SC/66a/SP/8

Proponents additional responses to the Report of the Expert Panel to review the proposal for NEWREP-A

Government of Japan

INTERNATIONAL
WHALING COMMISSION

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The Government of Japan

The Proposed Research Plan for New Scientific Whale Research Program in the Antarctic Ocean (NEWREP-A) (Government of Japan, 2014) was submitted to the International Whaling Commission (IWC) in conformity with Paragraph 30 of the Schedule to the International Convention for the Regulation of Whaling (ICRW) and Annex P (IWC, 2013) as a possible basis for issuing special permits in accordance with Article VIII, paragraph 1, of the ICRW. The IWC Scientific Committee (IWC SC) carried out a review of the NEWREP-A research plan through a workshop of specialists (Review Panel), which offered several scientific recommendations to improve the research plan (IWC, 2015 SC/66a/Rep6). The proponents provided preliminary response to the report of the Expert Panel and noted that additional analyses and information will be submitted to the IWC SC (Government of Japan, 2015 SC/66a/SP1).

The objective of this document is to provide additional analyses and information, particularly on two specific topics:

i) Some analytical updates on NEWREP-A, and
ii) The research plan for the NEWREP-A's dedicated sighting survey in 2015/16 austral summer season (= season).

Topic i) is related mainly to recommendations 1, 10, 11, 12, 13 and 26 offered by the NEWREP-A Review Panel while topic ii) is related to recommendations 4-5 (feasibility studies on non-lethal methods), 6-7 (sighting surveys), and 15 (krill surveys) (see Government of Japan, 2015 SC/66a/SP1).

Annex 1 shows the results on topic i) while Annex 2 shows the research plan for topic ii).

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Government of Japan. 2014. Proposed research plan for New Scientific Whale Research Program in the Antarctic Ocean (NEWREP-A). 101pp.

Government of Japan. 2015. Proponents' preliminary response to the Report of the Expert Panel to review the proposal for NEWREP-A. Paper SC/66a/SP1 presented to IWC Scientific Committee, May 2015 (unpublished). 33pp. [Paper available at the IWC Office].

International Whaling Commission. 2013. Process for the review of special permit proposals and research results from existing and completed permits. *J. Cetacean. Res. Manage*. 14 (*suppl.*): 463-8.

International Whaling Commission. 2015. Report of the Expert Panel to Review the proposal by Japan for NEWREP-A, 7-10 February 2015, Tokyo, Japan. Paper SC/66a/Rep6 presented to IWC Scientific Committee, May 2015 (unpublished). 62pp. [Paper available at the IWC Office].

ANNEX 1

Some analytical updates on NEWREP-A

1. INTRODUCTION

The Review Panel carefully evaluated the proposal of original “NEWREP-A” program submitted to the IWC Scientific Committee, and it made a number of recommendations in its report for further clarification of the program. The proponent (the Government of Japan) has responded to the review report by indicating that quantitative analyses (Recommendations 1, 11, 12, 13 and 26) would be done and submitted as a paper by 2015 IWC/SC (see Table 1). This paper aims at reporting on progress.

Table 1. Extracts of recommendations made in the Panel Review Report and “planned and achieved”.

Review Panel recommendations			Proponents’ responses		
# (Item)	Summary	Timeframe	Planned works	Planned timeframe	Current status
1 (2.1.2)	Evaluate the level of improvement that might be expected either in the SCAA or in RMP performance by improved precision in biological parameters using simulation studies including updated Implementation Simulation Trials	Within 6 months	Simulation study to be conducted	Before 2015 IWC/SC	On-going in a), e)
2 (3.1.3)	Analyses to distinguish between 2-stocks with mixing versus isolation by distance	Within 3 months	Analyses to be conducted to elucidate whether the genetic and morphometric data are consistent with isolation by distance hypothesis	Within program (results to be presented to 2016 IWC SC meeting)	-
3 (3.1.3)	Simulation study to examine how additional sampling could be expected to improve precision and/or reduce bias in estimates of mixing rates	Within 3 months	Simulation study to be conducted	Within program (results to be presented to 2016 IWC SC meeting)	-
10 (3.4.3.1)	Evaluate the effect on SCAA of assuming ‘resting’ females are immature females	Within 6 months	Simulation study to be conducted	Before start of the program	-
11 (3.4.3.2)	Update SCAA with respect to density-dependence following Punt et al., in press, and stock mixing based on existing data	Within 3 months	Simulation study to be conducted	Before 2015 IWC/SC	Punt’s model used. Party in c) below
12 (3.4.3.2)	Identify more fully the data to be used to inform the time-varying natural mortality in the SCAA and analyze existing data to determine the feasibility and accuracy of obtaining such estimates.	Within 6 months	Simulation study to be conducted in the context of work related to recommendation1 above	Before 2015 IWC/SC	To be conducted
13 (3.4.3.2)	Develop metrics to evaluate the benefits of including time varying ASM data in the SCAA	Within 3 months	Simulation study to be conducted in the context of the work related to recommendation 1 above	Before 2015 IWC/SC	Some analyses conducted in b) below
25 (3.11.2)	Provide an improved outline of the proposed ecosystem and multispecies model structures and provide a data gap analysis	Within 3 months	More detailed description of underlying data and data quality related to ecosystem modelling to be provided, with an explanation of how the information will be acquired. Data gaps will be identified	Within program (preliminary results will be presented to 2016 IWC/SC and final ones will be presented to 2017 IWC/SC)	-
26 (4.3.2)	Provide a thorough power analysis of sample sizes required to detect change in ASM and follow the other recommendations in this Item	Within 3 months	Simulation study to be conducted	Before 2015 IWC/SC	Conducted - see d) below

Some analyses were conducted to cover Recommendations 1, 11, 13 and 26. The following items among a)-i) originally shown in the proponent's response paper were conducted and are reported in this paper.

a) Prepare a document describing a specification of calculation to be used for this evaluation process (which will be based on the SCAA framework).

b) Using existing data assess how the biological parameters such as change in the ASM have impacts on the estimation outcomes in the SCAA through some possible metrics [incl. Recommendation 13].

c) Using existing data, conduct SCAA analysis with consideration of the existing mixing information [Recommendation 11]

d) Conduct additional simulation tests with a more realistic model to assess the sample size using data generated from the SCAA [Recommendation 26].

e) Conduct simulation performance tests to evaluate the level of improvement in the precision of quantities estimated by the SCAA during the period of NEWREP-A given the proposed sample size. [Recommendation 1]

2. PROGRESS MADE

a) Prepare a document describing a specification of calculation to be used for the evaluation process

Under Main Objective I (Improvements in the precision of biological and ecological information for the application of the RMP), drawing information on certain biological and ecological parameters is one of key issues for the specification of trials. After a decadal discussion in the IWC, the SCAA model (see. Punt, 2015, in press) is now recognized as the best currently available model for examining stock dynamics for Antarctic minke whales (IWC, 2014). In the age-structured population dynamics model, parameters such as the "natural mortality rate (*M*)", the "MSYR", recruitment relationship and time-varying carrying capacity are influential on the results. The biological parameters including these which will be estimated from data collected by this program will contribute to the trials structure in the RMP *ISTs*. That is why "refinement of the SCAA model and estimation of biological parameters" is one of the research sub-objectives.

Although future SCAA and relevant associated analyses may contribute to further refinement of specification and conditioning, the results which have been derived for the base case scenario of Punt et al. (2015) are used for any quantitative assessments in this paper. The summary of specification is shown in Table 2. Formulae and their detailed explanation are shown in the original paper and omitted here.

Using an operating model (OM) conditioned on the base case result of the SCAA, future catch-at-age and abundance estimates are generated and used in estimation by the SCAA model. In the estimation, to reduce computation time and avoid non-convergence cases in the iteration, some parameters are fixed at their assumed true values (i.e. the values estimated in the Punt et al.'s base case) in these further estimations. Even so, getting convergence is not easy with the SCAA.

Although this is not handled in this paper, the OM is potentially used for a simulation for evaluating future benefit in terms of RMP *Implementation Simulation Trials* (*ISTs*), which is planned as one of the sub-objectives under Main Objective I. Note that *Small Areas* will be defined based on the updated information on stock structure and possible whaling operations.

Table 2. Specification of SCAA-based OM and estimation model.

Parameter/Assumption	Assumption in OM (based on "base case result" of Punt et al. 2015 *in press*)	Estimation in SCAA in simulation
Stock structure (# stocks)	2 (I/P: a hard boundary in between Area V-W and V-E)	Fixed
Mixing pattern	No mixing (with process error)	Fixed
$MSYR_{1+}$	Stock-specific	Calculated
Mortality rate	Stock/age-specific	Fixed
Age-at-sexual maturity (ASM)	Common to stocks: 8.5 and 11.5 for 50% and 95% ASM	Fixed
Exploitation rate (F)	Year/fleet-specific	Estimated
Initial year and initial depletion	D (=1) at 1930 (1929/30 season)	Fixed
Carrying capacity in 1930	Stock-specific	Estimated
Time varying K_{1+}	Auto-correlated deviation (given sigma=0.05, no time-varying since 2012)	Estimated
Growth formula	Stock/sex-specific VB (no change in *k* since 2012)	Fixed
Resilience	Stock-specific	Estimated
Recruitment deviation	Stock/year-specific	Estimated
Selectivity during commercial whaling	Length-based	Fixed
Selectivity during scientific whaling	Length-based (Ass. NEWREP-A = JARPA and JARPAII	Fixed
JARPA and JARPAII estimates (historical)	Assumed as biased estimates	Data
g(0)-corrected NEWREP-A abundance estimates	Assumed as unbiased estimates as in IDCR/SOWER	Additional data (CV=0.2)
Survey plan	See Annex 2	Survey Design
CAA	Age-reading errors (results of Kitakado et al. (2013) are assumed)	Additional data

b) Using existing data assess how the biological parameters such as change in the ASM give impacts on the estimation outcomes in the SCAA through some possible metrics

Punt *et al*. (2015 *in press*) assumed that the 50% and 95% age-at-sexual maturity (ASM) are respectively at 8.5 and 11.5 for both of I- and P- stocks. However, as shown in Figure 1, the ASM has declined since 1940's because of increase of prey availability, and it may start increasing due to prey competition to other baleen whales. The detection of a future change in ASM is one of main targets in the NEWREP-A and has been used to determine the annual sample size of 333.

Of course it is of interest to see an impact of misspecification of values of ASM in the SCAA analyses, and it may be possible to use a simulation framework above. However, the impact on the estimation outcomes can be quickly assessed in an experimental analysis using existing data. Here two results based on Punt et al.'s assumption for the ASM and an alternate one are compared.

Results for biological parameters such as M and MSYR are not so sensitive (see Table 3 below). This is also the case for some population component trajectories in the 1+ population size and recruitment, although those for the mature component and associated recruitment rate do differ (Figs 3 and 4). This is explained by a trade-off between the ASM and fecundity rate (f_0) at the carrying capacity (K) as shown in Table 3.

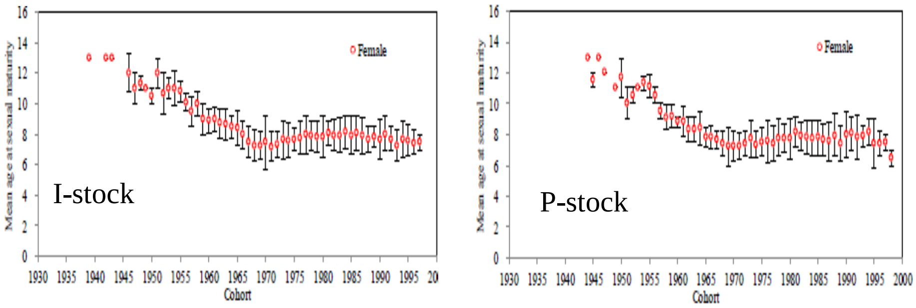


Figure 1. Time series of the mean ASM for I- and P- stocks female animals (extracted from Bando *et al*. 2014). Open circles are the point estimates and the error bars are ranges of one sigma (SD).

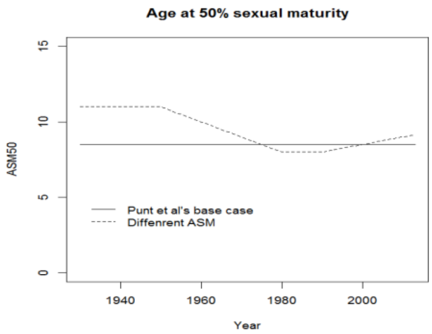


Figure 2. Common values assumed for the age at 50% sexual maturity for both the stocks.

Table 3. Biological parameters estimated by the two different assumption of ASM.

	M (age 3)	M (age 15)	M (age 35)	MSYR	f_0 (pregnancy rate at K)
I-Stock					
Base case	0.0765	0.0479	0.1070	0.219	0.229
Different ASM50 assumption	0.0773	0.0479	0.1070	0.227	0.270
P-stock					
Base case	0.0737	0.0460	0.1030	0.217	0.218
Different ASM50 assumption	0.0745	0.0461	0.1032	0.225	0.256

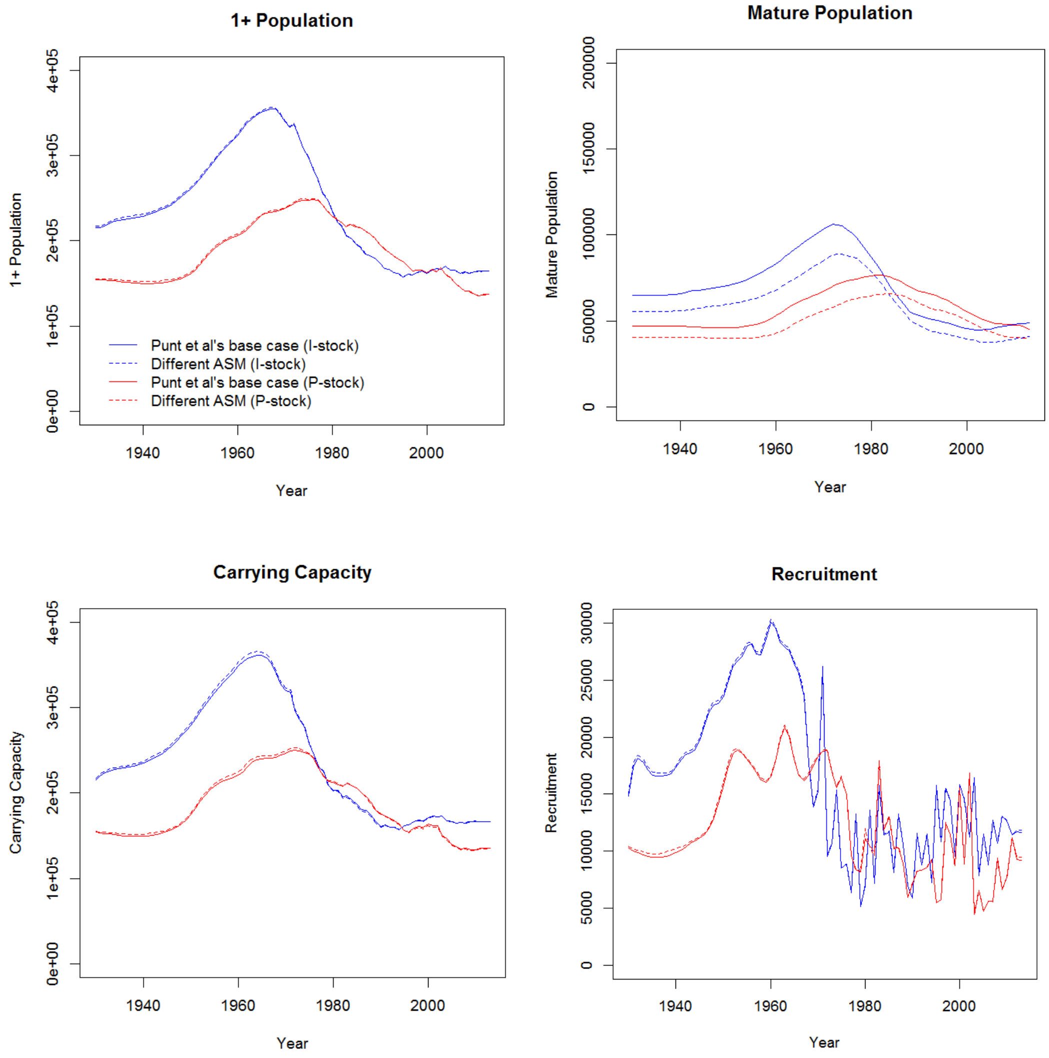


Figure 3. Population trajectories for the two different assumptions about ASM

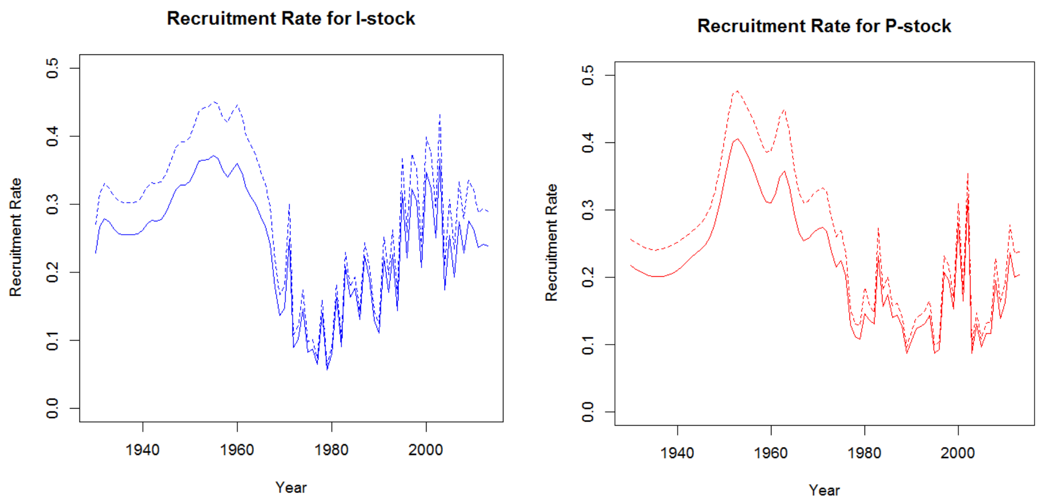


Figure 4. Recruitment rates for by the two different assumptions about ASM.

c) Using existing data, conduct SCAA analysis with consideration on the existing mixing information

As mentioned in item a), the SCAA analysis has been conducted assuming a hard boundary between Area V-W and V-E although there also assumed to be an inter-annual variation in distribution. The inter-annual variation was suggested in the analysis by Kitakado et al. (2014), where the spatial and temporal pattern of mixing was examined (Figure 5 a,b), but the central of mixing occurs more west compared to the hard boundary assumed in the SCAA. In theory, it is possible to incorporate this sort of mixing pattern into the SCAA, but an SCAA analysis with a different hard boundary easily allows one to see the impact of stock structure. For this purpose, a comparison was made between the analyses for two different stock boundaries as shown in Table 4.

The results are shown in Figures 6 and 7. Of course, the population size differs between stocks, but the difference in the totals for the two stocks is negligible. However, the population management is implemented on a stock basis, so the investigation of stock structure is of central to the SCAA analysis.

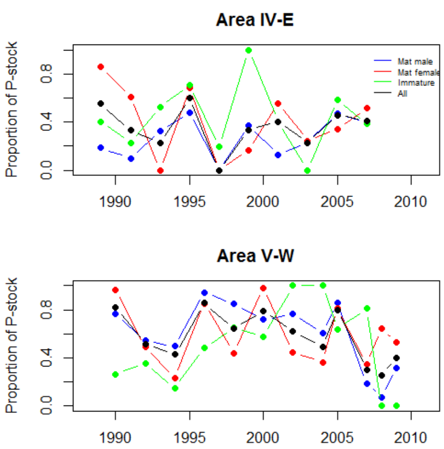


Figure 5(a). Yearly variation of mixing proportion by Area and Group (blue=mature males, red=mature females, green=immature animals, black=all animals).

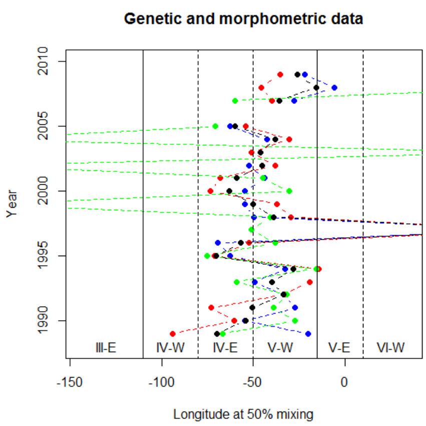


Figure 5(b). Yearly variation of longitudes at which 50% mixtures occur. The blue, red, and green dots and lines are for mature male, mature female and immature animals, respectively.

Table 4. Mixing proportions of P-stock used in Punt et al. and assumed in this preliminary trial.

	III-E	IV	V-W	V-E	VI-W
Punt et al.'s base case	0	0	0	1	1
Different boundary	0	0	1	1	1

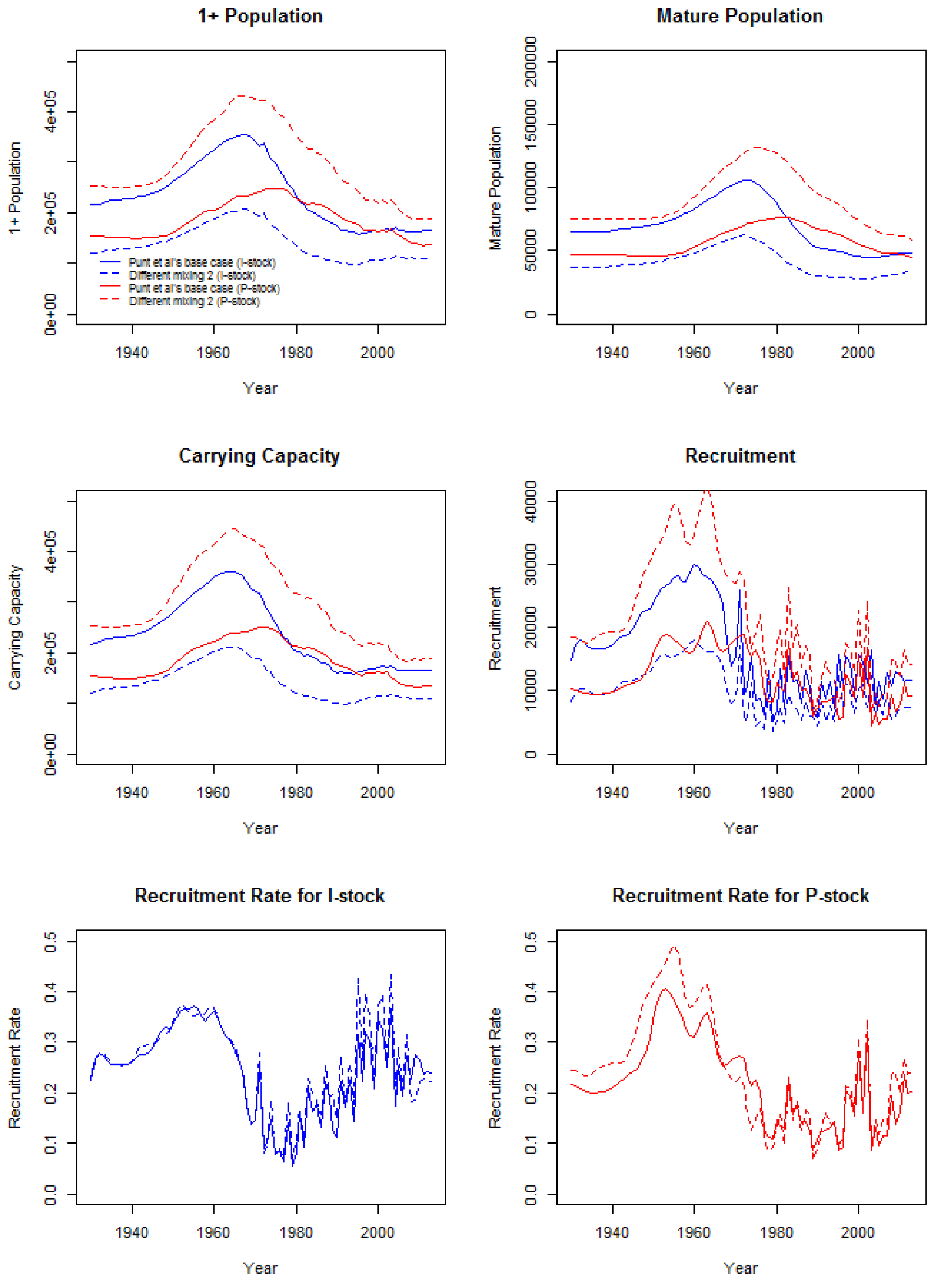


Figure 6. Population trajectories by the two different stock boundaries.

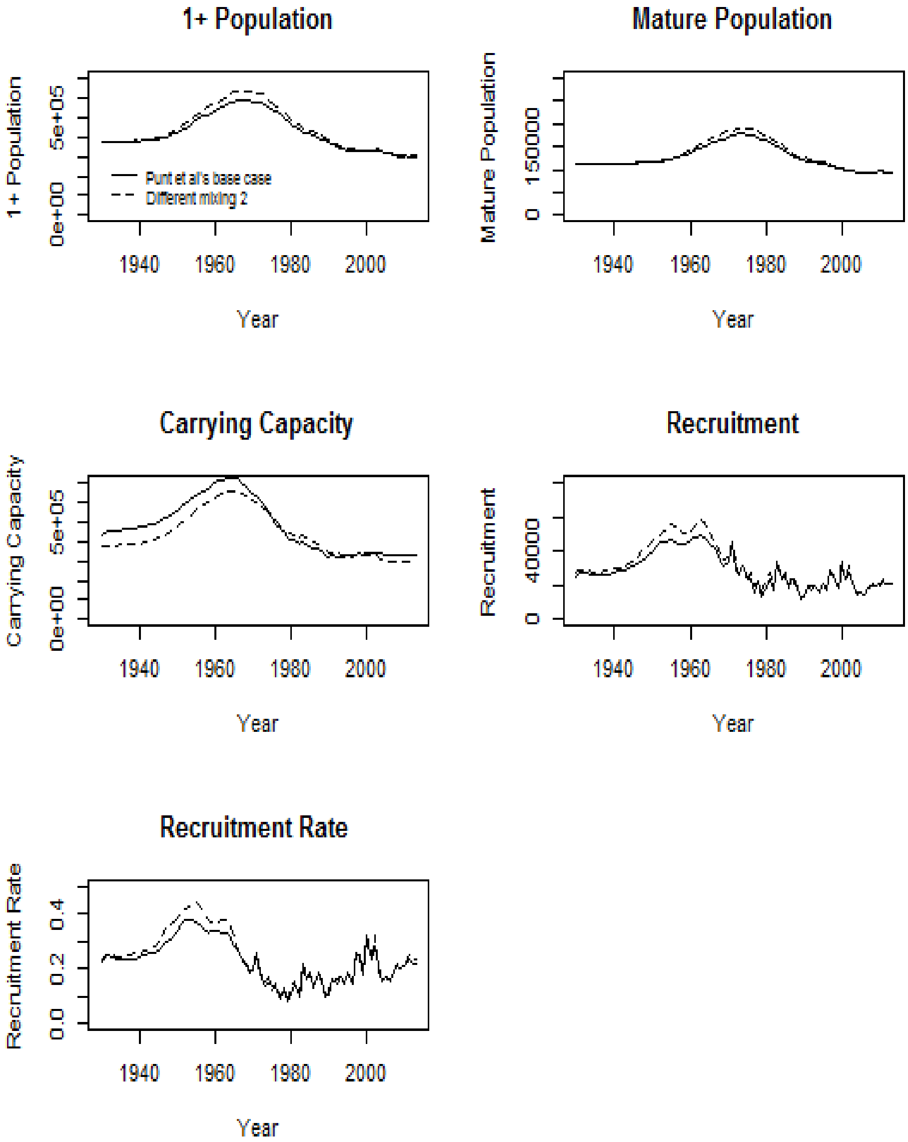


Figure 7. Population trajectory for the total of the two stocks

d) Conduct additional simulation tests with a more realistic model to assess the sample size using data generated from the SCAA

In the original NEWREP-A proposal, the proponents performed a simulation study to indicate the sample size needed to detect the changes in an important ecological and nutritional indicator, ASM. In the simulation, data were generated given a set of effect size and sample size values according to the intended experimental design (though restricted in the AREA IV), and analyses were conducted to assess the estimation precision for the ASM and statistical power of rejecting the null hypothesis (no ASM changes over the research period).

The Panel acknowledged that this procedure is a standard approach for determining sample sizes, but at the same time it recommended that the proponents conduct a power analyses by postulating a fairly complex and realistic process model, fitting it to available data, and then simplifying it by eliminating factors that are not supported by the data. Especially, in the generation of the data set, the following process model was recommended to be used:

> *(1) Generate the cohort sizes for all cohorts that will be subject to sampling during NEWREP-A. This can be achieved given the estimates of the cohort sizes from the SCAA [note that some of the cohorts to be sampled during NEWREP-A already exist and the analysis could condition on those]*
>
> *(2) Select the ASM for each cohort. A model which is likely sufficient would entail an underlying time-trend, and cohort-specific variation about that trend that is temporally correlated.*
>
> *(3) Select the width of the maturity ogive, likely a constant, but perhaps with temporally-correlated cohort-specific deviations.*
>
> *(4) Project each cohort forward given natural and NEWREP-A related mortality, taking account of the selectivity of NEWREP-A.*
>
> *(5) For each year generate a year-specific random effect to account for the effect of spatial and temporal variation in sampling effect.*
>
> *(6) Generate the expected numbers of females by age and maturity state (mature, immature) for each survey year*
>
> *(7) Sample from the expected numbers given the intended sample numbers*
>
> *(8) Add ageing error to true ages based, for example, on the analyses of Kitakado et al. (2014a). This would necessarily account for the possibility of ageing bias as well as random ageing error.*
>
> *(9) Restrict the data set to ages 4-13 if the analysis method is to be based on this range of ages.*

Procedure

To attempt to incorporate the fundamental idea underlying this recommended procedure, the proponents considered that the following approach would be adequate.:

(1) Fix a population dynamics until XX (XX= 1999/00 or 2003/04), make a projection forward until 2026/27 according to an assumed sample size.

(2) Assume ASM50 for the cohort up to XX as 8.5 and increase it by an effect size (/year) until 2026/27. Assumed effect sizes are 0.075 and 0.1 (/year).

(3) Assume 95% maturity age as 11.5 up to the cohort XX, which is same as that of Punt et al. (2014), but 10.5 thereafter, which is nearly consistent with the conditioned value shown in Appendix 13 of NEWREP-A proposal.

(4) In addition to the age-specific natural mortalities, the catch is taken into account in the projection.

(5) To account of heterogeneity in the representativeness, some extent of overdispersion can be considered. However, as shown in Annex G of the SC/66a/Rep06, the estimated overdispersion is negligible. Nevertheless, purely for illustration, attempts are made to use a variance inflation factor $\phi(=0.01)$ in the variance of counts, $(1+\phi)Np(1-p)$, through a Dirichlet-multinomial distribution, so that the coefficient of variation of p is around 30% in case of p=0.1. To illustrate the impact of the inflation factor on the performance in the estimation and testing, $\phi=0.1$ is also used.

(6) Calculate the expected numbers of females by age and maturity state

(7) Sampling is conducted based on an intended total sample size

(8) Supposing that the observed ages with ageing-errors can be reasonably transformed to the actual ages in expectation, it might be appropriate to account only for some additional variation in observed ages in addition to the overdispersed ages of the whales actually sampled.

(9) Here we do not need restrict the age range of samples for the analysis because sampling from all the age classes by accounting length-based selectivity is assumed in the simulation.

Performance measures

Performance measures are same as in Appendix 13 of NEWREP-A.

1) RRMSE (relative root mean squared error, a proxy for CV because estimated values for ASM50 can be negative)

$$RRMSE = \frac{1}{\theta}\sqrt{\frac{\sum_{i=1}^{n}\left(\hat{\theta}_i - \theta\right)^2}{n}},$$

where θ is the true parameter (ASM50, here), and $\hat{\theta}_i$ is the *i*-th estimate among the *n* replications in each sample size.

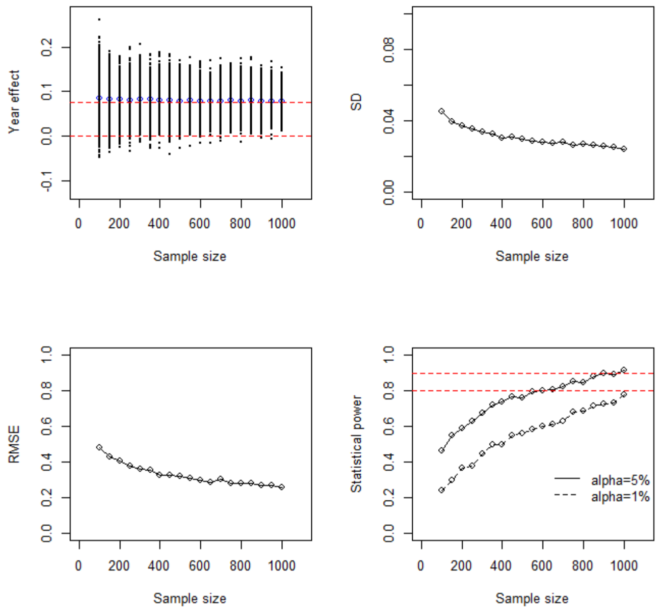
2) Power of the statistical test for a null hypothesis of no year effect in age-at-sexual maturity.

Results

Results are shown in Figures 8-12. Figure 8 compares the results of the more complex procedure recommended by the Panel in their review with those given in Appendix 13 of the NEWREP-A proposal. The horizontal axis for the previous results is modified by multiplying by a reciprocal value, 0.15, which is an observed sampling proportion of female animals of age 4-13. This Figure shows that accounting the age-reading error variance and random sampling from a whole population inflated the variance of estimates and reduced the statistical power. Note that, as shown in Figure 10, the re-assessed power without accounting for the ageing-error is similar with the power assessed using an equilibrium condition in the original NEWREP-A proposal. Of course, the incorporation of overdispersion (random effects) also tended to worsen estimation and testing performance (see Figure 12).

Note that, although the results are not shown here, an integrated likelihood approach to account for the age-reading error via integration did not change performance as regards estimation and statistical power. This might be a consequence of the nature of smaller age-reading errors in ages at which the numbers caught are influential for the sexual maturity analysis.

(i) Simulation results with a complicated procedure recommended by the Panel's review



(ii) Previous simulation results shown in the NEWREP-A proposal

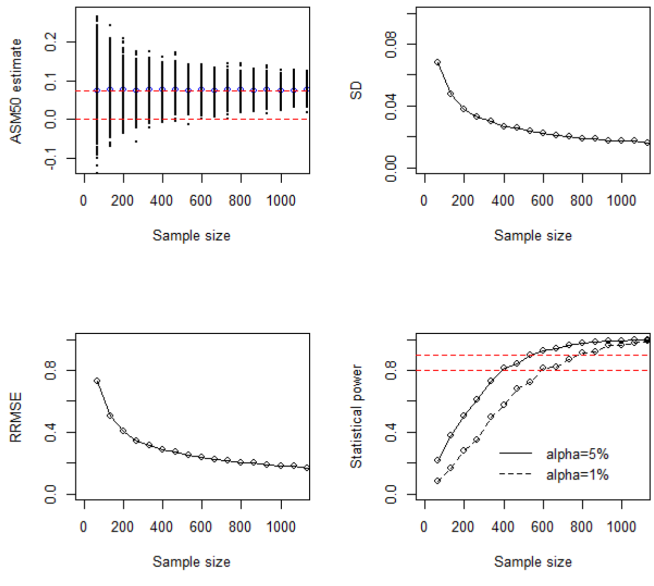
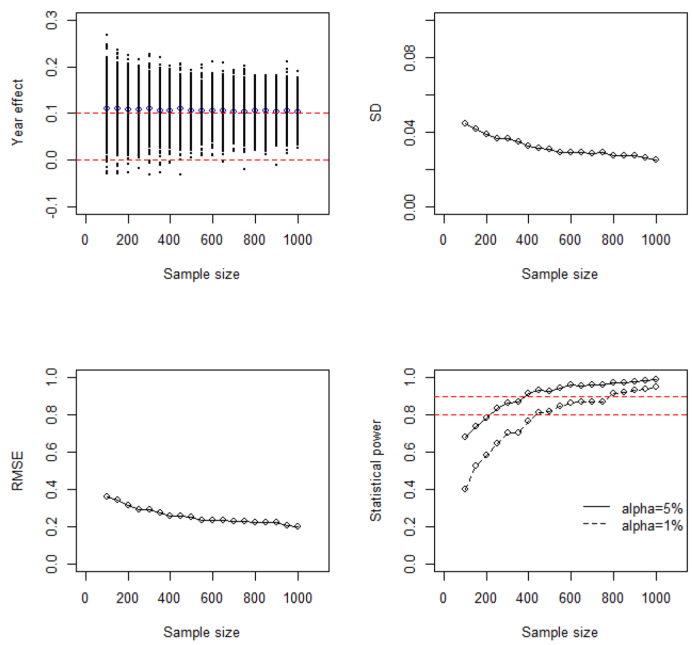


Figure 8-(a). (i) Simulation results for an effect size of 0.075 (/year) with unbiased age-reading errors. The first cohort for which the ASM changes is the 1999/2000 cohort. In the top left panel, 1000 estimates of ASM50 of cohort at its initial change are plotted against the total sample size. Blue points are the mean of estimates in each sample size. In the top right and bottom left panels, the standard deviations and relative root mean squared relative errors are drawn to correspond to the sample size under consideration. The bottom right graph shows the statistical power for two significance levels (5% and 1%). The dashed red lines are 80% and 90% power levels. (ii) Previous simulation results shown in the NEWREP-A proposal. The horizontal axis is modified by multiplying by a reciprocal value, 0.15, the sampling proportion of female animals of age 4-13.

(i) Simulation results with a complicated procedure recommended by the Panel's review



(ii) Previous simulation results shown in the NEWREP-A proposal

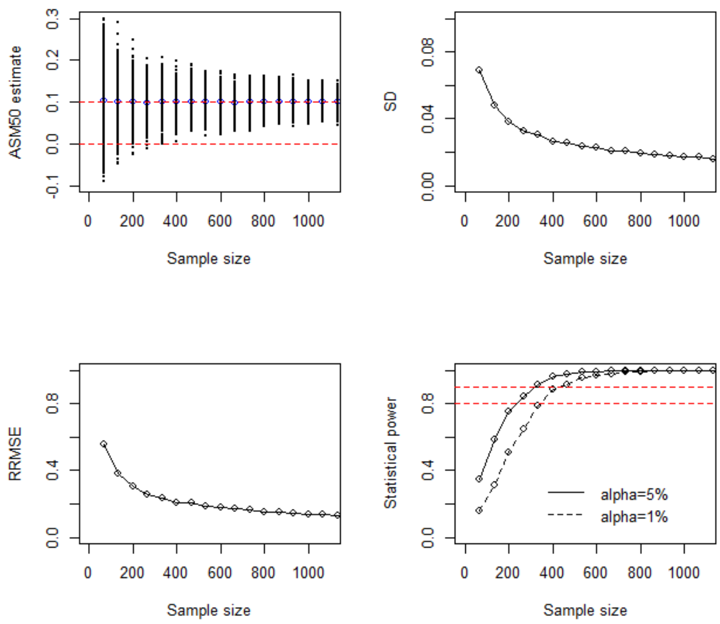


Figure 8-(b). Simulation results as in the previous Figure except here for an effect size 0.1 (/year).

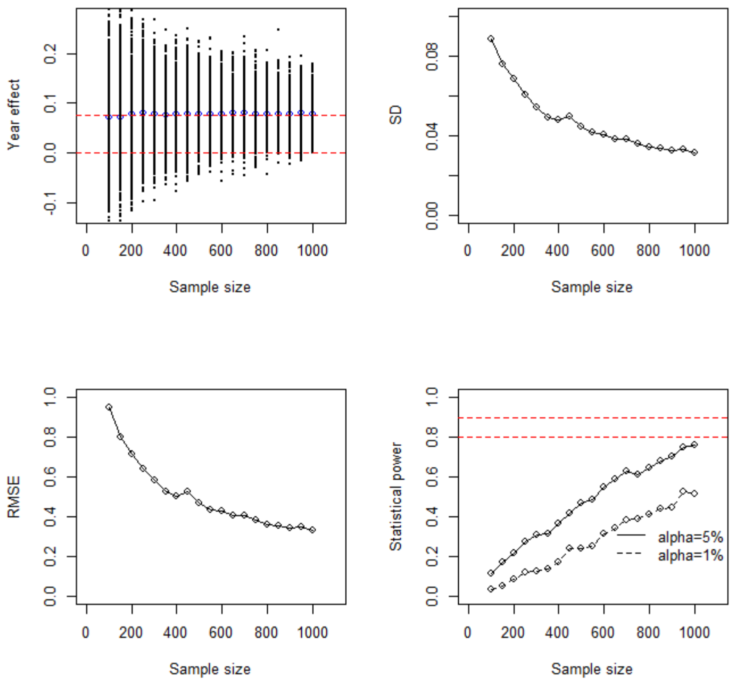


Figure 9-(a). Simulation results for an effect size of 0.075 (/year) with unbiased age-reading errors. The first cohort for which the ASM changes is the 2003/2004 cohort.

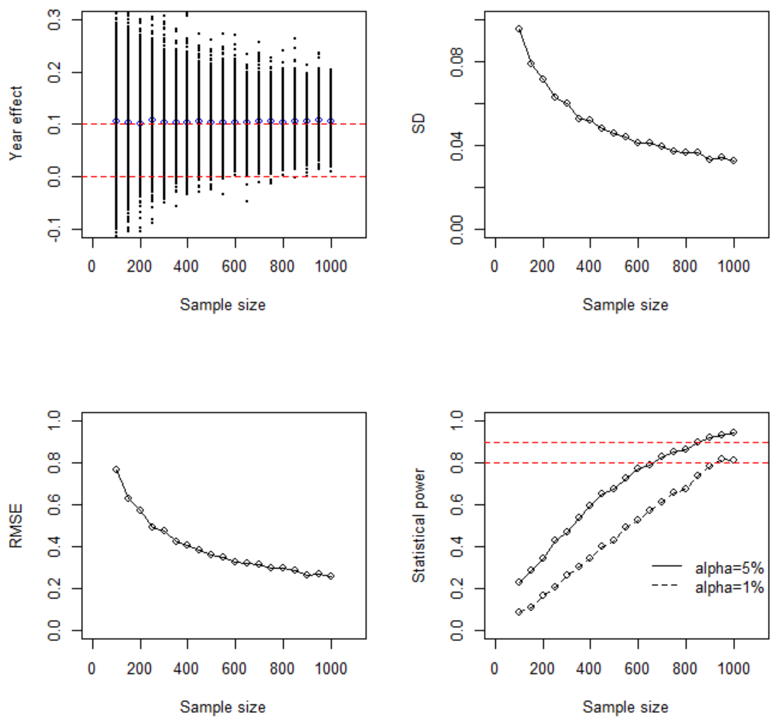


Figure 9-(b). Simulation results as in Figure 9-(a) except here for an effect size of 0.1 (/year).

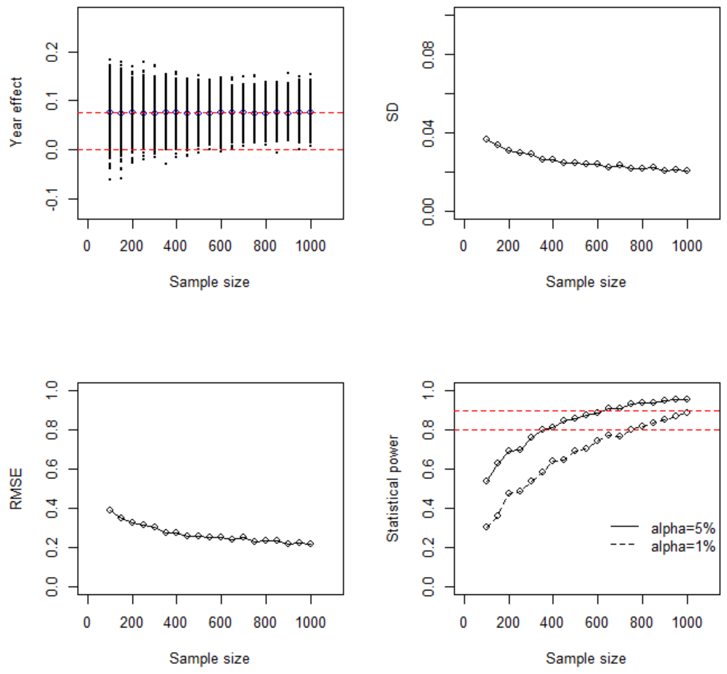


Figure 10-(a). Simulation results for an effect size of 0.075 (/year) without age-reading errors. The first cohort for which the ASM changes is the 1999/2000 cohort.

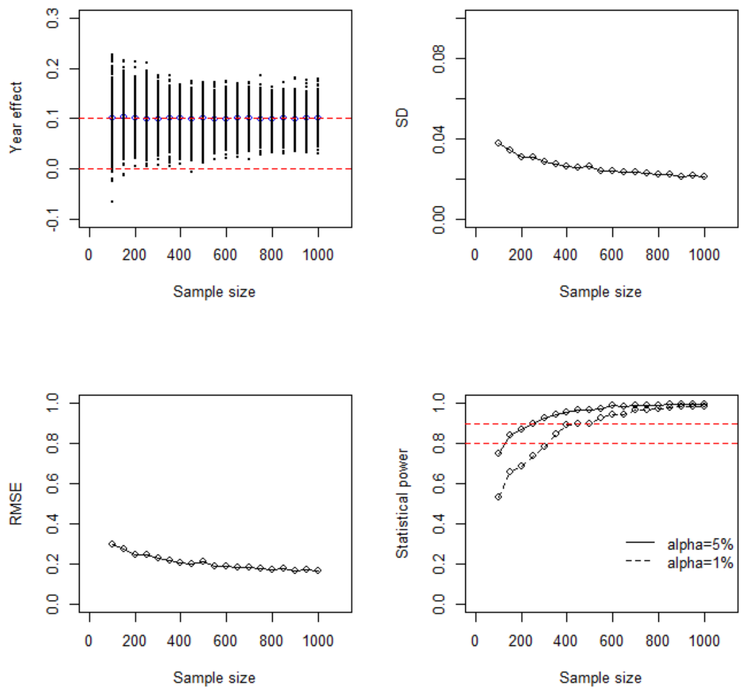


Figure 10-(b). Simulation results as in Figure 10-(a) but here for an effect size of 0.1 (/year).

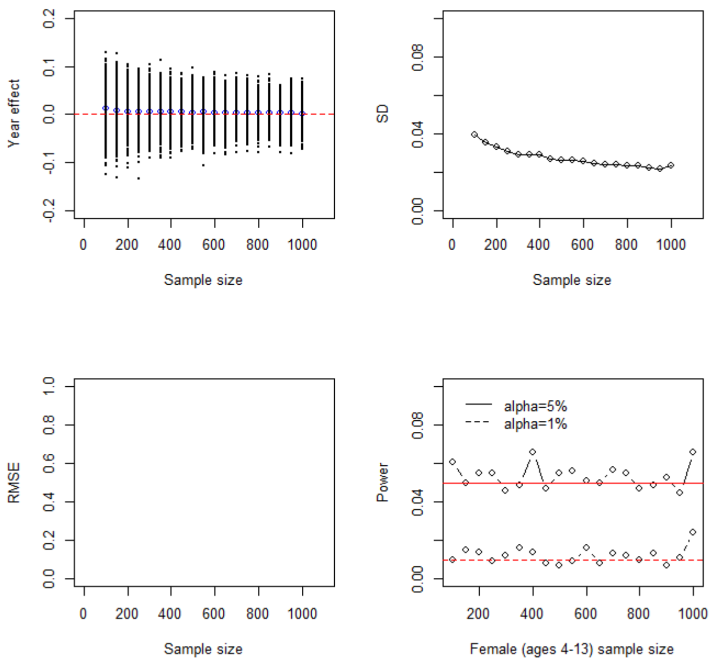


Figure 11-(a). Simulation results for an effect size 0 (/year) with unbiased age-reading errors. The first cohort for which the ASM changes is the 1999/2000 cohort. The type I errors with values of 5% and 1% are shown to be verified.

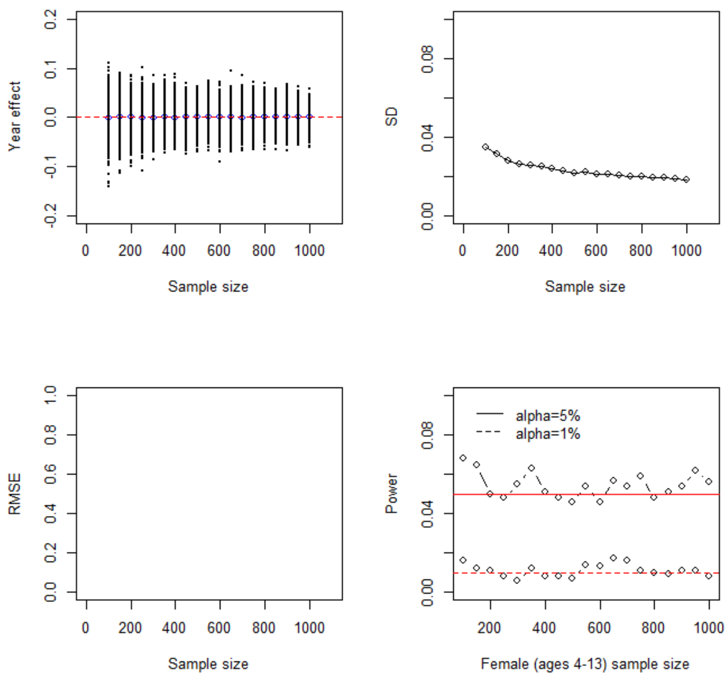


Figure 11-(b). Simulation results for the effect size 0 (/year) without age-reading errors. ASM50 of cohort at its initial change is 1999/00. The type I errors with values of 5% and 1% are shown to be verified.

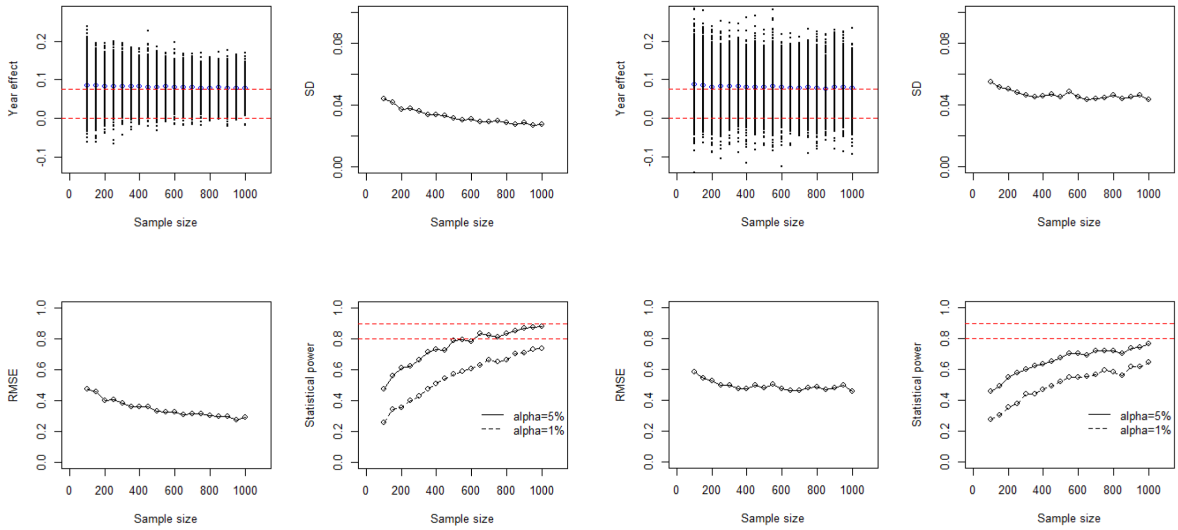


Figure 12-(a). Simulation results for an effect size of 0.075 (/year) with age-reading errors and overdispersion ϕ =0.01 (left) and 0.1 (right). The first cohort for which the ASM changes is the 1999/2000 cohort.

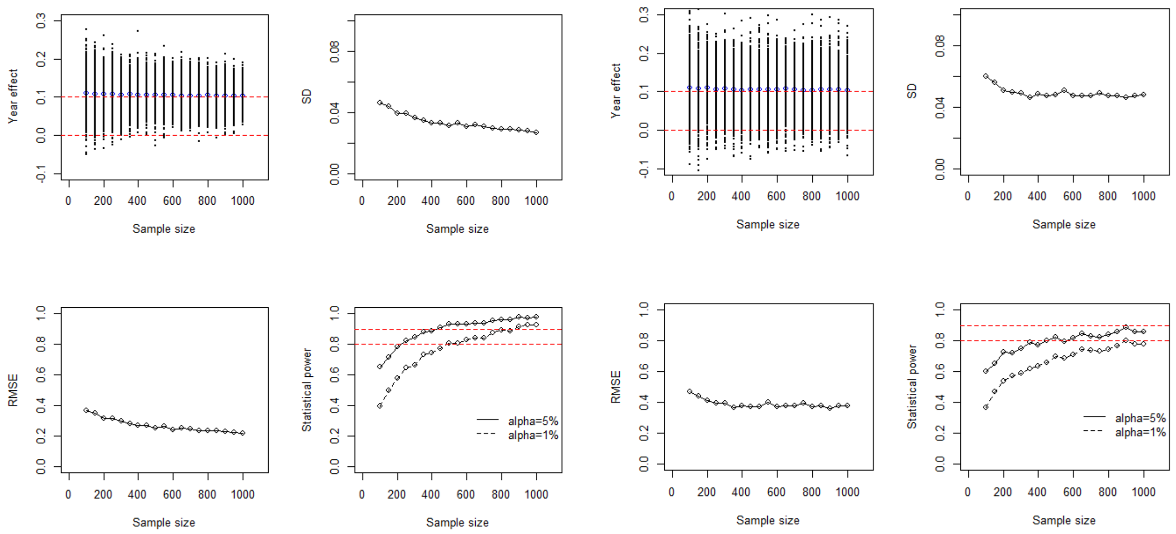


Figure 12-(b). Simulation results for an effect size of 0.1 (/year) with age-reading errors and overdispersion ϕ =0.01 (left) and 0.1 (right).

e) Conduct simulation performance tests to evaluate the level of improvement in the precision of quantities estimated by the SCAA during the period of NEWREP-A given the proposed sample size

The base case SCAA summarized in Table 2 is used as an operating model for these simulations to see how the future catch-at-age (CAA) data contribute to improving scientific knowledge on the population dynamics. Here, a comparison is made for the estimation performance between the analysis with both the abundance and CAA data and that only with the abundance data. The CVs of abundance estimates are assumed to always be 0.2, and the annual sample size of CAA is fixed at 333. The true recruitment rate is fixed as the average over the last 10 years for each stock to investigate the variation in their estimates against the true value (0.161 and 0.115 for I- and P-stocks, respectively).

In the proposed specification for estimation shown in Table 2, some nuisance parameters are assumed to be fixed at the same values as in the OM. This is to reduce the computation time for optimization and avoid non-convergence situations. Further time is necessary for completing those simulations.

For the moment, we assess the confidence interval estimates for recruitment rates for a single set of generated data:

(a) Results using data up to 2012 [Both abundance and CAA data]

(b) Results using data up to 2012 [Both abundance and CAA data, *M*, Selectivity, growth parameters are fixed]. Note that by fixing *M*, the recruitment CVs no longer include the more important uncertainties about their absolute levels, which depend on M.

(c) Results using data up to 2027 [Both abundance without noise and CAA data, M, Sel, growth parameters are fixed, future sample size equals to 333]

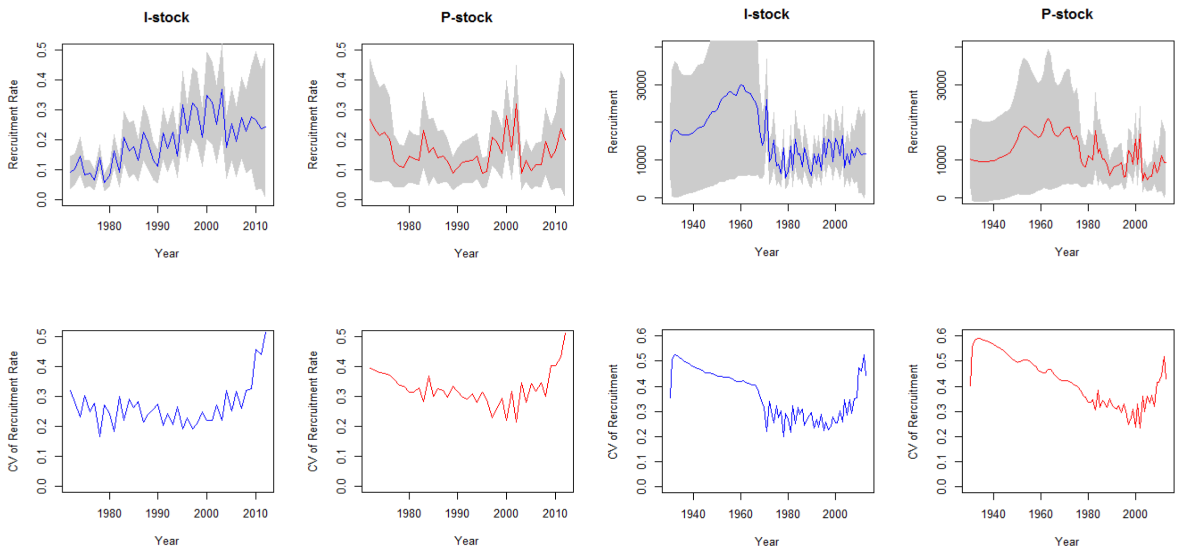
(d) Results using data up to 2027 [Only abundance without noise, M, Sel, growth parameters are fixed, future sample size equals to 0]

The CVs are assessed through the Hessian matrix for a single set of generated future data as well as past data. This is adequate for current purposes, whose aim is to show the how the precision of recruitment estimates depends on the availability of various future types of data. These estimates are important for management and related purposes, as they give more details of and insight into the dynamics of the population, as well as providing a more powerful basis to check for evidence of the effects of possible environmental change.

Results

The results are shown in Figure 13 and are perhaps clearest in the comparative plots for CVs shown in Figure 14. Note in Figure 13-(a) that the CVs for recruitment estimates increase for the most recent years in the assessment (around some years before 2012); this is because the more recent the cohort, the fewer occasions during which it has been sampled. Figure 13-(b) for which M is fixed rather than estimated shows CVs that are slightly smaller. Given 12 years future data with survey estimates of abundance but no further age data, CVs (Figure 13-(d) and also Figure 14) show hardly any difference from those up to 2012 in Figure 13-(b), and the CVs continue at a high level for the next 15 years. However, if the additional age data (from 2016 onwards) are added to the existing age data, CVs from about 2008 onwards decrease dramatically, especially for the I stock, showing that the analysis provides more information on recent yearly changes in the recruitment and recruitment rate (Figure 13-(3) and Figure 14). Hence the availability of age data from NEWREP-A will provide substantially improved estimates of key aspects of these minke whale populations’ dynamics, which will in turn enable improved management and related recommendations.

(a) Results using data up to 2012



(b) Results using data up to 2012 (some parameters fixed)

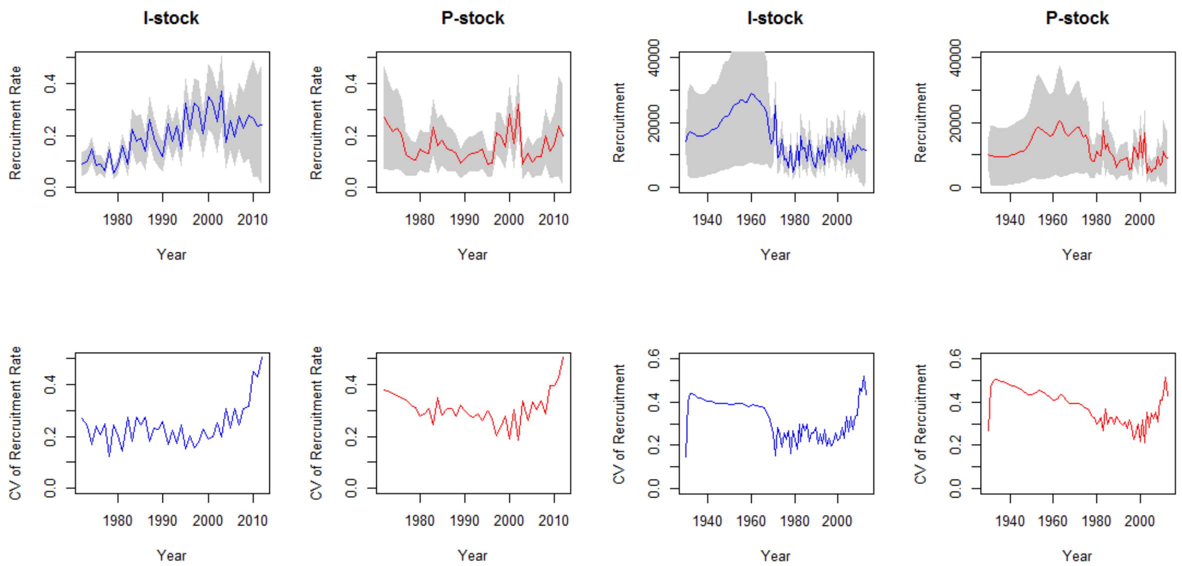
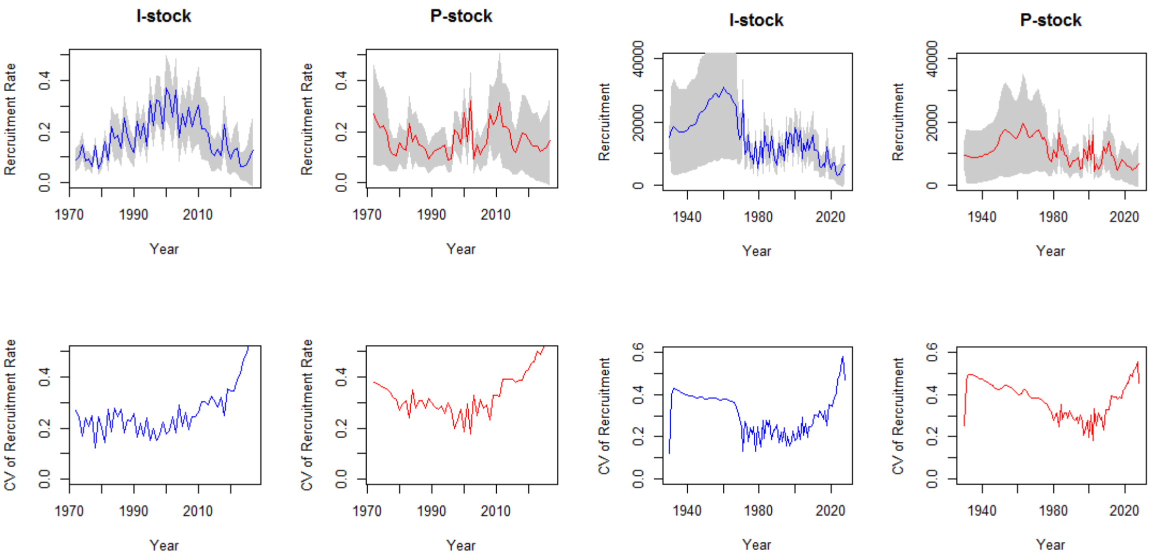


Figure 13. Trajectories for recruitment rates and recruitment estimates with their precision estimated from the existing data. The gray regions are 95% confidence intervals.

(c) Results using data up to 2027 (with 333 CAA data)



(d) Results using data up to 2027(without CAA data)

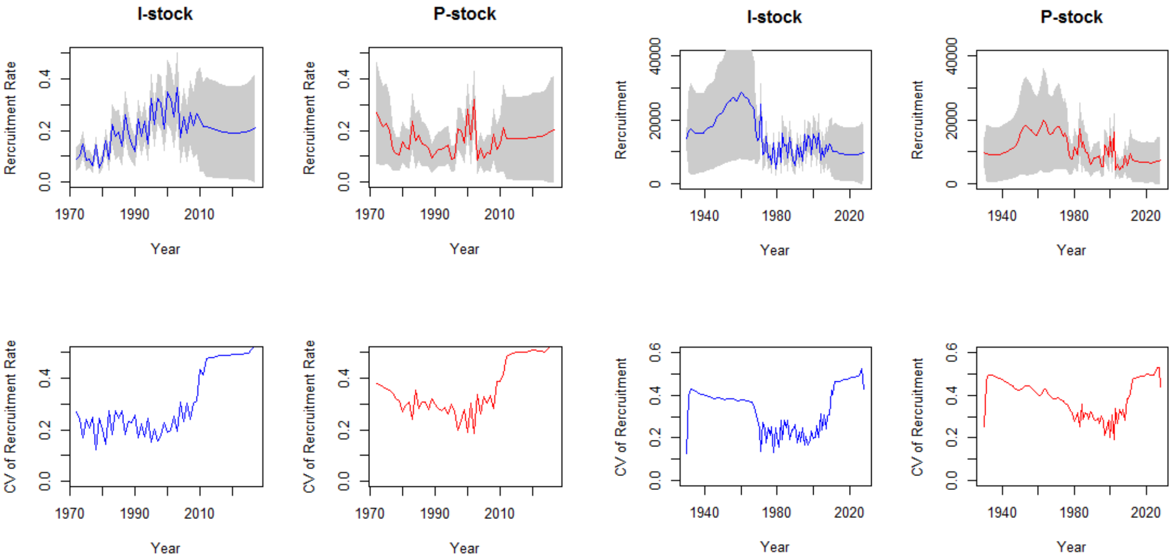


Figure 13(continued). Trajectories for recruitment rates and recruitment estimates with their precision estimated from the <u>additional future data</u>. The gray regions are 95% confidence intervals.

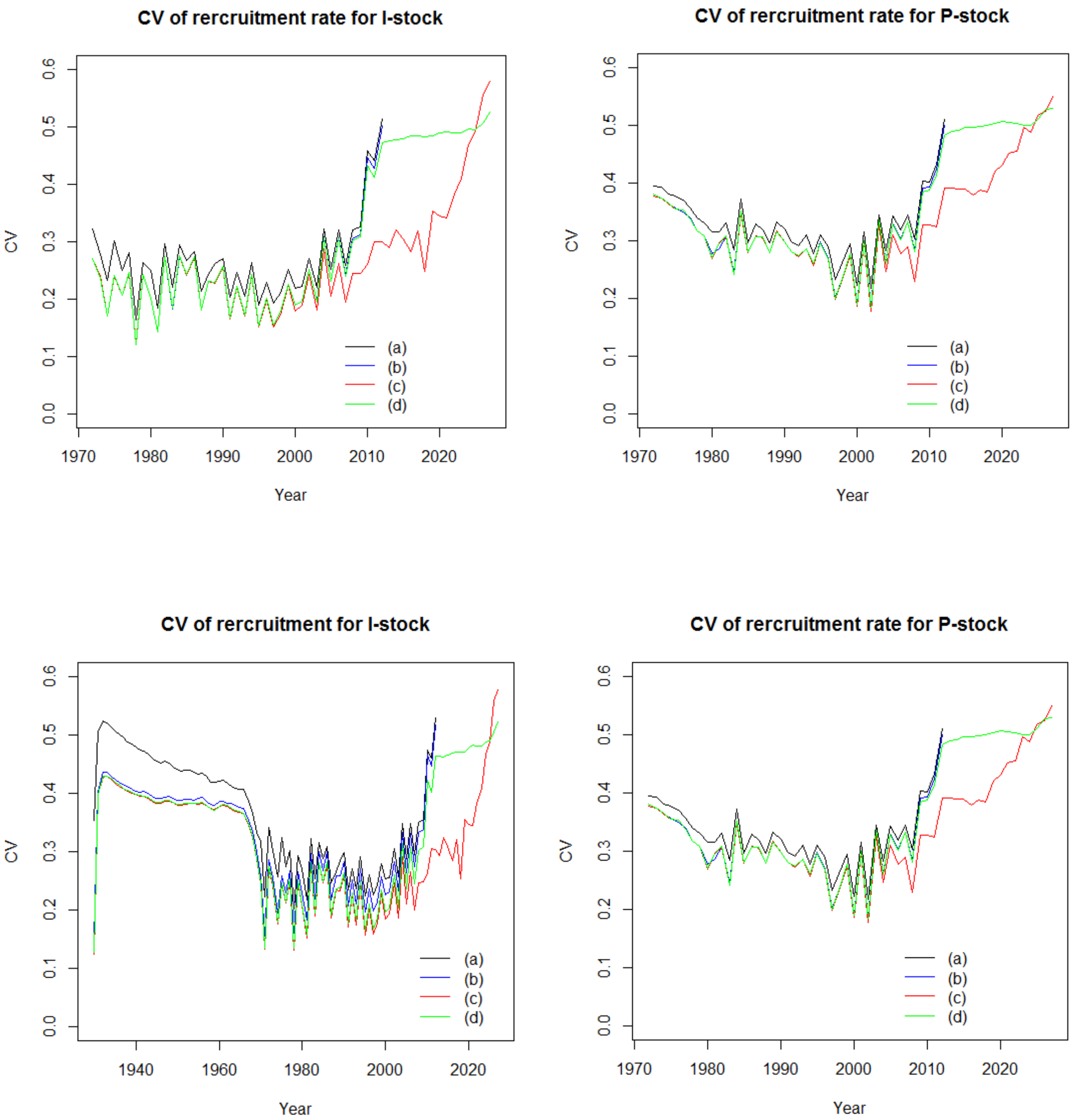


Figure 14. Comparison of the trajectories of estimated CV for recruitment rates and recruitment estimates.

3. FUTURE PLANS

The Review Panel provided several insightful recommendations to improve the NEWREP-A program. A comprehensive simulation for assessing the performance of SCAA and improvement of RMP as recommended by the Review Panel is on-going. Progress has been made for creating an evaluation procedure including developing the code for linking possible scientific improvements with the proposed sample size and research design. Further analyses are planned before the start of program so that the plan of NEWREP-A can be modified if necessary.

Finally, note that the NEWREP-A has the following implications for RMP trials and improving the RMP.

a) The operating models for the trials (see Table 2) can now be based on the more realistic SCAA model which is able to take more detailed data into account, especially ageing data, and also assumes more realistic stock structure models based on genetic analyses.

b) A problem with past ISTs for minke whales has been lack of information about MSYR. The new trials can use this as the stock-recruitment relationship estimated in the SCAA model contains information about the productivity of the population assessed. It also provides a basis for forward projection of recruitment in the trials under alternative hypotheses about future trend (if any) in carrying capacity.

c) Because of the information now available, through JARPA and JARPA II, on Antarctic minke whale productivity, it will no longer be necessary to require robustness to inputs used previously for a minimum MSYR value. Instead the actual SCAA-basaed estimates from the data can be used to provide plausible values.

d) Given new age information, the RMP can be improved by incorporating use of these data as well. For example, as with fish populations to provide an early indication of poor recruitment and hence make timely adjustments to catches in a manner, the existing CLA is less able to do well.

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ANNEX 2

Research plan for the dedicated sighting survey in 2015/16

Background

The NEWREP-A includes a dedicated whale sighting component aimed to produce abundance estimates of Antarctic minke whale and other large whales species and develop spatial distribution models (SDM). This information will contribute to the ecosystem models as well as providing direct input for the SCAA and the RMP. In other words this information is considered essential for addressing Main Objectives I and II of NEWREP-A.

The NEWREP-A also includes a krill survey component, and two kinds of surveys are planned: ‘krill survey under the NEWREP-A’ and ‘CCAMLR standard type krill survey’. The former survey is relevant to the 2015/16 dedicated sighting survey, which is aimed to provide an index of relative abundance of this prey species.

On the other hand, section 4 of the proposed research plan for NEWREP-A explains that the feasibility and practicability of non-lethal methods will be evaluated in a systematic manner through the implementation of the research plan. The feasibility and practicability of some of those non-lethal methods such as biopsy sampling and telemetry studies on Antarctic minke whale will be evaluated during the NEWREP-A dedicated sighting surveys, and such evaluations will start at the 2015/16 season.

In this annex, a draft research plan for the 2015/16 dedicated sighting survey in Antarctic Area V is presented for consideration of the IWC SC. While the main research activity will be systematic sighting surveys for abundance estimates and SDM, the surveys will be also engaged in the systematic collection of krill and oceanographic data as well in the start of experiments on the feasibility of some non-lethal methods. The draft research plan considers the specific recommendations offered during the NEWREP-A review workshop.

Research needs and recommendations from the NEWREP-A Review Panel

Sighting survey for abundance estimates and SDM

Systematic sighting surveys of whales by the Line Transect Method are required to address Objective I (i) ‘Abundance estimates for Antarctic minke whales taking into account of g(0) and additional variance’, Objective II (ii) ‘Abundance estimates of some cetacean species as input data for ecosystem modeling’ and II (iv) ‘To study the spatial interaction among baleen whales – To construct appropriate SDMs of cetacean as well as krill, based on the guidelines developed by the IWC SC’, of the NEWREP-A research plan.

The NEWREP-A Review Panel made the following recommendations regarding the sighing survey (IWC, 2015 SC/66a/Rep6):

a) Every effort be made to estimate $g(0)$ for the other whale species, at least to determine rather than assume whether it is significantly different from one.

b) The survey design and analysis methods be carefully considered to enable the survey results to have multiple uses.

c) Carefully consider a number of options for survey design and methods taking into account: (i) the experience gained from the several years of data analysis before the Scientific Committee adopted abundance estimates from the previous IWC IDCR/SOWER cruises; (ii) the developments in spatial modelling approaches; (iii) the experience of previous multi-disciplinary survey efforts; (iv) the recommendations from the JARPAII review; (v) the possibility of incorporating more focused surveys to address specific issues in some years; (vi) consideration of whales within the ice; (vii) updated power analyses of the effects of survey interval and estimation of trend to determine necessary levels of effort and survey design in the future (including consideration of the regions outside the core study area (additional longitudinal range in Areas III, VI, and coverage north of 60°S).

d) Work closely with the IWC Scientific Committee before finalising their survey approaches.

e) Ensure that future survey plans submitted to the Scientific Committee follow fully the guidelines for such survey plans, including incorporating proposed track lines - since the dedicated sighting survey/echo sounder platform will be separated from the sighting/sampling vessels, sabotage should not be an issue.

The section 'survey procedure and design' below shows the procedure and design for the sighting surveys in the context of the 2015/16 season. The recommendations from the Review Panel were taken into account as much as possible.

Krill surveys for relative abundance estimate

Systematic krill surveys are required to address Objective II (i) 'Krill abundance estimation and oceanographic observations – To produce annual krill abundance estimate by using echo-sounder and net installed in research vessels participating in the NEWREP-A surveys', of the NEWREP-A research plan. It should be noted that the 'krill surveys under NEWREP-A' are focused to estimate an index of relative abundance as noted above.

The NEWREP-A Review Panel made the following recommendations regarding the krill surveys related to NEWREP-A (IWC, 2015 SC/66a/Rep 6):

a) Consider the adoption of this multibeam sonar in krill surveys.

b) Trial the ship and echosounder system(s) in Japan well before going to the Antarctic to determine the likely effective acoustic sampling range and potential for detecting krill for multiple frequencies over the required survey depth. Conduct for both annual and board-scale survey vessels.

c) In the years (two out of 12) when both NEWREP-A and CCAMLR-type surveys are conducted, try to survey the same transects by both vessels in near synchrony.

d) Conduct full analysis of statistical power to detect changes in krill abundance from proposed techniques.

e) Develop more detailed plans to consider whether comparisons between stomach contents and proposed krill survey data are feasible and if so, how they can be done.

f) Ensure that sufficient time is allocated for adequate net sampling, based an analysis of previous net sampling data (e.g. BROKE/BROKE West data).

As noted earlier, two kinds of krill surveys are planned in relation to NEWREP-A: 'krill survey under the NEWREP-A' and 'CCAMLR standard type krill survey', and only the former survey is relevant to the sighting survey in the 2015/2016 season. It should be clarified here that only the recommendation b) above is directly relevant to and covered by this research plan, since the recommendations a), c), e) and f) are mainly relevant to the latter one, and the recommendation d) is on the statistical power analysis.

The section 'survey procedure and design' below shows the procedure and design for the krill surveys in the context of the 2015/16 season.

Oceanographic survey

Systematic oceanographic surveys are required to address Objective II (i) 'Krill abundance estimation and oceanographic observations, of the NEWREP-A research plan.

The NEWREP-A Review Panel made the following recommendation regarding the oceanographic survey in relation to NEWREP-A (IWC, 2015 SC/66a/Rep6):

a) Give careful consideration to scale and design of oceanographic sampling, taking into account BROKE/BROKE West data.

It should be noted that this recommendation from the Review Panel mentions the BROKE/BROKE-West data and seems to be offered mainly in the context of the 'CCAMLR standard type krill survey', but not of the 'krill survey under the NEWREP-A'.

The section 'survey procedure and design' below shows the procedure and design for the oceanographic surveys in the context of the 2015/16 season.

Feasibility of biopsy sampling in Antarctic minke whale

The NEWREP-A research plan includes a feasibility study on biopsy sampling in Antarctic minke whale to be undertaken along the dedicated sighting surveys. On this particular study, the NEWREP-A Review Panel made the following recommendations (IWC, 2015 SC/66a/Rep6):

a) The experiment to examine the effort required to obtain biopsy samples from Antarctic minke whales be given high priority at the start of any long-term programme.
b) Involve people with expertise in successfully biopsy sampling common minke whales in the North Atlantic.
c) Mimic the sampling strategy developed for lethal sampling (e.g. when dealing with schools >2).
d) Record information on time taken, sea state, swell, etc. to enable a plausible measure of effort required to be developed.
e) Consider the amount of tissue and nature of tissue required (for each analysis and in total).

The section 'survey procedure and design' below shows the procedure and design for the feasibility study on biopsy sampling in the context of the 2015/16 season. The recommendations from the Review Panel were taken into account as much as possible.

Feasibility of telemetry in Antarctic minke whale

The NEWREP-A research plan includes a feasibility study on telemetry in Antarctic minke whale to be undertaken along the dedicated sighting surveys. On this particular study, the NEWREP-A Review Panel made the following recommendations (IWC, 2015 SC/66a/Rep6):

a) This experiment should be accorded high priority but notes the difficulties in the attachment and functioning of long-term satellite tags on minke whales in both hemispheres.
b) Undertake this work in collaboration with research groups with experience in such work rather than try to develop techniques on their own.

The section 'survey procedure and design' below shows the procedure and design for the feasibility study on telemetry in the context of the 2015/16 season. The recommendations from the Review Panel were taken into account as much as possible.

Survey procedure and design

This section describes the survey procedure and design for each of the research items mentioned above for this multi-purpose survey. Some of the Review Panel's recommendations summarized above are taken into consideration in this survey while others will be considered in future surveys or during the analyses.

General

<u>Research area</u>

Antarctic Area V (130°E-170°W) included the Ross Sea will be covered by the 2015/16 survey.

<u>Research period and schedule</u>

The duration of the survey including transit is planned to be 115 days. The number of days dedicated to research in Antarctic waters is planned to be 65 days.The schedule of the survey is as follow:

Date	**Activity**
Late November	Vessels leave Japan
Late December	Start survey in the research area
Early March	Complete survey in the research area
Late March	Vessels return to Japan

<u>Research vessels</u>

Two specialized vessels will be available for this survey, the *Yushin Maru No. 3* (*YS3*) and an undetermined vessel similar to *YS3* (Figure 1 and Table 1). Both vessels are equipped with top barrel (TOP), independent observer platform (IOP) and upper bridge platform (UBP). The *YS3* is also equipped with instruments required for the krill and oceanographic surveys (see details below).

<u>Researchers on board</u>

For the sighting activities including experiments in IO mode, two researchers are required on board each vessel. An additional researcher to conduct the krill and oceanographic surveys is required on board the *YS3*.

Sighting survey for abundance estimates and SDM

<u>Guidelines for sighting survey</u>

The plan outlined here follow the 'Requirements and guidelines for conducting surveys and analyzing data within the Revised Management Scheme (RMS)' (IWC, 2012), as recommended by the NEWREP-A Review Panel. Table 2 summarizes the proposed sighting procedure and design in the context of the IWC requirements and guidelines.

<u>Stratification of the research area</u>

The research area is divided into a western and eastern sector at 165°E. Each sector is further divided into a southern and northern strata. At the western sector the boundary between southern and northern strata is defined by a line 45n. miles from the ice-edge. At the eastern sector the boundary is defined at 69°S (Figure 2).

Track line design

The survey track line for each vessel will consist of two legs in the northern stratum at 5° longitudinal degree intervals and four legs in the southern stratum at 2°30’ longitudinal degree intervals in a 10 degrees longitudinal band following Nishiwaki *et al*. (2014). The two vessels alternately survey the northern and southern strata each crossing the track line at the way-point between two strata (Figure 3). Track lines are decided based on the original longitude line, which was selected at random. The interval of legs and number of legs in each stratum could be changed in consideration of delay caused by bad weather conditions and other factors. The proposed track lines in sectors and strata of Area V are shown in Figure 4. Note that these tracks are based on ‘guess estimated’ ice conditions in an unpredictable area, especially the Ross Sea. Considerable flexibility may be needed by the Cruise Leader in determining the final cruise tracks.

In principle, the South East stratum in Area V (Ross Sea) is defined as an area south of 69°S and between 165°E and 170°W surrounded by ice edge. The stratum is divided into western and eastern part by 180° longitudinal line. A longitudinal zig-zag line was allocated in the western and eastern sector, respectively (Figure 4). Track lines are decided based on the original longitude line, which was selected at random in the western and eastern part of the stratum, respectively. The interval of legs and number of legs in each stratum could be changed in consideration of delay caused by bad weather conditions and other factors.

Sighting effort and mode

Research hours will be consistent with those in previous IWC/SOWER surveys. Research will start 60 minutes after sunrise and will end 60 minutes before sunset, with a maximum 12-hour research day (approximately 06:00-18:00). Time-zone changes will be recorded in 30-minute intervals, effective from 01:00h. Schedules will adhere to local ‘ship’ time ranging between +9.0 and +12.0 GMT. Data collected throughout the survey and all associated reporting will be in accord with the local ‘ship’ time. The vessel speed during the sighting survey will be 11.5 knots with slight adjustment to avoid vibration of the vessels.

Sighting activities onboard the vessels will be classified into two principal types: ‘On-effort’ and ‘Off-effort’. On-effort means sightings activities executed under weather and sea state conditions considered acceptable (e.g. visibility better than 1.5n. miles and wind speed less than 20knots in the northern stratum and less than 25 knots in the southern stratum). Off-effort means all activities that are not On-effort. All sightings to be recorded On-effort will be classified as ‘Primary sightings’. All other sightings will be classified as ‘Secondary sightings’.

Sighting effort will be conducted by the boatswain and topmen from the top barrel (there will be always two primary observers on the top barrel) and the upper bridge where the helmsman, captain or officer-on-watch, researchers, and the chief engineer (or second engineer) will be also present (always two primary observers and four secondary observers).

The sighting survey will be conducted using (1) Closing mode (NSC) and (2) Passing with Independent Observer (IO) mode. Both survey modes follow the protocol endorsed for the IWC/SOWER surveys (e.g. Matsuoka *et al.*, 2003, IWC, 2008).

Under NSC mode, there will be two primary observers on the top barrel (TOP). These observers will search for cetaceans by using angle board and binoculars (7x), which include the distance estimate scales. Members of two observer teams on TOP will be fixed and will operate in one or two hours-shifts. There will be open communication between the upper bridge and the TOP. These observers report sighting-information to researchers and other observers on the upper bridge for data recording.

Under IO mode, there will be two primary observers on the TOP and one primary observer on the independent observer platform (IOP). These observers on TOP and IOP platforms will conduct searching for cetaceans by using angle board and binoculars (7x). Members of the two observer teams on TOP will be fixed and will operate in one or two hours-shifts. There will be no open communication between the IOP and the TOP. The observers on the upper bridge will communicate to the TOP (or IOP) independently, with the topmen required only to clarify information without distracting them from their normal search procedure. These observers report sighting-information to researchers and other observers on the upper bridge for data recording. For encounters of very rare species (e. g. blue and southern right whales), it will be decided that the vessels approach the whales immediately to avoid losing them due to the delay of closing (IWC, 2008).

Following a recommendation from the NEWREP-A Review Panel, IO experiments will be conducted on both Antarctic minke and other large whale species.

Distance and angle experiment

Sighting distance and angle experiment will be conducted in order to evaluate the accuracy of sighting distance and angle provided by primary observers. Observers on each vessel will be required to assess eight sets of angles and distance from two platforms (TOP and IO) and upper bridge. All trials will be conducted under the weather and sighting conditions defined above.

Data entry system

Researchers will input the data collected during the survey (weather, effort, sighting and experiments data) into the computer onboard the vessel using the 'onboard data collecting system' (ICR, 2013). Survey modes and effort codes definitions for this survey correspond to those used in the IWC/SOWER surveys. The data will be validated and stored at the Institute of Cetacean Research (ICR), and all sighting data for abundance estimates will be submitted to the IWC based on the IWC SC Guidelines (IWC, 2008; 2012).

Krill surveys for relative abundance estimate

Echosounder system and frequencies

Research vessel *YS3* is equipped with a scientific echo sounder Simrad EK60, a '*de facto*' world standard system for fishery research applications. The Simrad EK60 can operate seven echo sounder frequencies simultaneously ranging from 18 to 710kHz. Therefore it can operate in the frequencies recommended by the NEWREP-A Review Panel: 38, 120 and 200KHz.

Echo-sounder survey will be conducted during the sighting survey. The data obtained on the sighting track line will be used for the analysis.

Trial of the vessel and echosounder system

A trial of the ship and echosounder system will be carried out in Japan before going to the Antarctic to determine the likely effective acoustic sampling range and potential for detecting krill for multiple frequencies over the required survey depth. This is in line with one of the recommendations from the NEWREP-A Review Panel (see recommendations above).

Net equipment

Research vessel *YS3* is equipped with a small ring net with over 45cm mouth opening (e.g. NORPAC Standard Net). A high intensity white LED lamp would be used to increase sampling efficiency of krill (e.g. Wiebe *et al.*, 2004). Basically, this net will be hauled vertically from 250m to surface.

Scale and design of the net sampling

Net sampling will be conducted along the sighting survey track line. Basically it will involves one sampling site per day.

Oceanographic survey

Instruments

Research vessel *YS3* is equipped with a SBE 19plus V2 SeaCAT Profiler CTD. This instrument measures conductivity, temperature, salinity, pressure, chlorophyll and oxygen at 4 scans/sec (4 Hz) at different sea depths. The wire of CTD is equipped with a Niskin-sampling bottle (Model 1010). It can sample a maximum of 1.2 little of sea water. The depth selected for the present survey is 500m.

Scale and design of oceanographic sampling

CTD survey will be conducted along the sighting survey track line. Basically it will involve one sampling site per day.

Feasibility of biopsy sampling in Antarctic minke whale

Following a NEWREP-A Review Panel recommendation, this feasibility study will start early at the NEWREP-A program, i.e. at the 2015/16 season.

Biopsy sampling system

The Larsen gun will be used for the feasibility experiment of biopsy of Antarctic minke whale. The Larsen gun is considered one of the most efficient method for biopsy sampling and it is used regularly during the IWC POWER surveys in the North Pacific. It was also used during the former IWC IDCR/SOWER cruises.

Feasibility study design

The NEWREP-A Review Panel provided very useful suggestions for conducting this feasibility study (see summary above). The Review Panel also noted that ‘consideration might be given to focus initial training efforts primarily in near-shore areas where animals can more reliably be encountered. Consideration also should be given to standard issues relating to any biopsy programme, such as an upper limit to the number of attempts to be made on an individual, how long a whale will be followed, whether females with calves will be targeted, etc.’ (IWC, 2015 SC/66a/Rep 6).

In this first year the objective will be the training of research personnel with the Larsen biopsy gun on Antarctic minke whales. Following the Review Panel’s statement above, efforts will be focused in near-shore, when the vessels survey the southern strata. A total of 10 trials on Antarctic minke whales are planned by *YS3*. In each trial the school size, school behavior, sea state, swell, wind speed and the time taken in the trial will be recorded. The kind and amount of tissue obtained will be recorded as well.

A whale will be followed for a maximum of 1h, and the upper limit to the number of attempts to be made on an individual will be 3.

The procedure for shifts from the sighting surveys to the feasibility studies on biopsy sampling and from the feasibility studies to the sighting surveys will be similar to those during the past IWC/SOWER surveys and will be determined by the Cruise Leader.

Feasibility of telemetry in Antarctic minke whale

Following a NEWREP-A Review Panel recommendation, this feasibility study will start early at the NEWREP-A program, i.e. during the 2015/16 season.

<u>Telemetry system and feasibility study design</u>

The NEWREP-A Review Panel noted 'the difficulties in the attachment and functioning of long-term satellite tags on minke whales in both hemispheres' and recommended that 'the proponents undertake this work in collaboration with research groups with experience in such techniques rather than try on their own'.

In this first dedicated sighting survey, effort will be spent in developing an attachment system in consultation with the National Research Institute of Far Seas Fisheries (NRIFSF).

During NEWREP-A surveys, tags have to be attached by shot of air gun from a large vessel. Additionally the mount system needs to be suitable for long-term monitoring of satellite tracking. A blubber penetration-type mount by air-gun will be tried on Antarctic minke whale, which already proved useful in other applications (Fernando and Guzman, 2014; Guzman *et al*., 2013). If this attachment becomes useful for Antarctic minke whales, then it will be used to deliver both satellite tracking and data logger tags in future surveys.

At least ten attachment trials on Antarctic minke whales are planned by *YS3*. In each trial the school size, school behavior, sea state, swell, wind speed and the time taken in the trial will be recorded.

The procedure for shifts from the sighting surveys to the feasibility studies on telemetry and from the feasibility studies to the sighting surveys will be similar to those during the past IWC/SOWER surveys and will be determined by the Cruise Leader.

Data availability

After validation by ICR, the sighting and associated data will be submitted to the IWC secretariat. Other data and samples obtained during the survey will be available to IWC SC members through data access Procedure B.

Cruise report

A cruise report will be prepared just after completed the survey and will include a list of the samples and data collected during the survey. The cruise report will be presented to the 2016 IWC SC meeting.

Oversight report

An oversight report will be presented as an appendix to the cruise report of the survey.

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Table 1. Specifications of the vessels to be engaged in the 2015/16 season dedicated sighting survey under the NEWREP-A (TBT = to be determined).

	Yushin-Maru No.3	*TBD*
Call sign	7JCH	
Length overall [m]	69.61	
Gross tonnage (GT)	742	
Barrel height [m]	19.5	
IO platform height [m]	13.5	
Upper bridge height [m]	11.5	
Bow height [m]	6.5	
Engine power [PS / kW]	5,280 / 3,900	

Table 2. Correspondence of sighting survey design proposal and the 'Guidelines for Conducting Surveys and Analyzing Data within the Revised Management Scheme (IWC, 2012).

Item	Suggestions/Guidelines in IWC (2012)	Responses/Proposals	Related section Reference
2.Requirement under RMS			
2.1 Oversight by the Scientific Committee	The design and conduct of surveys and the verification and analysis of data from such surveys that are intended to provide estimates of abundance to be used in the CLA shall be under the oversight of the Scientific Committee to ensure that they adequately follow the requirements described in Section 2 and take into account the guidelines described in Sections 3-6.	This table shows that the proposal adequately follow the requirements described in Section 2 and take into account the guidelines described in Sections 3-6.	
2.2 Notification and planning	Plans for survey design and proposed methods of data collection, verification and analysis that are intended to provide estimates of abundance to be used in the *CLA* shall be reviewed by the Committee in advance of their being carried out.	This document explained the plans for the survey.	
2.3 Survey conduct and personnel	Based on review of the proposed survey plans, including the experience of scientists participating in the surveys, the Committee will determine the level of oversight required. (a) For surveys in which the proposers have previous experience in applying the methodology for the species and region being surveyed, the Committee will generally specify one of the proposing scientists as its representative to oversee survey conduct; (b) If the proposers request Committee oversight, or if the Committee judges that the proposers have insufficient experience of conducting the planned surveys, independent oversight by a scientist appointed by the Committee will be required	The steering group of this cruise will nominate these researchers, including international researchers. These researchers should have enough experience conducting line transect surveys, biopsy sampling and photo-id experiments in the Antarctic through the IWC/IDCR-SOWER, JARPA/JARPA II Programs or other research program. Koji Matsuoka (Institute of Cetacean Research) will be the responsible person for this survey, and same as recent seasons, would act as the oversight person on behalf of the IWC SC if the IWC SC agree.	Researchers on board and oversight person

	to assess the adequacy of survey conduct.		
2.4 Survey documentation and data provision and verification	The following documentation shall be provided to the Secretariat no later than six months prior to the meeting of the Scientific Committee in which data from the survey are to be used as input to the CLA: (1) cruise planning report; (2) field instructions and example data sheets; (3) cruise summary report; (4) documentation of any experiments conducted, e.g. to estimate measurement error in distances and angles; (5) documentation of methods used to estimate distances and angles to sighted groups; (6) specification of data accuracy verification procedures; (7) documentation of observations excluded for any reason; (8) description of analysis methodology planned to be used, including factors or covariates to be used in the derivation of the estimate; and (9) documentation of additional information related to the conduct of the survey necessary for interpretation of the data The data outlined in Appendix 1 shall be provided to the Secretariat no later than six months prior to the meeting of the Scientific Committee in which they are to be used..	Before submitting results of abundance estimation based on this survey data, documentations (1)-(9) will be submitted to the Secretariat before six months prior to the meeting. Sighting data obtained during the survey will be submitted to the the Secretariat no later than six months prior to the meeting of the Scientific Committee in which they are to be used	
2.5 Data analysis	The documentation should be sufficient to allow: (i) independent replication of the estimates; (ii) evaluation of the appropriateness of the estimates presented relative to possible alternatives (e.g. model selection procedures, pooling/stratification of the data); and (iii) evaluation of whether the estimates, associated variances and potential biases fall within the ranges used in evaluating the CLA.	Documentation of data analysis will be sufficient to allow (i)-(iii).	
3. Survey design			
3.1 Area and timing	Consideration therefore needs to be given to which particular areas should be surveyed in the context of providing the information on abundance needed by the RMP.	Management Areas V in south of 60^{o}S is planned to be surveyed in 2015/16 survey for abundance estimation.	Research schedule, Research area
3.2 Choice of platform	The choice of platform for a survey may be determined by factors beyond the control of those designing the survey. For example, the area to be covered may be so large or so remote that it is impossible to survey from any platform other than a ship.	Two survey vessels will be used.	Research vessels
3.3 Cruise tracks	If qualitative or quantitative information on the relative abundance of animals is available, more effort should be devoted to strata of known high abundance. Surveys should be designed so that the coverage probability in each stratum is uniform, or close to uniform, or can otherwise be determined. When considering the placement of cruise tracks, care should be taken that they do not follow physical features that may be correlated with whale abundance. If there is a known or suspected migration of whales through the survey area, care should	It is suggested that Antarctic minke whales tends to distribute near ice edge. Therefore more track lines will be allocated in southern strata than northern strata. Track lines will be allocated in each stratum so that the coverage probability in each stratum is close to uniform Track lines will be designed not to parallel to ice edge lines given distance from ice edge may be correlated to whale density. By using two dedicated sighting surveys, two vessels simultaneously survey the northern and southern strata	Track line design

	be taken when designing cruise tracks and survey direction to ensure that the data collected are representative.		
3.4 Personnel	It is essential that survey teams contain at least some personnel who are experienced in conducting sightings surveys for whales. Cruise leaders should have sufficient knowledge of the analytical methods to enable them to make informed decisions in the face of unforeseen circumstances, e.g. with respect to modification of cruise tracks and coverage due to weather, ice extent etc.	Researchers should have enough experience conducting line transect surveys, biopsy sampling and photo-id experiments in the Antarctic through the IWC/IDCR-SOWER, JARPA/JARPA II Programs or other research program. Cruise leader will be selected who has sufficient knowledge of the analytical methods to enable them to make informed decisions in the face of unforeseen circumstances.	Researchers on board and oversight person
4. SHIPBOARD SURVEYS			
4.1 Methodology	A number of methods have been developed to account for animals missed on the track line and, in some cases, responsive movement. These methods require the use of two teams of observers on independent platforms on the same vessel and the identification of groups, animals or cues seen from both platforms (duplicate identification).	In the research proposal, accounting for animals missed on the track line, the sighting survey will be conducted using (1) Closing mode (NSC) and (2) Passing with Independent Observer (IO) mode. Hazard probability method is planned to be used in analysis of sighting data.	Primary searching activity
4.2 Methods used by the Committee			
4.2.1 IO method	Collecting data from two independent platforms is considered by the Committee to be a standard method and estimates of abundance have been obtained from these data e.g. for Antarctic minke whales.	The sighting survey will be conducted using (1) Closing mode (NSC) and (2) Passing with Independent Observer (IO) mode.	Primary searching activity
4.2.2 Tracking method	Buckland and Turnock (1992) proposed a method to account both for animals missed on the track line and responsive movement. The method is based on one team of observers (the Tracker team) searching sufficiently far ahead of the vessel to detect groups/animals before they may have responded to it.	Instead of tracking method, The resighting record will be record by researchers in upper bridge to collect resighting data during IO modes.	IWC (2008)
4.2.3 Hazard probability method	The hazard probability method treats the sighting process as a point process in space (representing the locations of individual whales), time (representing the surfacing of the whales), and a sequence of Bernoulli experiments representing whether or not a whale was observed at a given surfacing	The hazard probability method is planned to applied to model detection function used in Okamura and Kitakado (2012)	
4.3 Common considerations			IWC (2008)
4.3.1 ‘Passing’ versus ‘closing’ mode	When a sighting is made by an observer, either (i) data on the sighted group can be collected and recorded as searching continues (passing mode) or (ii) searching can cease while the group is approached to confirm species identification and estimate group size (closing mode). There are advantages and disadvantages to both methods.	Considering the advantage and disadvantage in both mode, the sighting survey will be conducted using both mode. Two survey modes will be conducted alternately (Figure 3).	Primary searching activity
4.3.2 Searching effort data	Searching effort data should be collected and recorded in a disaggregated form to allow the recalculation of estimates of abundance if boundaries of Management Areas are altered. Changes in Beaufort sea state and other indicators of sighting conditions should be recorded to allow the data to be stratified	Searching effort data will be collected and recorded in effort record. Sighting condition will be recorded in weather record	IWC (2008)

	by these variables where appropriate.		
4.3.3 Estimates of angle and distance to a sighted group of whales	Angle and distance experiments should be carried out, if possible, before, during and after the survey.	Distance and angle measurement training is to be conducted at the first stage of the survey. The experiment to evaluate measurement error is to be conducted twice around the middle of the survey and at the last stage of the survey (IWC, 2008)	Distance and angle experiment
4.3.4 Species identification and estimation of group size	The species must be identified with certainty and the number of whales in the group must be counted or estimated.	To ensure that species and group size data are recorded accurately, researchers should have enough experience conducting line transect surveys (see item 3.4)	Researchers on board and oversight person
4.4 Independent observer data			
4.4.1 Duplicate identification	Use of electronic recording devices is critical for obtaining accurate sighting times of individual groups or cues, and hence reliable duplicate identification.	An automated data collection system (ICR accurate information system) will be implemented in the NEWREP-A surveys, and therefore it will contribute to help duplicate identification.	
4.4.2 Tracking procedures	Tracking teams should consist of more than one observer. When one member of a team starts tracking, the operational procedures for the other observer(s) should be explicit.	Observers in upper bridge will be in charge with tracking. Procedure of tracking is provided in e.g. Information for Researchers on the IWC SOWER Circumpolar Cruises (IWC, 2008).	IWC (2008)
4.4.3 Direction of movement of detected animals	Information on the direction of movement of groups/animals should be recorded for each detected sighting of a group, animal or cue.	This information will be recorded in sighting record.	IWC (2008)
4.4.4 Group fragmentation and formation	When tracking, group fragmentation and group formation should be explicitly recorded. Data forms should be designed to accommodate the recording of these data.	Observations of the dynamic structure of the group will be recorded in sighting record.	IWC (2008)
4.4.5 Additional data	Each (re)sighting record in the data forms should have field for additional data, such as details of group/animal behavior.	Group/animal behavior will be recorded in (re)sighting record	IWC (2008)
4.4.6 Closing with IO mode surveys	If analysis is group-based, closing should be delayed until either the group has been detected by observers on both platforms (2-way independence), the primary platform (BT method), or it has passed abeam.	Closing should be delayed until detected school has passed abeam during IO mode.	IWC (2008)
5. AERIAL SURVEYS		We didn't check if our proposal meets guideline regarding aerial surveys because it is not planned to conduct aerial surveys in 2015/16 surveys.	
6. Analytical considerations			
6.1 Variance estimation and the CLA	It is important that underestimation of the CV of abundance estimates be avoided and that the estimator for the CV of an abundance estimate should not have an excessively high variance. A CV estimate should take into account, to the extent possible, all major sources of observation error.	This situation can arise when survey effort has been very small, which may result in very few transects upon which to base a CV estimate. Sufficient effort will be allocated in the research to avoid this situation. Additional variance (i.e. variance due to inter-annual variation in distribution of whales) will be estimated to avoid underestimate of CV of abundance estimate.	Track line design
6.2 Simulation techniques	Simulations should be carried out to provide sufficient information to indicate the basic statistical properties (e.g. bias and precision) of the abundance estimators and their variance.	It may be necessary to conduct simulation test for model-based g(0) estimation model. The current simulated data are designed to represent features of minke whales in the North Atlantic and the Southern Hemisphere and the protocols used on surveys of these species (Palka and Smith, 2004)	

Figure 1. Research vessel to be used in the dedicated sighting survey: *Yushin Maru No. 3*.

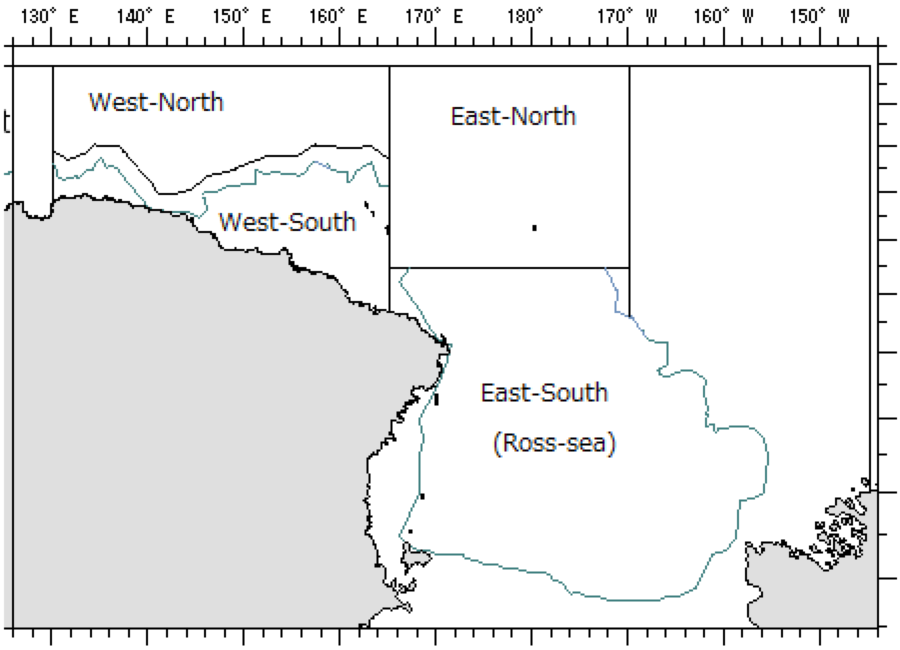

Figure 2. Sectors and strata to be covered by the dedicated sighting survey in Area V.

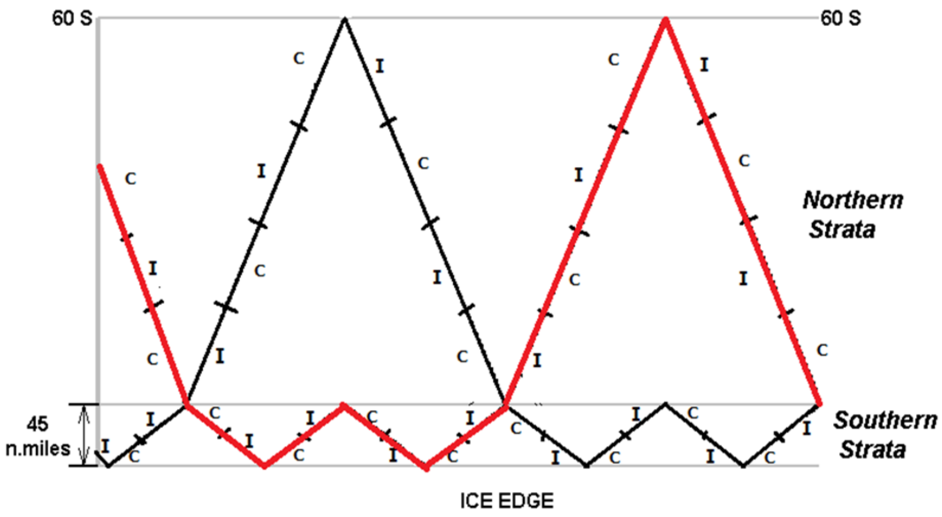

Figure 3. Basic design for track lines. Red and black bold line indicates track line for each vessel, respectively. ‘I’ indicates that the survey will be conducted under IO mode and ‘C’ indicates that the survey will conducted in NSC mode.

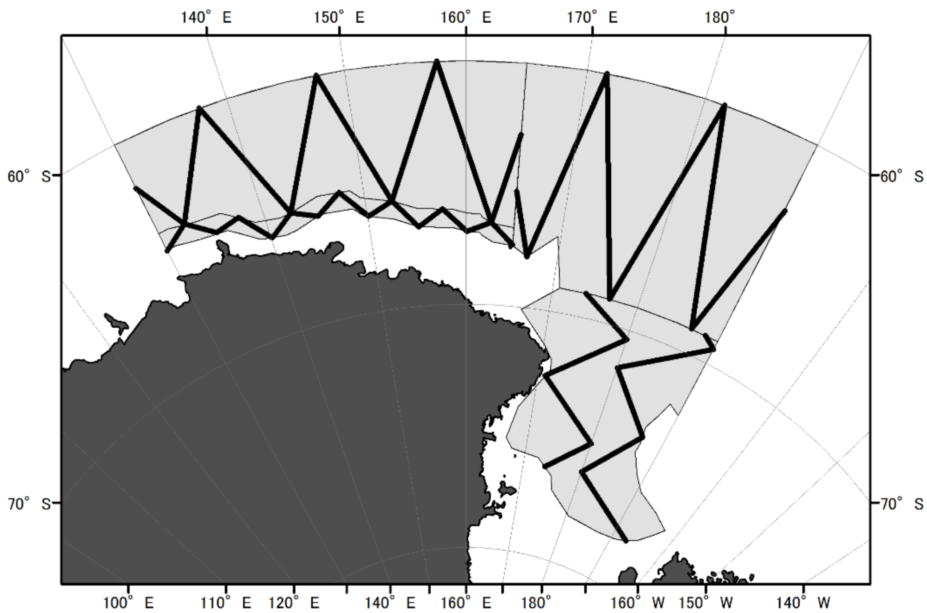

Figure 4. Proposed track lines given assumed ice edge lines. Considerable flexibility may be needed by the Cruise Leader in determining the final cruise tracks.