure and agreed to take forward two stock structure hypotheses - one of the four considered at the 2007 *Implementation* and one new hypothesis (Fig. 5).

   (a) *Hypothesis 2*: There are two stocks, one feeding in sub-area 1 and the second feeding in sub-area 2.
   (b) *Hypothesis 5*: There are two stocks, one feeding in sub-area 1 and the second feeding in sub-area 2 with mixing occurring in sub-area 1E. There are more animals from stock 1 than stock 2 in the mixing area.

(2) The Workshop reviewed new information on abundance estimates and developed a workplan to try to obtain agreed abundance estimates (including additional variance) for use in conditioning the trials and the *CLA*.
(3) The Workshop developed a new set of simulation trials for the *Implementation Review* that involve exploring the implications of uncertainty in stock structure, stock boundaries, MSYR, removals and additional variance.
(4) The Workshop developed an ambitious workplan to try to complete the *Implementation Review* at SC67a in May 2017.

The sub-committee noted that the intersessional Workshop led to considerable progress towards completing the *Implementation Review* and had been conducted in an excellent spirit of co-operation among the participants. It thanked Donovan for chairing the meeting and all the participants for their contributions to the development of trial specifications and workplan.

3.3.2 Progress since the intersessional Workshop

Allison and de Moor stated that they had begun updating the previous *Implementation Simulation Trials* for the North Pacific Bryde's whales to include the new hypotheses and trials. However, no conditioning results are available at present. It will be necessary to update the trials to include density-dependence in *M* as agreed last year (JCRM 18 (Suppl): 123). In addition, the future survey plan needs to be clarified. It was noted that the proposed intersessional Workshop would provide a forum to review further progress and to finalise the trials based on density-dependence in *M*.

SC/67a/RMP04 responded to a recommendation from the Workshop and provided estimates of abundance for 2008-15 based on data from the 2013-15 IWC-POWER and 2008, 2012 and 2014 JARPN II surveys, along with an estimate of additional variance. These estimates were adopted for use in trials and in the *CLA* (see Item 3.x of Annex X). The trial specifications will need to be updated to reflect this new information.

Wade noted that SC/67a/Rep07 reported that only 65% of samples could be aged using earplugs and suggested that the use of epigenetic methods for age determination should be explored for Bryde's whales. Other members noted that there is continuing debate on the value of the use of epigenetic methods (Jarman *et al*., 2015; Polanowski *et al*., 2014; SC/67a/Rep01). The sub-committee noted that the trials are no longer conditioned using age data unlike the *Implementation* (IWC, 2008), but that the value of alternative methods for age determination remains of general scientific interest.

3.3.3 Conclusions and recommendations

The *Implementation Review* is progressing well, but the ambitious workplan established at the March 2017 Workshop could not be achieved in the limited time available. Progress towards completing the *Implementation Review* will be enhanced if a Workshop were to take place during the intersessional period to finalise trial specifications and review

initial conditioning results. This Workshop could be conducted in conjunction with the preparatory meeting proposed for the *Implementation Review* for the North Pacific minke whales (Item 3.2.2).

3.4 North Atlantic fin whales

There was no new information for the North Atlantic fin whales.

3.5 Review RMP *Implementation Review* schedule for the next six years

There is a system of regular (5-6 year) *Implementation Reviews* with established guidelines. The current schedule of *Implementation Reviews* (which may need to be adjusted if the *Implementation Reviews* that are scheduled first take longer than anticipated) is:

(1) Western North Pacific Bryde's whales: started in 2017.
(2) Western North Pacific common minke whales: starting in 2018.
(3) North Atlantic common minke whales: starting in 2022.
(4) North Atlantic fin whales: starting in 2023.

This schedule should be considered to be tentative and periodically reviewed. The sub-committee **agrees** that it is not feasible to conduct more than one *Implementation* or *Implementation Review* simultaneously.

3.6 Work plan

Item	***During the Intersession period***	***During SC67b***
Item 3.1: North Atlantic minke whales.		Review any new abundance estimates.
Item 3.2: Western North Pacific minke whales.	Conduct a preparatory meeting focused on synthesising information on stock structure.	Initiate the *Implementation Review.*
Item 3.3: Western North Pacific Bryde's whales.	(a) conduct the Second Intersessional Workshop (b) code the resulting trials, condition the trials, and conduct projections under proposed RMP variants.	Conduct the work required for the Second Annual Meeting.
Item 3.4: North Atlantic fin whales.		Review any new abundance estimates.

4. EFFECTS OF SPECIFIC SCIENTIFIC PERMIT CATCHES ON STOCKS

4.1 Western North Pacific common minke whales

4.1.1 Panel summary

The conclusion of the Review Panel is as follows:

> The Panel has two major concerns with the approach used to assess the potential effects of catches for common minke whales as summarised below.
>
> (1) The approaches taken are based on projecting an SCAA model forward (O-stock) and an age- and sex-structure HITTER model (J-stock). However, the Scientific Committee and past expert panels have recommended that the impact of catches on stocks be based on trial framework (not the *CLA*) developed for RMP *Implementations* when these are available (IWC, 2010a). The projections should be based on the anticipated Scientific Permit catches as well as any projected other human-caused removals (e.g. by-catches). In the case of common minke whales, use of the trials structure on which the 2013 *Implementation* was based would account for uncertainty regarding future by-catch and also assume that the amount of by-catch is related to population size rather than being assumed to be constant.
>
> (2) The results are based on the assumption that there is a single J-stock and a single O-stock (Stock Hypothesis A). However, the 2013 *Implementation* considered scenarios in which there is a Y-stock in the Yellow Sea (Stock Hypothesis Y) and in which there are two J-stocks and two O-stocks (Stock Hypothesis C). The proponents consider Stock Hypothesis C to be implausible, but nevertheless Secondary Objective I(iii) involves investigating the likelihood of two O-stocks, which suggests that the proponents consider the possibility of there being two O-stocks is not fully resolved.
>
> The Panel notes that stock size is projected to decline even under the optimistic situation of a single J-stock when $MSYR_{mat}$=1% - due primarily to bycatch. Population size is projected to be reduced further (by 20% in approximately 2030 if catches of 47 continue to be taken). While this reduction is probably overestimated owing to assuming $MSYR_{mat}$=1% rather than $MSYR_{1+}$=1% and assuming that bycatch will remain at current levels, any further reduction of J-stock is of **concern**. The Panel **recommends** that the assessment of the effects of catches on stocks be based on a subset of the trials on which the 2013 *Implementation* was based (including two levels for MSYR and all three stock hypotheses) as this will better account for uncertainty regarding current abundance and future bycatch, as well as time-variation in the J-O mixing proportion. The trials will also be able to account for the location (sub-area) and timing (month) of future catches. However, the trials on which the 2013 *Implementation* was based consider $MSYR_{mat}$=1%, whereas the Scientific Committee has agreed that the lower bound for MSYR should be MSYR1+=1% (IWC, 2014). Furthermore, those trials did not use the most recent estimates of abundance. Thus, before a full consideration of the effects of the catches can be concluded, the Panel **recommends** that the proponents update the trials so that trials are conducted for MSYR1+=1% and $MSYR_{mat}$=4% are fit to the most recent estimates of abundance. The Panel **recognises** that modifying trials is a substantial undertaking (and must be accompanied by evidence of satisfactory conditioning) and it may not be possible to update even a subset of the trials prior to the 2017 Annual Meeting. However, the Panel **stresses** the importance of this being completed before the programme commences.

4.1.2 Proponent responses

Section 4 of SC/67a/SCSP13 provides results of additional assessments of potential effect of NEWREP-NP catches on the stocks of common minke and sei whales. In the case of the common minke whales, the baseline trials for stock structure hypotheses A and C developed in the previous *Implementation Review* were used to assess the effect of catches. The deterministic versions of the trials in question were reconditioned with $MSYR_{1+}$ values of 1%, 2%, 3% and 4% (only the value of MSYR was changed in this reconditioning). The constant future annual research catches considered when projecting under the proposed annual take of 170 minke whales were divided amongst sub areas as set out in Table 4.1.1 of Section 4, which corresponds to the temporal and spatial allocation proposed. For $MSYR_{1+}$=2%, all stocks show increases and/or are well above 54% of their pre-exploitation levels under the research catches proposed, so there are no

population conservation concerns. For $MSYR_{1+}$=1%, under Hypothesis A the J stock is currently less than 54% of its pre-exploitation level and is projected to continue to decline, while under Hypothesis C the same applies for the Jw stock (though this is a consequence of the bycatches only, as no research take from sub areas where this stock is present is planned) and the Ow stock, currently at 70.2% of its pre-exploitation level, decreases slowly to reach 66.3% by 2066. However, while these instances might be considered by some to be population conservation concerns, the proponents consider that issue not to be relevant, as recent information/analyses using the J:O ratio in bycatches and the close-kin analyses have shown the associated stock structure/MSYR combinations to be clearly implausible, for the reasons explained in Section 4 of SC/67a/SCSP13. In summary, the results provided therefore show that the research catches proposed will not adversely impact the stocks, so that no population conservation concern arises.

4.1.3 Discussion

The sub-committee noted that the analyses in Section 4 of SC/67a/SCSP13 address the major concerns raised by the Panel. Several members stated that the revised analyses involved considerable work in a short period of time and commended the proponents for conducting this work. The sub-committee also **agrees** that the analyses based on bycatch data are suggestive of $MSYR_{1+}$ >0.01 and that the close-kin data suggest that a hypothesis of two O sub-stocks with different breeding grounds is implausible. However, there was insufficient time to fully evaluate the technical basis for these analyses, in particular whether adequate account had been taken of statistical properties of the data and uncertainty in the bycatch information. The sub-committee **recommends** that the full set of equations on which the analyses in Section 4 of SC/67a/SCSP13 be provided to the sub-committee for review next year and possible use in revised *Implementation Simulation Trials*. The poor fits to the bycatch rates by sub-area mentioned in SC/67a/SCSP13 provide further support for the need to revise the *Implementation Simulation Trials* for the western North Pacific minke whales.

4.2 North Pacific sei whales

4.2.1 Panel summary

The conclusion of the Review Panel is as follows:

> The Panel **agrees** that approach on which the evaluation of the effects of catches for North Pacific sei whales was based was largely appropriate. However, the analysis is based on the (single) best estimate of abundance and $MSYR_{1+}$ values of 1% and 4%. The Panel **recommends** that the proponents consider additional analyses in which current abundance is assumed to equal to the lower 95% confidence bound for the current estimate of abundance and present results for $MSYR_{1+}$=1% and $MSYR_{mat}$=4%, as these are the values selected by the Scientific Committee (IWC, 2014).

4.2.2 Proponent responses

Figure 8 of Section 4 of SC/67a/SCSP13 shows projections of the cases considered for the North Pacific sei whales. The calculations were conducted based on conditioned age-/sex-structured models. Regardless of parameters assumed, there is no serious difference in the median trajectory between two catch scenarios (0 and 134 per year) over the 12-year research period, and therefore, it is evident that the impact of an annual catch of 134 whales is negligible.

4.2.3 Discussion

The sub-committee **agrees** that the proponents have adequately addressed the recommendations by the Panel.

4.3 Work plan

Item	***During the Intersessional period***	***During SC67b***
Item 4.1: North Atlantic minke whales	Further evaluate the information content of bycatch data for western North Pacific common minke whales in terms of estimating MSYR as part of the *Implementation Review* that will start with a preparatory meeting in early 2018.	

5. BUDGET ISSUES

(1) A preparatory meeting (in early 2018) with a focus on stock structure to initiate the *Implementation Review* for Western North Pacific minke whales (Convenor: Donovan) (£5,000; Item 3.2).
(2) An intersessional Workshop (in early 2018) to conduct the *Implementation Review* for North Pacific Bryde's whales (Convenor: Donovan) (£10,000; Item 3.3).

The Workshop and meeting will occur back-to-back, with some consequent cost savings. The sub-committee supported the proposed meeting and Workshop, recognising that without meetings to co-ordinate and focus intersessional work it will be impossible to achieve the Committee's ambitious schedule for two-year *Implementation Reviews*.

6. ADOPTION OF REPORT

The Report was adopted at 14:21 on 17 May 2017. The sub-committee acknowledged the considerable work undertaken by Allison, de Moor, and Punt during the intersessional period to ensure that the Committee was in a position to complete the *Implementation Review* for the North Atlantic minke whales and to progress the *Implementation Review* for the western North Pacific Bryde's whales. The sub-committee expressed its deep appreciation to Robbins who stepped into the role of Chair of the sub-committee given Bannister's unfortunate unavailability, and excellently guided the sub-committee through an extremely complex and challenging agenda.

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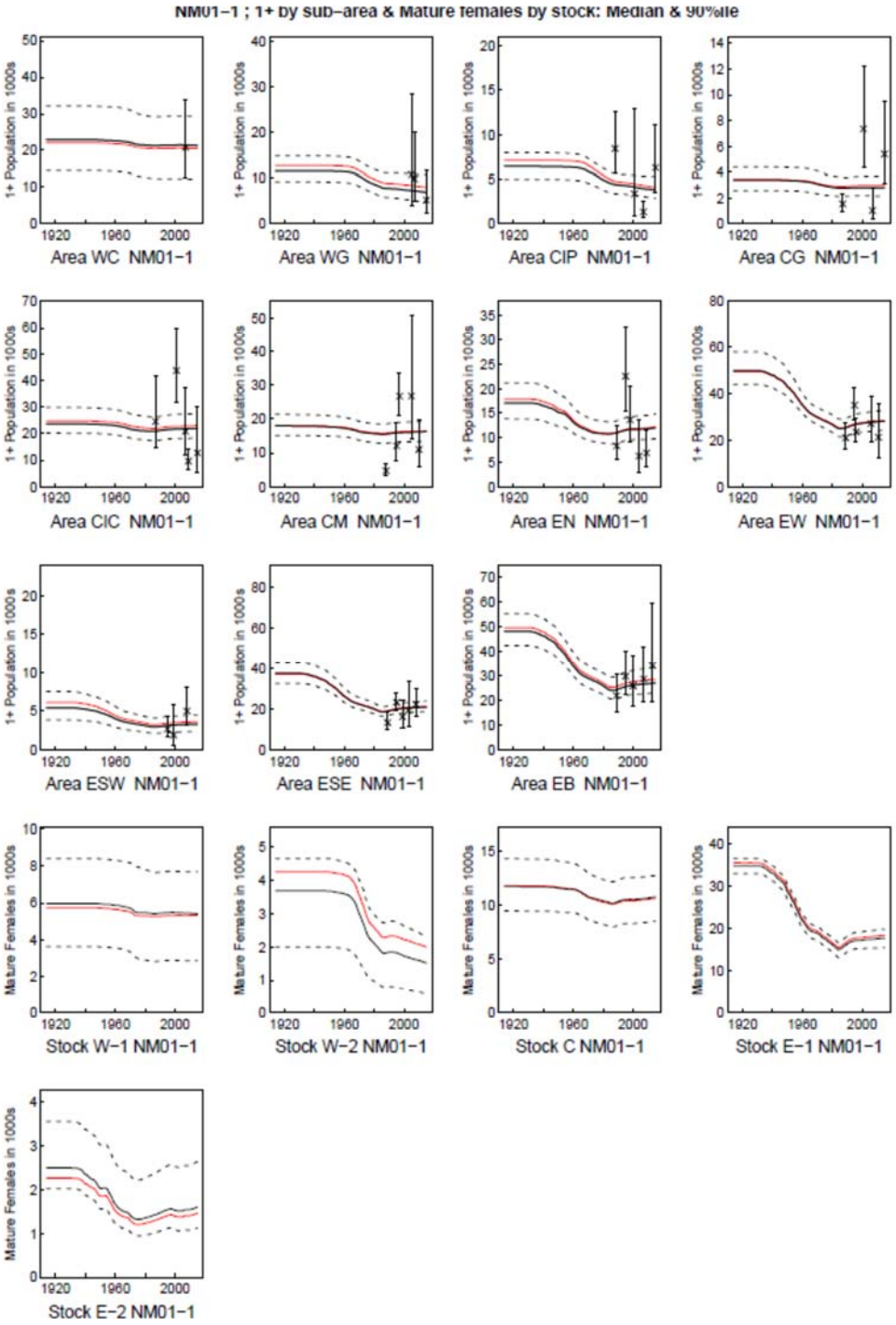
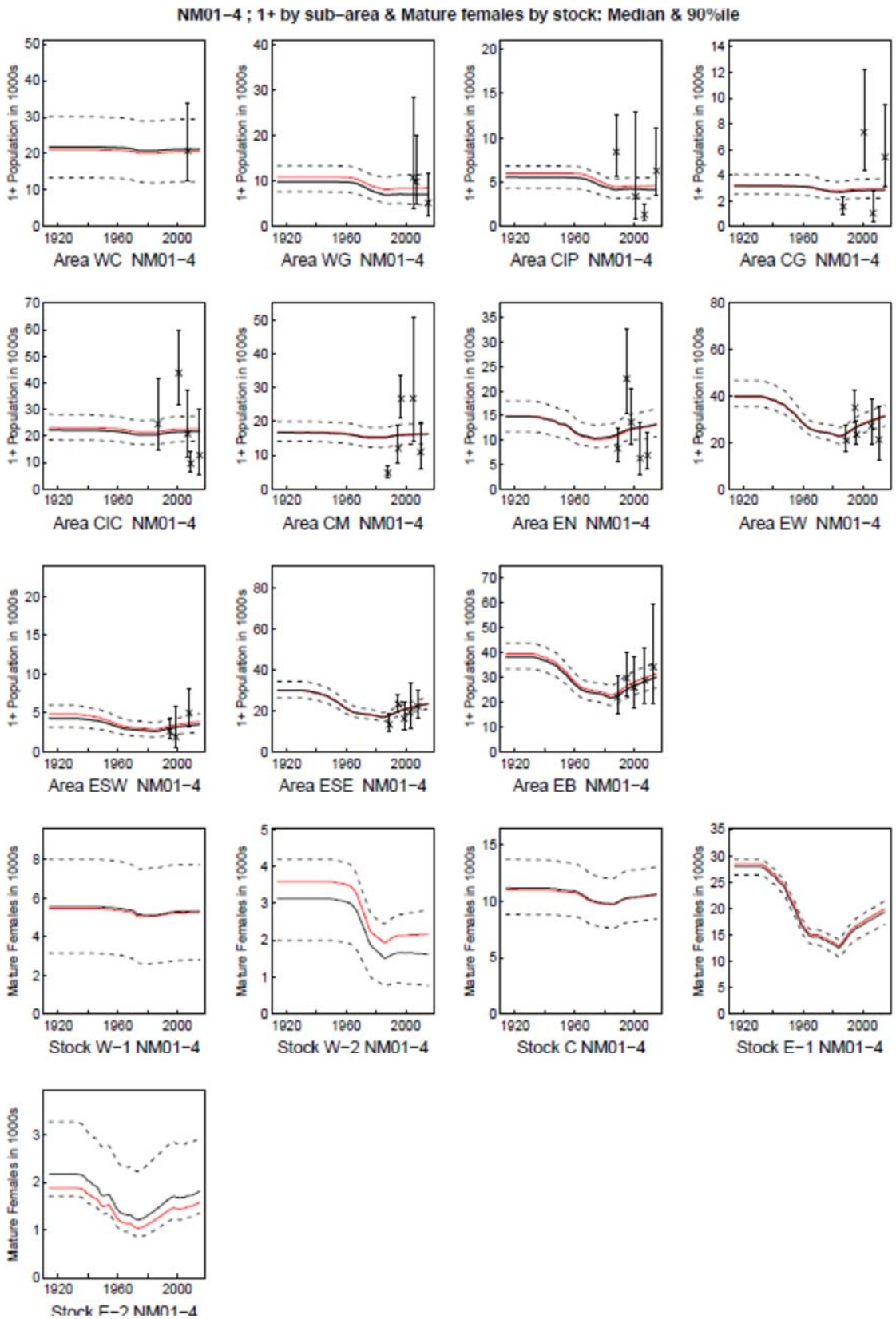
Polanowski, A.M., J. Robbins, D. Chandler and S.N. Jarman. 2014. Epigenetic estimation of age in humpback whales. *Molecular Ecology Resources* 14: 976-87.




NM01−4 ; 1+ by sub−area & Mature females by stock: Median & 90%ile
1+ Population in 1000s
Area WC NM01−4
Area WG NM01−4
Area CIP NM01−4
Area CG NM01−4
Area CIC NM01−4
Area CM NM01−4
Area EN NM01−4
Area EW NM01−4
Area ESW NM01−4
Area ESE NM01−4
Area EB NM01−4
Mature Females in 1000s
Stock W−1 NM01−4
Stock W−2 NM01−4
Stock C NM01−4
Stock E−1 NM01−4
Stock E−2 NM01−4

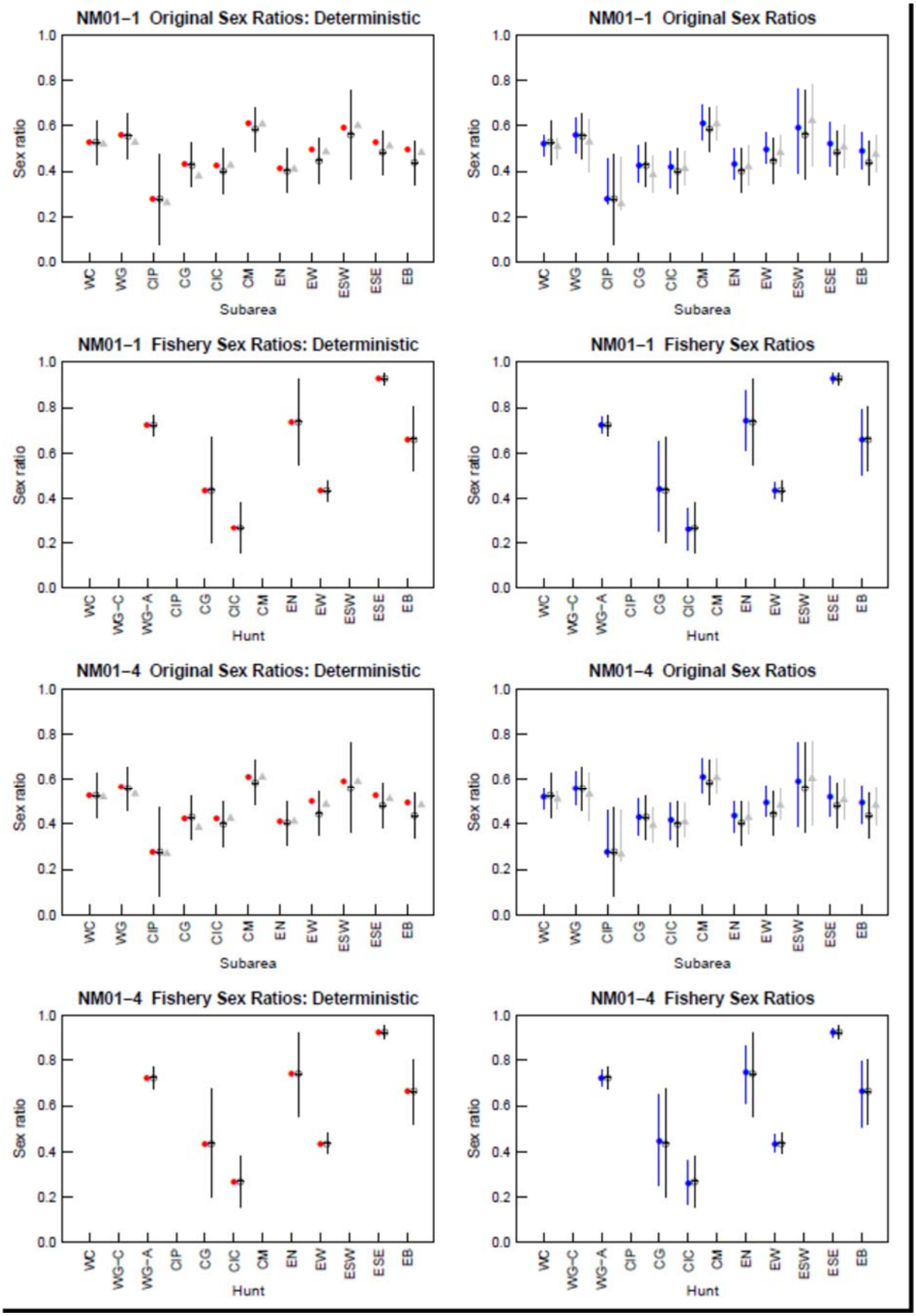


Figure 3. Examples of the plots used to evaluate conditioning.

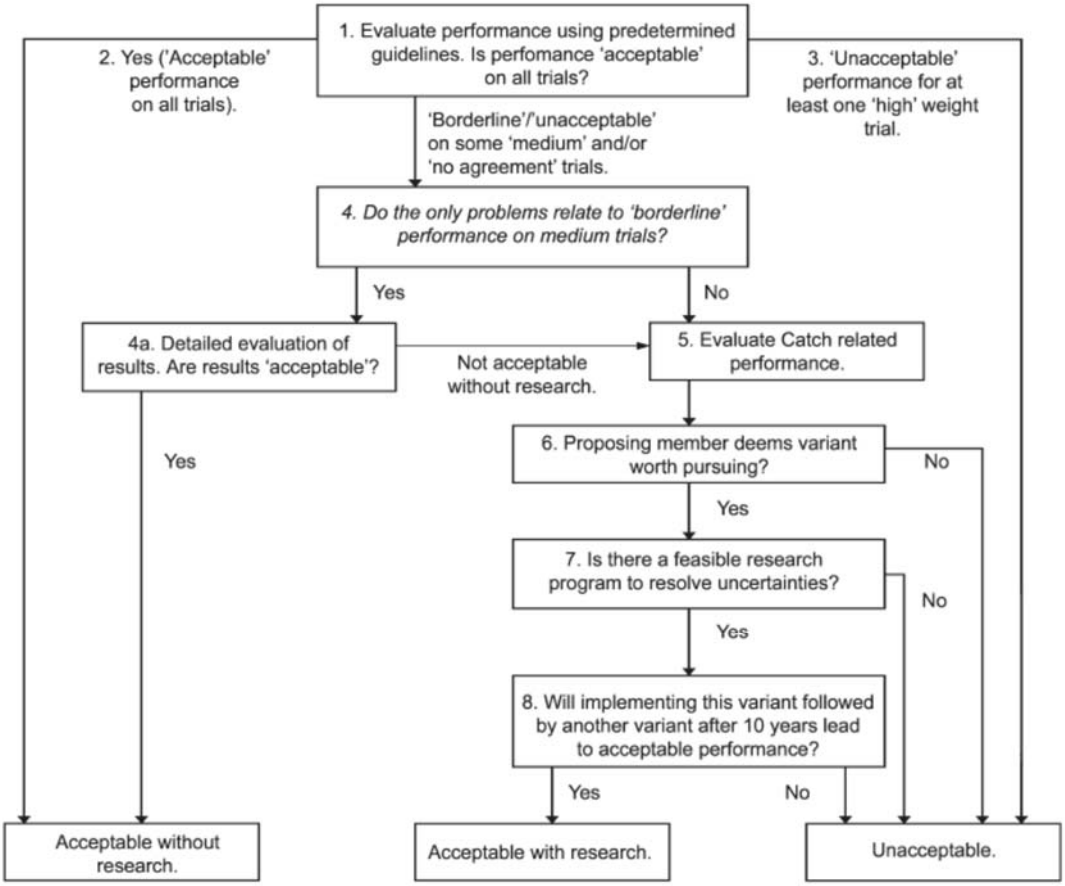


Fig. 2. Flowchart summarising the procedure for review of *IST*s (from IWC, 2005).

Fig. 4 Flowchart summarising the procedure for review of ISTs (from IWC, 2005).

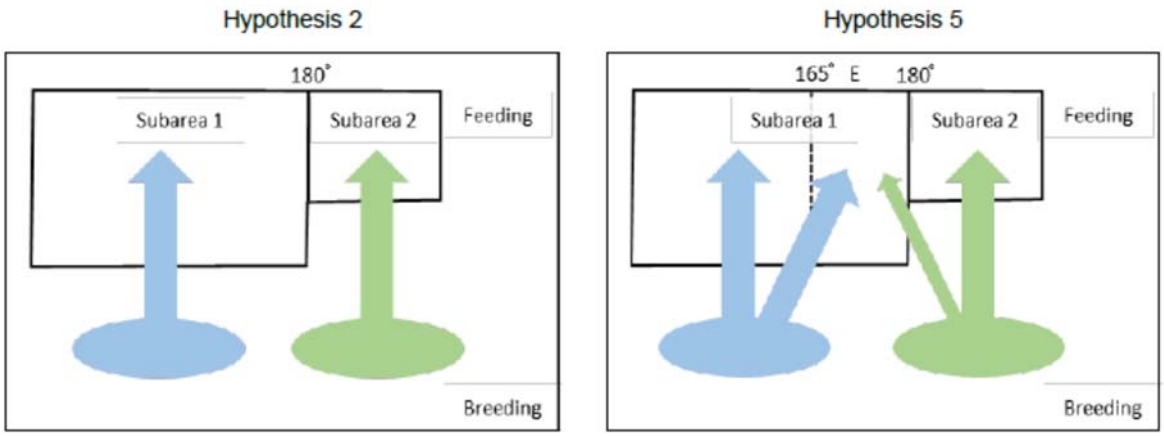


Fig. 5. The two hypotheses that will be considered in the *Implementation Simulation Trials* for the western North Pacific Bryde's whales.

Appendix 1

AGENDA

1. INTRODUCTORY ITEMS
    - 1.1 Convenor's opening remarks
    - 1.2 Election of Chair and appointment of rapporteurs
    - 1.3 Adoption of Agenda
    - 1.4 Available documents

2. GENERAL ASSESSMENT ISSUES WITH A FOCUS ON THOSE RELATED TO THE REVISED MANAGEMENT PROCEDURE
    - 2.1 Relationship between $MSYR_{mat}$ and $MSYR_{1+}$: evaluate energetics-based model
    - 2.2 Implications of IST_s for consideration of 'status'
    - 2.3 General consideration of how to evaluate the effect of special permit catches on stocks
    - 2.4 Improvements in management performance (in relation to RMP and SCAA) by improved precision in biological parameters
    - 2.5 Work plan

3. RMP – IMPLEMENTATION-RELATED MATTERS
    - 3.1 North Atlantic common minke whales
        - 3.1.1 Report of the intersessional Workshop
        - 3.1.2 Completion of *Implementation Review*
        - 3.1.3 New information
        - 3.1.4 Conclusions and recommendations
    - 3.2 North Pacific common minke whales
        - 3.2.1 Review of new information
        - 3.2.2 Prepare for the next *Implementation*
    - 3.3 Western North Pacific Bryde's whales
        - 3.3.1 Report of the intersessional Workshop
        - 3.3.2 Progress since the intersessional Workshop
        - 3.3.3 Conclusions and recommendations
    - 3.4 North Atlantic fin whales
    - 3.5 Review RMP *Implementation Review* schedule for the next six years
    - 3.6 Work plan

4. EFFECTS OF SPECIFIC SCIENTIFIC PERMIT CATCHES ON STOCKS
    - 4.1 Western North Pacific common minke whales
        - 4.1.1 Panel summary
        - 4.1.2 Proponent responses
        - 4.1.3 Discussion
    - 4.2 North Pacific sei whales
        - 4.2.1 Panel summary
        - 4.2.2 Proponent responses
        - 4.2.3 Discussion
    - 4.3 Work plan

5. BUDGET ISSUES

6. ADOPTION OF REPORT

Appendix 2

GUIDELINES ON EVALUATING THE EFFECT OF SCIENTIFIC PERMIT CATCHES ON STOCKS

Projections should be conducted under the pre-specified series of catches as proposed in the special permit. In addition, projections should also be run with zero scientific, commercial and aboriginal catches (see details below) for comparison. Again, for comparative purposes, the time period considered and for which projections are reported should include:

(a) the specified time of the permit proposal;
(b) 50 years with scientific permit and other commercial and aboriginal catches (but not incidental catches) set to zero after the specified time of the permit proposal and
(c) 50 years with catches set at the level specified in the proposal (plus any likely incidental catches).

Where an *Implementation* has been completed

The default for such stocks would be to use the trials on which the most recent *Implementation / Implementation Review* was based. Results of projections should be presented for:

(a) base-case trials and
(b) any other trials considered to be 'influential'; the guidelines for conducting *Implementations* and *Implementation Reviews* should be modified include identification of 'influential' trials.

It is possible that research since the most recent *Implementation*/*Implementation Review* has shown that some (influential) trials are no longer considered plausible by the Committee. In such cases, the associated trials would not be run. In principle, the trials could be modified to reflect new information (such as a change to the lowest value of MSYR considered plausible). However, this may require changes to model structure and reconditioning of trials, which could be both time-consuming and difficult. Given the practical difficulties associated with changing *Implementation Simulation Trials*, it is not a requirement that the trials be modified if new information is available, although other computations indicating the likely impact of those new data on the effect of catches in some way should be presented. If the aim of the programme is to show that some of the factors on which the most recent *Implementation* / *Implementation Review* was based are implausible, those trials should be run for comparative purposes. Those trials should be highlighted, and arguments for the asserted implausibility need to be presented.

Stocks with an in-depth assessment

This case is similar to that above. The scenarios and model structures used in the in-depth assessment (to the extent that those have been adequately specified) should be used. Time periods for projections would be the same, with runs being undertaken for base case and 'influential' trials.

Other stocks

It is more challenging to evaluate the effects of scientific permit catches for other stocks. In developing a research plan, proponents should identify the core uncertainties for the region/species. The evaluations presented of the effects of catches upon stocks may require development of a simple modelling framework to broadly captures such uncertainties. They should call upon the advice of relevant experts when doing so.

Appendix 3

AUTHOR SUMMARY OF PAPER SC/67A/SCSP13

Annex 11 also provides the general background and the rationale for the sample size of common minke whale under NEWREP-NP in the Pacific side of Japan. Analyses in this Annex demonstrated first that self-evidently optimal management based the scenario (and associated sensitivities) provided by the SCAA, which can estimate recruitment directly through the availability of age data, would be very different to that from the deterministic stock-recruitment relationship scenarios (as, e.g., the FITTER methodology has to assume), which at best would need to consider a very wide range of robustness tests, resulting in an inefficient approach (less allowable catch for the same perceived risk).

Annex 11 noted that the Punt *et al*. (2014) analysis constitutes an important step in contributing to the evolution of the RMP towards a more efficient version which is based on better conditioned operating models, and is stock specific rather than generic as at present. Age data contribute to this better conditioning through allowing much improved estimation of recruitment and its changes and may also be able to improve the performance of a refined version of the RMP, as has been demonstrated in the case of Antarctic minke whales (GOJ, 2016). The NEWREP-NP proposal, with its analyses, has the intent that the age data to be collected will contribute to this evolutionary process.

The JARPNII Final Review Workshop report, endorsed by the IWC SC, noted that 'if the *Implementation Simulation Trials* (*IST*s) for the western North Pacific minke whales are to be revised in future, the age data should be included in the conditioning process' (SC/66b/Rep06). Age data, whenever potentially available, are needed for conditioning such trials so that recruitment and its changes may be reflected far better. This is the primary reason why the NEWREP-NP proponents support the use of age data for the conditioning of the next set of *ISTs* for the North Pacific common minke whale, which they understand to be endorsed also by the IWC SC. Naturally recruitment is hardly estimable for other than past years spanned by the collection of age data, so for future sets of *ISTs* also to best reflect underlying dynamics, age data must continue to be collected, notwithstanding the fact that the impact of data from the first few years of NEWREP-NP to the next NP common minke whale *Implementation Review* may not be that large.

The proponents' approach is entirely in line with fisheries management approaches elsewhere, including in the development of MPs in other Regional Fisheries Management Organizations (RFMO). There a high premium is placed on obtaining and improving age data and/or on equivalent information to provide information on recruitment changes. Further comments on this and other aspects of the use of age data in fisheries management may be found in Adjunct 1 of Annex 11. Furthermore Adjunct 2 of Annex 11 provides an example of how the availability of age data aids the estimation of the extent of the impact of environmental factors on recruitment trends – a matter of importance at this time given concerns about the possible impacts of Climate Change.

While age data could be used in a future RMP in a similar way to that in the proposal in GOJ (2016), the primary contribution of such data remains to the conditioning of *ISTs*, and (as has proven to be the preferred approach for other MPs internationally) their contribution to feedback adjustments to management measures might be through the regular re-conditioning of the *ISTs* rather than by changes to the MP itself.

Regarding the matter of sample size, Annex 11 summarises the proponents' rationale for the number advanced:

- Age data are needed for improved conditioning of *IST*s for testing management procedures, to inform better on recruitment changes and hence improves the trials' realism.
- Simulation results (see Adjunct 2 of Annex 11) indicate that larger age samples would allow better estimation of recruitment changes for this NP minke situation.
- On the other hand, operational considerations regarding the practically maximum sample size and the effect on the population must also be taken into account in determining the optimal sample size
- Therefore, the optimal sample size should meet both of these criteria: that it is operationally maximal and is also sufficient to provide meaningful improvement in the estimation of recruitment changes; simulation results (see Adjunct 3 of Annex 11) indicate that is the case for this NP minke situation.

Given the clear and widely accepted benefits in principle of the inclusion of ageing data to the *IST* conditioning process, the only question that then remains is how much age data is needed to make a meaningful improvement to that NP minke whale conditioning. A detailed calculation for this would need to be based on the planned updated conditioned (including with the age data available at that time) set of NP minke *ISTs*, and consequently would need to await completion of that exercise which is the responsibility of the IWC SC.

However, in the interim, much simpler computations are adequate to bound the problem, and are conducted in Adjunct 3 of Annex 11. These are based on a simpler model broadly accepted when presented to the JARPNII review, which was intended to be illustrative and to assist this bounding.

Note first that the model showed performance improved with increases in the sample size aged, and that these improvements are meaningful over the sample sizes examined which were consistent with what was operationally practical. This last consideration then provides the desirable sample size, but always provided that a) the criterion of no adverse effect on the population is met, and b) that sample size is itself sufficient to provide a meaningful improvement in performance. The intent of the calculations of Adjunct 3 of Annex 11 is to address this last question, and this is successfully achieved – note that this is an exercise for which primarily only relative measures of performance when comparing results with to those without ageing data are needed. Once the updated conditioning is complete, that could be used to update these overall results, though any difference would not be expected to be large, and the priority for such an update would not seem to be very high, and results from this bounding an illustrative exercise are sufficient to address the immediate question.

Given the relatively slow dynamics of minke whales, coupled to the nature of the information content of age data, the improvements to *IST*s achieved by use of these data take time to reveal their full extent (see the plots in Adjunct 3 of Annex 11), so that there is a need to show results for projections over a number of decades, extending beyond the time-frame of the current research program. Self-evidently the results for these larger numbers of years must be taken into account; otherwise the injudicious situation would arise that research with longer term benefits would never commence because those benefits could never become evident in the short term.

In summary it is considered that the annual sample size of 107 common minke whales in sub-areas 7-9, which is the maximum feasible within the operational constraints of the program, is sufficient to result in meaningful improvement in the detection of minke whale recruitment changes.

This intended sample size applies to O stock whales. It is planned that 60% of this sample size be taken in coastal sub-areas (7CS and 7CN) and 40% in offshore sub-areas (7WR, 7E, 8 and 9). Evaluating an optimal coastal:offshore ratio for this sample would be an enormous task technically, but it seems reasonable to expect that a 50:50 split would be near optimal in terms of distinguishing possible differences between the two regions if any. Taking into account operational reasons as well, the ratio has been decided to be 60:40, noting that typically such 'distinguishability' performance behaves quadratically, so does not deteriorate much with relatively small movement away from the actual optimal split. Hence it is planned that 64 animals will be sampled in coastal sub-areas and 43 in offshore sub-areas. Because around 20% of the animals in sub-areas 7CS and 7CN are from the J stock (see Annex 7 of the revised NEWREP-NP research plan), the sample size in the coastal sub-areas needs to be adjusted upwards to 80 animals in total to achieve sampling of 64 O stock whales. Thus the total sample size planned on the Pacific side of Japan becomes 123 whales.

For the area north of Hokkaido (sub-area 11), the main objective is to estimate the J-O mixing proportion in this subarea annually with a standard error of no more than 0.1 irrespective of the true proportion. The sample size selected is 47. The basis for the selection of this value is explained in Adjunct 4 of Annex 11.

With 123 whales to be taken on the Pacific side of Japan, and 47 north of Hokkaido, the total sample size planned for common minke whales is 170.

Annex 16 introduces an approach to estimate the proposed sample size for the North Pacific sei whales to meet the Primary Objectives II, especially the Secondary Objective II (ii). The approach followed is based on the age- and sex-structured model applied to this stock for conditioning and generating future data in a simulation. The target is to estimate the natural mortality rate, *M*, by using the SCAA methodology.

Figure 4 of Annex 16 shows the performance measures for the four scenarios (true *M*/MSYR combinations) considered. Robust results across these scenarios are that for an annual sample size *n* of 100 or above, bias reduces to close to zero, and RMSE stabilises at about 0.005. Figure 5 of Annex 16 illustrates how the variance of the distribution of *M* estimates narrows considerably as the sample size is increased from 40 to 100. This value makes no allowance for possible over-dispersion in the age data, and the sample sizes available are too small to estimate this reliably. Therefore the assumption has been made that this is the same as for minke whales, corresponding to a need to increase the sample size by a multiplicative factor of 1.34 (see Appendix D of Adjunct 3 of Annex 11). Consequently the proposed annual sample size for sei whales is 134.

Appendix 4

A RESPONSE TO SC/67A/SCSP08 RE THE VALUE OF IMPROVING ESTIMATES OF NATURAL MORTALITY *M*

L.A. Pastene, T. Kitakado and D.S. Butterworth

The author of SC/67A/SCSP08 adds simulation results to complement the views expressed by the Review Panel for NEWREP-NP about the likely poor precision of attempts to simultaneously estimate the values of *M* and MSYR for North Pacific sei whales given the information currently available and planned to be obtained under NEWREP-NP.

It has already been pointed out by the Proponents in their responses during the Review that such joint estimation was not the purpose of the proposal (see their morning papers of 1 and 2 February, 2017) submitted to the Panel. Note also that the Panel seems not to have taken certain important comments in these papers into account in its report (SC/67A/SCSP01).

It is also certainly true that in the case on North Pacific sei whales, the limited data available (either now or in the short term future) would be insufficient to allow reliable direct estimation of MSYR, either on its own or in combination with *M*. However, this last point has little immediate pertinence, as at present the standard practice for *IST*s is to consider trials for fixed values of MSYR, and as explained in those morning papers, the NEWREP-NP proposal related to estimation of *M* conditional on a value for MSYR to secure *IST*s that more realistically reflected stock dynamics, as always needs to be the aim for such trials.

Those morning papers explained that the utility of having such an estimate of *M* related to transient effects in the stock dynamics. The higher the value of *M*, the more rapidly population abundance will respond to changes (for example in recruitment). SC/67A/SCSP13 (the Annex 16 section, Figure 5) reports that present data do not exclude values of *M* for North Pacific se whale within the range of about [0.02; 0.10]. This corresponds to a multiplicative range of a factor of five, about the same as typical for a cod compared to a sardine, for which fisheries management approaches certainly differ in consequence.

One example of the differential consequences of the value of *M* as a result of such transients emerges from projections based on the set of assessments for North Pacific sei whales presented in SC/67A/SCSP13 (Annex 16 section). The conditioning is simple given that this example is intended to purely as a simple illustration: commercial and research selectivities are taken to be fixed at their values for the *M*=0.04 and MSYR(1+)=1% case of the four scenarios considered in that Annex 16 section (in any case those selectivities do not differ greatly across those scenarios), and the resilience parameter *A* is adjusted for compatibility with MSYR(1+)=1% and a range on *M* values from 0.02 to 0.10. For each value of *M*, a value of *K* for the mature female component of the population is found to secure the population trajectory passes through the abundance estimate for the stock as a whole for 2010. Finally projections are used to establish what constant future annual catch would result in the population reaching a depletion of 0.72 (the *CLA* equilibrium) of that component of *K* after 50 years.

Table 1 lists the values of this catch for each of the values of *M* considered. What is evident is that despite all these calculations being conducted for the same value of MSYR, the value of the annual catch changes by relatively substantial amounts as the value of *M* is changed. Such differences would certainly be of interest to managers. Thus even if the value of MSYR is known/assumed, knowledge of the value of *M* remains important.

Table 1

Values of a fixed annual catch that secures a depletion of 0.72 in terms of the mature female population of North Pacific sei whales after 50 years in relation to the value of natural mortality *M*.

M	**Catch**
0.02	153
0.04	93
0.06	57
0.08	30
0.10	6

Moving beyond the current typical *IST*s, there is of course the general relationship evident for marine species that values for productivity and *M* across resources tend to be positively correlated (e.g. Andersen *et al*. 2009), so that information on the value of *M* adds qualitatively at least to an evaluation of the plausibility of different values for MSYR.

But as SC/67A/SCSP01 states, the NEWREP-NP proposal considers the RMP not only in its current form, but as it will need to be modified for future improvement, particularly given the availability of age data. This allows for much improved estimation of annual recruitments and their changes over time, and moves the situation for the whale stock concerned much closer to that typical for the management (including under MPs) of fish populations. The calculation basis underlying SC76A/SCSP08 is a class of assessment models (sometimes called age-structured production models) used in a "data-limited" situation (as has applied in the past for most whale populations), and in particular relies heavily of an assumed stock-recruitment function and the assumption of a resource at equilibrium prior to the onset of exploitation. In contrast, the greater data set (particularly including age data) that is available for many fish stock assessments sees much less reliance on such assumptions to obtain more reliable results. The associated projections (including for MP testing purposes) are typically much more heavily based on estimates over a recent period of annual recruitments in relation to the reproductive component of the population. In these circumstances, the value of *M* has a much greater influence on assessment outputs and on the estimation of target levels for abundance. For whales there are already cases such as the Eastern North Pacific gray whale and the Indo-Pacific Antarctic minke whale which provide examples of violations of those assumptions regarding pre-exploitation equilibrium and standard stock-recruitment relationships. This adds weight to the desirability of moving whale stocks closer to the typical fish stock assessment situation, given especially the availability of age data; this process is likely to see the value of *M* start to play a more important role in the manner in which *IST*s are developed in the future.

Reference

Andersen, K. H., Farnsworth, K. D., Pedersen, M., Gislason, H., and Beyer, J. E. 2009. How community ecology links natural mortality, growth, and production of fish populations. – *ICES Journal of Marine Science*, 66: 1978–1984.

Appendix 5

RESPONSE TO APPENDIX 4 RE THE VALUE OF IMPROVING ESTIMATES OF NATURAL MORTALITY *M*

William de la Mare

Using the model in de la Mare SC/67a/SP08 this paper looks at the conclusions that might be drawn about the conservation performance of management using different values of M, with and without increasing mortality for older animals.

In this demonstration it is assumed that the value of *M* for the bulk of animals in the population is known after the completion of the NEWREP-NP program. The proposed special permit catches are removed during this period. Thereafter a management procedure is applied which leads to a constant catch of 100 whales per year for 50 years.

The table below gives the mature population sizes in 1910 and 2080 and the depletion with constant catches of 100. The table also shows for reference the depletion in the mature stock without catches after NEWREP-NP.

M	Age dependence	N_{1910} (K)	N_{2080} with catch = 100	*D* without further catch	D_{100}
0.02	N	65741	41446	0.696	**0.632**
0.10	N	49719	39152	0.643	0.584
0.02	Y	72654	40425	0.615	0.556
0.10	Y	49910	29029	0.640	**0.582**

These results show that the apparent conservation performance of the procedure is better (in terms of less depletion for a given catch) in the case conditioned where M is age-independent with a value = 0.02. However, in the case where few whales reach an age of 50 because of age dependence in *M* the conservation performance of the procedure is now better than when the procedure is conditioned using *M*=0.10.

Age dependence in mortality is important to understanding the demonstrations in Appendix 4 and here. *M*=0.02 gives a mean age of animals in a population at *K* of 50. *M* = 0.10 gives a corresponding mean age of 10. However, when few animals reach an age of 50 because of age-dependence in *M* there will be a much smaller difference between the average ages of populations with *M* = 0.02 and *M* =0.10. Consequently estimating age-dependence in mortality becomes as important as estimating its value for the bulk of the population.

It is important when considering the value of information in contributing to management that a realistic context is used. Although there are management procedures related to the demonstration in Appendix 4 that set target stock recoveries in the future, such procedures are very different from the RMP. These procedures usually integrate over uncertainty in *M*, and take into account both the target recovery level and a constraint on the probability of the populations becoming depleted.

Consequently, to the possibility raised in Appendix 4 that a different constant catch can be taken on the way to recovery to 0.72 cannot be realised to the extent shown with the achievable bias and precision in estimates of *M* shown in SC/67a/SP08.

Setting a catch level, as in the demonstration here, is more like the RMP and the question of conservation performance for a given catch is closer to the approach used to evaluate RMP variants. The demonstration shows it the details of how mortality is modelled and estimated are much more important than in the simple demonstration in Appendix 4.

Appendix 6

FINAL TRIAL SPECIFICATIONS (NORTH ATLANTIC MINKE WHALES)

[To come]

Appendix 7

CURRENT TRIAL SPECIFICATIONS (WESTERN NORTH PACIFIC BRYDE'S WHALES)

[To come]