Report of the Expert Panel Workshop on the Proposed Research Plan for the New Scientific Whale Research Programme in the Western North Pacific (NEWREP-NP)

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EXECUTIVE SUMMARY

The Panel's tasks were twofold: (1) review the JARPN II programme including analyses of data up to 2016; and (2) review the NEWREP-NP proposal in light of Annex P.

With respect to the JARPN II programme, although the additional data for the period were provided, only some analyses were available, primarily on the work carried out comparing lethal and non-lethal techniques. The Panel **agrees** that a full 'final' review of the JARPN II programme will be possible only when final analyses are completed, in line with the IWC Scientific Committee-agreed timeframe for analyses, and a full consolidated report made available. The Panel made several recommendations related to this item, including some directed at clarifying Annex P with respect to final reviews.

With respect to the review of NEWREP-NP, the Panel recognised the considerable work that had been undertaken by the proponents in developing the proposal and **commends** their efforts to: (a) follow Annex P and the Checklist; and (b) provide additional information during the Workshop itself (Annex D).

The Panel **agrees** that the Primary and most of the Secondary Objectives are important for conservation and management, although the level of the contribution varies. Despite the work undertaken by the proponents, the Panel **concludes** that, in its current version: (1) the Proposal does not adequately justify the need for lethal sampling and the proposed sample sizes, particularly with respect to quantifying the likely extent of management and conservation improvement in the context of the IWC; and (2) has basic design shortcomings. The Panel **recommends** that the lethal sampling components of the programme should not occur until the additional work identified in its report is undertaken and reviewed. The detailed rationale for this can be found in the full report. In short, the Panel's main concerns relate to:

(1) insufficient justification for the proposed sampling design and sample sizes for the lethal components;
(2) insufficient justification that *additional* age data will notably improve conservation and management; and
(3) the proponents' approach used to assess the potential effects of catches on common minke whales (and especially that even under the approach taken by the proponents, J-stock was shown to decline under some scenarios).

The Panel has provided **recommendations** on additional analyses that should be undertaken to limit some of these shortcomings (summarised in Table 3).

The Panel has also developed **recommendations** to improve the Annex P process, including the need to develop agreed frameworks to compare lethal and non-lethal approaches, to quantify 'improvements' in management in an IWC context and to evaluate the effects of catches on stocks.

1. INTRODUCTORY ITEMS

The Expert Panel Workshop of the Proposed Research Plan for New Scientific Whale Research Programme in the western North Pacific (NEWREP-NP) was held in the Toyomi Center Building, Tokyo from 30 January to 3 February 2017. The Panel also considered final data from the western North Pacific Japanese Special Permit programme (JARPN II).

1.1 Opening remarks

The Scientific Committee Chair, Fortuna, welcomed the Panel Members[2], Observers and Japanese Proponents to Tokyo and thanked the Fisheries Agency of Japan for hosting the Workshop. Morishita (IWC Commissioner for Japan) also welcomed the Panel and all participants.

The meeting was organised following the previous style of Expert Workshops. Mornings comprised open sessions with summary presentations by the proponents and the opportunity for questions and discussion (Panel members, proponents and observers present), followed by afternoon closed sessions for the Panel to discuss the morning topics and begin to outline relevant sections of its report and assign writing tasks. This year, live streaming of the open sessions was set up as a trial to allow remote participation: four observers (Baker, Bjørge, McKinlay and Weinrich) connected at least some of the time whilst four additional members of the Scientific Committee requested access but did not connect, perhaps due to the time difference with their respective countries. The list of participants is given as Annex A.

1.2 Appointment of chair and rapporteurs

Fortuna, as Chair of the IWC Scientific Committee, chaired the Workshop. Palka and Punt co-ordinated the report writing, which was finalised by Donovan. All members of the Panel contributed to the report. The report will be made public on 3rd April.

1.3 Available documents

The list of documents is given as Annex C. Four primary papers (SC/F17/JR01-04) were available, along with five 'For Information' papers, two Observer's Statements (SC/F17/O01-O02) and two responses by Japan to the Observer's statements (SC/F17/O03-O04). In addition, a number of 'morning papers' were provided by the proponents in response to questions during open sessions. These have been collated by subject as Annex D.

1.4 Adoption of the Agenda

The adopted Agenda is given as Annex B.

[1]Presented to the IWC Scientific Committee as SC/67a/Rep01.
[2]One member of the Panel (Donovan) participated remotely during all open and closed sessions. Another member (Gaichas) participated by e-mail.

2. OBJECTIVES OF THE WORKSHOP

2.1 Introduction to the Annex P process

The Scientific Committee Chair provided an introduction to the Annex P review process, which was revised in 2015 and endorsed by the Commission at its biennial meeting in 2016, focusing on aspects relevant to this review.

The primary objective of the Expert Panel Workshop was to review the proposal in the light of the stated objectives, with the help of the checklist outlined in Appendix 1 of Annex P.

The agreed three broad categories of objectives for Special Permits proposals are: (1) improve the conservation and management of whale stocks; (2) improve the conservation and management of other living marine resources or the ecosystem of which the whale stocks are an integral part; and (3) test hypotheses not directly related to the management of living marine resources. In this context, the Panel's tasks were to:

(1) 'comment briefly on the perceived importance of the stated primary objectives from a scientific perspective and for the purposes of conservation and management, noting particularly the relevance of each to the work of the Scientific Committee[3];
(2) evaluate whether the objectives of the research could be achieved by non-lethal methods or whether there are reasonably equivalent objectives that could be achieved non-lethally[4];
(3) for broad categories of objectives 1 and 2, evaluate whether the elements of the research that rely on lethally obtained data are likely to lead to improvements in the conservation and management of whales. This evaluation should include whether the proposal demonstrates the likely magnitude and relevance of improvements to conservation and management arising from the achievement of the programme objectives;
(4) evaluate whether the design and implementation of the programme are reasonable in relation to achieving the programme's stated research objectives[5], and in particular, evaluate whether sample sizes and the spatial and temporal scales[6] are reasonable in relation to the programme's stated research objectives and whether non-lethal alternatives are not feasible to either replace or reduce the size of the lethal sampling being proposed;
(5) assess the degree to which the programme coordinates its activities with related research projects[7];
(6) provide advice on the likely effects of the catches on the stock or stocks involved under various scenarios of length of the programme. This will include inter alia examination of abundance estimates provided and may involve a different analysis to that provided in the original proposal, including assumptions that short permit proposals may be projected further into the future;
(7) determine whether the programme has specified intermediate targets that would allow for an adequate review of progress relative to programme objectives; and
(8) consider any other relevant matters as decided by the Scientific Committee'.

In relation to the JARPN II programme, the Panel tasks were to consider: (1) updated analyses that included data obtained up to 2016; and (2) responses to recommendations made in IWC (2017a; 2017b).

2.2 Introduction to the Revised Management Procedure (RMP) process

Given that key aspects of the new proposal NEWREP-NP related to the RMP, Punt gave a short presentation on behalf of Donovan on the Revised Management Procedure (RMP) process and key parameters. Schematic representations of the RMP framework (Fig. 1) and its *Implementation Process* (Fig. 2) were presented.

Key requirements to implement the RMP are information on:

(a) stock identity (identify a range of plausible hypotheses in light of supporting data);
(b) absolute abundance (specified in light of stock hypotheses);
(c) MSYR; and
(d) removals (historical series in light of stock hypotheses, past and future estimates for ship strikes and bycatches).

It was stressed that within the *IST* framework, conditioning can be improved by using 'additional' data (e.g. age and marking data for North Atlantic fin whales, sex ratio data for North Atlantic common minke whales) to the types of data commonly used. Use of all data in conditioning must take into account uncertainty. In some cases, these additional data can be valuable to, but are not essential for, the process.

Where more detailed explanation of aspects of the process are required in light of specific components of NEWREP-NP, these are developed under the relevant agenda items below.

3. REVIEW OF THE JARPN II PROGRAMME

3.1 Overview of the 2016 Panel and Scientific Committee recommendations and the earlier JARPN II review

The Chair provided an overview of the 2016 Panel and Scientific Committee recommendations and the current status of progress (Table 1). In general, the 2016 Panel recognised the extensive field and laboratory components of the programme, but was concerned that this was not matched by analytical efforts. To this end, it made almost 40 recommendations for improved analyses, 15 of which could be achieved in the short-term (by the 2016, or at the latest the 2017 annual Scientific Committee meeting). The 2016 Panel did not make any recommendation that required or suggested the need for additional lethal sampling. Table 1 summarises the status of progress and comments made by the Panel on new received material (i.e. SC/J17/JR02rev1, Annex D and PowerPoint presentations by the Proponents).

[3]Include whether the programme objectives are sufficiently defined to enable an evaluation of the likely contribution of the different data sets to objectives.

[4]The comparison of lethal and non-lethal means should be based on their potential to meet the programme objectives (or their reasonable equivalents) based on power analyses and feasibility, including effort and time frames required to produce comparable results.

[5]For broad categories of objectives 1 and 2, and with respect to methods and sample size, 'reasonable' is determined by a demonstration that methods and sample sizes are necessary and sufficient.

[6]With respect to spatial and temporal scales, assess whether the timeframe, as well as the seasonal and spatial distribution of lethal or non-lethal sampling are appropriate.

[7]This will include assessment of whether the degree of coordination is sufficient to ensure that the field and analytical methods are appropriate and best practice to achieve the stated objectives and whether the degree of coordination is sufficient to avoid unnecessary duplication.

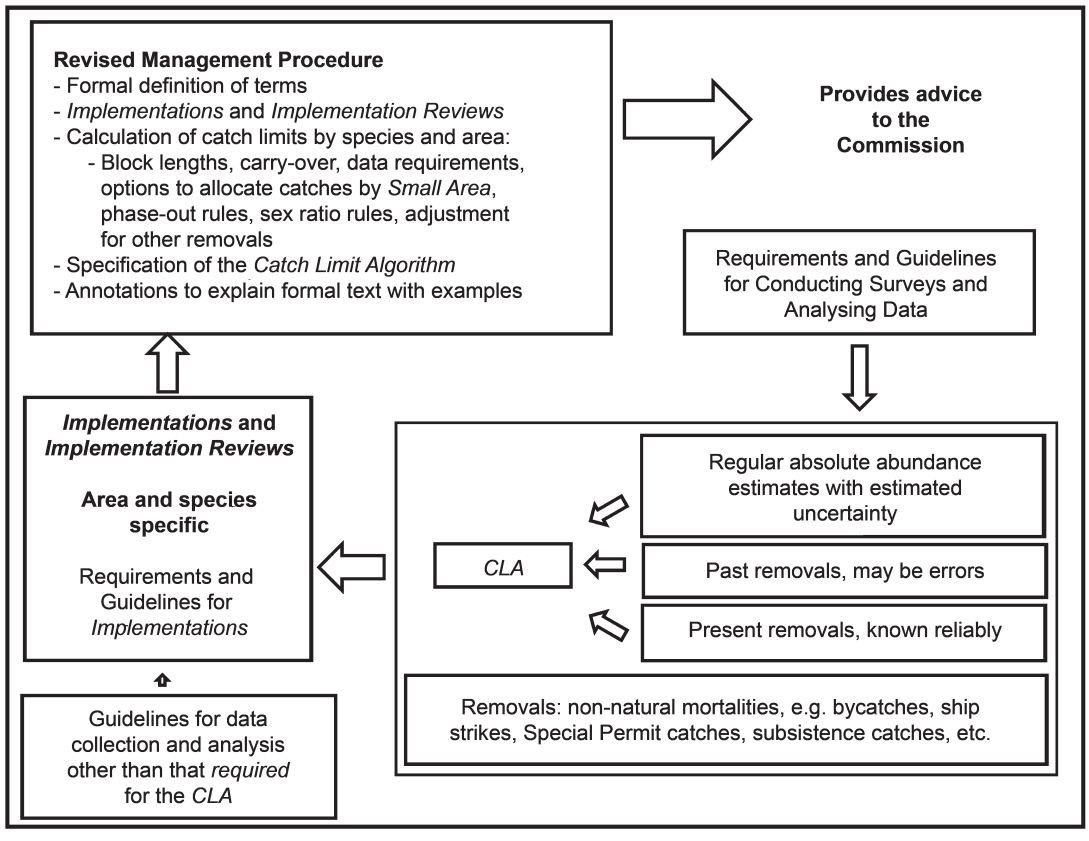

Fig.1. Schematic representation of the RMP.

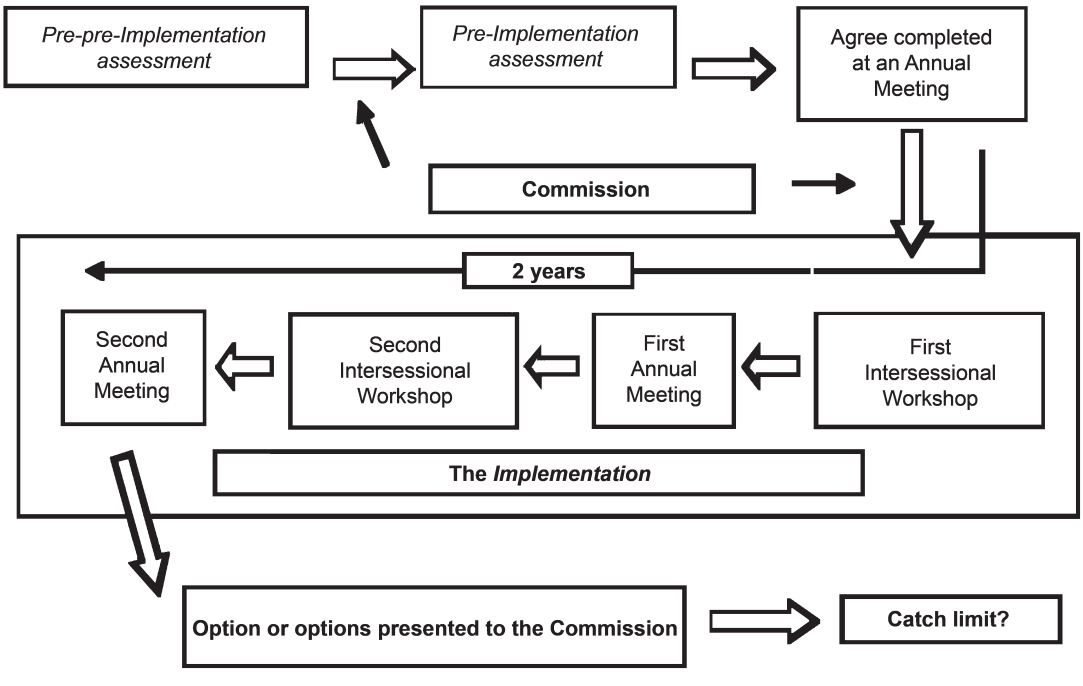

Fig.2. Schematic representation of the RMP *Implementation Simulation Trial* process.

Table 1

2016 Panel and Scientific Committee recommendations and the current status of progress.

Topic (and agenda number from the 2016 Panel review)		2016 Panel suggested timeline, progress by 2017 Panel meeting and 2017 Panel comments and conclusions	Comments by the Proponents presented to the Panel (SC/J17/JR02rev1)
Sampling design and areas (Item 3.4.2.1)			
(1)	A new paper that in addition to the information on sightings, it should document, for each year and season: (a) the predetermined tracklines for sampling and the rationale for those lines; and (b) the actual coverage of those tracklines and the rationale for any decisions taken to deviate from the predetermined lines including the rationale for any new lines developed. (c) It should also address the issue of whether the actual sampling that occurred can be said to be representative of: (a) the animals in the surveyed area; and (b) those in the biological population(s) and discuss the extent to which this may affect those objectives/parameters/ analyses for which this is or may be important.	By SC/2016: The proponents responded in Bando *et al.* (2016). The Committee discussed this at some length (see Item 18.2.3.1). Suggestions were made to improve the manuscript and to better evaluate the appropriateness of the pooling of data. This requires analyses that disaggregate the data collected according to the two different sampling strategies. This may allow pooling of data but the precision of estimated quantities, and hence required sample sizes, should also be examined. Issues related to the sample representativeness and the effect of this are partially addressed. **2017 Panel comment: Relevant to discussion under Item 4.2.**	No new information presented.
(2)	Papers using data from the inshore component must fully address the implications of the logistical rather than scientific sampling design.	By SC/2016: Partially addressed in Bando *et al.* (2016) but further analyses required to make allow-ance for non-random sampling. **2017 Panel comment: Relevant to discussion under Item 4.2.**	No new information presented.
Sample size (Item 3.4.2.2)			
(3)	A new paper should be developed that: (a) provides a clearer rationale for the changes in sample sizes initiated in 2014 and any implications for meeting the original objectives of the programme; and (b) provides the field and analytical protocols for the comparison of using lethal and non-lethal techniques for each key parameter taking into account the advice provided in 2009.	By SC/2016: (3a) The proponents provided some information in Tamura *et al.* (2016a). The Committee noted that this largely referred to information already available to the Panel and Committee and noted that further information, especially with respect to the implications for meeting the original objectives would be helpful. By SC/2016: (3b) The proponents presented the field and analytical protocols in Mogoe *et al.* (2016). Committee advice on presentation of results and analyses in a final report is given under Item 18.2.3.2 of SC/66b. **2017 Panel comment: Relevant to discussion under Item 3.**	No new information presented.
Stock structure (Item 4.4.3)			
(4)	All inferences regarding 'randomness' of observations (e.g. satellite tracks, mitochondrial DNA haplotypes and unassigned common minke whales) should be substantiated by a statistical assessment of the presumed randomness.	By SC/2016 (or 2017 at latest): Tamura *et al.* (2016a) indicates this will be addressed and proposes two approaches.	*These results will be submitted to the 2017 SC Annual Meeting. Progress at this stage is shown in Appendix 1 [of SC/J17/JR02rev1].*
(5)	The presence of multiple stocks within sample partitions should be assessed (employing, e.g. STRUCTURE and DAPC).	By SC/2016 (or 2017 at latest): In progress (see discussion in IWC, 2017c). **See Item 3.3.1 for 2017 Panel's full comments.**	*STRUCTURE analyses for Bryde's and sei whales were conducted and presented in Pastene et al. (2016, and Appendix 2.1 of SC/J17/JR02rev1). DAPC analysis is in progress (Appendix 2.2 of SC/J17/JR02rev1). The final results of DAPC for Bryde's whale will be submitted to the Bryde's whale Implementation Review Work-shop to be held in March 2017.*
(6)	More explicit information on quality checks be provided in each study as well as study-specific estimates or genotyping and DNA sequencing error rates.	By SC/2016 (or 2017 at latest): Goto *et al.* (2016) fully addresses this (see IWC, 2017d). **The 2017 Panel agreed that this recommendation has been completed.**	*See Appendix 3 of SC/J17/JR02rev1.*
(7)	To facilitate more definitive discrimination between single and multiple stock hypotheses, undertake work to determine the demographic dispersal rates among areas at which whales in different areas can be managed as a single stock. Identifying 'critical' dispersal rates by specific case and the corresponding levels of genetic divergence, should enable such discrimination. The approach of Van der Zee and Punt (2014) is commended. This will allow the development of a working definition of a 'stock'.	2-3 years after the 2016 Annual Meeting: The proponents noted that work had begun to address (7), (9) and (10). They propose use of kinship analyses to address (8). Progress is discussed further in IWC (2017c). **2017 Panel: No progress presented at the meeting.**	*This will be addressed after a discussion on direction of the analysis with panel members.*
(8)	Analytical approaches should be applied that do not assume mutation-drift-migration equilibrium (Hey, 2010).		*This may not be feasible for the cases of O stock common minke, Bryde's and sei whales where the effect sizes are low. Instead, kinship information will be used as a way to estimate migration rates, as this is an approach that does not depend on the assumption of genetic equilibrium.*

Topic (and agenda number from the 2016 Panel review)		2016 Panel suggested timeline, progress by 2017 Panel meeting and 2017 Panel comments and conclusions	Comments by the Proponents presented to the Panel (SC/J17/JR02rev1)
(9)	Serious consideration should be given to using genome-wide SNP genotyping approaches, such as RAD sequencing and GBS Elshire *et al.,* 2011; Miller *et al.*, 2007). This will increase the data per sample thereby improving the accuracy and precision of genetic parameter estimates and facilitate additional analyses Hey and Machado, 2003; Robinson *et al*., 2014).		*Novel SNPs for minke whale species were developed under the collaborative research with Norway (Malde et al., in review) which will be used for the subsequent genetic analyses.*
(10)	A focused satellite tagging programme should be developed to greatly increase sample size to assess individual migration in the context of stock structure hypotheses more thoroughly.		*The proponents agree to make efforts to increase the number of satellite tagging experiments. In the case of the Bryde's and sei whales, this information should be examined in conjunction with the available information on mark-recapture from the period of commercial whaling. Effort to collect tagging data will be increased in the NEWREP-NP.*
Feeding ecology and ecosystem studies – Oceanography (Item 5.4.3.1)			
(11)	Chl-a concentration should be examined as a potential proxy for the food environment for whales.	2 years after the 2016 Panel review: Used in some analyses already and discussed in Tamura *et al.* (2016a).	
(12)	Oceanographic monitoring is required to compare with prey species distribution and abundance in the new 'decadal regime'.	Several years - The proponents agreed – this is long-term monitoring.	*Long-term monitoring.*
Feeding ecology and ecosystem studies – Distribution (Item 5.4.3.2)			
(13)	With respect to papers Murase *et al.* (2014; 2016), Matsuoka *et al.* (2016), Sasaki *et al*. (2013) and Tamura *et al.* (2016c), develop revised versions that: (a) include statistical summaries on model fit (R2 and % deviance explained) and model com-parison and spatial covariate selection (e.g. AIC, GCV scores); (b) avoid extrapolation of the regression models outside to data-poor areas or areas lacking coverage (especially when combining food consumption with sightings data); and (c) include variance plots of the fitted prediction surfaces in order to address precision and data sparseness.	By SC/2016: (13a) The proponents provided statistical summaries relating to model fits in papers Murase *et al.* (2014; 2016), Tamura *et al.* (2016c) and Tamura *et al.* (2016c), but not in Matsuoka *et al.* (2016). (13b, 13c) No information received. **2017 Panel: no progress presented at the meeting. See new details on plans in Annex D**.	*Improvement of analyses of Matsuoka et al. (2016) (spatial abundance estimation) and Tamura et al. (2016c) (spatial prey consumption estimation) is ongoing. Because they are companion papers, the improvement is conducted in parallel. Some of the results were presented to 2016 PICES annual meeting (Sasaki et al. (2016) to invite comments from regional experts. The improved version will be presented to 2017 PICES annual meeting for further consideration. Fully improved version would be submitted to IWC/SC after 2018. Revision of published papers (Murase et al., 2014; Sasaki et al., 2013) will not be conducted because they only used part of JARPN II data and full consideration can be achieved by improving Matsuoka et al. (2016) and Tamura et al. (2016c).*
(14)	Considerable effort be put into the methodological improvement of the spatial modelling in the various analysis related with the objectives on distribution of large whales and oceanography. A particular focus must be on the combination of survey data from the different years to make them more comparable in terms of distribution (and abundance) over time; use of data from other sources (e.g. the IWC POWER programme). This work is not only valuable in itself but is essential for a better parameterisation of ecosystem models.	2-3 years after the 2016 Annual Meeting: The proponents agreed and will undertake in light of guidelines to be developed by the Scientific Committee in 2017 (see Annex D). Will also include additional data. **2017 Panel: no new analyses presented at the meeting although the proponents suggested that a new paper will be presented at the 2018 Scientific Committee meeting.**	*See also comments to Recommendation 13.*
(15)	Additional effort be placed on fulfilling the 2009 recommendation with respect to the photo-identification data to contribute to the under-standing of large scale movements and whale distribution within and outside the JARPN II survey area for several species.	2-3 years after the 2016 Annual Meeting: The proponents agreed that consideration will be given to sharing photo-ID data. **2017 Panel: no progress presented at the meeting.**	*The database validations work started for several species.*
Feeding ecology and ecosystem studies – Distribution (Item 5.4.3.2)			
(16)	Explore methods to account for sampling differences between areas and years to obtain measures of short- and long-term variation and trends and estimates the extent of additional variance due to changes over time in spatial distribution (essential for modelling efforts, for example, in food consumption models and ecosystem models).	2-3 years after the 2016 Annual Meeting: The proponents agreed and expect to achieve this within the timeframe. **2017 Panel: no progress presented at the meeting.**	*The proponents will explore the method using models such as mixed effect model.*
(17)	Compare results from the design-based estimates of abundance with those of model-based estimates to potentially address problems of unequal sampling coverage between surveys and to potentially account for additional sources or causes of variability.	2-3 years after the 2016 Annual Meeting: The proponents agreed and expect to achieve this within the timeframe and in line with the IWC guidelines discussed under (14) above.	No new information presented.
Feeding ecology and ecosystem studies - Field and laboratory studies			
(18)	The sampling distribution for the parameters should be used in the assessment of the uncertainty associated with the estimation of consumption.	By SC/2016 (or 2017 at latest): Proponents agreed and will complete by 2017. **2017 Panel: see Item 3.3.2 for full comments.**	*Progress summarized in Appendix 4* [of SC/J17/JR02rev1].

Topic (and agenda number from the 2016 Panel review)		2016 Panel suggested timeline, progress by 2017 Panel meeting and 2017 Panel comments and conclusions	Comments by the Proponents presented to the Panel (SC/J17/JR02rev1)
(19)	Clarification should be provided on how density and diet consumption have been extrapolated outside the areas and months covered during the surveys and diet studies.	By SC/2016 (or 2017 at latest): Response provided in Bando *et al.* (2016) and discussed.	-
(20)	All sources of uncertainty should be quantified and an evaluation of which parameters contribute the most to uncertainty be conducted and taken into account in the analyses and modelling.	2-3 years after the 2016 Annual Meeting: The proponents agree. **2017 Panel: no progress presented at the meeting.**	*Analyses are ongoing.*
(21)	The studies on allometric relationships should be developed further to refine the range of suitable allometric-energy intake/consumption relationships.	2-3 years after the 2016 Annual Meeting: The pro-ponents will complete the work within the timeframe. **2017 Panel: no progress presented at the meeting.**	*Analyses are ongoing.*
(22)	The analyses of diet composition should consider the effect of seasonal changes in energy density of the various prey species.	2-3 years after the 2016 Annual Meeting: Proponents agreed and will complete by 2017. **2017 Panel: see Item 3.3.2 for 2017 Panel's full comments.**	*The proponents considered the effect of seasonal changes in energy density of the various prey species. Table 3 of Tamura et al. (2016b) indicated seasonal changes in energy density of the various prey species. Table 4 indicated prey composition (W%) of each whale sampled. Table 5 indicated the energy contents consumed by whales calculated based on their prey composition in research area based on Tables 3 and 4.*
(23)	Stable isotope analysis of whale tissues and their prey should be introduced not only into the assessment of diet, but also to statistically evaluate overlap in distribution and trophic niche between baleen whale species.	2-3 years after the 2016 Annual Meeting: With respect to (23) a study has begun with Hokkaido University. **2017 Panel: see Item 3.3.2 for 2017 Panel's full comments.**	*Preliminary result is shown in Appendix 6* [of SC/J17/JR02rev1].
Feeding ecology and ecosystem studies – Ecosystem modelling (Item 7.4.3)			
(24)	Generic recommendations identified by the 2009 Panel remain.	2-3 years after the 2016 Annual Meeting	
(25)	Generic recommendations identified by the 2009 Panel remain.	2-3 years after the 2016 Annual Meeting: The proponents agree.	
(26)	Establish clear objectives on the ultimate use of the models to make further progress (e.g. better understanding ecosystem linkages, delivering advice for fishery management) – ecosystem models are not suitable for tactical management.	2-3 years after the 2016 Annual Meeting: The proponents agree. **2017 Panel: no progress presented at the meeting.**	*Objective will be considered by a domestic group comprising scientists and managers in parallel with improvement of basic structures of models.*
(27)	Use models in concert e.g. use food web modelling to establish key predation linkages for extended single-species or multispecies models. In such a way the suite of available modelling tools can be used to integrate available knowledge.	2-3 years after the 2016 Annual Meeting: The proponents agree. **2017 Panel: no progress presented at the meeting.**	*The proponents have been undertaking some basic analysis especially on the effect of presence of ghost population etc. Construction of food web model at local scale (e.g. off Sanriku) will also be considered.*
(28)	Use stable isotopes to provide information on long term feeding patterns and inform models about trophic relationships between whales and their prey (see also Item 6.4).	2-3 years after the 2016 Annual Meeting: The proponents agree in broad terms but note the use in modelling may be limited. **2017 Panel: no progress presented at the meeting.**	*See also comments to Recommendation 23.*
(29)	With respect to the EwE modelling: (a) evaluate data quality for each input parameter (the 'pedigree': e.g. Gaichas *et al.*, 2015) to characterise uncertainty in model inputs; (b) further evaluate PREBAL and other diagnostics; (c) present more clearly and evaluate further the estimated vulnerabilities and other fit diagnostics (including sensitivity analysis using ranges of consumption estimates).	2 years after the 2016 Panel review: The proponents agree and will undertake analyses within the time frame but note some limitations with EE in the western North Pacific situation. **2017 Panel: no progress presented at the meeting.**	*Improved version of the model was presented to 'ICES/PICES: Drivers of dynamics of small pelagic fish resources' in March 2017 to invite comments from experts of small pelagic fish (Watari et al., 2017). Further improvement will be considered based on the comments if any. Fully improved version would be submitted to IWC/SC after 2018.*
(30)	With respect to extended single-species modelling: (a) ensure that the majority of predation mortality is captured; (b) carry out additional diagnostics: (1) examine the fits to: (i) fishery-independent survey data; (ii) proportion information; and (iii) trends in fishing mortality; (2) use posterior predictive checks to evaluate Bayesian model. (c) provide thorough justification for the current spatial boundaries of the model and the use of fishery CPUE as an index of abundance. (d) focus the model fitting on the fishery-independent survey if CPUE not considered likely to index abundance; (e) examine sensitivity to alternative plausible functional forms of the feeding relationship; and (f) explore the causes of the implausible pos-teriors, e.g. Kitakado *et al.* (2016) by changing the weights assigned to the data sources and fitting the model.	2-3 years after the 2016 Annual Meeting: The proponents broadly agree with all components of this recommendation, but identify some difficulties with lack of data for item (e). **2017 Panel: no progress presented at the meeting.**	*Some works have been undertaken such as standardisation of CPUE series and use of them in the model fitting. In addition to Bayesian methods, estimation with ML method has been revisited. All but (e) will be finalised in 2018.*

Topic (and agenda number from the 2016 Panel review)		2016 Panel suggested timeline, progress by 2017 Panel meeting and 2017 Panel comments and conclusions	Comments by the Proponents presented to the Panel (SC/J17/JR02rev1)
Monitoring environmental pollutants in cetaceans and marine ecosystem (Item 8.4.3)			
(31)	To improve the statistical analyses based on clear and well-formulated hypotheses.	By SC/2016 (or 2017 at latest): Addressed in Yasunaga *et al.* (2016a; 2016b), although additional consultation with statisticians would be beneficial.	-
(32)	Recalculate OC concentrations as values on a lipid weight basis, and Hg concentrations on a dry weight basis.	By SC/2016 (or 2017 at latest): The proponents elucidate some difficulties to address this recommend-ation due to e.g. loss of samples by tsunami in 2011.	-
(33)	Explore trends in pollutant concentrations using generalized additive models (GAMs) or other non-linear approaches, in addition to the linear models.	By SC/2016 (or 2017 at latest): Addressed in Yasunaga *et al.* (2016a; 2016b).	-
(34)	Evaluate the pollutant concentrations found in comparison with data from previous studies conducted in comparable species and available in the literature.	By SC/2016 (or 2017 at latest): More discussion on comparisons with previously published studies were included in Yasunaga *et al.* (2016a; 2016b).	-
(35)	Since body length is a poor proxy for age, particularly in sexually mature whales, incorporate age data into the multivariate analysis of pollutant concentrations as soon as they become available.	2-3 years after the 2016 Annual Meeting: The proponents agree and will undertake work. **2017 Panel: no progress presented at the meeting. However, in light of the proponents' comments, the Panel stresses that this recommendation can be implemented without collecting additional samples and the results can be presented within the suggested timeline.**	*This item will be addressed under Ancillary Objective I (i) of the research plan for NEWREP-NP.*
(36)	To include stable isotope values in the analyses to investigate the bioaccumulation process of pollutants through the food chain.	2-3 years after the 2016 Annual Meeting: The proponents agree and will undertake work. See comments in SC/J17/JR02.	*See progress on Recommendation 23. Proponents will integrate this result for investigating the bioaccumulation process of pollutants.*
(37)	To assess more widely the risk that these chemical pollutants present to the populations' abundance or distribution.	2-3 years after the 2016 Annual Meeting: The proponents agree but for long-term. They note no health risk from OCs or Hg thus far. **2017 Panel: no progress presented at the meeting. However, in light of the proponents' comments, the Panel stresses that this recommendation can be implemented without collecting additional samples and the results can be presented within the suggested timeline.**	*This item will be addressed under Ancillary Objective I (iii) of the research plan for NEWREP-NP.*
Ageing (Item 9.1.2)			
(38)	To investigate into whether there is any relationship between age or sex and readability that may affect the representativeness of the earplugs that can be read.	2 years after the 2016 Panel review: The proponents agree and work is underway. **2017 Panel: progress in this area was presented at the meeting (see Annex D). See Item 3.3.3 and 4.4.3.2 for 2017 Panel's full comments.**	*Some additional progress of ageing methods is provided under Item 3.2 in this Review Workshop.*
(39)	To age as many of the existing samples as possible and to incorporate age where appropriate in updated analyses (e.g. see the recommendations on pollutant studies).	2 years after the 2016 Panel Review: Work is underway. **2017 Panel: no progress presented at the meeting.**	*Analyses are ongoing. See also progress on Recommendation 38.*
Recommendations to the Scientific Committee on process (Item 11)			
(40)	The Panel recommends that the Scientific Committee considers: (a) including a guideline either relating to the minimum time after completion of a programme that a final review can take place or establishing a small review group to determine whether the materials available are for a review Workshop; (b) adopt guidelines for an integrated final report by the proponents. (c) to consider a mechanism for proponents to provide a short biennial update on progress with recommendations. (d) develop a mechanism to allow for the completion of expert panel reviews if a Panel states that its review is incomplete until further information/analyses is provided.	Some of these matters are under consideration by the Scientific Committee - see Item 26.3 in IWC (2017b). **The Panel reiterates recommendations 40a, 40c and 40d. See Item 3.3.5 and 5.1 for 2017 Panel's full comments.**	Proponent's representatives are fully involved in the intersessional work carried out by the Intersessional Correspondence Group on 'Annex P'.

3.2 Update analyses incorporating data up to 2016 and responding to recommendations made in IWC (2017a)

3.2.1 Proponents' overview

In concordance with the timeline agreed in the 2016 IWC SC Annual Meeting, SC/F17/JR02 presented the overall progress of the work and analyses implemented by the proponents since the IWC SC Annual Meeting in 2016 in response to the recommendations made in IWC (2017a). Responses to the recommendations are being implemented. Table 1 of SC/F17/JR02 presented a list of the data by JARPN II in the period 2014-16 related to the three objectives of JARPN II, obtained both in the field as well at the laboratory. The complete data set (2000-2016) is being used to implement some of the analytical recommendations in IWC (2017a). Table 2 of SC/F17/JR02 presented a summary of the work conducted by the proponents in response to each of the 38 recommendations in IWC (2017a). Appendices to this table were prepared when the progress made on a particular recommendation was considered substantial. For example, substantial progress has been made in responding to the recommendations on stock structure (Recommendations 4, 5, and 6). Final reports on some recommendations on stock structure will be reported to the upcoming Bryde's whale *Implementation Review* Workshop and the annual meetings of the IWC SC. Substantial progress was made on the treatment of uncertainty associated with the estimation of prey consumption by whales (Recommendation 18), on the investigation of the effects of seasonal changes in energy density of the various prey species on the analyses of diet composition (Recommendation 22), and on Recommendation 23, on the stable isotope analysis of whale tissues and their prey species.

Also substantial progress was made on the recommendation on ageing (Recommendation 38). At present, age is a key type of information for studies on life history, stocks and population dynamics of whales. The earplug is considered the most reliable source of absolute age determination in baleen whales. Under JARPN and JARPN II surveys, all earplugs were carefully collected and attempts were made to read growth layers in all earplugs collected. In 2007, a new sampling technique (Gelatinized Extraction Method) was developed to prevent damage of earplugs at the collection stage for common minke whales. As a result, age readability of North Pacific common minke whales could be improved from 8.7% in the past commercial whaling to 44.1% (45.2% for males, and 41.2% for females) in the JARPN and JARPN II surveys. In recent years, the Gelatinized Extraction Method was also applied to North Pacific sei whales. For earplugs collected in 2014 to 2016, laboratory work was carried out to read growth layers. New age data (96 earplugs for common minke whales, 118 earplugs for sei whales) were added to the data set, and further research on the relationship between body length/sex and readability, was made. Readability increased with body length class in both sexes.

SC/F17/JR03 presented results of the feasibility study on non-lethal techniques to address the main research objective of JARPN II (feeding ecology and ecosystem studies), based on data and samples obtained by JARPN II surveys during 2014-2016. Both field (biopsy and faecal sampling) and analytical techniques (stable isotope and fatty acids that potentially can be used based on biopsy samples and DNA analyses that potentially can be used to investigate prey in faecal samples), were investigated and evaluated. Evaluation of the techniques was conducted using a conceptual frame (protocol) developed by Mogoe *et al.* (2016), which includes four main questions: Q1: Can a tissue and other samples be obtained by a non-lethal method?; Q2: Can enough samples be obtained for statistical analyses?; Q3: Can the samples obtained by a non-lethal method produce scientific information comparable to that produced by a lethal sampling?; Q4: Is the cost for obtaining the sample and for producing scientific information reasonable? All of the four tests need to be satisfied to conclude that a particular non-lethal method is feasible and practicable to the extent that it can replace lethal sampling. Regarding biopsy sampling, response to Q1 was 'Possible' for the three species (common minke, sei and Bryde's whales); response to Q2 was 'Possible' for sei and Bryde's whales and 'Difficult' for common minke whale. Regarding faecal sampling, the response to Q1 was 'Possible' for sei whale and 'Very difficult' for common minke and Bryde's whales; response to Q2 was 'Very difficult' for the three species. Further analyses are required to respond to Q3 regarding isotope and fatty acid techniques using biopsy samples. Regarding the DNA analysis of faeces (intestine samples were used instead), response to Question 3 was 'Difficult' for the three species. In summary these results suggested that, given the main objective of JARPN II and available research resources, biopsy sampling is not feasible for common minke whale in the coastal area, and faecal sampling is not feasible for all three whale species at this stage. Further analyses on new non-lethal techniques will be conducted under the NEWREP-NP programme taking into account the results and progress made in JARPN II (see agenda item 4.2.2).

3.3 Panel conclusions and recommendations

The Panel noted that relatively few new analyses were presented but noted that field and laboratory data for the period 2014-16, as specified by objective, had become available; this is discussed by topic below. SC/J17/JR02rev1 contains some new information and results, and additional results were presented on ageing techniques at the review meeting, during open sessions (see Annex D). Recommendations for which substantial new information was available are discussed in the following paragraphs.

3.3.1 Stock structure

RECOMMENDATION 5

The Panel noted that analyses applying STRUCTURE to genotypes from Bryde's and sei whales were presented at SC/66b (Pastene *et al.*, 2016). The results of additional DAPC-based analyses of Bryde's whale genotypes were presented during the NEWREP-NP meeting (SC/J17/JR02rev1). None of the above analyses detected the presence of multiple clusters. Additional assessments of potential genetic structuring in North Pacific common minke whale presented thus far by the proponents have confirmed O and J stocks, but not detected further structure. However, the Panel noted the long-standing difficulties arising from the fact that an inability to reject the null-hypothesis of a single stock is not the equivalent of 'proof' that there is only one stock. That being said, the Panel **reiterates** the need for additional analyses of existing samples as outlined during the JARPN II report and considered further under Item 4.

3.3.2 JARPN II component on 'Feeding ecology and ecosystem studies - Field and laboratory studies'

RECOMMENDATION 18

The Panel noted that there appears to have been a mis-understanding in the interpretation of what was meant by the use of 'the sampling distribution of the parameters' in the recommendation. SC/J17/JR02rev1 shows the triangular distributions (and uniform distribution for assimilation efficiency) assumed in the Monte Carlo analysis, and calls this the 'data distribution'. As the actual data are not plotted, it is not possible to determine if they follow a triangular distribution, and any revised document should address this. More importantly, however, the intention of the recommendation was to investigate assumed parameter distributions other than the triangular distribution, because the 2016 Panel felt the triangular distribution put too much weight in the tails of the distribution and that a bootstrap approach (which would naturally follow the distribution of the actual data) would have been an improvement. The present Panel **agrees** that, in order to address this

recommendation, the proponents should examine the actual sampled data distributions for body weight and caloric value of prey species and compare these to the triangular distributions used.

RECOMMENDATION 22

The Panel noted that the new table in SC/J17/JR02rev1 combines the previously presented energy content analysis with the diet compositions to examine overall energy content per unit weight of prey by season. However, it appears no additional sampling of prey energy density across seasons occurred in response to the recommendation. The Panel noted that the original recommendation was more towards addressing whether energy content of individual prey species changes seasonally, which may not be detectable with the original samples. With such small sample sizes of individual prey for energy density, differences between seasons are extremely difficult to detect, but this was not commented on, nor was the power to detect changes considered by the proponents. Given this, any differences between energy content for prey as a whole by season for each cetacean species may therefore be driven by changes in diet composition, changes in energy content, or both. Some discussion or conclusions in addition to the provided tables (e.g. on whether or not these differences are significant, and if additional sampling of prey energy content to resolve this matter had been or will be conducted) will help determine whether this recommendation has been sufficiently addressed by the proponents. In some ecosystems, prey energy content has changed over time as well as seasonally, so monitoring for this type of information would be useful to determine how ecological changes may affect cetacean productivity.

RECOMMENDATION 23

The Panel noted that the information in SC/J17/JR02rev1 represented a good start towards addressing the stable isotope recommendations. The comparison of the data from different sources and discussion of where and why isotopes agree with stomach data or not are interesting but there is a lack of detailed consideration of comparable data from other studies (e.g. Iceland) or a discussion of how the information from the various techniques relate to the ability to reach the broader objectives of JARPN II. In summary, the paper begins to address each of the components of the recommendation although did not answer them fully with this brief study. Further discussion is provided under Item 3.3.4.

OVERALL

The Panel **stresses** that for a final review, a synthesis document should be developed combining all of the parts of the uncertainty analysis to indicate the largest sources of uncertainty in consumption estimates - such a comprehensive overview has not yet been developed.

3.3.3 Ageing techniques

The Panel was pleased to learn that the work to improve ageing techniques for baleen whales is still ongoing. It re-iterated the 2016 commendation of the progress made in the development of the gelatinised extraction method. Further discussion can be found under Item 4.2.1.

3.3.4 Comparing lethal and non-lethal approaches

General, as well as specific discussions on lethal versus non-lethal approaches in whale research under Special Permits have occurred several times in the IWC Scientific Committee in the past (e.g. IWC, 1998; 2014b). The complexity of the issue was recognised along with the need for consideration of a number of disciplines, not all of which are scientific and/or require value judgements that may be considered subjective (e.g. economics, 'ethics', 'importance' of objectives). Scientific issues of concern include the practical aspects of collecting the data, which laboratory and analytical methods to use, quantification of comparable uncertainty and the interpretation of the results in the context of objectives.

The Panel **welcomes** SC/J17/JR03 presenting the results of the feasibility study on non-lethal techniques to address the key research objective of JARPN II, based on data and samples obtained during 2014-16. The objectives of JARPN II for those three years had been reprioritised in part to conduct a comparative study of lethal versus non-lethal techniques. A comparison of lethal and non-lethal techniques had been recommended by previous Panels. The Panel noted that several of the analyses are preliminary, perhaps not unexpected given that some of the data were collected less than a year ago. Comments on the various analyses presented are provided below.

CONCEPTUAL FRAMEWORK

Recognising that there is no single agreed approach to addressing the comparison of lethal and non-lethal techniques, the Panel **welcomes** the fact that the proponents have developed a conceptual framework to evaluate the feasibility and practicability of non-lethal techniques as one good way to structure data collection, analyses and reach conclusions (Mogoe *et al.*, 2016). Whilst the four general questions provide a suitable foundation for the framework, the Panel commented on the lack of quantifiable definitions of the terms used e.g. 'enough', 'comparable', 'reasonable', and 'costs'. The first three questions are primarily scientific, whereas the fourth - whether the cost for obtaining the sample/producing scientific information is 'reasonable' - while important, is vague upon how this will be evaluated either in terms of what would be considered as 'reasonable' or what will be included in the term 'cost'. For example, cost could include one, some or all of the following (this is an illustrative not an exhaustive list of possibilities), for both lethally and non-lethally obtained samples:

(a) the cost of collecting the sample alone;
(b) the cost of processing the sample in the laboratory;
(c) the cost of analysing the data as part of a broad analysis;
(d) the cost of individual components or an integration of all components in a multi-objective programme;
(e) the inclusion or exclusion of some or all costs associated with using existing material (e.g. vessels, equipment) and personnel (e.g. permanent staff versus contract staff, expertise and training); and
(f) the offset of costs against the sale of products (e.g. whale meat).

The Panel **agrees** that an expansion and clarification of the conceptual framework will help provide a way to evaluate Special Permit programmes that combine lethal and non-lethal sampling methods and optimise data collection methods in the light of objectives (and see Item 5.4.1).

BIOPSY SAMPLING

The Panel **agrees** with the proponents' conclusions that it is feasible to collect biopsy samples from all three species, minke, sei and Bryde's whales (question 1 of the framework) and that it is efficient to collect biopsy samples from at least sei (147 targeted) and Bryde's (117 targeted) whales (question 2). In that regard, it noted that the IWC-POWER cruises had already answered these questions for sei and Bryde's whales from a similar vessel to that used offshore by JARPN II.

The Panel also **agrees** that it is more difficult to biopsy sample common minke whales than the other species. However, the Panel **stresses** that insufficient effort (number of targeted animals and expertise) had been put into the feasibility study for common minke whales to allow a conclusion to be reached on the efficiency for that species based upon adequate data. Only 17 common minke whales had been targeted during 2014-16 although determining this efficiency had been a key component of the reprioritisation of JARPN II for those years. The additional information provided by the proponents in response to questions (Annex D) confirmed that:

(a) the advice from previous Panels that scientists with expertise in biopsy sampling common minke whales should be involved had not been followed;
(b) insufficient time had been allocated to the experiment for common minke whale biopsy sampling to determine if it was feasible; and
(c) the amount of effort dedicated to biopsy attempts for common minke whales was greatly exceeded by that effort used to catch common minke whales, making comparison of the two approaches infeasible.

These factors render any analysis of relative efficiency for this species from the existing data premature.

Given this, the Panel **recommends** that a properly designed experiment to assess the efficiency of biopsy sampling of common minke whales be undertaken (there is already sufficient detail on catch to render additional capture experiments unnecessary). This should incorporate at least:

(a) the use of the expected vessels in the programme (i.e. the small type whaling vessels);
(b) the use of vessels (that may be different) considered suitable by scientists already experienced with biopsy sampling this species;
(c) suitable levels of effort to allow a statistical comparison (effort for biopsy sampling should be measured or converted to the same effort used for examining catching efficiency);
(d) effort should be carried out in various environmental conditions (e.g. sea state, swell, visibility) up to the maximum conditions that would apply to whaling;
(e) advice and training from invited experienced minke whale biopsy samplers (e.g. Christian Ramp or Lars Kleivane); and
(f) analyses that provide a proper comparison of biopsy sampling and catching (including time to process samples under various variables such as experience of sampler, vessel, equipment, effort under similar conditions).

FAECAL SAMPLES

The Panel **agrees** that it is not feasible to use faecal samples to collect diet information for North Pacific minke, Bryde's and sei whales and further attempts are not worthwhile. In addition to the relatively low observations of faecal matter, another important reason for this decision is the issue that some parts of the faecal samples quickly sink and thus could easily be lost if not collected almost immediately; this will lead to bias of any resultant analyses.

STABLE ISOTOPES AND FATTY ACIDS

The Panel **welcomes** the analyses of the stable isotopes and fatty acids presented by the proponents. SC/J17/JR02rev1 provided a progress report on relevant recommendations from the JARPN II final review. Appendix 6 of that report addressed recommendation 23 and included a preliminary analysis of stable carbon and nitrogen isotopes ratios in the skin of sei and Bryde's whales and their prey. The Panel made several observations about the methods and results. Sample sizes of skin from sei and Bryde's whales were relatively large (n=180 and 50, respectively). However, sample sizes for prey were small (one prey item had a sample of 10 while the other seven prey items had samples sizes less than 5). There was considerable overlap in isotope ratios for most prey of sei whales, although copepods and krill appeared different from fish. There was no overlap in the ratios for prey of Bryde's whales. Although mixing models were used to estimate diet based on stable isotope ratios, a major flaw was that the results did not include estimates of uncertainty. This was especially problematic for sei whales for which stable isotopes suggested the diet was substantially different than analysis of stomach contents. As well-known and referred to in several previous Expert Panel reports (including that for the Icelandic Special Permit final reviews), stable isotopes and stomach contents provide information on diet at different time (and geographical) scales; comparisons must thus be undertaken carefully. Stable isotopes likely represent diet over the previous several months while stomach contents represent recent feeding bouts. Thus, one must include a careful consideration of uncertainty in any analyses before formal conclusions on differences in diet can be made. The Panel noted that the results from the mixing model of stable isotopes from whale skin suggest a much greater precision in diet than is justified given the overlap in the stable isotope ratios of many of the prey items.

The Panel **recommends** the proponents to review and apply the approach used by Iceland for analysis and comparisons of stable isotopes, fatty acids and stomach contents (IWC, 2014a). Icelandic researchers presented detailed results of prey species found in whale stomachs and acknowledged the biases associated with that type of study. For stable isotopes, they did not try to estimate the prey species, but rather compared the estimated trophic levels as measured in the whale's skin with prey found in the stomach. For fatty acids, they used a qualitative approach and analysed three different tissues, including inner and outer blubber. They concluded that the inner layer of blubber best represents diet, but there was considerable spatial and temporal variation in fatty acids.

The Expert Panel for the review of the Icelandic programme strongly recommended that 'integrated analyses including comparison of the information from each approach [i.e., stomach contents, stable isotopes, and fatty acids] (including consideration of uncertainty) be developed and submitted to the Scientific Committee.' The Panel **recommends** this approach also be used for the JARPN II investigation of foraging ecology.

NEXT-GENERATION-SEQUENCING (NGS)

The Panel **acknowledges** the attempt to use Next-Generation-Sequencing (NGS) techniques for prey determination in stomach/intestine and faecal samples. It however notes that the sensitivity of such an approach critically depends on the experimental setup prior to sequencing. Specifically, the proponents used universal primers developed for DNA barcoding, targeting amplicons of >500bp. This approach is suited for DNA of high quality. However, both in stomach/intestine and faeces, DNA of prey species can be expected to be highly degraded, such that the application of universal primers constitutes a strong filter, likely to detect only a limited fraction of the DNA of prey species that was present. The Panel therefore **recommends** that if additional studies with faecal samples are undertaken, application of techniques tailored to degraded DNA, i.e. amplification of small amplicons or hybrid capture, both methods well

established in faecal, environmental and ancient DNA research. Further, if the prey species to be expected are known beforehand, amplification/hybrid capture can be designed to specifically target these species, enhancing both specificity and sensitivity.

3.3.5 Overall conclusion and the Annex P process

The Panel noted that a full 'final' review of the JARPN II programme will be possible only when final analyses are completed, in line with the IWC SC-agreed timeframe for analyses, and a full consolidated report made available. Given the recurring difficulties with finalising reviews, in terms of Annex P process, the Panel **reiterates** some of the 2016 Panel recommendations, in particular that the Scientific Committee considers:

(a) including in Annex P a guideline relating to the minimum time after the field programme/the programme itself is completed that a final review can take place. This time must allow the completion of all analyses related to the programme's objectives. The Panel **agrees** that a full description of the fieldwork, collected samples and data and preliminary results are not to be considered sufficient to call a final review.
(b) to consider a mechanism for proponents to provide a short biennial update on progress with recommendations. Given the biennial cycle of the Commission, the Scientific Committee needs to be informed about progress only in years when the Commission meet.
(c) develop a mechanism to allow for the completion of Expert Panel reviews if a Panel states that its review is incomplete until full further information/analyses is provided/concluded.

4. REVIEW OF THE RESEARCH PROGRAMME PROPOSAL

4.1 Objectives of the proposal

This section evaluates the various primary, secondary and ancillary objectives of the proposal in terms of their 'in principle' contribution to the conservation and management of whale stocks and of other living resources. It does not consider whether the proposed research is feasible, whether the sample sizes are sufficient to address the objectives, and the relative benefits of the additional samples proposed to be collected during NEWREP-NP. These aspects are discussed under Item 4.2. Most of the discussion focussed on the Secondary Objectives - the Panel **agrees** that the broad primary objectives are important to the conservation and management of whales.

4.1.1 Proponents overview

The NEWREP-NP has the following Primary and Secondary Objectives (details in sections 2.1 and 2.2 of SC/J17/JR01):

Primary Objective I: Contribution to optimizing the establishment of a sustainable catch limit for common minke whales in the coastal waters of Japan.

Secondary Objectives
I (i): Investigate the spatial and temporal occurrence of J stock minke whales around Japan, by sex, age and reproductive status.
I (ii): Estimate the abundance of the J and O stocks in coastal waters of Japan.
I (iii): Verify that there is no structure in the O stock common minke whale in the Pacific side of Japan.
I (iv): Improve RMP trials by incorporating age data in their conditioning.
I (v): Investigation of the influence of regime shift on whale stocks.

The proponents consider that it is difficult to reconcile the results of the 2013 RMP *Implementation Review* for western North Pacific common minke whales with the empirical observations from the field. For example, the average catch under the New Management Procedure (NMP) in 1978-1987 was 340 animals but no sign of decreasing CPUE under this level of catches was observed. On the other hand, no drop in the J stock bycatch under constant effort in Japan has been observed and the J/O stock proportion has increased over the past 30 years on the Pacific side of Japan. The wide discrepancy between the empirical evidence from the field and the results of the 2013 *Implementation Reviews* suggests problems with the interpretation of data and key assumptions used in the population assessment under the RMP *Implementation Review*. Some of the questions which research needs to address are the following: (a) Is the J stock heavily depleted? (b) Is there an Ow stock on the Pacific side of Japan? (c) Were the abundance estimates of O and J stocks sufficient and reliable? (d) Was sufficient use made of biological (e.g. age) data during the conditioning? (e) What is the effect of the major environmental change (e.g. regime shift) on the distribution/abundance of common minke whale?

NEWREP-NP will attempt to respond to these questions under the five Secondary Objectives listed above. Response to the questions above will assist and improve the next RMP *Implementation Review* to be conducted by the IWC SC starting probably in 2018 or 2019, particularly for its work of developing and conditioning of trials.

The key information requiring lethal sampling is the age of the animals, which is essential for Secondary Objective I (iv). The intent under this objective is to determine whether and how well, using the SCAA methodology to analyse the future age data generated, it is possible to detect changes in recruitment (strictly in the number of recruits per adult female) and other biological parameters.

Primary Objective II: Contribution to the RMP/*IST* for North Pacific sei whale.

Secondary Objectives
II (i): Abundnace estimates for North Pacific sei whale taking account of additional variance.
II (ii): Estimation of biological and ecological parameters in North Pacific sei whales for RMP *Implementation*.
II (iii): Additional anayses on stock structure in North Pacfici sei whale for RMP *Implementation*.
II (iv): Specification of RMP *IST*s for North Pacific sei whale.
II (v): Investigation of the influence of regime shift on whale stocks.

No RMP *Implementation* has been conducted previously for North Pacific sei whale by the IWC SC. Considerable information on stock structure and abundance has been accumulated in recent years from JARPN II surveys as well as from IWC POWER. The idea under this primary objective is that the data collected so far, in addition to biological (e.g. age data) to be collected under the NEWREP-NP, will be used as input information for the current in-depth assessment, as well as for future RMP *Implementation* to be conducted by the IWC SC, including the *pre-Implementation assessment*. In particular, the use of age data in the conditioning of trials has the potential to improve the *Implementation*.

The research needs under this primary objective are the following: (a) Confirm the existence of a single pelagic stock; (b) Get new series of abundance estimate and its precision; (c) Estimate biological parameters such as natural mortality; (d) Use of biological data (e.g. age) during the conditioning of trials; and (e) Investigate the regime shift, and its implication for management.

NEWREP-NP will address these research needs under the five Secondary Objectives listed above. By doing this, NEWREP-NP will assist and improve the current in-depth assessment, future pre-implementation assessment and RMP *Implementation*.

The key information requiring lethal sampling is the age of the animals, which is essential for Secondary Objective II (ii). As in the case of common minke whale, the intent under this objective is to determine whether and how well, using the SCAA methodology to analyse the future age data generated, it is possible to detect changes in recruitment (strictly in the number of recruits per adult female) and other biological parameters such as natural mortality.

Ancillary Objective I: Examination of the effects of pollutants on whale stocks.

In 1980, the Special Scientific Committee Working Group on Management Procedures identified that 'Management measures should take into account the effect on whale stocks of environmental changes due either to natural causes or to human activities' as one of the principles for whale management.

In response to this suggestion, the JARPN II conducted environmental studies under one of its objectives ('Monitoring environmental pollutants in cetaceans and the marine ecosystem'). It was observed that PCB levels in common minke whales and total mercury (Hg) levels in common minke, Bryde's and sei whales, did not change during the research period, and were sufficiently under their thresholds in other whale species. It was suggested that the adverse effects of pollutants such as PCB and total Hg to whale health could be low in the area. On the other hand, some areas for further research were identified: (i) examination of possible adverse effects of pollutants with adjustment for confounding factors such as nutritional condition and age; (ii) species differences in sensitivity and response to pollutants; and (iii) investigate adverse effects of novel compounds. Research under these items will be conducted under this ancillary objective.

Ancillary Objective II: Study of distribution, movement and stock structure of large whales with particular emphasis on blue and North Pacific right whales.

JARPN and JARPN II were useful platforms for the collection of biopsy and photo-id data from large whales, included the depleted North Pacific right whale. NEWREP-NP also will be a platform for further collection of those kinds of data, particularly for blue and right whales. For blue whales the IWC SC recommended the analysis of biopsy samples from the central and western North Pacific for comparison with genetic data from the eastern North Pacific population. NEWREP-NP will contribute with additional biopsy and photo-id data for such purpose.

The IWC SC has welcomed the research on distribution, movement and stock structure of North Pacific right whales. The only genetic study on stock structure was based on samples collected in the eastern North Pacific. The available biopsy samples from JARPN II and those to be obtained by NEWREP-NP will allow the genetic comparison between eastern and western North Pacific right whales.

In conclusion, the proponents consider that Primary, Secondary and Ancillary Objectives above are important for the improvement of the conservation and management of whale stocks for the following reasons (see details in section 2.5 of SC/J17/JR01):

(a) Collection and analyses (following guidelines and recommendations from the IWC SC) of relevant data and samples (abundance, stock structure, and biological parameters) will improve the application of the RMP to the western North Pacific common minke and North Pacific sei whales.
(b) Those data, samples and analyses will contribute to the next *Implementation Review* in the case of the western North Pacific common minke whale, and the completion of an in-depth assessment and the carrying out of the pre-implementation assessment and RMP *Implementation* in the case of sei whale.
(c) Information on stock structure (biopsy) and abundance trends (sighting surveys) in large baleen whales, including the North Pacific right and blue whales, will contribute to understanding of the patterns of recovery of those whales after past commercial whaling. These works have been encouraged and recommended by the IWC SC.
(d) Research on the health of whales is directly related to whale conservation purposes, and studies in this field have been recommended by the IWC SC.

The proponents consider that Primary, Secondary and Ancillary Objectives above are important for the conservation and management of other living marine resources or the ecosystem of which the whale stocks are an integral part for the following reasons (see details in section 2.5 of SC/J17/JR01):

(a) under the Secondary Objective on regime shift, NEWREP-NP will contribute to the understanding of the interaction between whales and several components of the ecosystem, of which they are part;
(b) research on regime shifts will contribute to better understanding of the dynamics of fish resources and in turn improve their management; and
(c) new ecological data from NEWREP-NP will contribute to the effort to develop ecosystem models by JARPN II researchers and other organizations.

The proponents consider that Primary, Secondary and Ancillary Objectives above are important *for testing of hypotheses not directly related to the management of living resources* for the following reasons (see details in section 2.5 of SC/J17/JR01):

(a) information will be provided to characterize the oceanographic structure and dynamics of the research area;
(b) long-term oceanographic data will provide insight into whether or not environmental changes are occurring in the research area, particularly in the context of global warming.

NEWREP-NP will contribute information about the effects of marine debris on cetaceans.

4.1.2 Importance of stated objectives from a scientific perspective and for the purposes of conservation and management of whale stocks

4.1.2.1 CONTRIBUTION TO PAST RECOMMENDATIONS OF THE SCIENTIFIC COMMITTEE

Recent recommendations and research needs identified by the IWC Scientific Committee relevant to Secondary Objectives of the NEWREP-NP were summarised by the Proponents below.

Secondary Objective I (i): Investigate the spatial and temporal occurrence of J stock common minke whales around Japan, by sex, age and reproductive status.

(a) 'There is still a lack of information on stock structure in sub-areas 10 and 11. This is very important to the in-depth assessment' (IWC, 2008b, p.198).
(b) Several recommendations listed in IWC (2010b) are relevant to this objective.
(c) 'In light of continued uncertainty about the best way to deal with purging of samples that do not demonstrate strong assignment to either the O or the J stock of common minke whales, the Committee suggests to the proponents that:
(d) including the results of analyses conducted on both purged (at various levels) and non-purged samples would be valuable in the future; and
(e) further exploration of the relationship between departures from Hardy-Weinberg equilibrium and FST values for individual microsatellite loci be conducted with the expanded dataset, given that this method may be informative in evaluating hypotheses of mixing' (IWC, 2017b, p.47).

Secondary Objective I (ii): Estimate the abundance of the J and O stocks in coastal waters of Japan.

(a) 'The Committee therefore recommends that variance-covariance matrices be computed for the entire time-series of abundance estimates for sub-areas 7CS, 7CN, 8, and 9' (IWC, 2013b, p.10).

(b) 'The Committee strongly recommends that the Government of the Russian Federation give permission for the survey to take place in its EEZ in the Sea of Okhotsk throughout sub-area 12, given the importance of abundance estimates for sub-area 12 to the understanding of the status of common minke whales in the western North Pacific' (IWC, 2013b, p.15).
(c) 'The Committee recommends continued development of appropriate confidence intervals for *g*(0) be developed (e.g. using resampling approaches). This information will be of value in the expected 2018 *Implementation Review* of western North Pacific common minke whales, particularly in the context of also estimating additional variance' (IWC, 2017b, p.13).
(d) 'Compare results from the design-based estimates of abundance with those of model-based estimates to potentially address problems of unequal sampling coverage between surveys and to potentially account for additional sources or causes of variability' (IWC, 2017b, p.87).
(e) 'Explore methods to account for sampling differences between areas and years to obtain measures of short-and long-term variation and trends and estimates the extent of additional variance due to changes over time in spatial distribution (essential for modelling efforts, for example, in food consumption models and ecosystem models)' (IWC, 2017b, p.87).

Secondary Objective I (iii): Verify that there is no structure in the O stock common minke whale in the Pacific side of Japan.

(a) Several recommendations listed in IWC (2010b) are relevant to this objective.
(b) 'In order to be able to evaluate the preliminary analysis presented, the Committee recommends that a paper to examine the spatial distribution of close kin in North Pacific minke whales be submitted by the proponents for review at next year's meeting. In the interest of providing advice to the proponents that might be useful as this analysis moves forward, the Committee:
(c) emphasises the importance of evaluating the potential for false positive and false negative detections of parent offspring pairs (Tiedemann *et al.*, 2014);
(d) encourages the authors to explore different approaches (e.g., software) to conduct kinship-based analyses; and
(e) recommends that the samples be genotyped at additional loci (microsatellites or SNPs) to validate the putative parent offspring pairs that were identified' (IWC, 2017b, p.47).

Secondary Objective I (iv): Improve RMP trials by incorporating age data in their conditioning.

(a) 'Thus, if the *Implementation Simulation Trials* for the western North Pacific minke whales are to be revised in the future, the age data should be included in the conditioning process' (IWC, 2017a, p.542; 2017b).

Secondary Objective I (v): Investigation of the influence of regime shifts on whale stocks.

(a) 'Oceanographic monitoring is required to compare with prey species distribution and abundance in the new 'decadal regime'' (IWC, 2017b, p.87).
(b) 'Explore methods to account for sampling differences between areas and years to obtain measures of short-and long-term variation and trends and estimates the extent of additional variance due to changes over time in spatial distribution (essential for modelling efforts, for example, in food consumption models and ecosystem models)' (IWC, 2017b, p.87).
(c) 'In the medium-term, the Panel recommends further oceanographic monitoring to compare with prey species distribution and abundance in the new regime' (IWC, 2017a, p.548).

Secondary Objective II (i): Abundance estimates for North Pacific sei whale taking account of additional variance.

(a) 'The Committee looks forward to receiving consolidated analyses of results from a number of recent and past surveys on North Pacific sei whales at next year's meeting' (IWC, 2017b, p.36).
(b) 'Explore methods to account for sampling differences between areas and years to obtain measures of short-and long-term variation and trends and estimates the extent of additional variance due to changes over time in spatial distribution (essential for modelling efforts, for example, in food consumption models and ecosystem models)' (IWC, 2017b, p.87).
(c) 'Compare results from the design-based estimates of abundance with those of model-based estimates to potentially address problems of unequal sampling coverage between surveys and to potentially account for additional sources or causes of variability' (IWC, 2017b, p.87).

Secondary Objective II (ii): Estimation of biological and ecological parameters in North Pacific sei whales for RMP *Implementation*.

(a) 'The Committee recommends the work plan in Appendix 5, Annex G….' which stated that 'Historical age and reproductive data from commercial whaling in the eastern and western North Pacific should be recompiled and presented, so that comparisons with results from modern catches can be made when the latter are available' (IWC, 2008a, p.50).

Secondary Objective II (iii): Additional analyses on stock structure in North Pacific sei whale for RMP *Implementation*.

(a) 'In the case of North Pacific common minke, Bryde's and sei whales, as with several other baleen whale populations assessed by the Committee, the lack of samples from breeding areas makes discriminating between stock structure hypotheses difficult. All of the analysed samples were collected in areas used by feeding and/or migrating whales, and thus could represent a mixture of animals from different breeding stocks. Thus, in addition to longstanding advice to try to locate breeding grounds, the Committee emphasises the importance of using methods that do not require a priori stratification of samples (e.g. DAPC, PCA) when analysing these datasets, while noting that the power of such methods to detect weak levels of differentiation needs to be assessed' (IWC, 2017b, p.46).
(b) 'The Panel has developed a number of recommendations….' 'The presence of multiple stocks within sample partition should be assessed (employing, e.g. STRUCTURE and DAPC) for Bryde's and sei whales' (IWC, 2017a, p.543; 2017b).

Secondary Objective II (iv): Specification of RMP *IST*s for North Pacific sei whale.

(a) 'Thus, if the *Implementation Simulation Trials* for the western North Pacific minke whales are to be revised in the future, the age data should be included in the conditioning process' (IWC, 2017a, p.542; 2017b) (also relevant for sei whales).

Secondary Objective II (v): Investigation of the influence of regime shift on whale stocks.

(a) Same as I (v) above.

The Panel noted these recommendations and **agrees** that the objectives of the proposal are relevant to many Scientific Committee recommendations. In doing so, it notes that a number of the JARPN II final review recommendations concerned improved or new analyses of existing data rather than the collection of new data.

4.1.2.2 CONTRIBUTION TO THE COMPLETION OF THE COMPREHENSIVE ASSESSMENT OR IN PROGRESS OR FUTURE IN-DEPTH ASSESSMENTS

The Panel noted that as written, Primary Objective II relates to providing a 'Contribution to the RMP/*IST*' for North

Pacific sei whales and thus should be discussed under Item 4.1.2.3. However, to date there has been no request for the Scientific Committee to undertake an *Implementation* for this species/region, which in any event could only occur after the completion of a *pre-Implementation assessment* and would require approval by the Commission (see Fig. 2). Rather, the Scientific Committee is currently undertaking an in-depth assessment of North Pacific sei whales. Once the in-depth assessment is completed it could form the basis for a *pre-Implementation assessment* and ultimately an *Implementation*. Therefore, the Panel's views of Primary Objective II are provided under this Agenda Item and references as to any possible future *Implementation* for North Pacific sei whales in this report are phrased in terms of 'should one occur' rather than 'when one occurs'.

An in-depth assessment involves developing models that reflect hypotheses regarding stock structure, parameterized using biological parameters such as MSY rate, natural mortality rate, pregnancy rates, and the age-at-maturity and fitted to available data, such as estimates of abundance, mark-recapture data and age-composition information.

Secondary Objective II(i) – Abundance estimates taking account of additional variance. NEWREP-NP will provide two estimates of abundance for sei whales west of 170°E over the 12-year duration of the programme. These estimates, in conjunction with estimates for other parts of the North Pacific (e.g. from IWC-POWER surveys), will provide important information for estimating parameters of population models for North Pacific sei whales. Information on abundance is always important for conservation and management, but the contribution to the present in-depth assessment will depend on how long it takes to complete. Should an *Implementation* occur, then abundance is a key parameter and more abundance estimates are always better (the RMP is a feedback procedure). The additional contribution of new surveys depends on their precision (which will include sampling error as well as additional variation) and the current number and quality of abundance estimates.

Secondary Objective II(ii) – Estimation of biological and ecological parameters. The data currently available could allow parameters such as natural mortality and fishery selectivity to be estimated; the potential value of information from additional samples is discussed under Item 4.2. Issues related to the time scale above (with respect to the completion of the in-depth assessment and the potential for a future *Implementation*) for abundance estimates are also relevant for this Secondary Objective. Estimation of these parameters would improve understanding of the population dynamics of North Pacific sei whales, but it is currently unclear how precise and with what bias the estimates of these biological parameters will have. However, the key 'biological' parameter is the MSY rate, which the proponents do not plan to estimate. The proponents aim to address this Secondary Objective using biological data (related to age, sex and reproductive class) collected using lethal means as well data such as survey estimates of abundance.

Secondary Objective II(iii) – Additional analyses on stock structure. Stock structure is integral to any in-depth assessment. The Panel noted that NEWREP-NP is focused on the pelagic region of the North Pacific, which the Scientific Committee has agreed probably contains only a single stock (IWC, 2016b) based upon the existing data and analyses. Thus, the Panel **agrees** that the additional value new information might provide to the in-depth assessment (or any potential future *Implementation*) is unclear (and see Item 4.2). The proponents aim to address this objective using a range of approaches, in part using data collected using lethal sampling.

Secondary II(iv) – Specification of ISTs. Should an *Implementation* to be conducted in the future, then formally specification (and coding) of *IST*s is the responsibility of the Scientific Committee. However, the Panel **agrees** that a 'strawman' set of specifications could assist the work of the Scientific Committee.

Secondary Objective II(v) – influence of regime shift. The Panel noted that the objective lacked a practical definition of 'regime shift' (and see Item 4.2 for feasibility discussions). In fact, the objective appears to relate to the impacts of environmental variability, and the Panel **agrees** that this terminology is more appropriate. The Panel **agrees** that analysis of cetacean biological/physiological responses (e.g. blubber lipids, body condition, etc.) to 'environmental variability' is worthy of investigation. Such analyses would contribute to the basic understanding of responses of cetaceans to environmental factors (George *et al.*, 2015; Harwood *et al.*, 2015; Schick *et al.*, 2013). However, the Panel also **agrees** that this sub-objective would be better treated as an ancillary objective in that it is unlikely to make a direct contribution to the in-depth assessment or even an *Implementation* within a reasonable timeframe. This is partially due to enormous difficulties identifying more than one regime shift during NEWREP-NP, as well as because simulation trials have been conducted to examine the robustness of the *Catch Limit Algorithm* to regime shifts. The Panel notes that analysis of cetacean biological/physiological responses (e.g. blubber lipids, body condition, etc.) to 'environmental variability' as an ancillary objective would contribute to the basic understanding of responses of cetaceans to environmental factors (George *et al.*, 2015; Harwood *et al.*, 2015; Schick *et al.*, 2013).

In conclusion, the Panel **agrees** that:

(a) Secondary Objective II(i) could contribute substantially to the in-depth assessment (but note the time-scale issue) and a possible future RMP *Implementation,* should one occur;
(b) Secondary Objective II(ii) could contribute to the in-depth assessment (but note the time-scale issue) and a possible future RMP *Implementation,* should one occur - however, the parameters that are the focus of this Secondary Objective are not the most important in terms of management;
(c) Secondary Objective II(iii) could contribute to a possible future RMP *Implementation,* should one occur but whilst stock structure is an extremely important issue, the extent of the contribution of the expected new information is unclear;
(d) Secondary Objective II(iv) could contribute to a possible future RMP *Implementation* should one occur; and
(e) Secondary Objective II(v) should be considered an ancillary objective.

4.1.2.3 CONTRIBUTION TO *IMPLEMENTATIONS* OR *IMPLEMENTATION REVIEWS* OF THE RMP OR AWMP

The Panel noted that the *Implementation Review* for common minke whales in the western North Pacific completed in 2013 was based on 23 sub-areas, three primary stock structure hypotheses and explored the performance of 11 RMP variants (IWC, 2014c). The next *Implementation Review* is due to start in 2018 and will incorporate data and analyses from the JARPN II programme. Priority should

be given to completion of all of the recommendations from the Review Panel and the Scientific Committee. However, the Panel **agrees** that any outcomes of NEWREP-NP are most likely to feed into the *Implementation Review* that is scheduled to start in 2024 and that this implies that sufficient priority and resources must be put into completed analyses being ready by the proposed mid-term review. The results of the 2013 *Implementation Review* indicated that the two key components influencing the results were: (a) stock structure; and (b) abundance estimates. Stock structure was a key determinant of which RMP variants were considered to be 'acceptable without research', 'potentially acceptable with research' and 'unacceptable'. Abundance estimates also affect this as well as influencing acceptable removal levels. Thus, the Panel **agrees** that the objective to refine stock structure hypotheses, if achieved, can have an important and substantial impact on the conservation and management of common minke whales in the western North Pacific – the extent to which this requires additional samples rather than improved analyses of existing samples and data for the Secondary Objectives is discussed elsewhere in this report (e.g. see Item 4.1.5.2).

Secondary Objective I(i) – Investigate the spatial and temporal occurrence of J-stock common minke whales around Japan by sex, age and reproductive status. The results of trials depend on the mixing proportions for J-stock minke whales. Increasing knowledge of mixing proportions for some sub-areas (e.g. sub-area 11) and months could substantially reduce uncertainty and also potentially help to assign probabilities to stock structure hypotheses. The proponents aim to address this objective using a range of approaches, including data collected using lethal sampling.

Secondary Objective I(ii) – Estimate the abundance of the J- and O-stock stocks in the coastal waters of Japan. The availability of estimates of abundance by stock would enhance the ability to condition the operating models on which trials are based. The proponents aim to address this objective using a range of approaches, including data collected using lethal sampling.

Secondary Objective I(iii) – Verify that there is no structure in the O-stock common minke whales off the east coast of Japan. Refining stock structure hypotheses and particularly whether or not there are two 'O-stocks' is the most influential factor in terms of which RMP variants are 'acceptable without research' and thus extremely valuable. The Panel **advises** that this Secondary Objective be reworded as 'Investigate whether there is structure in the O-stock common minke whales off the east coast of Japan', as that better reflects the work to be conducted under this Secondary Objective and does not imply a pre-determined outcome. The proponents aim to address this objective using a range of approaches, including data collected using lethal sampling.

Secondary Objective I(iv) – Improve RMP trials by incorporating age data in their conditioning. There is no requirement within the RMP process to include age data (or any biological data) when conditioning trials, but doing so could improve estimates of selectivity and biological parameters such as natural mortality rate. In principle, inclusion of age-composition data in the conditioning could indicate that some stock structure hypotheses are implausible. Reduction of the number of stock structure hypotheses could reduce the disagreements over which RMP variants can be implemented for the western North Pacific common minke whales. Inclusion of age data in the conditioning is unlikely to reduce uncertainty regarding MSYR, to which trial results are very sensitive. The proponents aim to address this objective using age data collected using lethal sampling.

Secondary Objective I(v) – influence of regime shift. For the reasons provided above for sei whales, the Panel **agrees** that this sub-objective as stated would be better treated as an ancillary objective - it is unlikely to make a direct contribution to future *Implementation Reviews* within a reasonable timeframe, if at all.

In conclusion, whilst noting the proponents' additional information presented in Annex D, the Panel **agrees** that:

(a) Secondary Objectives I(i), I(ii) and I(iii) all address important aspects related to stock structure of common minke whales in the western North Pacific and would be of importance in future *Implementation Reviews*. The extent to which this requires additional samples rather than improved analyses of existing data for the Secondary Objectives is discussed elsewhere in this report (see Item 4.2);
(b) Secondary Objective I(iv) would enhance the way trials are conditioned, but would not likely have the same magnitude of impact as Secondary Objectives I(i), I(ii), and I(iii); and
(c) Secondary Objective I(v) should be considered ancillary as it is unlikely to make a direct contribution to future *Implementation Reviews* within a reasonable timeframe, if at all.

4.1.2.4 CONTRIBUTION TO IMPROVED UNDERSTANDING OF OTHER PRIORITY ISSUES AS IDENTIFIED IN THE SCIENTIFIC RULES OF PROCEDURE OR IN ITS REPORTS.

The Proponents stated that Ancillary Objective I (Examination of the effects of pollutants on whale stocks) will contribute to improved understanding of the 'Effect of environmental change on cetaceans' that is identified as one of the 'specific topics of current concern' in the Scientific Committee Rules of Procedure.

The Panel **agrees** that this is the case.

The Panel **welcomes** the proposed studies of other large whales with particular focus on blue and North Pacific right whales under Ancillary Objective II and **agrees** that this is a contribution to the conservation and management of these species, even though this is considered an ancillary objective of the NEWREP-NP programme. The two focus species are considered a high priority to the Scientific Committee (IWC, 2011).

4.1.2.5 CONTRIBUTION TO RECOMMENDATIONS OF OTHER INTERGOVERNMENTAL ORGANISATIONS

The Proponents stated that NEWREP-NP is designed mainly to contribute to conservation and management of whale stocks by the IWC. The Panel **concludes** that while the proposal does not necessarily refer to recommendations of other intergovernmental organisations, NEWREP-NP establishes provision and protocols to facilitate research collaboration with external scientists and organisations (and see Item 4.5).

4.1.3 Improvement in the conservation and management of other living resources or the ecosystem of which the whale stocks are an integral part

Some of the data that will be analysed as part of NEWREP-NP such as oceanographic data and data on prey species abundance may provide information pertinent to the conservation and management of species other than whales. However, the Panel **concludes** that none of the Primary and Secondary Objectives of NEWREP-NP pertain in a direct way to living resources other than whales or to the

ecosystem, although in principle the data could be used by other researchers addressing such matters if the data were made available.

4.1.4 Hypothesis testing not directly related to the management of living marine resources

The Panel **concludes** that all of the activities in NEWREP-NP are related to hypothesis testing directly linked to the management of living marine resources.

4.1.5 Evaluation of options in terms of lethal vs non-lethal methods in relation to the objectives

4.1.5.1 PROPONENTS' OVERVIEW

Lethal sampling is required mainly for Secondary Objectives I (i), I (iv) and II (ii) (sample/data for age determination, body length and sexual maturity); I (v) and II (v) (sample/data on prey composition/consumption and on nutritional condition indices such as blubber thickness, girth, fat weight and body weight). Lethal sampling is also required for Ancillary Objective I (sample/data on blubber, liver, muscle and plasma) (see details in section 3.1.1 of SC/J17/JR01). A detailed evaluation of the available information on feasibility of lethal and non-lethal techniques led the proponents to a conclusion that the sample/data listed above can only be obtained through lethal methods at this stage (see details in section 3.1.1 of SC/J17/JR01).

4.1.5.2 PANEL CONCLUSIONS

The discussion on the complexities and need for a proper evaluation of options for lethal and non-lethal techniques has already been discussed under Item 3.3.4. All recommendations and conclusions of that section are also relevant here. The proponents presented their evaluation of the use of non-lethal methods to address their objectives and concluded that certain data could only be obtained using lethal techniques (see Item 4.1.4.1). The Panel **agrees** that certain data types (e.g. age and body measurements) require lethal sampling and may in principle provide improved conservation and management but **also recommends** that a more thorough *quantitative* review of the contribution of those data types to the ability of the proponents to meet their primary objectives is warranted (and see Item 4.2 for a fuller evaluation of options in terms of lethal *vs* non-lethal methods in relation to the objectives). Government of Japan (2016) provide initial work to show modifying the *CLA* to use age data could improve the performance of the IWC's whale management procedure and similar work could be conducted for common minke whales in the western North Pacific. However, modification of the *CLA*, as it is applied to common minke whales in the western North Pacific is not proposed under NEWREP-NP.

Given the focus in Annex P in several places (e.g. sample sizes) on comparing lethal and non-lethal methods (and the general contribution this can make to many scientific studies related to the conservation and management of whale stocks), the Panel **recommend**s that any future Special Permit programme should include a specific Primary Objective to continually review new techniques as these become available in order to facilitate discussions of methods and samples sizes at milestones such as the mid-term reviews.

If available data do not allow for a full comparison of relevant lethal and non-lethal techniques of a proposal, a focussed pilot study to enable a full and proper evaluation of lethal *vs* present non-lethal methods integrated across objectives should be undertaken, prior to a full programme starting; where such data already exist then the desktop-study evaluation should be undertaken before the permit programme begins. Such evaluations could be undertaken in light of an expanded framework as recommended under Item 3.3.4 and must be properly designed to enable more effective reviews of sample sizes/methods during mid-term reviews.

Informative evaluations must include using analyses and/or simulations to evaluate the influence of the same or similar data obtained lethally and non-lethally on the objectives related to the management/conservation of the whale stock, and recognise that the data obtained using different methods, may be slightly different, and may have slightly different interpretations or provide different levels of precision.

4.2 Field and analytical methods to address stated objectives

This section evaluates the various primary, secondary and ancillary objectives in terms of their feasibility, whether the sample sizes are sufficient to address the objectives, and the benefits of the additional samples proposed to be collected during NEWREP-NP.

For Primary Objective I, the western North Pacific common minke whale will be the target species and the study areas will be: (i) the Sea of Japan side of Japan; (ii) north of Hokkaido (sub-area 11) and Pacific side of Japan (sub-areas 7-9). The Sea of Japan will be the main target area for dedicated sighting surveys for abundance estimate purposes. North of Hokkaido (sub-area 11) and Pacific side of Japan (sub-area 7-9) will be the main target area for non-lethal and lethal sampling. The research area will be surveyed between April and October, which is the migratory season of common minke whale around Japan.

For Primary Objective II, the North Pacific sei whale will be the target species. The study area will be the pelagic region of the North Pacific delimited approximately by the Japanese DNA survey (30°N-50°N; 143°E-140°W), which is occupied by a single stock of sei whale. Lethal sampling of sei whale will be conducted mainly in the western part. This research area will be surveyed between April and October.

4.2.1 Secondary Objective I(i): Investigate the spatial and temporal occurrence of J stock common minke whales around Japan, by sex, age and reproductive status (Annex 7 of SC/J17/JR01)

Age: The proponents intend to determine the age of captured whales using two methods: (1) counting growth layer groups (GLGs) accumulated in the earplugs; and (2) racemization of aspartic acid (AAR) in the eye lens. The former will be the primary ageing method and the Panel **reiterates** that the gelatinized extraction technique (Maeda *et al.*, 2013) is a substantial improvement on past methods (see discussion under Item 3.3.3). Both methods are well established in the literature (Masters *et al.*, 1977; Rosa *et al.*, 2013) and the Panel **agrees** that they are acceptable.

Sexual maturity: The proponents intend to determine the sexual maturity of females by the presence of *corpora* in the ovaries (for both species). This is a well-known and developed technique and the Panel **agrees** that it is appropriate and accurate technique. Both ovaries need to be examined in case ovulations favour one ovary. Additionally, the presence of *corpora lutea* suggests a pregnancy (even if an embryo/foetus is not found) and should be recorded. The Panel **recommends** that levels of progesterone in blubber and serum should be compared with sexual maturity and reproductive status of examined females. This comparison is valuable for assessing the efficacy of biopsy sampling for assessing reproductive status.

The proponents propose to determine the sexual maturity of males '*preliminarily on the research vessel, based on testis weight*'. The Panel **highlights** that this approach is only suitable if there is a clear distinction in testis mass between immature and mature males. Histological examination of testes of pubertal males is needed to confirm maturity,

e.g. by microscopically determining if there is sperm in the epididymis or if the seminiferous tubules exceed 100µm in diameter (Kato, 1986; O'Hara *et al.*, 2002).

Sightings surveys: The Panel notes that abundance estimates are important for several of the Secondary Objectives for both primary objectives. The comments in this section are usually generally applicable, but include some specific comments by objective. The Panel **agrees** that line-transect surveys are an appropriate and well-established method of obtaining estimates of abundance provided that the correct design and implementation is undertaken. The proposal provided relatively few details on line transect survey design and data collection protocols as they proposed to use standard data collection and analysis methods in accordance with the Scientific Committee requirements and guidelines (IWC, 2012). As such, the details will be discussed and approved by the Scientific Committee before the survey is conducted and IWC oversight will be assigned. In the light of this, the Panel **concludes** that appropriate methods will be applied by the proponents.

However, the Panel noted that there are several issues unique to this proposed programme for which it either requested additional information or highlighted that would need to be addressed before the programme starts. For example, the Panel requested (and received – see Annex D) details on the survey strategy of how to cover this vast area in multiple years using multiple platforms and potentially multiple data collection methods. The Panel was informed that sub-Areas 6E, 10E, 11, 7CS and 7CN were proposed to be covered twice in each half of the programme (each half is six years long), and that offshore sub-Areas (7WR, 7E, 8, and 9) will only be covered once in each half of the programme. The Panel **welcomes** the idea of covering all areas at least twice. It notes that for common minke whales, the proponents suggest addressing additional variance following the approach of Kitakado *et al.* (2012). Design- and model-based estimators will be considered. A similar approach is suggested with respect to North Pacific sei whales (see Annex 14 of SC/F17/JR01).

The Panel also highlighted several other issues that must be considered when designing line transect surveys that are expected to provide abundance information to address multiple objectives (overall stock abundance estimate, the spatial-temporal abundance patterns within each sub-area, the influence of 'regime shifts). The Panel **recommends** that these issues related to survey design, data collection protocols and priorities, data analyses and coordination are included in the plans to be submitted to the Scientific Committee for approval before the surveys start. The main additional issues that should be covered in the proposals for surveys submitted to the Scientific Committee are summarised below.

(a) **Evaluation of past surveys' analytical difficulties**. These new surveys provide an important opportunity to evaluate and potentially add/modify the variables or values of variables that are collected. Evaluating the shortcomings of previous surveys (for example, sample size issues and the amount of effort expended, problems that arose in analyses of past data) could suggest ways to supplement the future surveys. For example, during the spatial abundance pre-meeting in Bled in May 2017, issues may become apparent that indicate that small modifications to the data collection scheme could greatly increase the ease of analysing future data.

(b) **Appropriate temporal stratification** of the surveys (e.g. comparability with past surveys, which months are the most appropriate to survey in each sub-area to document potential shifts, account for the fact that these waters include a known common minke whale migratory path).

(c) **Appropriate direction of travel** for the survey vessel(s) and direction of tracklines to account for the fact that the animals are migrating.

(d) **Use of independent observer (IO) mode,** especially in the offshore waters where the weather and sea state conditions are poorer, which means the estimate of $g(0)$ will be lower and thus the IO mode will be most important to avoid negatively biased abundance estimates.

(e) **Use of passive independent observer mode** with abeam closing to get the benefits of estimating $g(0)$ and also improving the precision of the group sizes.

(f) **Development of protocols/priorities for biopsy-related activities** since both activities will be competing for survey time.

(g) **Evaluation of additional variance analysis and spatial model methods** to determine which is preferred or whether both methods are investigated.

(h) **'Regime shift'-related aspects**, also a Secondary Objective, require that consideration should be given to whether sampling of prey is possible during the line transect surveys - obtaining simultaneously collected prey and whale data seems ideal, however logistically challenging. Possible approaches include running an EK60 at the same time the visual sighting surveys are conducted from the sighting vessel, net sampling from the sighting vessels during non-visual survey times (such as during the night or poor weather), or coordinating the line transect surveys (Annexes 7 and 14 of SC/F17/JR01) with the trawling and acoustic surveys conducted on other vessels (Annex 11 of SC/F17/JR01).

These survey-related conclusions and recommendations also apply to Secondary Objective II(i): Abundance estimates for North Pacific sei whales taking account of the additional variance (Annex 14 of SC/J17/JR01).

4.2.2 Secondary Objective I(ii) Estimate the abundance of the J and O stocks in coastal waters of Japan (Annex 8 of SC/J17/JR01)

Comments on line-transect sighting surveys are provided under Item 4.2.1. However, assigning individuals to 'stock' with abundance estimates is a key, but difficult part of the *Implementation Review* exercise (see the mixing matrix discussions of previous *Implementation Reviews*). The proponents refer to undertaking further biopsy sampling experiments for common minke whales; this is especially important in terms of mixing of stocks during surveys; the Panel refers to its discussion under Items 3.3.4 and 4.1.4.

In addition, the proponents are suggesting trying to generate an additional estimate of abundance employing so-called 'gametic' mark-recapture of males that sired the foetus in sampled mother-foetus pairs. Gametic mark-recapture has been applied to large whales before, such as Caledonian and North Atlantic humpback whales (Garrigue *et al.*, 2004; Nielsen *et al.*, 2001). The Panel **welcomes** consideration of new techniques but in this case it **cautions** that while it is in principle possible to estimate the abundance of males by this approach, the precision of such estimates is generally low

even with large sample sizes (Nielsen *et al.*, 2001; Palsboll *et al.*, 2005). The approach is also sensitive to migration in and out of the target population (Palsboll *et al.*, 2005).

4.2.3 Secondary Objective I(iii) Verify that there is no structure in the O stock common minke whale in the Pacific side of Japan (Annex 9 of SC/J17/JR01)

As noted above, the Panel **recommends** that this specific objective is rephrased in a manner that does not assume the result is already known.

The Panel notes that the proponents are intending to follow the kinship analysis approach used by Tiedemann *et al.* (2014) for common minke whales in the North Atlantic. Kinship analyses can detect genetic cohesion and is hence informative about stock structure. Conceptually, dispersal rates could be inferred from such data, but there has been so far no specific threshold dispersal rate defined above which a single stock hypothesis is adopted.

The Panel **welcomes** the proposal to implement SNP genotyping, which has multiple benefits in terms of number of loci and data sharing.

Whichever genetic approach is used, the Panel **concludes** that the additional samples NEWREP-NP intends to collect will add relatively little to the existing genetic data for common minke whale in the O-stock area. The main effort is planned to be directed towards sub-area 7 and is relatively low compared to the existing data. Consequently, the impact of the samples to be collected during NEWREP-NP is likely limited in terms of resolving current stock structure hypotheses compared to conducting additional work on existing samples (see Items 5.3.1 and 5.10).

As the Scientific Committee has previously noted, telemetry data can provide valuable information on movements and stock structure (especially with respect to the location of breeding grounds) although sample size issues can be a limiting factor. The Panel **welcomes** the information that the proponents are intending to undertake a feasibility study in conjunction with outside experts on common minke whales (and see Item 4.4.3.2).

4.2.4 Secondary Objective I(iv): Improve RMP trials by incorporating age data in their conditioning (Annex 10 of SC/J17/JR01)

Annexes 10 and 12 of SC/J17/JR01 outline the proponents proposed approach to address this Secondary Objective with a focus on a Statistical Catch-at-age (SCAA) method. The Panel **agrees** that SCAA is an appropriate basis for developing RMP trials and for including age data in conditioning (the JARPN II review had concluded that if age data are to be included *Implementation Simulation Trials*, this should be achieved through the conditioning process). Age data were considered in the recent North Atlantic fin whale *Implementation Review* (IWC, 2016a) and can be one source of information used to refine stock structure hypotheses. However, the Panel **reiterates** (as noted under Item 4.1.2.3) that few data from NEWREP-NP are likely to be available for the 2018 *Implementation Review*, although the existing age data could be used as part of the conditioning process if made available in time. The current (and likely future) trials will be multi-stock, which will mean that the trial specifications in Annex 12 of SC/F17/JR01 will need to be modified to include multi-stock and multi-area components and also modified to fit the other sources of data included in the current *Implementation Simulation Trials* such as J-O mixing rates.

4.2.5 Secondary Objective I(v): Investigation of the influence of regime shift on whale stocks (Annex 11 of SC/J17/JR01)

Under this Secondary Objective, the proponents aim to assess the effects of 'regime shifts' on the distribution and prey consumption of western North Pacific common minke whales through the analysis of the stomach contents of whales and changes in the environment encountered by whales. The Panel refers to its recommendation under Item 4.1.2.2 to replace the term 'regime shift' with 'major environmental change' and also the suggestion that this should become an ancillary objective.

Secondary Objective II(v) is the same, but for sei whales and proposes the same field and analytical methods. Therefore, the Panel discusses both species together in this section.

'Regime shifts' can be considered 'a relatively rapid change from one decadal-scale period of a persistent state to another decadal-scale period of persistent state' (King, 2005). It is unclear whether 12 years will be sufficiently long to document such a shift using the methods and effort levels proposed. The detection of a 'regime shift' requires several years to pass after the shift to allow differentiation of a 'regime shift' from interannual variation. One might expect one or at most two major environmental changes during the NEWREP-NP period and perhaps none. The Panel **concludes** that it would be more productive for the proponents to focus on the impacts of shorter-term (inter-annual) environmental variability on the distribution and prey consumption of the whales which may in the future allow examination of major environmental changes should they occur.

The proponents propose to address this Secondary Objective by monitoring changes in distribution of whales and their prey species and state that the objective under NEWREP-NP is not to detect a regime shift directly. The proponents do not, however, provide information or analysis of the power of the methods they propose to detect changes in either prey use or oceanographic conditions given present knowledge (including data collected during JARPN and JARPN II). However, these data may be of future use to others conducting retrospective analyses of prey habits or oceanographic conditions. In addition, it is not clear how the proponents or other future users of the data will be able to associate the responses of the whales regarding distribution and prey use to environmental change without documenting and quantifying both major environmental changes, and the responses of whales. To achieve their objective, the proponents will need to identify and quantify the timing and nature of the environmental change, and the responses of the whales, such that they can compare the environmental conditions before and after the environmental change as well as the distributions and prey habits of the whales before and after the change.

The *field methods* described for stomach sampling are standard and appropriate. Fixation of prey in 10% formalin and freezing is appropriate. It should be noted that freezing is increasingly the method of choice as an array of analyses can be conducted with archived samples (e.g. screening for HABS, microbiome analyses) if deemed necessary and as new techniques are derived.

Considering the total stomach volume of a sei whale can reach 1,000kg, the question of proper sub-sampling arises, particularly with mixed prey types. Care is required during sub-sampling to assure that the sample is representative when stomach volumes are large and prey diverse, the Panel **recommends** that the proponents specify how this is to be achieved in the field protocols.

The methods for collecting samples/data for condition indices are appropriate and include blubber weight blubber thickness, girth, body weight, and the (%) lipid content

of blubber. The Panel **recognises** the considerable work required to gather these data. The addition of '% lipid' measurements of the blubber reflects responsiveness to past recommendations (IWC, 2010a).

The Panel **agrees** that, while the basic field sampling of the captured whales appears standard and appropriate, the sensitivity of the biological metrics for detecting effects of an environmental 'regime shift' on the two species is not specified. Whether changes in metrics such as blubber volume, body weight, and % lipid (blubber) can be statistically detected depends on the degree of natural variation in these parameters and the strength/persistence of the putative ecosystem shift. However, the Panel acknowledges that such data can contribute to a better understanding of how whales respond to environmental change and of cetacean ecology generally (Lockyer, 1987).

Calculation of '*feeding period estimation*' and '*feeding habits, estimation of daily and seasonal prey consumption*' (Annex 7 of SC/F17/JR01, p.104) requires many assumptions such as estimates of standard metabolic rate as a function of body mass. Therefore, estimates of prey consumption for instance must be accompanied with appropriate variance estimates, as uncertainty is typically quite high in these kinds of estimates which require large extrapolations from individuals to population.

The Panel **agrees** that proponents clearly specify the *types* of data that they will use to document the responses of the whales to a major environmental change, but do not demonstrate that they will have adequate information to *detect* environmental changes in the various study regions. The plans for obtaining data on oceanographic conditions, by which we assume is meant climate data and physical oceanographic data, are not well specified. For example, Annex 11 of SC/F17/JR01 provides detailed methods for sampling fish prey in the Sanriku region, but there is apparently no sampling of fish prey planned for the Kushiro, Okhotsk and offshore regions. Additionally, there is apparently no plan to sample krill or copepods, even though these are potentially important prey.

The Panel **concludes** that, as stated this objective is unrealistic within the given timeframe. In any event, the present proposal does not provide sufficient information to demonstrate that the proponents will be able to meet this Secondary Objective. To demonstrate this feasibility, the Panel **recommends** that the proponents must specify more fully:

(a) quantitative criteria with respect to identifying [major] environmental change and potential responses by whales;
(b) the adequacy of the methods and effort to specify the distribution, seasonality, and precision of the environmental data, for the regions in which the whales being studied are feeding; and
(c) taking into account uncertainty, conduct a power analysis to determine the sample sizes/effort for the characterisation of the environment and whales (including distribution and prey use) needed to determine if there are changes before and after a major environmental change occurred, should one occur during the programme.

4.2.6 Secondary Objective II(i): Abundance estimates for North Pacific sei whales taking account of the additional variance (Annex 14 of SC/J17/JR01)

The Panel refers to its comments under Item 4.2.1 with respect to sightings surveys.

4.2.7 Secondary Objective II(ii): Estimation of biological and ecological parameters in North Pacific sei whales for RMP Implementation (Annex 15 of SC/J17/JR01)

The field and laboratory methods proposed for obtaining information on age, sexual maturity and reproductive status discussed elsewhere in this report (e.g. see Items 3.3.3, 4.2.1). The Panel **agrees** that these are adequate.

The proponents aim to estimate natural mortality and selectivity using an SCAA approach (Annexes 15 and 17 of SC/F17/JR01). However, the SCAA is based on the assumption of a single stock and time-invariant selectivity. However, unless the 5-stock hypothesis for the North Pacific as a whole (IWC, 2017b) is rejected as part of the in-depth assessment, any future *IST*s, will need to be based on a multi-stock, multi-area model, (including a single 'pelagic' stock) which will complicate the analysis. The Panel notes that there are considerable age-composition data already available for North Pacific sei whales (Fig. 2 of Annex 17 of SC/F17/JR01), which already provide some information on natural mortality and all the information on commercial selectivity. The results in Annex 17 of SC/F17/JR01 suggest that additional sampling will reduce the RMSE of the estimates of mortality, with the extent of improvement proportion to the number of years of sample (Fig. 5 of Annex 17 of SC/F17/JR01) but bias will remain. The estimation of natural mortality is related to the value assumed for MSYR, a key parameter, but the proponents are not planning to estimate MSYR thus any estimates of natural mortality will need to be consistent with the assumed value(s) for MSYR. The Panel **reiterates** that a primary determinant of the performance of RMP variants is MSYR rather than natural mortality.

4.2.8 Secondary Objective II(iii) Additional analyses on stock structure in North Pacific sei whale for RMP Implementation (Annex 16 of SC/J17/JR01)

The planned sampling effort is directed towards a single area which is already assumed in the ongoing in-depth assessment to comprise a single pelagic stock (notwithstanding discussions about whether or not there are a number of coastal stocks – the '5-stock' hypothesis referred to under Item 4.2.7). Thus, while the addition of new genetic samples may be valuable, the Panel **agrees** that it is unlikely to have a substantial impact on the outcome of the analysis of past samples with regards to stock structure in this area. The Panel noted the lack of a sampling effort in other putative North Pacific sei whale stocks where the stock structure remains unresolved. Accordingly, the Panel **agrees** that the proposed samples and genetic analyses will not add to further resolve current stock structure hypotheses *per se* for the entire North Pacific, but will naturally provide data which later may be employed towards the ocean-wide stock structure in the North Pacific.

The proponents also propose to undertake satellite tagging in collaboration with outside experts and the Panel **welcomes** this and refers to its comments under Item 4.4.3.2.

4.2.9 Secondary Objective II(iv): Specification of RMP ISTs for North Pacific sei whales

The proponents aim to base *Implementation Simulation Trials* on the SCAA approach. The Panel's comments regarding the timing and process with respect to any future *Implementation* are given under Item 4.1.2 and on the SCAA approach under Item 4.2.7.

4.2.10 Secondary Objective II(v): Investigation of the influence of regime shift on whale stocks (Annex 15 of SC/J17/JR01)

The Panel refers to its discussion under Item 4.2.5.

4.2.11 Ancillary Objective I: Examination of the effects of pollutants on whale stocks (Annex 18 of SC/J17/JR01)

This objective has three components, to examine: (i) the possible adverse effects of pollutants with adjustments for cofounding factors such as nutritional condition and age; (ii) species differences in sensitivity and response to pollutants; and (iii) the adverse effects of novel compounds. The aim is in line with several IWC Resolutions such as 2012-1 (IWC, 2013a), which 'requests the Scientific Committee to remain engaged in the evaluation of the available data on organic contaminants and heavy metals in some cetaceans as well as the effect of such contamination on the health of cetaceans and their reproduction'. The Panel **welcomes** the inclusion of pollution work as an ancillary objective and agrees that it is well specified – however, the three approaches do not address the effect of pollutants on whale *stocks* as the original proposal stated. They are aimed at identifying pollutant effects at the molecular, cellular and individual level. To tackle the objective, as currently stated, the proponents need to assess the effects at the population or stock level, for example using the approach developed under the IWC's Pollution 2000 initiative (Hall and Williams, 2015). This could be carried out for the major pollutant classes, PCBs and mercury, and using currently available data (as indicated by the Resolution) because studying the effects of pollutants was also an aim of the JARPN II research programme. However, during the Workshop the proponents clarified (see Annex D) that the objective is to monitor effects at the individual rather than the stock level.

The Panel **agrees** that the broad methods outlined in the research plan appear to be appropriate to address each of the research items, but there was a lack of detail about the specific methods.

The aim of research item (i) is to investigate relationships between pollutants and immune function, which has been addressed in many studies on marine mammals. The reference given in the proposal regarding the immune function assays to be used (Wayland *et al.*, 2002) relates to studies on birds, which are not relevant to mammalian systems. Mammalian immunotoxicologists have established the most sensitive assays to use, a combination of which is recommended due to the complexity of the immune system and the potential for compensatory effects of different arms (innate and acquired). The Panel **recommends** that any immune function assays used should be those already established for cetaceans (Schwacke *et al.*, 2012) so that the results are comparable to published studies. However, the main concern regarding this item is that the results of the JARPN II studies demonstrated that PCBs and mercury were at very low levels in these stocks, well below established no observable effect levels (NOELs). Thus, the likelihood that this study will result in any positive relationships between exposure and immune response is small, particularly as the existing data suggests very little variability in exposure levels, resulting in, at best, a negligible exposure gradient and thus no variation in pollutant concentration and immune response. In addition, following previous Expert Panel recommendations, the Panel **strongly reiterates** that all lipophilic compounds being measured must be reported on a lipid weight and not a wet weight basis.

Research item (ii) relates to the investigating the link between intracellular receptor signalling and pollutant exposure. The method referenced (Hirakawa *et al.*, 2011) uses a microarray to investigate the induction of various cytochrome P450 enzymes (e.g. CYP1A1 and CYP1A2), which is mediated through the aryl hydrocarbon receptor. However, this microarray was developed for seals rather than cetaceans so sequence differences in these enzymes (Teramitsu *et al.*, 2000) will almost certainly affect the accuracy of the results and the ability of the proponents to fulfil their goal. Given that the gene sequences for the CYP1A family for minke whales have been available for a long time (Niimi *et al.*, 2005; Teramitsu *et al.*, 2000) and that the genome for this species has been published (Yim *et al.*, 2014), the Panel **agrees** that other approaches, such as RNA-seq (i.e. a transcriptomic method), are more appropriate than the use of heterologous microarrays. The proponents clarified that it is in fact the hepatic oligo array available for minke whales (Niimi *et al.*, 2014) and used in the JARPN II studies that would again be used (along with additional 'omic approaches being developed by collaborators) in pursuit of this objective.

Research item (iii) relates to novel compound exposure and indicates that the levels of polybrominated diphenyl ethers (PBDEs) and other flame retardants would be quantified in blubber, prey and marine debris (presumably micro- and macro-plastics found in whale stomachs). In addition, the contaminant content of any plastic material collected would be conducted using a Fourier transform infrared spectroscopy (FTIRS) technique that identifies the presence of organic, polymeric, and in some cases, inorganic materials in samples. However, there is no indication of how these results would be related to 'adverse effects' as stated in the objective. The Panel, therefore, **recommends** an integration and combined analysis of the results obtained by all three research items (i.e. relating exposure to polychlorinated biphenyls, flame retardants and novel compounds from plastics to responses such as immune function and enzyme induction, including controlling for any effects of age (emphasizing the need to use the age estimates obtained from the earplugs rather than body length) and nutritional condition. This would require samples from the same individuals to be included in each of the three research items.

4.2.12 Ancillary objective II: Study of distribution, movement and stock structure of large whales with particular emphasis on blue and North Pacific right whales

The Panel **welcomes** the proposed studies of other large whales with particular focus on blue and North Pacific right whales. The two focus species are considered a high priority to the Scientific Committee (IWC, 2011). The Panel **agrees** that sightings, biopsy and photo-identification methods are appropriate. Biopsies of blue whales in the NEWREP-North Pacific study area (central and western North Pacific) are of particular importance so that the genetics of these animals can be compared to existing samples from the eastern North Pacific animals. This may assist in the North Pacific blue whale in-depth assessment. Biopsy and photo-identification studies of North Pacific right whales found in the NEWREP-NP study area will be very informative to assist in discovering more about this rare species.

The Panel **concludes** that the methods proposed are appropriate and **recommends** continued coordination with IWC-POWER to ensure consistent data collection and processing, as appropriate. The Panel also **recommends** information on these species are included in annual reports to the Scientific Committee to encourage collaboration with scientists involved with research on these two species.

4.3 Sampling design (coastal component in Annex 6; offshore component in Annexes 6 and 13 of SC/J17/JR01)

4.3.1 Lethal sampling

The Panel notes that the sampling designs for the inshore and offshore components of NEWREP-NP differ quite markedly, with the inshore component involving day trips

for catcher boats from land stations in Kushiro (sub-area 7CN), Ayukawa (sub-area 7CS) and Abashiri (sub-area 11). Annex 6 of SC/J17/JR01 outlines the general procedure for sampling in the inshore areas, which is similar to that for JARPN II and for which the JARPN II Review Panel made a number of recommendations for clarification and analyses (and see Table 1). The Panel **agrees** that there are several aspects of this procedure that make the design unusual for a scientific survey and will complicate and possibly compromise data analyses. In particular, the Panel **concludes** that:

(a) the design would lead to oversampling of the areas close to ports (the Panel was informed that an additional land-based station may be established in the northern Sanriku to better cover sub-areas 7CS and 7CN);
(b) the boats can search freely once they reach 30 n.miles from port if no whales have been encountered *en route* from port, which means the design is not fully specified in terms of the catches by the port-based boats; and
(c) the *Nisshin Maru* will conduct sampling if the number of common minke whales caught does not reach the target number, but no sampling plan for this contingency is provided.

The Panel **agrees** that the impact of non-random sampling of the inshore areas has different consequences for each Secondary Objective under primary objective I. In particular, the Panel **concludes** that it will substantially complicate achievement of Secondary Objective I(i), which investigates the spatial and temporal occurrence of J-stock animals around Japan by sex, age and reproductive state for which random sampling is ideal if not essential. In addition, the power to achieve Secondary Objective I(iii) depends on sample size in the inshore and offshore areas (see Item 4.2.4), but also how samples are collected within sub-areas 7CS (n=50), 7CN (50) and 11 (47). In terms of resolving stock structure from genetic analyses (traditional population genetic as well as kinship-based inference methods), the key issue is to obtain and include representative samples from all areas to be included in the assessment of stock structure. Whilst random sampling is not essential to include age data in an SCAA analysis, lack of random sampling will reduce statistical power to detect stock structure as well as it will necessitate estimation of selectivity parameters and hence to increased overdispersion of any resulting age data relative to the case of uniform (or near uniform) sampling by sex and age. Estimation of additional parameters and larger overdispersion will further reduce the power of the age data to detect trends in recruitment (which is already poor over the short- to medium-term; see Item 4.2.4). The Panel **recommends** that analyses be conducted, before the start of the programme, to assess the extent of loss in statistical power and precision due to the sampling strategy for the objectives related to common minke whales and the implications for meeting Secondary Objectives. The Panel also **recommends** that the experience/data gained from JARPN II should be used by the proponents to investigate (a)-(c) above.

The Panel noted that the offshore sampling design matches that on which JARPN II was based. The Panel **concludes** that the given sampling lines will not achieve uniform coverage of the research area and do not cover the whole distribution range of each whale species (Bando *et al.*, 2016). The unbalanced sample sizes in the offshore (27) and inshore (100) areas will complicate the estimation of the selectivity pattern for offshore common minke whales (if there is a single O-stock). It may lead to a dome-shaped selectivity, which will need to be accounted for in any SCAA analysis, at the cost of additional parameters and lower precision. The survey plan allows for the possibility of taking multiple animals from a school, which could impact the power of analyses related to diet and genetic structure owing to the possibility of pseudo-replication. Additionally, the rather small sample size offshore may reduce the likelihood of detecting the effects of a major environmental shift on both the diets and the distributions of common minke whales. The Panel **concludes** that Proponents must thoroughly consider these issues and provide further justification/modification to their current data collection plan.

During the Workshop, the proponents provided the Panel with the sampling strategy (samples by month, year, and sub-area). The Panel **welcomes** this information and **recommends** that it be included in the version of the proposal that is provided to the Scientific Committee. The Panel also **recommends** that tables of past samples in the same format as the new samples should be included in a revised proposal to place the new samples in a spatio-temporal context. In itself, this does not negate the need for a further justification/modification to their current plan as discussed above.

4.3.2 Survey tracklines

The Panel's views on issues relating to abundance estimates are given under Item 4.2.1. In response to a request, the proponents provided the Panel with example survey tracklines (see Annex D). This assisted an understanding of both the survey strategy and also how the direction of the surveys relates to the expected direction of whale movement. It confirms that the survey component of NEWREP-NP should provide estimates of abundance comparable with those from earlier surveys. The Panel **reiterates** the importance of submitting detailed plans in accord with the RMP requirements and guidelines.

4.4 Sample size of the lethal component of the programme

4.4.1 Common minke whales (Section 3.1.3 and Appendix 12 and addendum of proposal)

4.4.1.1 PROPONENTS' SUMMARY

For the Pacific side of Japan (sub-areas 7-9), the sample size was estimated in the context of Secondary Objective I (iv) 'Improve RMP trials by incorporating age data in their conditioning'. The approach followed is founded on the SCAA methodology applied to the O-stock of the common minke whale by Kitakado and Maeda (2016), which is used to generate future data in a simulation testing context. The intent is to determine how well, using the SCAA methodology to analyse the future data generated, it is possible to detect changes in recruitment. Data such as historical catch, catch-at-age, life history parameters (e.g. age-depended natural mortality, 50% age-at-maturity etc.), which were used in the RMP/*IST*s for this species (IWC, 2014b), were used. Stock hypothesis A (i.e. a single O-stock distributed from the Japanese coast until approximately 170°E) was assumed, given that preliminary results from close-kin genetics are not compatible with the existence of an Ow stock as in Hypothesis C. The estimation process assumed that carrying capacity K could change every 10 years. The scenario of a 30% drop in recruitment after 10 years with MSYR (mature)=1% was the base case scenario. For sensitivity, two scenarios for recruitment with a step function change, and two for recruitment based on the recruitment variability evident for two Antarctic minke whale stocks, were considered. Annex 12 of SC/J17/JR01 provided results labelled in terms of annual catches n of 0, 40, 80 and 120. These numbers n do, however, refer to an 'effective' sample

size which justifies analysis under the assumption of no over-dispersion in the ageing data. The actual sample sizes have to take that over-dispersion into account, which increase them to 0, 53, 107 and 160 respectively. In the baseline scenario, results showed that drop in recruitment was detected sooner and much better when n=80 than when n=0. It was evident that the drop in recruitment would not be predicted well without age data. Regarding precision, total numbers is predicted much more precisely when n=80 than n=0 with future changes in K. Results of sensitivity analyses were similar to the baseline scenario although estimation performance deteriorated somewhat when this trend is increasing. From the results, the annual sample size of 80 whales (corresponding to the actual sample size of 107 after taking into account of over-dispersion) from the O-stock was also found to be the most appropriate sample size. 75% of the sample size would be taken in coastal sub-areas (7CS and 7CN) and 25% in offshore sub-areas (7WR, 7E, 8 and 9) (Annex 12 of SC/J17/JR01). Therefore 80 animals will be sampled in coastal sub-areas and 27 in offshore sub-areas. Because around 20% of the animals in sub-areas 7CS and 7CN are from the J-stock (Annex 7 of SC/J17/JR01), the sample size of O-stock in coastal sub-areas should be adjusted to 100 animals. Therefore, the total sample size in the Pacific side of Japan is 127 animals.

For Hokkaido (sub-area 11), sample size was preliminarily estimated so that standard error of mixing proportion of the J stock in sub-area 11 is less than 0.1. This is related to the assumptions of an over-dispersion parameter of 1.689 and a proportion of unassigned samples (0.09) based on an estimate from JARPN II data. Sample size was estimated using the formula for the standard derivation of a binomial distribution and given the assumptions above, the resultant sample size was estimated as 47 (see details in section 3.1.3 and Annex 12 of SC/J17/JR01). This estimate applies for the first six years of NEWREP-NP only. More detailed estimates of sample size for the objective of studying temporal changes and trend for the J-stock mixing proportion will be made once data have accumulated from the first six surveys. The survey in the first six years can be considered as a feasibility study.

4.4.1.2 PANEL CONCLUSIONS

The sample size (127) for common minke whales in sub-areas 7-9 is based on the ability to estimate recruitment when there is a 30% reduction in recruits-per-female 10 years after the start of NEWREP-NP and when carrying capacity changes (as for the P-stock of Antarctic minke whales – Punt *et al.* (2014)). However, the proponents did not provide a strong link between a reduction in recruits-per-female and the primary or any of the Secondary Objectives, in particular evaluation of potential methods for setting sustainable catch limits for coastal areas east of Japan using the RMP (Primary Objective I). The analyses do show some value in including age data in assessments of common minke whales based on SCAA, and allowing for variation in recruitment will improve the realism of the *Implementation Simulation Trials* for the western North Pacific common minke whales. Nevertheless, the Panel **agrees** that even if the power to detect a change in recruitment was high, the analyses in Annex 12 of SC/F17/JR01 do **not** provide a defensible basis for the currently assigned sample size (i.e. 50 from 7CS, 50 from 7CN and 27 from 7E-8-9). The Addendum to Annex 12 (SC/J17/JR04) shows improved estimation performance for a step-function reduction in recruitment ten years into the programme compared to Annex 12 where the proposed SCAA approach is not able to detect a change in recruitment even after 50 years, i.e. well beyond the project timeframe of 12 years. The Panel **notes** that the SCAA was able to provide unbiased estimates of total numbers even without age data. However, as the proponents note in Annex D, the analyses show how the conditioning can be improved in the future (if a substantial reduction in recruitment occurred) but no analyses are provided to qualify the improvement in RMP performance. They also state in Annex D that 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 *IST*s, and consequently must await completion of that exercise which is the responsibility of the IWC Scientific Committee'.

The Panel had several technical concerns with the analyses presented which could be addressed in further analyses. However, the Panel **stresses** that these would **not** remove the fundamental problem that the planned sample size is not fully justified for the primary objective or any of the Secondary Objectives. While Annex D does refer to the use of age data for Objective I (iv), the Panel believes that the link with conditioning is rather weak and the number chosen not well justified in terms of management performance. These concerns are summarised below.

(a) The analysis assumes that there is single O-stock, when in fact testing the hypothesis whether there is one O-stock is one of the Secondary Objectives. In principle, the analysis of sample size should have been conducted for both the one-O-stock and the two-O-stock hypotheses, to avoid potential issues of circularity and prejudging the results of other Secondary Objectives.
(b) The estimator is provided with the true values for several (unknown) key parameters including natural mortality, MSYL, and, in particular, MSYR, which would increase (overestimate) the power to detect changes in recruitment.
(c) Selectivity post-1988 equals selectivity pre-1998, but with female selectivity multiplied by an estimated constant. The rationale for this is not provided, but the SCAA estimator knows that this is the parameterization of selectivity, which would increase (overestimate) the ability to estimate trends in recruitment.
(d) The abundance data are provided as estimates of mature female numbers, but in actuality the estimates of abundance would be estimates of 1+ numbers.

The Panel noted that the total sample size is split between sub-areas 7 and 8+9 based on historical catches, adjusting the sample sizes to account for age-readability and the proportion of the catch that is likely to be J-stock. The overall sample size would be lower if more animals were taken in sub-areas 8+9, because the J-stock proportion is lower offshore. The Panel **agrees** that the impact of the split of the total sample size between sub-areas 7 and 8+9 will impact the ability to achieve Secondary Objective I(iii). Uneven sampling efforts also impact some genetic analyses, such as the identification of clusters (usually assumed to represent populations) using programme STRUCTURE (Landguth and Schwartz, 2014). Disproportional sample sizes from different populations reduce the probability of detecting dyads of close relatives where each member is sampled in different populations, which constitutes the basic data points to infer dispersal rates from identification of close kin.

The Panel noted that concentrating sampling over short periods increases the probability of detecting dyads of close kin. This has potential consequences in terms of detecting dyads of close kin across sub-areas assumed to contain common minke whales from different stocks (e.g. stock structure hypothesis III) where the large historical datasets will decrease in utility due to natural and whaling mortalities

that eventually remove related individuals, which, in turn, effectively will reduce the probability that new samples are close kin to older samples.

Finally, the Panel **agrees** that the small sample size of common minke whales in the offshore area (sub-areas 8+9) will reduce the ability to detect a change in whale diets in response to major environmental changes.

In conclusion, the Panel **agrees** that the proponents have not justified the sample size proposed for sub-areas 7-9.

For the area north of Hokkaido (sub-area 11), the sample size (47) was selected to estimate the J-O mixing proportion in this sub-area annually with a standard error of no more than 0.1 irrespective of the true proportion[8]. The Panel **agrees** that the technical approach adopted to compute the sample size is justified and accounts for both overdispersion and the probability of not assigning animals to J- or O-stock for the period from May to September. The proposed sampling scheme will allow J-O mixing proportions to be estimated for May-September. The months with low current sample sizes are April and September-November and thus the Panel **concludes** additional samples will not inform mixing proportions for the most data-poor months. The sample sizes are computed under the assumption that each annual estimate has a standard deviation of 0.1 or less. However, lower sample sizes would be needed if data were pooled over multiple years.

4.4.2 North Pacific sei whales (Section 3.2.3 and Appendix 17 of proposal)

4.4.2.1 PROPONENTS SUMMARY

The sample size was assessed by focusing on the acquisition of biological information. More specifically, it was calculated based on the number of earplugs for age-information on sei whales for Secondary Objective II (ii), which is 'Estimation of biological and ecological parameters in North Pacific sei whales for RMP Implementation'. The analyses are based on the hypothesis of a single stock in the pelagic region of the North Pacific to which the catches to be made will be restricted. Abundance estimates taking account of additional variance in future surveys were used with the aim of estimating sample size. Based on the conditioned models, projections were made to generate future abundance estimates and catch-at-age data. In a 12-year research period, it was assumed that abundance estimates are available twice, though not for the whole area of the North Pacific instead only for the survey area in the NEWREP-NP. These abundance estimates are subject to process error due to inter-annual variation in spatial distributions, and therefore it was assumed that the abundance estimates inflated to the whole area have larger CV (30%) than CV=21.4% for the actual survey, to take additional variance into consideration. In the projection and generation of future data, log-normal deviations were accounted for when generating recruitment. The projection starts from 2014 because the model was conditioned on data up to 2013. In the three-year gap, the actual catch was allocated to age composition using estimated selectivity and numbers-at-age. For future catch-at-age data, multinomial distributions were used without assuming any overdispersion or age-reading error. Age-readability was taken to be 70% across all the ages. The parameter of interest is natural mortality (M). Two measures, root mean square error and relative bias, were used for evaluation of estimation performance by sample size. Although there are Monte Carlo errors and non-convergence issues in the iterations, the estimation performance is, as expected, improved when the sample size increases. Simulations conducted suggest that the preferred sample size is 200 if M=0.05yr^{-1}, and 140 if M=0.07yr^{-1} since the variability of the estimate asymptoted at a sample size of 140. Both M=0.05 yr^{-1}and M=0.07 yr^{-1} were considered to be realistic assumptions for the natural mortality rate for the North Pacific sei whale. The annual sample size of 140 was found to be consistent with the policy to limit the sample size to the extent necessary to achieve the research objectives. The annual sample size of 140 was also found to be a feasible sample size in terms of the capacity of the research vessels. Taking account of these factors, it was concluded that the sample size of 140 per annum is the appropriate size for this research plan. The levels of the CV for abundance and unaccounted overdispersion and age-reading error may drive the levels of performance measures, but the relative difference over candidate sample sizes is likely to be similar to the results shown here.

4.4.2.2 PANEL CONCLUSIONS

As noted earlier, the Panel did not see a clear link between the ability to estimate natural mortality and improvements in the conservation and management of sei whales. For example, if there was a relationship between natural mortality and MSYR, improvements in the estimate of natural mortality would lead to a reduction in the range for MSYR that needs to be considered in the in-depth assessment and subsequently in *Implementation Simulation Trials*. However, no such relationship is suggested by the analyses in Annex 17 of SC/F17/JR01.

The Panel notes that even with the proponents' assumptions, the calculated sample size was underestimated because the analyses ignored the effects of age-reading error and age-readability, both of which will reduce the information content of the age data; such analyses must be updated to account for both of these sources of uncertainty. In addition, it appears that the SCAA was provided with information about MSYR and MSYL, which would not be available in reality. It is likely that attempting to estimate MSYR simultaneously with natural mortality would lead to imprecise estimates of both quantities, while setting MSYR to an incorrect value will lead to biased estimates for natural mortality. However, this needs verification.

The Panel notes that estimates of natural mortality are biased even at large annual sample size. This is probably due to the historical age-composition data (for which sample sizes are high) not being consistent with the values for natural mortality applied during the period of NEWREP-NP. Downweighting the historical age-composition data might reduce the conflict between the historical and simulated future data, but could also lead to less precise estimates of model outputs, including natural mortality. The Panel **recommends** conducting analyses in which the historical age-composition data are downweighted by various levels.

In conclusion, the Panel **agrees** that the proponents have **not** justified the sample size for sei whales.

4.4.3 Feasibility of non-lethal alternatives to either replace or reduce the size of proposed lethal sampling

4.4.3.1 PROPONENTS' OVERVIEW

During the implementation of the NEWREP-NP research, the proponents will conduct further study on the feasibility and practicability of a variety of new non-lethal methods including biopsy sampling, satellite tagging and their associated analytical methodologies which potentially could be used to address the objectives: DNA-Methylation for age determination, examination of hormone in blubber for determination of sexual maturity, stable isotope and fatty acids for studies on feeding ecology. Potentially all these techniques could be used based on tissues collected by biopsy sampling. The design of the feasibility studies in NEWREP-NP will take into account the results already obtained in JARPN II and NEWREP-A (see section 3.1.1 and Figure 2 of SC/J17/JR01). Further details of the feasibility studies to be conducted were presented during oral presentations at the Workshop. A final assessment of the feasibility of non-lethal techniques will be carried out during

[8]The proponents intend to review this estimate once data are accumulated to refine the estimate of the mixing proportion.

the mid-term review, including an evaluation of possible modification of sample size of the lethal component of the programme, on a whole-programme basis. The results of the feasibility study on age determination based on DNA-M will be relevant here because sample size calculation in NEWREP-NP bases on the necessity of age data. A final assessment of possibility to replace/reduce the size of lethal sampling will be conducted based on four questions provided by Mogoe *et al.* (2016). Even when all of the four questions are not satisfied at once, there could be a possibility to reduce the lethal sample size if non-lethal techniques can produce the same quality of age information. In this case, a part of sample numbers for lethal method will be transferred to biopsy sampling as long as research resources (time, funding, etc) allows. However, the effect of reduced lethal sample size on other data that can be obtained only lethally (e.g. sexual maturity, stomach contents), will be evaluated during the final review.

4.4.3.2 PANEL CONCLUSIONS

BIOPSY SAMPLING

Skin biopsies can be used to contribute to issues such as, stock structure, aging by DNA methylation, maturation state by hormone assays and feeding ecology from analyses of stable isotopes and fatty acids. The Panel **agrees** with the proponents that it is possible to collect large numbers of samples of sei whales. The proponents do not believe that this is possible yet for common minke whales. Their current skin biopsy system uses the Larsen gun and short light biopsy bolts.

The proponents concluded that in addition to the size and behaviour of the animals, the main technical cause of failure was the current barbed steel biopsy tip, which often failed to retrieve a skin biopsy at a successful hit; the Panel suggests that too short barbs could be the cause. The Panel **reiterates its recommendation** under Item 3.3.4 that the proponents undertake a fully resourced experiment to assess the efficacy of undertaking biopsy sampling of common minke whales as soon as possible, co-operating with outside experts and with clear milestones and quantitative criteria to ensure a timely completion of the feasibility study. The Panel **recommends** the implementation of biopsy sampling to reduce the lethal sample size as soon as it is deemed feasible rather than wait until the mid-term review.

SATELLITE TELEMETRY

Satellite telemetry, particularly in combination with genetic analysis, can be a powerful tool to address questions such as stock identity, migratory routes, feeding and wintering areas particularly for highly migratory whale species (Citta *et al.*, 2012; Heide-Jørgensen *et al.*, 2006). Satellite tag technology is rapidly evolving; hence, the Panel **commends** the proponents for collaborating with outside experts (e.g. Lars Kleivane and Restech Norway A/S) on their proposed satellite tag development (SC/J17/JR01, Annex 9) and notes the particular success rates now being achieved for large baleen whales. The Panel **recommends** that the proponents attend the IWC-ONR joint Workshop on Tag Development, Follow-Up Studies and Best Practices to be held in September 2017 in Silver Spring, MD (USA) to become acquainted with the most current tagging technologies and deployment methods.

Rather than set an arbitrary number of tags, the Panel **recommends** that the number, location and timing of tag deployments should reflect the questions being addressed. For example, tagging during the autumn migration could help delineate wintering and possibly breeding areas. Tagging during spring migration, or tags that last a year or more, can help elucidate migratory routes and possible sub-structuring on the summer feeding grounds (e.g. Oe- *vs* Ow-stocks).

Once a suitable tag is developed, the Panel **recommends** tagging North Pacific common minke whales within the study area to address stock structuring within the NEWREP-NP study region. Again, tag deployment location and tag design should be tailored to the question being addressed.

The possible health effects of tags on whales is an area of ongoing research by whale biologists and veterinarians (Robbins *et al.*, In Prep.). In the remote chance that a tagged whale is recaptured by lethal sampling, a thorough veterinary health assessment of the attachment site and general health of the animal would contribute greatly to the literature on this subject.

AGE DETERMINATION FROM ASSESSMENT OF DNA METHYLATION

The Panel **welcomes** the planned work aimed at assessing DNA methylation as a proxy for age.

DNA methylation has been thoroughly studied in several model animal and plant species (Mazzio and Soliman, 2014; Trucchi *et al.*, 2016; Xiong and Laird, 1997; Yang *et al.*, 2004). The nature of epigenetic changes across mammals are identical where only CpG sites are methylated (Nakao, 2001).

Changes in methylation at CpG sites can arise within a single generation due to a variety of processes, such as aging, physiological processes as well as environmental effects (Jarman *et al.*, 2015). The rate of methylation also varies across tissue types (Horvath, 2013). Epigenetic variation may also be transmitted across generations, either via germ-cell exposure or 'inheritance' (Daxinger and Whitelaw, 2012; Jablonka and Raz, 2009; Weyrich *et al.*, 2015).

The rate of change in methylation at a large number of CpG sites correlates closely with age in model species. In the case of humans, thousands of CpG sites have been identified where the degree of methylation correlates with chronological age (Florath *et al.*, 2014; Jung and Pfeifer, 2015). A total of eight such candidate loci, containing 37 CpG sites, was tested and optimized to assess age-related methylation in humpback whales by Polanowski *et al.* (2014). Among the 37 CpG sites assayed, the level of methylation at seven CpG sites correlated significantly with age (R^2=0.79, p <3.0E-14) in a sample of 63 humpback whale DNA samples collected from individuals of known ages. The study by Polanowski *et al.* (2014) also revealed (as expected) species-specific differences in which CpG sites level of methylation correlate with age. Although, unknown at this time, con-specific populations may also differ in methylation dynamics at homologue CpG sites.

Preliminary work under NEWREP-A focused on the seven CpG sites (across three loci), which correlated with age in North Atlantic humpback whales. Data were presented for one CpG locus, which revealed a statistically significant correlation between degree of methylation and age inferred from ear plugs in Antarctic minke whales. However, the correlation was low (R^2 = ~0.06) suggestive of a much lower precision compared to that observed in humpback whales. No results were presented that combined the correlation between the age inferred from earplugs with the combined change in methylation in all seven CpG islands.

Age data have been put forward as a key reason for the lethal sampling under NEWREP-NP. The Panel **recognises** the in principle value of reasonably precise age determination methodology for conservation and management (although see the discussion above concerning quantifying 'improved' management and sample sizes). The Panel **concludes** that an ability to reduce or eliminate the lethal sampling component of the programme will depend crucially upon approaches

that enable age determination from skin biopsies, such as methylation of CpG sites. However, the few CpG sites targeted so far, along with the comparatively poor level of correlation between inferred age and DNA methylation warrants further development to achieve a better precision. The Panel **recommends** using the extensive amount of data in age-related methylation in mammal model species (e.g. humans) where thousands of CpG sites have been identified in which the level of methylation correlates with age, similar to the approach taken by Polanowski *et al.* (2014) who assessed 37 CpG sites originally identified in humans. Once putative aging CpG sites have been identified among the candidate CpG sites observed in humans, a more targeted approach may be developed by identifying the homologous loci in the minke whale genome, thereby presumably increasing the precision of methylation-based aging in North Pacific minke whales. Existing tissue samples from animals aged using the earplug method should be used for this study.

The Panel **reiterates** that the key 'performance' parameter to assess in terms of the suitability in methylation-based ageing may not be whether methylation-based ageing achieves a comparable level of precision to earplug-based ageing, but rather whether or not the observed level of precision in ages inferred from methylation is sufficient for meeting conservation and management objectives requiring age data. Initial analyses to compare the estimation performance of an SCAA approach that uses age data was conducted in Government of Japan (2016). That analysis showed that the CV of recruitment was appreciably higher when ages were determined using the methylation approach compared to reading of ear plugs. To date, those analyses have not considered how such imprecision impacts management performance (e.g. how much poorer a *CLA* that uses age data would perform given age data from earplug readings compared to the methylation approach).

The above discussion does not negate the need to properly quantify the level of improvement that might be expected in RMP performance if age data (from any source) are incorporated (see Item 5.2).

BLUBBER PROGESTERONE

The feasibility of determining pregnancy status from concentrations of progesterone (P4) in the blubber of minke whales was demonstrated by Mansour *et al.* (2002) in which levels were significantly higher in females carrying a foetus and those with *corpora lutea* (CL) in the ovaries. Trego *et al.* (2013) carried out a similar study in various species of stranded delphinids, also finding significantly higher P4 blubber concentrations in pregnant females. Further studies have shown that this approach is feasible for pregnancy determination in samples from humpback whales (Mello *et al.*, 2017) and in remote biopsy samples of pantropical spotted dolphins (Kellar *et al.*, 2013). The study by Trego *et al.* (2013) concluded that although an embryo in the early stage of pregnancy might not be detected by visual inspection, all animals with a corpus luteum also had a corresponding foetus. In determining the feasibility of using P4 as an indicator of pregnancy in the North Pacific common minke whale, the Panel **stresses** the value of determining the presence of corpora (CL and *corpora albacantia*) in the study animals in addition to determining the presence or absence of a foetus to minimise misclassification errors. Resting and immature cetaceans have significantly lower levels of circulating and blubber P4 (Mansour *et al.*, 2002; Yoshioka and Fujise, 1992) than pregnant or ovulating females so it is important to evaluate samples from animals at all life history stages.

FATTY ACIDS AND STABLE ISOTOPES

The proponents discussed plans for improving knowledge about foraging ecology of common minke and sei whales through the analyses of fatty acids and stable isotopes. Non-lethal sampling will obtain skin and outer blubber samples through the biopsy programme. The blubber will be analysed for fatty acids and skin will be analysed for stable carbon and nitrogen isotopes. Other samples, including stomach contents, will also be obtained from whales taken lethally.

The proponents provided preliminary information about the analysis of fatty acids in prey items of Bryde's whales in the North Pacific. General prey type (i.e. krill, copepods, or fish) could be classified using analysis of fatty acids but individual fish species could not. Another concern was expressed by the Panel about the efficacy of using fatty acids to quantitatively assess diet of whales. Using fatty acids to estimate which species of prey are being consumed requires specific conversion factors of how fatty acids are converted from prey to blubber. Another confounding factor is that biopsy samples collect only the outermost blubber. Fatty acids are layered in blubber and the inner layer is most metabolically active and likely best represents diet. Thus, biopsy samples do not provide the appropriate tissues for fatty acid analysis if the other difficulties mentioned above could not be overcome. These limitations reduce the value of using fatty acids to estimate specific prey items. The proponents replied that they did not expect to use fatty acids alone but would instead use a combination of fatty acids, stable isotopes (from several tissues that represent diet over differing time periods), and stomach contents to improve understanding of foraging ecology.

NEWREP-NP will analyse more skin, muscle, liver, baleen, and prey samples for stable isotopes, blubber and prey for fatty acids, and collect stomach contents. The Panel **agrees** that combining these approaches will improve the knowledge of diet of North Pacific common minke and sei whales.

OVERALL CONSIDERATIONS

The Panel considers the four question criteria (Mogoe *et al.*, 2016) an appropriate general framework to evaluate the feasibility of using non-lethal methods as a replacement or in addition to lethal samples, though more quantification and clarification is needed to fully implement the framework (see Item 3.3.4 for further Panel comments on this framework).

The Panel **welcomes** the proponents' proposals to collect samples non-lethally, conduct the associated laboratory and analysis work, and report the results from the comparison of lethal and non-lethal methods. However, it **reiterates** that this should be seen as a priority and that the proponents provide the Scientific Committee with an estimate of the number of additional non-lethal samples required to complete the assessment so that a full analysis is available at least by the mid-term reviews. It also **recommends** that the similar data/results from the Icelandic sampling programme are incorporated in the analyses. Finally, the Panel **reiterates** that non-lethal techniques should be incorporated into the programme as soon as they are deemed plausible.

An important component of determining appropriateness is determination of sample size – as non-lethal techniques become appropriate, non-lethal and lethal sample sizes will need to be recalculated to ensure that objectives are met. The Panel noted there was no discussion in the proposal as to what the strategy would be to determine sample sizes or how the current methods that determine sample sizes might be modified to determine the new sample sizes. The Panel **recommends** that this issue is considered by the proponents and a strategy to be included in the project proposal before the start of the fieldwork.

The Panel **stresses** that the extensive number of samples and genetic data already available should be used to the fullest extent to guide the sampling design as well as genetic data and analyses in order to address the NEWREP-NP objectives in an efficient manner. The current genetic data could serve as a basis [by limiting the 'parameter space' to be explored] for conducting simulations aimed at evaluating the possible benefits of genotyping additional microsatellite loci and/or large number of SNP loci and different analytical approaches (see Hoban *et al.*, 2012 for a comprehensive review). Such an assessment will reveal the extent of the potential of additional genetic analyses of existing samples. This kind of assessment will also provide insights into how many more samples are required and from which areas. It is possible that the additional sampling in the current plans only will add marginally to the current available data/ samples, hence alleviating the need for additional lethal sampling in terms of the genetic analyses. Consequently, the Panel **strongly recommends** that the Proponents take full advantage of existing materials and data to assess the necessity of the planned efforts (in terms of numbers, timing and geographical areas) under NEWREP-NP to further resolve the current stock structure hypotheses in the targeted species before collecting additional samples.

4.5 Assessment of potential effect of catches

4.5.1 Common minke whales

4.5.1.1 PROPONENTS SUMMARY

The effect on the O-stock common minke whale of annual catch 107 and 160 was examined for 100 years using simulation based on SCAA) (see details in section 4.1 and Annex 12 of SC/F17/JR01). It was assumed that a single O stock distributed from the Japanese coast till approximately 170°E (i.e. stock structure hypothesis A). Abundance estimates in the sub-areas, historical catches and biological parameters were as in the 2013 RMP *Implementation*. A $g(0)$=0.8 was used, which was assigned high plausibility during the RMP *Implementation*. Results for the baseline scenario, which assumed the standard stock recruitment relationship of Annex 12 of SC/J17/JR01 for 100 years, indicated that the impact of an annual catch of 107 and 160 whales was very small. This was particularly clear when the ratio of projections with and without catches was considered. For the sensitivity scenario assuming a 30% drop in recruitment in 10 years, the ratio of projection indicated a relatively small impact of catches for MSYR=4%. For MSYR=1%, the impact of the catches was larger, but this needs to be considered in the context that this MSYR refers to MSYR (mature) as used for the IWC trials on which these analyses were based, and that the IWC SC has subsequently increased this lower bound to the larger MSYR (1+).

The effect on the J-stock of the proposed catch in sub-area 11 (14) and those in sub-areas 7CS and 7CN (20) was examined for 50 years (see details in section 4.1). Hitter runs with MSYR (1+)=1% and 4%, were conducted. A single J-stock was assumed (i.e. stock structure hypothesis A). It was assumed that g(0) was 0.856 (CV=0.120) for surveys with IO mode and 0.798 (CV=0.168) for surveys without IO mode (Okamura *et al.*, 2010). The abundance in sub-areas 5, 6 and 10 of 16,162 (CV=0.277) based on sighting surveys in 2005, was used (Kitakado *et al.*, 2010). Historical catches and biological parameters were as in the 2013 RMP Implementation. For MSYR (1+)=1%, the figure suggested that the population decrease from 1930 even in absence of catches. It can be considered that the decrease is due mainly to the level of bycatches. The ratio of the projections with and without the proposed catches was examined. The ratio becomes 0.8 after 50 years, which suggest that the effect on the stock of the proposed catches is not substantial. For MSYR (1+)=4%, population increases. The population trajectory with and without proposed catches were very similar to each other, suggesting that there is no negative effect of the catches on the J-stock for MSYR(1+)=4%. As a sensitivity test, trajectories were investigated assuming a mixing proportion of J-stock of 10% for commercial catches in sub-areas 7CS and 7CN. Results were similar to the base case scenario.

4.5.1.2 PANEL CONCLUSION

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 $MSYR_{1+}$=1% (IWC, 2014b). 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 $MSYR_{1+}$=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.

4.5.2 North Pacific sei whales

4.5.2.1 PROPONENTS' SUMMARY

To evaluate effect of proposed annual catches of 140 upon the stocks, population trajectory was projected based on conditioned SCAA models using the latest information on stock structure, abundance and biological parameters (see details in section 4.2 of SC/J17/JR01). The calculation was conducted based on conditioned age-/sex-structured models. Regardless of parameters assumed, there is no serious difference in the median trajectory between the two catch scenarios (0 and 140 per year) over the 12-year sresearch period, and therefore it is evident that the impact of an annual catch of 140 whales is very small.

4.5.2.2 PANEL CONCLUSION

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, 2014b).

4.6 Logistics and project management

4.6.1 Proponents' summary

To facilitate review by the IWC SC, the proponents will present progress under NEWREP-NP to annual meetings of the IWC SC. Furthermore, results for each Secondary Objective will be presented and evaluated during the mid-term review. Such scientific review will assist the direction of the analyses in the second period of the NEWREP-NP (see timeline of research activities in Figure 3 of SC/J17/JR01). The Fisheries Agency of Japan is responsible for providing financial support for personnel and logistic resources. Regarding personnel resources, the Institute of Cetacean Research will play the leading role in order to pursue the research activities and achieve the research objectives in collaboration with scientists from other domestic and/or foreign organizations. At least nine leading research institutes and universities including over 50 scientists will participate in the research under the NEWREP-NP. Five small type whaling catcher vessels will be employed for sampling of common minke whales in sub-area 11 and sub-areas 7CS and 7CN. One research base and two sampling/sighting vessels will be employed for sampling common minke whales and sei whales in offshore waters (sub-areas 7-9). NEWREP-NP establishes a backup plan for contingencies such as bad weather in order to respond to the contingency and secure the scientific value of data. The backup plan addresses three aspects; (i) adjustments of research protocols at the scene of bad weather, (ii) adjustment of research plans including research period, sample size, and research areas after the year of disruption, and (iii) consideration of analysis methods to compensate the effects of disruptions (see details in section 5 of SC/J17/JR01).

4.6.2 Panel conclusion

The Panel received a summary of: (1) the review process; (2) personnel and logistics; and (3) contingency plans for NEWREP-NP. A mid-term review to be held in 2023 will evaluate the results pertaining to the secondary and ancillary objectives, including an assessment of the success of non-lethal methods. Data collection for the second half of the programme and analyses will be modified, as necessary. The research activities will be led by staff at the Institute of Cetacean Research (ICR). ICR has 11 scientists and two technicians available to implement the research under NEWREP-NP. Additionally, approximately 40 scientists from eight other leading research institutes and universities in Japan will participate in the programme.

The Panel **welcomes** the logistical information provided by the proponents but has a number of comments as summarised below.

(1) The Panel **reiterates** its comments that the proponents must: (a) ensure that data are promptly analysed to ensure a meaningful mid-term review; and (b) it also refers to its comments about providing adequate resources into work on common minke whale biopsy sampling as soon as possible to facilitate the prompt use of non-lethal techniques.

(2) For the environmental chemistry laboratory, the proponents indicated that they have one experienced scientist and one recent graduate. They propose to carry out the immune function assays in this laboratory although they do not appear to have any immunotoxicologists working with them. The Panel **recommends** that the proponents collaborate with wildlife immunologists and immuntoxicologists to assist them as optimising, validating and interpreting the results from any immune assays requires specialist skill and knowledge; it is **not** a trivial undertaking.

(3) While on the surface, the number of researchers may seem adequate to conduct the research, the Panel **recognises** that the ICR scientists are also involved in other programmes, such as NEWREP-A and the completion of analyses from JARPN II. Although a new graduate analyst has been appointed, the Panel **remains concerned**, that, as has been the case for all previous Special Permit programmes undertaken by Japan, field and laboratory work and laboratory analyses have been allocated much higher priority than quantitative analyses and modelling. This has been reflected in the sometimes long times taken to complete analyses (some of which remain incomplete). The Panel **strongly recommends** the recruitment of sufficient highly trained and qualified analyst/modellers to improve NEWREP-NP study design, data analysis and review.

(4) Additional information on sample and data archiving, relational database(s) and multiple sampling on the same whales, as noted by previous Expert Panels would be welcome.

(5) The proponents recognised the need for a backup contingency plan in the event of disruption of the programme. The primary contingency is for the cruise leader to adjust sampling efforts and locations, if necessary, for example due to bad weather preventing the collection of data in a certain location. The Panel **agrees** that contingency plans are needed, but noted that the proponents have not yet developed a more detailed plan/protocol, *a priori*, for how research will be modified in the event of disruption.

4.7 Co-operative research

4.7.1 Proponents' summary

Scientists from the ICR will play the leading role in order to conduct the research activities and achieve the research objectives of NEWREP-NP. They will collaborate with scientists from other domestic and/or foreign organizations. At least nine leading research institutes and universities including over 50 scientists will participate in the research. Participation of foreign scientists in the field surveys of NEWREP-NP will be

welcomed, so long as they meet the qualifications established by the Government of Japan. Protocol for collaboration in field activities was developed. Data obtained by NEWREP-NP will be available to members of the IWC SC in accordance with the IWC SC Data Availability Agreement (DAA). Protocol for collaboration in analytical studies was also developed (see details in section 6 and Annexes 20 and 22 of SC/J17/JR01).

4.7.2 Panel conclusion

The Panel **welcomes** the information provided and **encourages** further collaboration with international researchers. It notes the proponents should separate out collaborators who have agreed to share expertise and data to assist in meeting NEWREP-NP objectives from research groups or programmes that are simply working independently in the same area, even if their data and analyses are relevant to the NEWREP-NP programme (such the IWC/POWER programme that was mistakenly included).

The NEWREP-NP programme is ambitious with many varied research objectives. As such, the Panel **encourages** the proponents to reach out to cutting edge researchers in many of the scientific fields associated with the objectives. Involvement of additional researchers will improve the quality of data, analysis, results and reporting, as is the case for any other large research programme.

5. PANEL CONCLUSIONS

Table 2 consolidates the Panel's views on the items assigned to it under Annex P with respect to NEWREP-NP. Summary text is provided under Items 5.2-5.6. Table 3 summarises all of the recommendations made by the Panel. The overall conclusion (which is also the Executive Summary) is given as Item 5.10.

5.1 Completion of the review of the JARPN II programme (see Item 3)

The Panel noted that the original expectation had been that it would receive a final integrated report of the completed programme (i.e. all data up to 2016). The proponents, however, explained (Annex D) that compiling such an integrated report at this time was inconsistent with the timeframe for completion of recommendations agreed at the 2016 Scientific Committee meeting (IWC, 2017b). They believed that producing such a report after finishing these recommendations would be more constructive.

The proponents had produced some additional material on stock structure, feeding ecology, ageing techniques and, in particular, progress with the comparison of lethal and non-lethal techniques that had been the focus of the 2014-16 programme. While welcoming the new information and recognising that some of the 2016 Panel's recommendations required one or two years more to be completed, the Panel **concludes** that it was not able to complete the full review of the JARPN II programme completed in 2016. This will be possible only when final analyses are completed following the timeframe agreed at the Scientific Committee in 2016 and a full consolidated report following the template outlined in Annex P is made available that addresses the recommendations made by the 2016 Expert Panel, this Panel and the Scientific Committee.

Given these recurring difficulties in terms of Annex P process, the Panel **reiterates** some of 2016 Panel recommendations that remain relevant. In particular, the Panel **requests** that the Scientific Committee considers the three items below.

(a) The inclusion in Annex P of a guideline relating to the minimum time after the field programme/ the programme itself is completed that a final review can take place. This time must allow the completion of all planned analyses related to the programme's objectives. The Panel **agrees** that a full description of the fieldwork, collected samples and data and preliminary results are not to be considered sufficient to call a final review;

(b) The development of a mechanism for proponents to provide a short biennial update on progress with recommendations. Given the biennial cycle of the Commission, the Scientific Committee needs to be informed about progress only in years when the Commission meets.

(c) The development of a mechanism to allow for the completion of Expert Panel reviews if a Panel states that its review is incomplete until full further information/analyses is provided/concluded.

5.2 General comments on process and Annex P

The Panel was pleased to verify that the use of the checklist helped the Proponents to produce a proposal covering all main areas relevant to the Annex P evaluation and for which the Panel and the Scientific Committee are required to provide their advice to the Commission.

However, the Panel wishes the Scientific Committee to clarify the purpose of the Expert Panel review process to avoid any misunderstandings. During the course of the Workshop, the Panel received the (perhaps mistaken) impression that the Proponents perceived the Expert Panel review as an intermediate step before a final evaluation by the Scientific Committee. Whether the impression was incorrect or not, the Panel **stresses** that it believes it's role is to review a *final* proposal (or final documents for a periodic or final review). Indeed, this is the reason for the Panel's report to be transmitted to the Commission untouched. This is not to say that the Proponents should not take into account Panel recommendations and respond to them by the Scientific Committee meeting – as indeed is envisaged in Annex P – but that the Proponents should be submitting to the Panel what they believe to be the final, fully justified proposal (or reports that contain full analyses of all data).

Whilst the Panel is pleased that Governments are prepared to revise their proposals where problems are detected, it does not believe that it is appropriate for a Panel to receive, as has sometimes happened, responses to questions along the lines that there had not been time for particular information to be prepared for the Panel, but that it would be provided for the next meeting of the Scientific Committee.

In short, the Panel **reiterates** its view that Expert Workshops are meant to undertake a thorough review of a **final** proposal (or a mid-term or final report). The Panel **recommends** that the Scientific Committee considers revising Annex P to provide the necessary clarity on this, in order to help future reviews.

In addition to the recommendations on final reviews provided under Item 5.1, the Panel also **recommends** that the Scientific Committee develops general guidelines/ frameworks, which could be appended to Annex P for the following:

(1) quantifying any likely improvements in conservation and management postulated for particular special permit objectives in an IWC/RMP context (e.g. using the RMP simulation trial framework under different data assumptions and scenarios to examine different catch performance statistics for the same conservation performance);

(2) assessing the impact of the effects of special permit catches upon stocks, for situations for which there has or has not been an RMP *Implementation* (and see Item 4.5); and
(3) evaluating the feasibility and practicability of non-lethal techniques (and see Item 5.4).

5.3 Importance of objectives in the NEWREP-NP proposal

Annex P requires that the review comments briefly on the perceived importance of the stated primary objectives from a scientific perspective and for the purposes of conservation and management, noting particularly the relevance to the work of the Scientific Committee. A summary of the Panel's views by Objective and Secondary Objective can be found in Table 2.

5.3.1 Primary Objective I

Primary Objective I is that the permit programme provides a 'Contribution to optimizing the establishment of a sustainable catch limit for common minke whales in the coastal waters of Japan'.

In conclusion, the Panel **agrees** that this overall broad objective is important for the purposes of conservation and management. With respect to the Secondary Objectives, the Panel **agrees** that:

(a) Secondary Objectives I(i), I(ii) and I(iii) all address important aspects related to the abundance and stock structure of common minke whales in the western North Pacific and would be of importance in future *Implementation Reviews*. The extent to which this requires additional biological samples rather than improved analyses of existing data to achieve the Secondary Objectives is discussed elsewhere in this report;
(b) Secondary Objective I(iv) relates to RMP trials – it will enhance the way RMP *Implementation Simulation Trials* are conditioned, but would not probably provide as great an impact as Secondary Objectives I(i), I(ii), and I(iii) – see discussion elsewhere in the report on the need to quantify postulated improvements; and
(c) Secondary Objective I(v) related to 'regime shifts' should be considered ancillary as it is unlikely to make a direct contribution to future *Implementation Reviews* within a reasonable timeframe, if at all.

5.3.2 Primary Objective II

Primary Objective I is that the permit programme provides a 'Contribution to the RMP/*IST* for North Pacific sei whales'.

In conclusion, the Panel **agrees** that this overall broad objective is important for the purposes of conservation and management, but that, as phrased, it is somewhat premature until the in-depth assessment and an RMP *pre-Implementation assessment* have been satisfactorily completed and the Commission approved moving to an *Implementation*. At present, the Scientific Committee is involved in an in-depth assessment of North Pacific sei whales and not an RMP *Implementation*, as explained under Item 4.1.2.2. With respect to the Secondary Objectives, the Panel **agrees** that:

(a) Secondary Objective II(i) relating to abundance will contribute substantially to the in-depth assessment (but note the time-scale issue) and a possible future RMP *Implementation,* should one occur;
(b) Secondary Objective II(ii) relating to improved estimates of biological parameters may contribute to the in-depth assessment (but note the time-scale issue) and a possible future RMP *Implementation,* should one occur - however, the parameters that are the focus of this Secondary Objective are not the most important in terms of management;
(c) Secondary Objective II(iii) relating to stock structure will contribute to a possible future RMP *Implementation,* should one occur but whilst stock structure is an extremely important issue, the extent of the contribution of the expected new information is unclear;
(d) Secondary Objective II(iv) relating to RMP trial specifications will contribute to a possible future RMP *Implementation* should one occur; and
(e) Secondary Objective II(v) related to regime shift should be considered an ancillary objective for the same reasons as for Secondary Objective I(v).

The Panel also **agrees** that the Secondary Objectives of both primary objectives of the proposal are relevant to many Scientific Committee recommendations. However, the Panel **reiterates** that several these recommendations concerned improved or new analyses of existing data, rather than the collection of new data.

5.4 Ability of objectives to be met by non-lethal methods

Annex P requires that the review evaluates whether the objectives of the research could be achieved using non-lethal methods or whether there are reasonably equivalent objectives that could be achieved non-lethally.

This Panel, as have previous Expert Panels, has noted the complexities of this issue overall and the need for a proper evaluation of options for lethal and non-lethal techniques (see discussion under Item 3.3.4, aspects of Item 4.2 and Item 4.4.3). The Panel **agrees** that certain data types (e.g. age and body measurements), specified to meet the objectives as stated, require lethal sampling, at least at present. However, it **recommends** that a more thorough quantitative review of the relative contribution of those data types to the ability of the proponents to meet their primary and Secondary Objectives is required before a formal conclusion can be drawn on the ability or otherwise of non-lethal methods to meet some specific sub-objectives.

Given the focus in Annex P on comparing lethal and non-lethal methods, the Panel **recommends:**

(a) that any Special Permit programme should include as a specific primary objective, the constant review of new techniques as these become available to facilitate discussions of methods and samples sizes at milestones such as the mid-term reviews;
(b) if present data do not allow for a full evaluation, a focussed pilot study to enable a full and proper evaluation of lethal vs present non-lethal methods integrated across objectives should be undertaken, prior to the start of a full programme - where such data already exist, then a desktop-study evaluation should be undertaken before the permit programme begins;
(c) such evaluations could be undertaken in light of an expanded framework as recommended under Item 3.3.4 and must be properly designed to enable more effective reviews of sample sizes/methods during mid-term reviews; and
(d) informative evaluations must include using analyses and/or simulations to evaluate the influence of the same or similar data obtained lethally and non-lethally on the objectives related to the management/

conservation of whale stocks, and recognise that the data obtained using different methods, may be slightly different, and may have slightly different interpretations or provide different levels of precision.

The Panel **agrees** that whilst the proponents have begun such work, it is not yet complete.

The Panel **recognises** that the responsibility for developing a suitable evaluation framework (see point (c) above) is not a trivial task given the complexities of the subject (see past Expert Panel reports and Items 3.3.4 and 4.4.3). It believes that the responsibility should not fall solely on the proponents and **recommends** that the Scientific Committee develops a mechanism to provide consolidated advice on this.

5.4.1 Primary Objective I and Secondary Objectives

The Panel **agrees** that at present, non-lethal methods are not suitable to meet those Secondary Objectives that require age data. See the discussion under Item 3.3.4 about the future feasibility of biopsy sampling for this species. Additional work is required to determine whether the present age data are sufficient to meet the objectives of the programme. The Panel also expresses **reservations** on the value additional age data would bring to improved conservation and management (see Item 5.6.1).

5.4.2 Primary Objective II and Secondary Objectives

As for Primary Objective I, the Panel **agrees** that at present, non-lethal methods are not suitable to meet those Secondary Objectives that require age data. Additional work is required to determine whether the present age data are sufficient to meet the objectives of the programme. The Panel also expresses **reservations** on the value additional age data would bring to improved conservation and management (see Item 5.6.2).

5.5 Are lethal methods likely to improve conservation and management?

Annex P asks that the review evaluate 'whether the elements of the research that rely on lethally obtained data are likely to lead to improvements in the conservation and management of whales. This evaluation should include whether the proposal demonstrates the likely magnitude and relevance of improvements to conservation and management arising from the achievement of the programme objectives'.

The Panel refers to its earlier general discussion of the complexities of issue related to the discussion of lethal and non-lethal techniques (and see Item 5.4 above) and the need to quantify any postulated improvements in conservation and management for both lethal, non-lethal and combined approaches (and see Item 5.2).

5.5.1 Primary Objective I and Secondary Objectives

With respect to Secondary Objective 1(i) on the spatial and temporal occurrence of J-stock, the Panel **recognises** that improving understanding of J-stock is useful for conservation and management. However, it notes that the lethal component contribution is not likely to be as substantial for overall management as addressing stock structure uncertainty (much of which may be able to be done using existing samples) and by improving estimates of abundance.

With respect to Secondary Objective I (iii) on resolving stock structure issues with O-stock(s), the Panel **agrees** that resolving this will have a substantial impact. The performances of some of the RMP variants, especially those that lead to higher catch limits for the *Small Areas* near Japan, depend critically on whether there are one or two O-stocks.

With respect to Secondary Objective I (iv) on incorporating age data into eventual RMP trials, the Panel **agrees** that whilst this may be of value, it is not clear to what extent additional samples will improve the conservation and management – this must be quantified (see Item 5.2).

5.5.2 Primary Objective II and Secondary Objectives

The Panel refers to earlier comments (Item 4.2.9) that it is not clear to what extent additional age data will improve the situation with respect to the estimation of biological parameters or the effect of this on conservation and management; this should be quantified by the proponents (and see Item 5.2).

5.6 Design and implementation

Annex P asks that the Review Panel to evaluate 'whether the design and implementation of the programme are reasonable in relation to achieving the programme's stated research objectives, and in particular, evaluate whether sample sizes and the spatial and temporal scales are reasonable in relation to the programme's stated research objectives and whether non-lethal alternatives are not feasible to either replace or reduce the size of the lethal sampling being proposed'.

5.6.1 Common minke whales

The Panel **agrees** that there are several aspects of the coastal sampling procedure that make the design unusual for a scientific survey and will complicate and possibly compromise data analyses. In particular, the Panel **concludes** that:

(a) the design would lead to oversampling of the areas close to ports (the Panel was informed that an additional land-based station may be established in the northern Sanriku to better cover sub-areas 7CS and 7CN);
(b) the boats can search freely once they reach 30 n.miles from port if no whales have been encountered *en route* from port, which means the design is not fully specified in terms of the catches by the port-based boats; and
(c) the *Nisshin Maru* will conduct sampling if the number of common minke whales caught does not reach the target number, but no sampling plan for this contingency is provided.

The Panel **agrees** that the impact of non-random sampling of the inshore areas has different consequences for each Secondary Objective under primary objective I. In particular, the Panel **concludes** that it will substantially complicate:

(a) achievement of Secondary Objective I(i), for which random sampling is ideal, if not essential; and
(b) estimating the power to achieve Secondary Objective I(iii), which depends not only on sample size in the inshore and offshore areas (see Item 4.2.4), but also on how samples are collected within sub-areas 7CS, 7CN and 11.

The Panel **recommends** that analyses be conducted, before the start of the programme, to assess the extent of loss in precision due to the sampling strategy for the objectives related to common minke whales and the implications for the meeting Secondary Objectives. The Panel also **recommends** that the experience/data gained from JARPN II should be used by the proponents to investigate (a)-(c) above.

The Panel **concludes** that offshore sampling lines will not achieve uniform coverage of the research area and do not cover the whole distribution range of each whale species (Bando *et al.*, 2016). The unbalanced sample sizes in the offshore (27) and inshore (100) areas will complicate the estimation of the selectivity pattern for offshore common minke whales (if there is a single O-stock). It may lead to a dome-shaped selectivity pattern, which will need to be accounted for in any SCAA analysis, at the cost of additional parameters and lower precision. The survey plan allows for the possibility of taking multiple animals from a school, which could impact the power of analyses related to diet and genetic structure owing to the possibility of pseudo-replication. Additionally, the rather small sample size offshore may reduce the likelihood of detecting the effects of a major environmental shift on both the diets and the distributions of common minke whales. The Panel **concludes** that Proponents must thoroughly consider issues such as unbalanced sample sizes and the taking of multiple animals from the same school and provide further justification/modification to their current data collection plan (see details in Item 4.3.1).

With respect to sample sizes for common minke whales, as explained under Item 4.4.1, the Panel **agrees** that even if the power to detect a change in recruitment was high, the analyses in Annex 12 do **not** provide a defensible basis for assigning sample size (i.e. 50 from 7CS, 50 from 7CN and 27 from 7E-8-9). The proposed SCAA approach is not able to detect a change in recruitment even after 50 years, i.e. well beyond the project timeframe of 12 years. The Panel **notes** that the SCAA was able to provide unbiased estimates of total numbers even without age data.

Although the Panel had several technical concerns with the analyses presented, which could be addressed in further analyses, it **stresses** that these would **not** remove the fundamental problem that the planned sample size is not fully justified for the primary objective or any of the Secondary Objectives. While Annex D does refer to the use of age data for Objective I (iv), the Panel believes that the link with conditioning is rather weak and the number chosen not well justified in terms of management performance.

5.6.2 Sei whales

The Panel **agrees:**

(a) that there is no clear link between the ability to estimate natural mortality and improvements in the conservation and management of sei whales;
(b) even with the proponents' assumptions, the calculated sample size was underestimated because the analyses ignored the effects of age-reading error and age-readability, both of which will reduce the information content of the age data; such analyses must be updated to account for both of these source uncertainty;
(c) analyses must be undertaken such that the SCAA is not provided with information about MSYR and MSYL; and
(d) analyses should be undertaken in which the historical age-composition data are downweighted by various levels.

In conclusion, the Panel **agrees** that the proponents have **not** justified the sample size for sei whales.

5.7 Collaboration

Annex P asks that the Review Panel to assess 'the degree to which the programme coordinates its activities with related research projects'.

The Panel **welcomes** the information provided on collaboration and **encourages** further collaboration with international researchers. Given that the NEWREP-NP programme is ambitious with many varied research objectives, the Panel **encourages** the proponents to reach out to cutting edge researchers in many of the scientific fields associated with the objectives. Involvement of additional researchers will improve the quality of data, analysis, results and reporting, as is the case for any other large research programme.

5.8 Effects of catches upon stocks

Annex P asks that the Review Panel provide 'advice on the likely effects of the catches on the stock or stocks involved under various scenarios of length of the programme. This will include *inter alia* examination of abundance estimates provided and may involve a different analysis to that provided in the original proposal, including assumptions that short permit proposals may be projected further into the future.

5.8.1 Common minke whales

The Panel had two major concerns with the approach used to assess the potential effects of catches for common minke whales related to both the approaches used (SCAA projections for O-stock and HITTER for J-stock) and the assumptions made especially related to stock structure (especially with respect to the number of O- and J-stocks). Whilst it recognises that the proponents did not agree that the 2-O and 2-J-stocks scenario was realistic, The Panel **concludes** that it is appropriate to at least present the results for comparison, especially as part of the programme's objective is to finalise the stock structure issue. Even using the proponents' methods, the Panel **expresses concern** that the results showed a decline in J-stock for cases where $MSYR_{mat}$=1%.

The Panel provided a detailed **recommendation** (see Item 4.5.1 and Table 3) for a more robust way to estimate the possible effects on stocks based upon a subset of the *Implementation Simulation Trials* from 2013 updated to use $MSYR_{1+}$=1% and $MSYR_{mat}$=4% and fitted to the most recent estimates of abundance. Previous Expert Panels have recommended using the *Implementation Simulation Trials* approach (but not the *CLA* itself) as the best framework for evaluating the effects of catches upon stocks (IWC, 2010a, pp.76-77). The Panel **stresses** the importance of this work being completed before the programme commences.

5.8.2 Sei whales

The Panel **agrees** that the proponents' approach to evaluate the effects of catches for North Pacific sei whales 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 develop additional analyses in which current abundance is assumed to be 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, 2014b).

5.8.3 General

The Panel notes that previous Expert Panels and the Scientific Committee have noted that where such a framework exists, RMP *Implementation Simulation Trials* (not using the *CLA*) should form the basis of any evaluation of the effects of catches on stocks (IWC, 2010a; 2017b). The Panel **recommends** that the Annex P is updated to provide clearer guidance on this.

Table 2a
Summary of the Panel's conclusions in light of Annex P – Part 1. PO=Primary Objective; SO=Secondary Objective.

Lethal	Importance: scientific prospective	Importance: conservation and management	Achievable with non-lethal methods	Equivalent objectives that can be achieved non-lethally?	Lethal components: magnitude and relevance for conservation and management	Design and implementation reasonable to achieve objectives?
PO I: Contribution to optimising the establishment of a sustainable catch limit for common minke whales in the coastal waters of Japan						
Y	**Yes**	**Yes**	**In part (see below)**			
SO I (i): Investigate the spatial and temporal occurrence of J stock common minke whales around Japan, by sex, age and reproductive status						
Y	Yes, particularly given availability of age structure. New compared to past programmes.	Not needed to run *CLA*, but increase accuracy of ISTs.	Currently not feasible, but current developments may change the situation in near future.	Replacing age with length is possible but not as precise	Magnitude and relevance of improving and understanding of spatial and temporal occurrence of J stock is useful but lethal components contribution not likely to be as substantial for overall management as addressing stock structure uncertainty and improving estimates of abundance.	The inshore sampling design makes analysis challenging and this has not been addressed. Field and laboratory implementation is reasonable.
SO I (ii): Estimate the abundance of the J and O stocks in coastal waters of Japan						
	Yes	Yes, for *CLA* and ISTs	NA	NA	NA	Yes. The split of abundance estimate to stock depends on appropriate modelling framework that includes stock structure
SO I (iii): Verify that there is no structure in the O stock common minke whale in the Pacific side of Japan						
Y	Yes	Yes, for ISTs	Yes	NA	Substantial impact. The performance of few RMP variants are critically dependent on whether there are one or two O stocks.	The design of the sampling scheme does not maximise the information available to assess whether there is a stock structure within O stock. The analysis of more genetic loci on the existing samples is more likely to meet the objective then additional sampling.
SO I (iv): Improve RMP trials by incorporating age data in their conditioning						
Y	Yes	Yes, for ISTs	Much of the age data already exist but has not been included in past ISTs. Age data for the future currently not feasible, but current developments may change the situation in near future.	The past age data could be included without collecting additional lethal samples.	Unclear because there are substantial historical samples which may be sufficient to improve conditioning without additional samples being collected.	Yes, this is a modelling exercise.
SO I (v): Investigation of the influence of regime shift on whale stocks						
Y	Yes for understanding responses of environmental change.	Not important	No	No	Little importance	Major concerns because of small sample sizes for common minke whales offshore, time-scale of programme against possible regime shifts occurring and requirement for better sampling of prey availability.
PO II: Contribution to the RMP/*IST* for North Pacific sei whale						
Y	**Yes**	**Yes (eventually)**	**Yes**			
SO II (i): Abundance estimates for North Pacific sei whale taking account additional variance						
	Yes	Yes, for IA	NA	NA	NA	Yes
SO II (ii): Estimation of biological and ecological parameters in North Pacific sei whales for RMP *Implementation*						
Y	Yes	Yes, for developing models for this species and IA.	Considerable age data already exist. Age data for the future but currently not feasible, but current developments may change the situation in near future.	The past age data could be included without collecting additional lethal samples.	Unclear because there are substantial historical samples which may be sufficient to improve conditioning without additional samples being collected.	Yes
SO II (iii): Additional analyses on stock structure in North Pacific sei whale for RMP *Implementation*						
Y	Very limited.	Yes, for IA	Limited	Yes	No	Yes
SO II (iv): Specification of RMP *ISTs* for North Pacific sei whale						
	Yes	Yes		Yes	NA	NA
SO II (v): Investigation of the influence of regime shift on whale stocks						
Y	Yes for understanding responses of environmental change.	Not important	No	No	Very little.	Major concerns because of time-scale of programme against possible regime shifts occurring and requirement for better sampling of prey availability.

Table 2b

Summary of the Panel's conclusions in light of Annex P – Part 2. PO=Primary Objective; SO=Secondary Objective.

Lethal	Degree of coordination with related projects?	Effects of catches on stocks	Intermediate targets	Any other relevant matter for the SC
PO I: Contribution to optimizing the establishment of a sustainable catch limit for common minke whales in the coastal waters of Japan				
Y				
SO I (i): Investigate the spatial and temporal occurrence of J stock common minke whales around Japan, by sex, age and reproductive status				
Y	Build extensively on JARPN II	Not fully evaluated. If it is a single O stock the effect of catches is minimal. However, the analysis presented did not consider possibility of two O stocks.	Unclear the intermediate target for biopsy sampling feasibility study	Unlikely to be used for the 2018 *Implementation Review* but it could feed into that in 2024.
SO I (ii): Estimate the abundance of the J and O stocks in coastal waters of Japan				
	Yes	NA	Sufficient	Abundance relevant to much SC work. Surveys could provide information on other species.
SO I (iii): Verify that there is no structure in the O stock common minke whale in the Pacific side of Japan				
Y	Builds extensively on JARPN II	If it is a single O stock the effect of catches is minimal. Unknown as the analysis presented did not consider possibility of two O stocks.	OK if sufficient analyses are carried out.	Small NEWREP-NP sample are expected to be available to be used for the 2018 *Implementation Review*, but it could feed in the 2024 *Implementation Review*.
SO I (iv): Improve RMP trials by incorporating age data in their conditioning				
Y	-	If it is a single O stock the effect of catches is minimal. Unknown as the analysis presented did not consider possibility of two O stocks.	Sufficient	This require coordination with the SC in the upcoming *Implementation Review.*
SO I (v): Investigation of the influence of regime shift on whale stocks				
Y	Partial. Potential for coordination with many other initiatives.	If it is a single O stock the effect of catches is minimal. Unknown as the analysis presented did not consider possibility of two O stocks.	Reasonable	Data could be relevant to EM
PO II: Contribution to the RMP/IST for North Pacific sei whale				
Y				
SO II (i): Abundance estimates for North Pacific sei whale taking account additional variance				
	Yes	NA	Sufficient	Abundance relevant to much SC work. Surveys could provide information on other species.
SO II (ii): Estimation of biological and ecological parameters in North Pacific sei whales for RMP *Implementation*				
Y	Yes	Negligible	Adequate	
SO II (iii): Additional analyses on stock structure in North Pacific sei whale for RMP *Implementation*				
Y	Yes	Negligible	Adequate	
SO II (iv): Specification of RMP *ISTs* for North Pacific sei whale				
	NA	NA	Adequate	
SO II (v): Investigation of the influence of regime shift on whale stocks				
Y	Partial. Potential for coordination with other initiatives.	Negligible	Reasonable	Data could be relevant to EM

5.9 Review of progress

Annex P asks that the Review Panel determine 'whether the programme has specified intermediate targets that would allow for an adequate review of progress relative to programme objectives'.

The Panel noted that the proponents are proposing a mid-term review after 6 years. The Panel **agrees** that:

(a) a mid-term review is desirable;
(b) the proponents must ensure that data are promptly analysed to ensure a meaningful mid-term review; and
(c) adequate resources must be allocated to work on common minke whale biopsy sampling as soon as possible to facilitate the prompt use of non-lethal techniques – this specific effort should be reviewed before the mid-term review.

In order to achieve the above, the Panel **strongly recommends** the recruitment of sufficient highly trained and qualified analyst/modellers to improve NEWREP-NP study design, data analysis and review.

5.10 Overall conclusions

The Panel's tasks were twofold: (1) review the JARPN II programme including analyses of data up to 2016; and (2) review the NEWREP-NP proposal in light of Annex P.

With respect to the JARPN II programme, although the additional data for the period were provided, only some analyses were available, primarily on the work carried out comparing lethal and non-lethal techniques. The Panel **agrees** that a full 'final' review of the JARPN II programme will be possible only when final analyses are completed, in line with the IWC Scientific Committee-agreed timeframe for analyses, and a full consolidated report made available. The Panel made several recommendations related to this item, including some directed at clarifying Annex P with respect to final reviews.

With respect to the review of NEWREP-NP, the Panel recognised the considerable work that had been undertaken by the proponents in developing the proposal and **commends** their efforts to: (a) follow Annex P and the Checklist; and (b) provide additional information during the Workshop itself (Annex D).

The Panel **agrees** that the Primary and most of the Secondary Objectives are important for conservation and management, although the level of the contribution varies. Despite the work undertaken by the proponents, the Panel **concludes** that, in its current version, (1) the Proposal does not adequately justify the need for lethal sampling and the proposed sample sizes, particularly with

Table 3

Summary of recommendations made relevant to NEWREP-NP.

No.	Agenda item	Panel recommendations	Comment/timeline
1	4.1.5	The Panel **recommends** that a more thorough quantitative review of the relative contribution of those data types that can only be obtained by lethal sampling to the ability of the proponents to meet their primary objectives is warranted for a full evaluation of options in terms of lethal *vs* non-lethal methods in relation to the objectives (see also Item 4.2).	Required for any revised proposal.
2	4.1.5	The Panel **recommends** that any Special Permit programme should include a specific Primary Objective to continually review new techniques as these become available to facilitate discussions of methods and samples sizes at milestones such as the mid-term reviews. *If* present data do not allow for this, a focussed pilot study to enable a full and proper evaluation of lethal vs present non-lethal methods integrated across objectives should be undertaken, prior the full programme starting; where such data already exist then the desktop-study evaluation should be undertaken *before* the permit programme begins. Such evaluations could be undertaken in light of an expanded framework as recommended under Item 3.3.4 and must be properly designed to enable more effective reviews of sample sizes/methods during mid-term reviews.	Whilst relevant to the proponents, this is directed primarily at the Scientific Committee and linked to Recommendation 19.
3	4.2.1	*Sexual maturity:* The Panel **recommends** that levels of progesterone in blubber and serum should be compared with sexual maturity and reproductive status of examined females. This comparison is valuable for assessing the efficacy of biopsy sampling for assessing reproductive status.	Add to the research protocols for any revised proposal.
4	4.2.1 and 4.3.2	*Sightings surveys*: The Panel highlighted several issues that must be considered when designing line transect surveys that are expected to provide abundance information to address multiple objectives. The Panel **recommends** that these issues related to survey design, data collection protocols and priorities, data analyses and coordination are included in the plans to be submitted to the Scientific Committee for approval, before the surveys start. The main additional issues that should be covered in the proposals for surveys submitted to the Scientific Committee are: (a) **Evaluation of past surveys' analytical difficulties**. These new surveys provide an important opportunity to evaluate and potentially add/modify the variables or values of variables that are collected. Evaluating the shortcomings of previous surveys (for example, sample size issues and the amount of effort expended, problems that arose in analyses of past data) could suggest ways to supplement the future surveys. (b) **Appropriate temporal stratification** of the surveys. (c) **Appropriate direction of travel** for the survey vessel(s) and direction of track lines to account for migrating animals. (d) **Use of independent observer (IO) mode,** especially in the offshore waters where the weather and sea state conditions are poorer. (e) **Use of passive independent observer mode** with abeam closing to get the benefits of estimating g(0) and also improving the precision of the group sizes. (f) **Development of protocols/priorities for biopsy-related activities**. (g) **Evaluation of additional variance analysis and spatial model methods** to determine which is preferred or whether both methods are investigated. (h) **'Regime shift'-related aspects** require that consideration should be given to whether sampling of prey is possible during the line transect surveys - obtaining simultaneously collected prey and whale data seems ideal, however logistically challenging.	Address in individual survey plans submitted to the Scientific Committee.
5	4.2.5	Care is required during sub-sampling of prey in whale stomachs to ensure that the sample is representative when stomach volumes are large and prey diverse; the Panel **recommends** that the proponents specify how this is to be achieved in the field protocols.	Add to the research protocols for any revised proposal.
6	4.2.5	To demonstrate the feasibility of meeting the Secondary Objective related to regime shift, the Panel **recommends** that the proponents specify more fully: (a) quantitative criteria with respect to identifying [major] environmental change and potential responses by whales; (b) the adequacy of the methods and effort to specify the distribution, seasonality, and precision of the environmental data, for the regions in which the whales being studied are feeding; (c) taking into account uncertainty, conduct a power analysis to determine the sample sizes/effort for the characterisation of the environment and whales (including distribution and prey use) needed to determine if there are changes before and after a major environmental change occurred, should one occur during the programme.	Required for any revised proposal if the proponents wish to continue with this Secondary Objective for either or both species.
7	4.2.11	In order to achieve aim of research item (i) the Panel **recommends** that any immune function assays used should be those already established for cetaceans (Schwacke *et al.*, 2012) so that the results are comparable to published studies.	Add to the research protocols for any revised proposal.
8	4.2.11	Following previous expert panel recommendations, the Panel **strongly reiterates** that all lipophilic compounds being measured must be reported on a lipid weight and not a wet weight basis.	Add to the research protocols for any revised proposal.
9	4.2.11	Research item (iii) relates to novel compound exposure and indicates that the levels of polybrominated diphenyl ethers (PBDEs) and other flame retardants would be quantified in blubber, prey and marine debris (presumably micro- and macro-plastics found in whale stomachs). However, there is no indication of how these results would be related to 'adverse effects' as stated in the objective. The Panel therefore **recommends** an integration and combined analysis of the results obtained by all three research items (i.e. relating exposure to polychlorinated biphenyls, flame retardants and novel compounds from plastics to responses) such as immune function and enzyme induction, including controlling for any effects of age (emphasizing the need to use the age estimates obtained from the earplugs rather than body length) and nutritional condition. This would require samples from the same individuals to be included in each of the three research items.	Recommendation for analyses of results relevant for any mid-term review.
10	4.2.12	The Panel **recommends** coordination with IWC-POWER with respect to sightings surveys, biopsy sampling and photo-ID for large whales to ensure consistent data collection and processing, as appropriate. The Panel also **recommends** information on these species are included in annual reports to the Scientific Committee to encourage collaboration with scientists involved with research on these two species.	Preparation for sightings surveys and presentation of results.
11	4.3.1	*Coastal component*: The Panel **recommends** that analyses be conducted, before the start of the programme, to assess the extent of loss in power and precision due to the sampling strategy for the objectives related to common minke whales and the implications for meeting Secondary Objectives. The experience/data gained from JARPN II should be used by the proponents to investigate issues (a)-(c) below: (a) the design would lead to oversampling of the areas close to ports (the Panel was informed that an additional land-based station may be established in the northern Sanriku to better cover sub-areas 7CS and 7CN); (b) the boats can search freely once they reach 30 n.miles from port if no whales have been encountered *en route* from port, which means the design is not fully specified in terms of the catches by the port-based boats; and (c) the *Nisshin Maru* will conduct sampling if the number of common minke whales caught does not reach the target number, but no sampling plan for this contingency is provided.	Add to the research protocols for any revised proposal.
12	4.3.1	*Offshore component*: During the Workshop, the proponents provided the Panel with the sampling strategy (samples by month, year, and sub-area) and the Panel **recommends** that this information be included in the version of the proposal that is provided to the Scientific Committee. The Panel also **recommends** that tables of past samples in the same format as the new samples should be included in a revised proposal to place the new samples in a spatio-temporal context.	Required for any revised proposal.

No.	Agenda item	Panel recommendations	Comment/timeline
13	4.4.2	The Panel **recommends** conducting analyses in which the historical age-composition data are downweighted by various levels.	Required for any revised proposal.
14	4.4.3.2	The Panel **recommends** the implementation of biopsy sampling to reduce the lethal sample size as soon as it is deemed feasible rather than wait until the mid-term review.	As soon as feasible.
15	4.4.3.2 and 4.6.2	Given the discussion under Item 3.3.4, the Panel **recommends** that a properly designed experiment to assess the efficiency of biopsy sampling of common minke whales be undertaken (there is already sufficient detail on catch to render additional capture experiments unnecessary). This should incorporate at least: (a) the use of the expected vessels in the programme (i.e. the small type whaling vessels); (b) the use of vessels (that may be different from the expected vessels) considered suitable by scientists already experienced with biopsy sampling this species; (c) suitable levels of effort to allow a statistical comparison (effort for biopsy sampling should be measured or converted to the same units used for examining catching efficiency); (d) effort should be carried out in various environmental conditions (e.g. sea state, swell, visibility) up to the maximum conditions that would apply to whaling; (e) advice and training from invited experienced minke whale biopsy samplers (e.g. Christian Ramp or Lars Kleivane); and (f) analyses that provide a proper comparison of biopsy sampling and catching (including time to process samples under various variables such as experience of sampler, vessel, equipment, effort under similar conditions). The Panel **reiterates** its comments that the proponents must (a) ensure that data are promptly analysed to ensure a meaningful mid-term review – it also refers to its comments about providing adequate resources into work on common minke whale biopsy sampling as soon as possible to facilitate the prompt use of non-lethal techniques.	High priority to begin as soon as possible this year.
16	4.4.3.2	The Panel **recommends** the proponents attend the IWC-ONR joint Workshop on Tag Development, Follow-Up Studies and Best Practices to be held in September 2017 in Silver Spring, MD (USA) to become acquainted with the most current tagging technologies and deployment methods.	September 2017.
17	4.4.3.2	Rather than set an arbitrary number of telemetry tags for deployment, the Panel **recommends** that the number, location and timing of tag deployments should reflect the questions being addressed.	Add to protocols for any revised proposal.
18	4.4.3.2	Once a suitable tag is developed, the Panel **recommends** tagging North Pacific common minke whales within the study area to address stock structuring within the NEWREP-NP study region. Again, tag deployment location and tag design should be tailored to the question being addressed.	As soon as practical.
19	4.4.3.2	The Panel **recommends** using the extensive amount of data in age-related methylation in mammal model species (e.g. humans) where thousands of CpG sites have been identified in which the level of methylation correlates with age, similar to the approach taken by Polanowski *et al*. (2014) who assessed 37 CpG sites originally identified in humans. Once putative aging CpG sites have been identified among the candidate CpG sites observed in humans, a more targeted approach may be developed by identifying the homologous loci in the minke whale genome, thereby presumably increasing the precision of methylation-based aging in North Pacific minke whales. This work should be undertaken in the context of whether the technique shows a suitable level of precision for meeting conservation and management objectives requiring age data, not whether it achieves a comparable level of precision to ear plug readings.	Can start with existing data.
20	4.4.3.2	The Panel **recommends** that the similar data/results from the Icelandic sampling programme are incorporated in the analyses. The Panel **reiterates** that non-lethal techniques should be incorporated into the programme as soon as they are deemed plausible	-
21	4.4.3.2	*Sample size (potential reduction of lethal sample size)*: An important component of determining appropriateness of techniques is determination of sample size - as non-lethal techniques become appropriate, non-lethal and lethal sample sizes will need to be recalculated to ensure that objectives are met. The Panel noted there was no discussion in the proposal as to what the strategy would be to determine sample sizes or how the current methods that determine sample sizes might be modified to determine the new sample sizes. The Panel **recommends** this issue be considered by the proponents and a strategy to be included in the project proposal before the start of the fieldwork.	Required for any revised proposal.
22	4.4.3.2	Sample size (in general): The Panel strongly recommends that the Proponents take full advantage of existing materials and data to assess the suitability of the planned efforts under NEWREP-NP to resolve the current stock structure hypotheses in the targeted species, before collecting more samples. Simulation studies based upon data collected from the current samples are recommended to adjust the experimental design to address the targeted levels of population divergence/heterogeneity. Such simulations may reveal that an increase in data from existing samples may prove beneficial over collecting additional samples.	Required for any revised proposal.
23	4.5.1.2	In relation to the impact of catches on common minke whales, 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 $MSYR_{1+}$=1% (IWC, 2014b).	Required for any revised proposal.
24	4.5.1.2	Furthermore, the analyses for common minke whales 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 $MSYR_{1+}$=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 it **stresses** the importance of this being completed before the programme commences.	Required for any revised proposal.
25	4.5.2.2	In relation to North Pacific sei whales, 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, 2014b).	Required for any revised proposal.
26	4.6.2	The Panel **recommends** that the proponents collaborate with wildlife immunologists and immunotoxicologists to assist them as optimising, validating and interpreting the results from any immune assays requires specialist skill and knowledge; it is **not** a trivial undertaking.	Prior to undertaking the immune function analyses.
27	4.6.2	Although a new graduate analyst has been appointed, the Panel **remains concerned**, that as has been the case for all previous special permit programmes undertaken by Japan, field and laboratory work and laboratory analyses have been allocated much higher priority than analyses and modelling. This has been reflected in the long times taken to complete analyses (some of which remain incomplete). The Panel **strongly recommends** the recruitment of sufficient highly trained and qualified analyst/modellers to improve NEWREP-NP study design, data analysis and review.	Prior to undertaking the programme.
28	4.6.2	Additional information on sample and data archiving, relational database(s) as noted by previous expert panels would be welcome.	Include as part of any revised proposal.
29	4.6.2	The proponents recognised the need for a backup contingency plan in the event of disruption of the programme. The primary contingency is for the cruise leader to adjust sampling efforts and locations, if necessary, for example due to bad weather preventing the collection of data in a certain location. The Panel **agrees** that contingency plans are needed, but noted that the proponents have not yet developed a more detailed plan/protocol, *a priori*, for how research will be modified in the event of disruption. It **recommends** that this be done.	Add to protocols for any revised proposal.

respect to quantifying the likely extent of management and conservation improvement in the context of the IWC and (2) has basic design shortcomings. The Panel **recommends** that the lethal sampling components of the programme should not occur until the additional work identified in its report is undertaken and reviewed. The detailed rationale for this can be found in the full report. In short, the Panel's main concerns relate to:

(1) insufficient justification for the proposed sampling design and sample sizes for the lethal components;
(2) insufficient justification that *additional* age data will notably improve conservation and management; and
(3) the proponents' approach used to assess the potential effects of catches on common minke whales (and especially that even under the approach taken by the proponents, J-stock was shown to decline under some scenarios).

The Panel has provided **recommendations** on additional analyses that should be undertaken to limit some of these shortcomings (summarised in Table 3).

The Panel has also developed **recommendations** to improve the Annex P process, including the need to develop agreed frameworks to compare lethal and non-lethal approaches, to quantify 'improvements' in management in an IWC context and to evaluate the effects of catches on stocks.

6. ADOPTION OF REPORT

The report was largely adopted by email on 1 March 2017 and updated after fact checking on 17 March 2017. The Chair deeply thanked all members of the Panel for their tireless dedication during both the meeting and the revision of the report (through email exchanges at impossible hours and weekends), with professionalism and good temper. She was grateful to them for having donated their time to this important activity of the Scientific Committee and Commission as part of the Annex P process.

The Chair also thanked the Proponents for their kindness, logistical support and patience during the process of the revision of the report.

The Panel expressed its thanks to the Chair for her excellent skills in leading it through a review of a complicated document, ensuring that the Annex P process was followed. It expressed special thanks to Greg Donovan, who in exceedingly trying times, contributed fully to the review and once again created a report that clearly and accurately reflected the review and the Panel conclusions. The Panel sent its continuing best wishes to Jette Donovan Jensen for a full recovery.

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Annex A

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Annex B
Agenda

1. Introductory remarks
   - 1.1 Welcome
   - 1.2 Available documents
   - 1.3 Adoption of the Agenda
2. Objectives of the Workshop
   - 2.1 Introduction to the Annex P process
   - 2.2 Introduction to the RMP process
3. Review of the JARPN II programme
   - 3.1 Overview of the Panel and Scientific Committee recommendations and the earlier JARPN II review
   - 3.2 Update analyses incorporating data up to 2016 and responding to recommendations made in IWC (2017)
   - 3.3 Conclusions and recommendations
4. Review of the research programme proposal
   - 4.1 Objectives of the proposal
     - 4.1.1 Importance of stated objectives from a scientific perspective and for the purposes of conservation and management of whale stocks
       - 4.1.1.1 Contribution to past recommend-ations of the Scientific Committee
       - 4.1.1.2 Contribution to the completion of the Comprehensive Assessment or progress for future in-depth assessments
       - 4.1.1.3 Contribution to the carrying out of *Implementations* or *Implement-ation Reviews* of the RMP or AWMP
       - 4.1.1.4 Contribution to improved understanding of other priority issues as identified in the Scientific Committee Rules of Procedure or in its reports
       - 4.1.1.5 Contribution to recommendations of other intergovernmental organisations
     - 4.1.2 Improvement in the conservation and management of other living marine resources or the ecosystem of which the whale stocks are an integral part
       - 4.1.2.1 Contribution to past recommend-ations of the Scientific Committee
       - 4.1.2.2 Contribution to the completion or carrying out Comprehensive Assessment, in-depth assessments, *Implementation Reviews* of the RMP or AWMP
       - 4.1.2.3 Contribution to improved under-standing of other priority issues as identified in the Scientific Committee Rules of Procedure or in its reports
       - 4.1.2.4 Contribution to recommendations of other intergovernmental organ-isations
     - 4.1.3 Hypotheses testing not directly related to the management of living marine resources
     - 4.1.4 Evaluation of options in terms of lethal vs non-lethal methods in relation to objectives
   - 4.2 Methods to address objectives: study area(s), sample size, sampling design and data analysis
     - 4.2.1 Evaluation of sample sizes, spatial and temporal scales and analytical methods in relation to the programme's stated research objectives
     - 4.2.2 Feasibility of non-lethal alternatives to either replace or reduce the size of proposed lethal sampling
   - 4.3 Assessment of potential effect of catches
   - 4.4 Logistics and project management
   - 4.5 Co-operative research
5. Conclusions

REFERENCE

International Whaling Commission. 2017. Report of the Expert Panel of the Final Review on the Western North Pacific Japanese Special Permit Programme (JARPN II), 22-26 February 2016, Tokyo, Japan. *J. Cetacean Res. Manage. (Suppl.)* 18:527-92.

Annex C
List of Documents

PRIMARY DOCUMENTS

SC/J17/JR

1. Government of Japan. Proposed Research Plan for New Scientific Whale Research Programme in the western North Pacific (NEWREP-NP).
2. Rev1. Tsutomu Tamura, Toshihide Kitakado and Luis A. Pastene. Progress Report of the Work Responding Recommendations from the JARPN II Final Review Workshop.
3. Genta Yasunaga, Toshihiro Mogoe, Tsutomu Tamura, Hideyoshi Yoshida, Takeharu Bando and Hidehiro Kato. Results of the feasibility study on non-lethal techniques to address the key research objective of JARPN II, based on data and samples obtained in the period 2014-16.
4. Government of Japan. Addendum to Annex 12.

OBSERVERS STATEMENTS AND RESPONSES

SC/J17/O

1. Government of New Zealand. New Zealand Statement to the NEWREP-NP Special Permit Expert Panel Review Workshop.
2. W.K. De La Mare. Observers Statement to the NEWREP-NP Special Permit Expert Panel Review Workshop.
3. The NEWREP-NP Proponents. Response to the New Zealand Statement to the NEWREP-NP Special Permit Expert Panel Review Workshop (SC/J17/O01).
4. The NEWREP-NP Proponents. Response to Observer Statement to the NEWREP-NP Special Permit Expert Panel Workshop by W.K. de la Mare (SC/J17/O02).

FOR INFORMATION DOCUMENTS

SC/J17/ForInfo

1. International Whaling Commission. Annex P Process for the Review of Special Permit Proposals and Research Results from Existing and Completed Permits.
2. International Whaling Commission. Extracts from SC Report on JARPN II [uncorrected page proof].
3. International Whaling Commission. Report of the Expert Panel of the Final Review on the Western North Pacific Japanese Special Permit Programme (JARPN II) [uncorrected page proof].
4. International Whaling Commission. Report of the Scientific Committee. Annex D1. Report of the Working Group on the *Implementation Review* for western North Pacific common minke whales (2014).
5. International Whaling Commission. 2014 SC Report (*JCRM Suppl.* 15) on NP minke whale *Implementation*. pp.11-15.

Annex D

A Compilation of Proponent's Responses to Questions and Request for Data from the NEWREP-NP Review Panel

The NEWREP-NP Proponents

This document presents a compilation of the proponent's responses to questions and request for data from the NEWREP-NP Review Panel. The responses and data were provided to the Review Panel as 'Morning Papers', and these are presented here in chronological order. These papers were prepared as unofficial information to assist the review by the Panel, and thus the contents and the view of the proponents may be revised further.

Morning paper, 31 Jan 2017-A: Issues derived from discussion on Document SC/J17/JR02Rev1

1. AGEING ISSUES

Progress in ageing techniques using earplugs for North Pacific minke and sei whales

Information on whale age is of key importance for estimate life-history parameters that can be used for stock management. At present, earplug is considered the most reliable source of absolute age determination in baleen whales.

Age reading from the earplugs of the common minke whale was generally believed to be difficult and impractical because of their softness and poor formation of growth layers. In the past, it was reported that age readability of common minke whales off Northern Japan collected by commercial whaling was only 8.7% (Kato, 1992, p.444). However, under JARPN and JARPN II survey, all earplugs were carefully collected and tried to read growth layers (Fig. 1). Furthermore, it was tried to improve age readability especially young animals to prevent breakage and losing neonatal line using new collection technique 'gelatinized extraction'. In recent years, this new technique had been applied to sei whales. In this document progress in ageing techniques using earplug is presented. This document also provides information of progress of age data since JARPN II review in 2016 including investigation on whether there is any relationship between body length or sex and age readability.

A new sampling method named 'gelatinized extraction method' was presented previously, which remove the earplugs safely from external auditory meatus using gelatin. In this method, gelatin is injected into the external auditory meatus for embedding earplugs to protect soft and easily broken parts at the collection stage. It was revealed that embedding earplugs by gelatin minimize breakage and lacking neonatal line.

This was effective especially in younger animals. It was suggested that gelatinized collection is found to be useful for improvement readability.

Under JARPN and JARPNII surveys, readability of common minke whale was improved from 8.7% to 44.1% because of careful treatment and efforts in technical development of sampling and introduction of Gelatinized extraction. Earplugs of North Pacific common minke whales, it had not been available for age estimation. However, it was found that some of earplugs of common minke whales are useful as a valid age tool for obtaining valuable age information. In recent years, gelatinized extraction method had been applied to sei whales. Problem on earplugs in this species is that it had already fallen apart inside the external auditory meatus before sampling. At the stage of preparation and ageing in the laboratory, it is difficult to reconstruct and it takes a time to determine their age. This method is effective for improving age readability and easy to handle at the stage of preparation and ageing for sei whale.

To have clearer core surface image of growth layers, we have examined histological sections (thickness 4μm) sliced by the Kawamoto specialized frozen sectioning techniques,

Table 1

Progress of age reading from the JARPN II review in 2016.

	2016 JARPN II Review	Additional data
Common minke whale		
Research year	1994-2013	2014-16
Number of whales	2,572	188
With readable earplugs	1,135	96
Sei whale		
Research year	2002-13	2014-15*
Number of whales	1,084	160*
With readable earplugs	683	118*

*Analysis of samples is still ongoing.

Table 2

Age readability of common minke whales collected by JARPN and JARPN II surveys from 1994 to 2016 by sex and maturity status.

	Sex	Number of whales	With readable earplugs	Age readability (%)
Combined	Male	2,085	963	46.2
	Female	775	326	42.1
Sexually	Male	625	231	37.0
immature	Female	563	200	35.5
Sexually	Male	1,460	732	50.1
mature	Female	212	126	59.4
Total		2,860	1,289	45.1

Table 3

Age readability of sei whales collected by JARPN II surveys from 2002 to 2015 by sex and maturity status.

	Sex	Number of whales	With readable earplugs	Age readability (%)
Combined	Male	575	379	65.9
	Female	678	425	62.7
Sexually	Male	179	95	53.1
immature	Female	157	77	49.0
Sexually	Male	396	284	71.7
mature	Female	522	317	60.7
Total		1,253	804	64.2

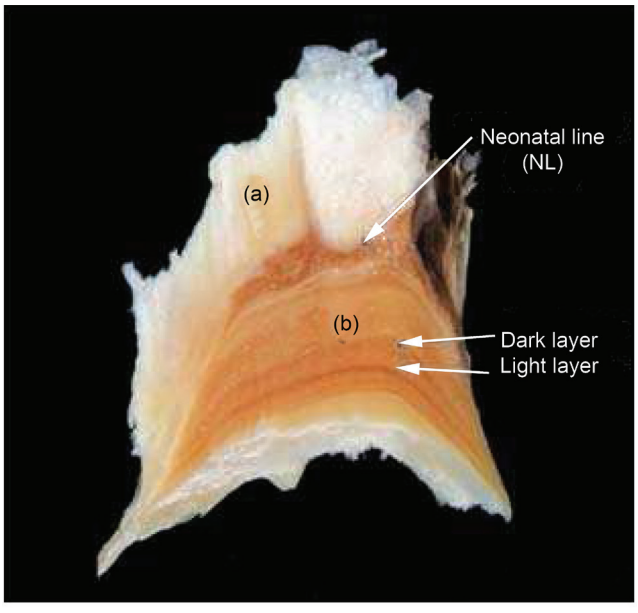

Fig. 1. Bisected surface of an earplug of a common minke whale. (a) outer covering; (b) core. Scale bar: 5mm.

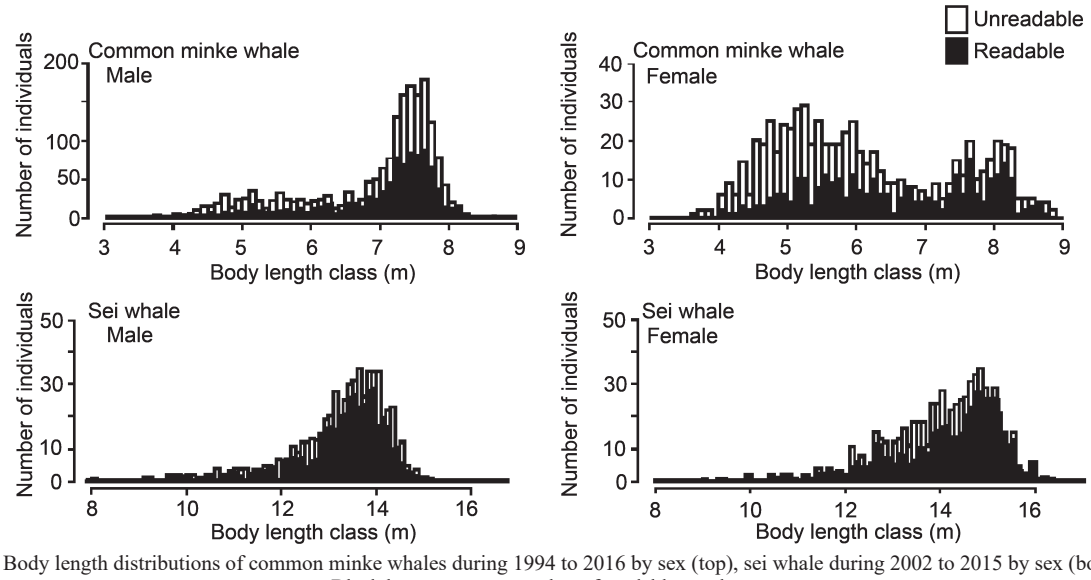

Fig. 2. Body length distributions of common minke whales during 1994 to 2016 by sex (top), sei whale during 2002 to 2015 by sex (bottom). Black bar represents number of readable earplugs.

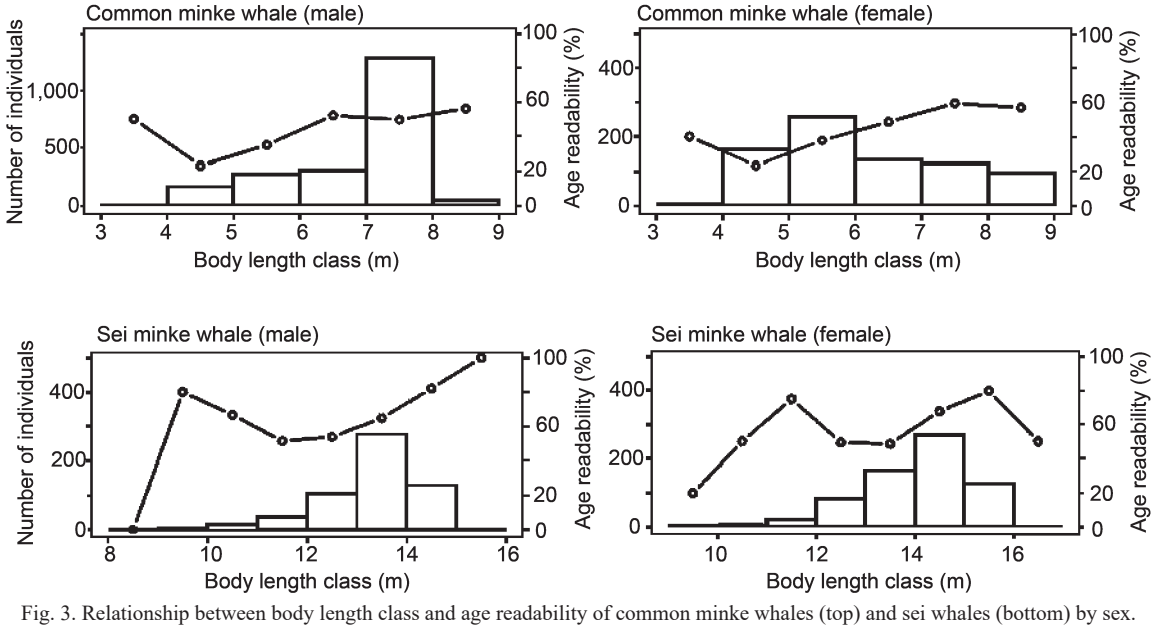

Fig. 3. Relationship between body length class and age readability of common minke whales (top) and sei whales (bottom) by sex.

with stained by Toluidine Blue, Hematoxylin and Eosin, SudanIII, SudanVII and Alizarin red-S. The histological section with Alizarin red gave the clearest lamination image that we easily identified both dark and pale laminations, suggesting close relation to the seasonal changes intake of calcium through feedings. Previous age determination has focused on a fat content in the growth layers, however there is the potential for the improvement in readability of unclear the growth layers when we focus on calcium.

Progress of age reading from JARPN II review in 2016

For earplugs collected in 2014 to 2016, laboratory work was carried out to read growth layers after 2016 JARPN II review. We added new age data (96 for common minke whale, 118 for sei whale) and investigated into whether there is any relationship between body length or sex and readability (Table 1).

About age readability of common minke collected during 1994 to 2016, age readability of all animals was 46.2% for males, 42.0 % for females (Table 2). Readability of mature animals was higher than immature animals in both sexes. Fig. 2 shows body length distributions of common minke whales and sei whale by sex. It is shown that body length compositions of readable earplugs in each sex are not always reflect entire whales. Fig. 3 shows age readability for each body length class of common minke whales and sei whale by sex. Both male and female showed the same tendency, readability was increased with body length class in common minke whale. Sei whales age readability by body length class was around 60 to 70%.

Age data from earplugs can contribute to conditioning SCAA models and the specification of RMP/*IST* trails. Since the readability varies depending on body length composition and species, it is necessary to take that into consideration when used for analysis like population dynamics and so on. Furthermore age data from earplugs can contribute to calibrating other age estimation methods such as AAR study or DNA methylation study.

Age reading error

Result of age-reading errors experiment for North Pacific common minke whale and sei whale are given in Appendix 1.

2. ECOSYSTEM MODELING ISSUES

After SC/66b, preliminary assessment on quality of input data were conducted and pedigree (ranking of data quality) in accordance with Gaichas *et al.* (2015) was assigned based on the assessment. Preliminary check on a series of pre-balance diagnostics, PREBAL (Link, 2010) was also conducted for improvement. These results were integrated in an improved version of Ecopath and some of the results will be presented to 'ICES/PICES: Drivers of dynamics of small pelagic fish resources' in March 2017 (Watari *et al.*, 2017) to invite comments from experts of small pelagic fish. Reconsideration of input data of Ecopath presented to the JARPN II Final Review Workshop (Murase *et al.*, 2016) will be necessary based on results of the additional analyses. Proponents recognize that it is premature to present the results in a form of scientific paper for consideration by the Panel and/or the IWC/SC at this stage. Proponents would submit fully improved version including Ecosim part of the modelling to the IWC/SC in the near future (hopefully after 2018) however considerable tasks need to be completed to obtain such results.

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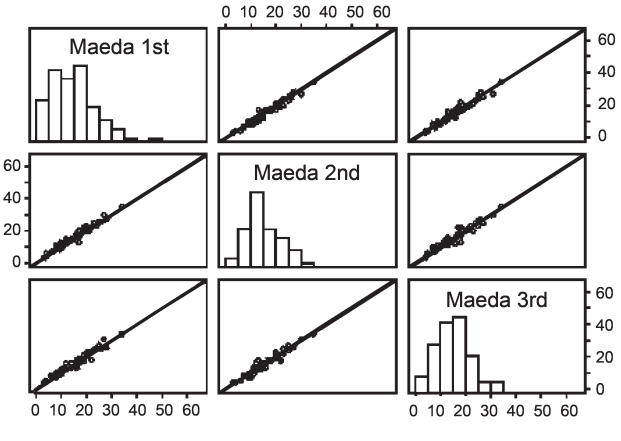
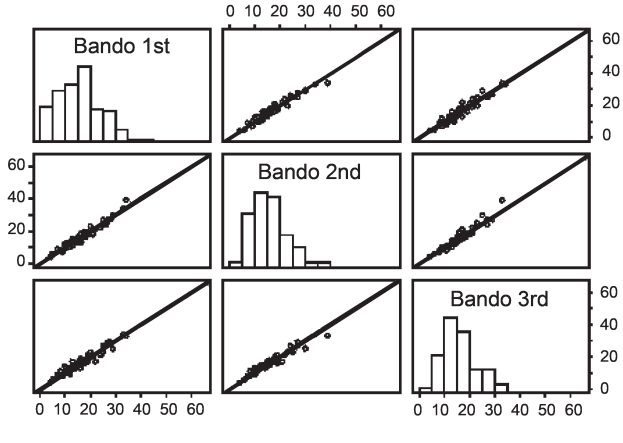
Appendix 1

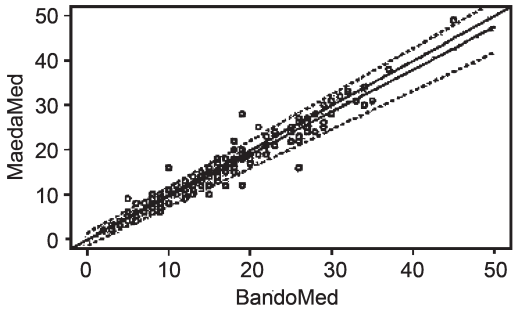
Age-reading error for the WNP minke whale

Data presentation





Estimation of age-reading error

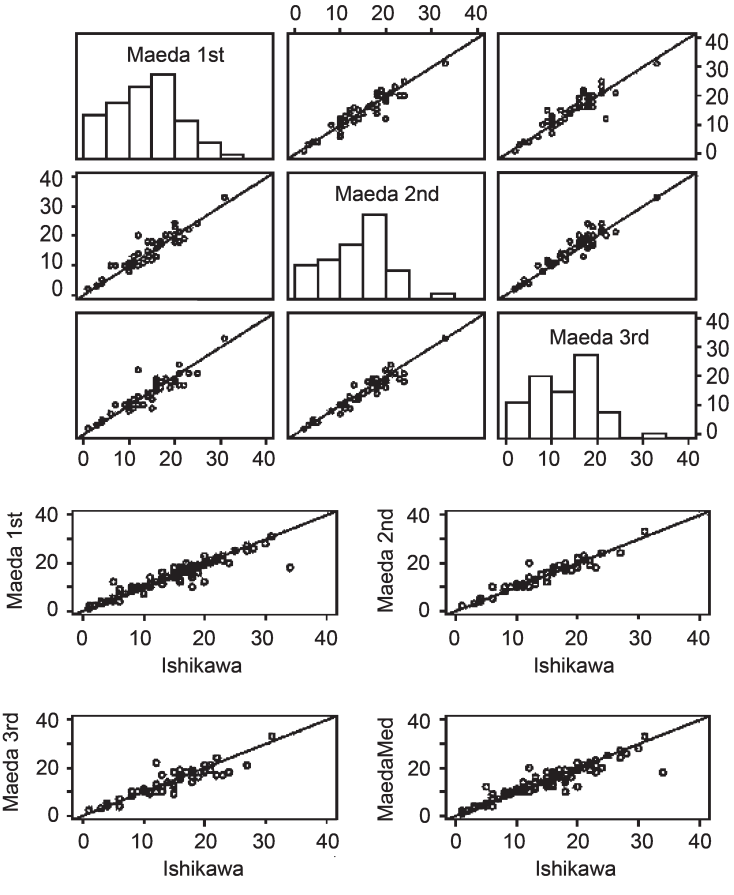


Appendix 2

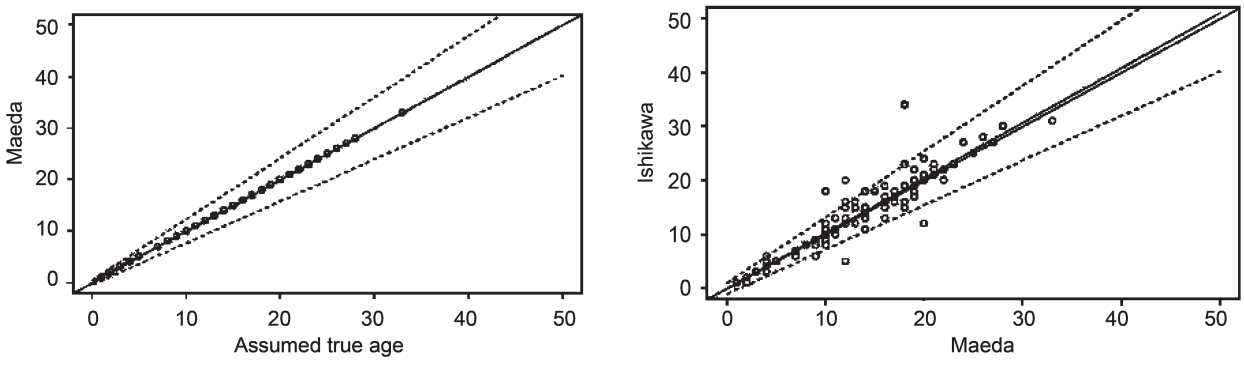
Age-reading error experiment for NP sei whale

Assumption

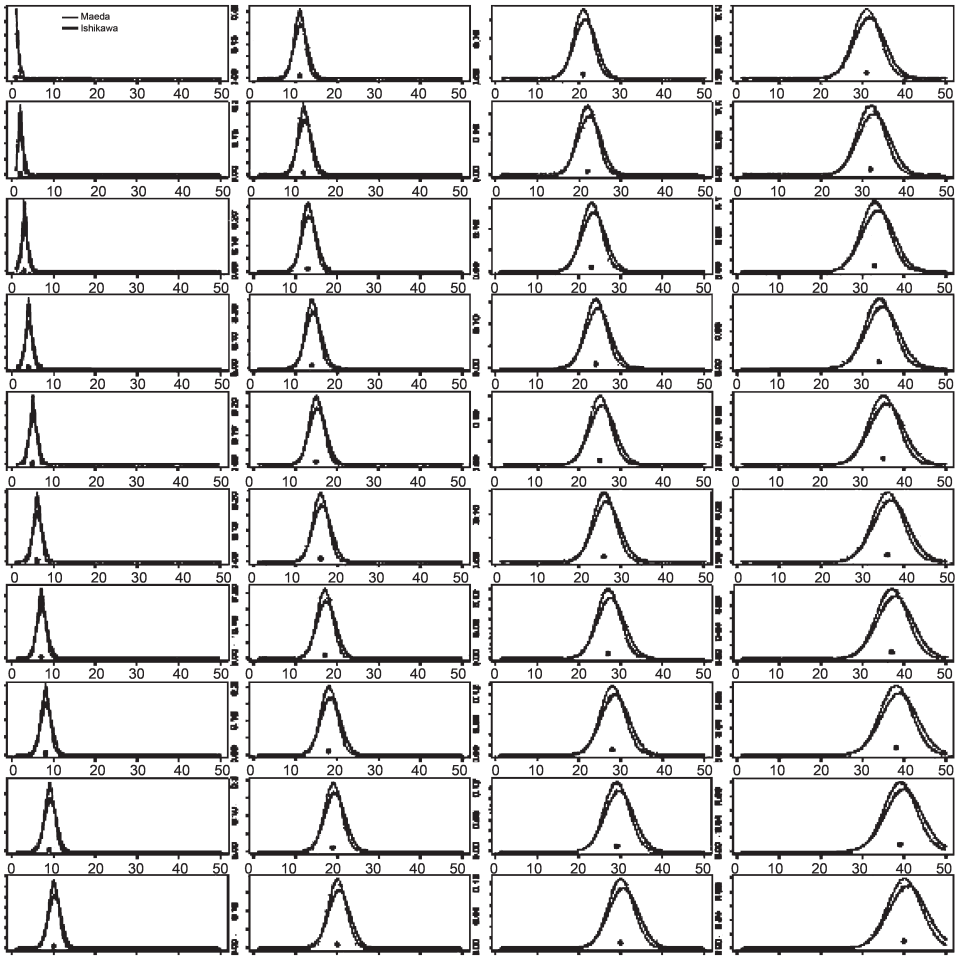
150 samples were used for 'age-reading experiment'. Maeda (2011-13) read three times at maximum (50 for the second and third times) as a 'control reader'. Ishikawa (2002-10) read once as a 'test reader'.



Estimation of age-reading error



Comparison of age-reading errors between the two readers



Morning paper, 31 Jan 2017-B: Issues derived from discussion on Document SC/J17/JR03

1. SUMMARY OF EVALUATION

Panel raised question about wording of 'Yes' or 'No' used by the proponents in their evaluation table.

Proponents had the same intent - this was a language issue- we will modify 'Yes' and 'No' to 'Possible' and 'Difficult' or 'Very Difficult' (see Table 1).

2. THE DATA SET OF JARPN II AND IWC/POWER CRUISES FOR BIOPSY SAMPLING

Proponents collected the same data set for biopsy sampling for the JARPN II as for the IWC POWER cruises. Table 2 shows the summary of the effort expended on biopsy sampling by species summed over 2014 and 2016.

Table 3 shows success proportion by species aggregated over years and methods. Assuming a binomial distribution these are as follows with standard errors in parenthesis. The differences are clearly statistically significant for all three species. The average time taken for sei and Bryde's whales to be biopsy sampled is around 47 and 27 minutes respectively, whilst common minke whales take match longer at around 172 minutes.

3. THE EXPERIENCE OF RESEARCHER FOR BIOPSY SAMPLING (LARSEN SYSTEM)

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. The shooters of Larsen system were experienced crew member for JARPN II. It has been noted that experience and training can play an important role in the efficiency of biopsy sampling. However, since the Larsen system was introduced for 2010 POWER surveys, we consider that for the offshore component the experience and training of shooters in JARPN II was sufficient. In the coastal component, the Larsen system was introduced for the 2015 JARPN II. Here the shooters would benefit from more experience and training time.

4. EFFORT OF FAECAL SAMPLING

During discussion, the Panel pointed out that the evaluation on faecal sampling was premature because of the small sample size (only five samples were taken in three years).

However, observation of excretion was conducted through 2,430 experiments for all three whale species combined in the period 2014-2016, involving a total observation time of 548.7 hours. Proponents spent huge effort and time conducting such experiments. Therefore, irrespective of the proportion of successful attempts, the low returns per time invested in this approach are clear.

5. PRECISION IN THE ESTIMATES OF ISOTOPE RATIOS

Such estimates will be provided by the next IWC SC Annual Meeting.

[Tables on next page]

Table 1
Evaluation of non-lethal methods.

		Biopsy sample				Faecal sample			
		Sanriku	Kushiro	Offshore		Sanriku	Kushiro	Offshore	
	Criteria	Minke	Minke	Sei	Bryde's	Minke	Minke	Sei	Bryde's
Q1	Probability of sampling	Possible	Possible	Possible	Possible	Very difficult	Very difficult	Possible	Very difficult
Q2	Efficiency of sampling	Difficult	Difficult	Possible	Possible	Very difficult	Very difficult	Very difficult	Very difficult
Q3	Data quality in non-lethal							Difficult	Difficult
Q4	Whale cost for non-lethal								

Table 2
Success rates, sampled whale numbers, target whale (experiment) numbers and time of experiment in sei, Bryde's and common minke whales of: (a) biopsy; and (b) lethal sampling in the JARPN II surveys for 2014-16.

Species	Year	Success rate	Sampled/ targeted	Time in experiment (min.)
1. Biopsy sampling				
Larsen system				
Sei whale	2015	0.615	16/26	507
	2016	0.533	16/30	456
Bryde's whale	2015	0.786	33/42	763
	2016	0.778	28/36	755
Minke whale (Sanriku)	2015	0.000	0/1	95
	2016	0.200	1/5	145
Minke whale (Kushiro)	2014	0.500	1/2	98
	2015	0.000	0/7	236
	2016	0.000	0/1	38
Crossbow				
Sei whale	2014	0.381	16/42	1,275
Bryde's whale (SSVs)	2014	0.641	25/39	789
Bryde's whale (SVs)	2014	0.533	16/30	402
Minke whale (Kushiro)	2014	0.500	1/2	110
LKARTS				
Minke whale (Kushiro)	2014	0.600	3/5	312
Totals				
Sei whale	2014-16	0.490	48/98	2,238
Bryde's whale	2014-16	0.694	102/147	2,709
Minke whale	2014-16	0.261	6/23	1,034
2. Lethal sampling				
Sei whale	2014	0.874	90/103	1,925
	2015	0.891	90/101	1,508
	2016	0.918	90/98	1,999
Bryde's whale	2014	0.926	25/27	264
	2015	0.862	25/29	534
	2016	1.000	25/25	401
Minke whale (Sanriku)	2014	0.652	30/46	2,546
	2015	0.594	19/32	1,509
	2016	0.696	16/23	1,587
Minke whale (Kushiro)	2014	0.680	51/78	3,616
	2015	0.718	51/71	2,940
	2016	0.618	21/34	1,769
Totals				
Sei whale	Total	0.894	270/302	5,432
Bryde's whale	Total	0.926	75/81	1,199
Minke whale	Total	0.662	188/284	13,967

Table 3
Success proportion of biopsy and lethal sampling and significances of binomial tests for differences in sei, Bryde's and common minke whales.

Species	Biopsy	Lethal	*P*
Sei whale	0.490 (0.050)	0.894 (0.018)	<0.0001
Bryde's whale	0.694 (0.038)	0.926 (0.029)	<0.0001
Common minke whale	0.261 (0.092)	0.662 (0.028)	0.00016

Morning Paper, 1 February 2017: Issues raised during discussion of Agenda item 4.1

1. LIST OF HISTORICAL AND FUTURE DATA RELEVANT TO RMP *IMPLEMENTATION* (NUMBER OF INDIVIDUAL WHALES)

Research year	Body length	Sexual maturity	Age from earplugs
(a) Common minke whale			
JARPN			
1994	21	21	11
1995	100	100	40
1996	77	77	35
1997	100	100	41
1998	100	100	34
1999	100	100	43
JARPN II			
2000	40	40	14
2001	100	100	41
2002	150	150	64
2003	150	150	70
2004	159	158	72
2005	220	220	109
2006	195	195	91
2007	207	207	101
2008	169	169	74
2009	162	162	61
2010	119	119	41
2011	126	126	66
2012	182	182	78
2013	95	95	49
2014	81	81	36
2015	70	70	41
2016	37	37	19
NEWREP-NP			
2017	174	174	78*
2018	174	174	78*
2019	174	174	78*
2020	174	174	78*
2021	174	174	78*
2022	174	174	78*
(b) Sei whale			
JARPN II			
2002	39	39	26
2003	50	50	34
2004	100	100	59
2005	100	100	68
2006	100	100	40
2007	100	100	59
2008	100	100	54
2009	100	100	71
2010	100	100	70
2011	95	95	69
2012	100	100	67
2013	100	100	66
2014	90	90	69
2015	90	90	53**
2016	90	90	0**
NEWREP-NP			
2017	140	140	90***
2018	140	140	90***
2019	140	140	90***
2020	140	140	90***
2021	140	140	90***
2022	140	140	90***

*Considering the total age readability for the period 1994-2016 (45.1%). **Analysis of earplugs is still ongoing. ***Considering the total age readability for the period 2002-15 (64.2%).

2. CLARIFICATION REGARDING THE FUTURE SIGHTING SURVEYS UNDER AND OUTSIDE THE NEWREP-NP

In order to estimate abundance estimate for western North Pacific common minke whale for J and O stocks and sei whale in North Pacific, sighting surveys are planned under NEWREP-NP. To cover the whole of distribution area for these whale species, information from sighting surveys from other programmememes will be considered as well.

Tentative plan for sighting surveys under NEWREP-NP

Table 2 below shows a tentative plan for dedicated sighting surveys under NEWREP-NP during 2018-2028. Sub-areas are defined as shown in Figure 1. The tentative plan for the first six year is planned to be repeated in the second six years.

Plan for sighting surveys outside NEWREP-NP

Table 2 also shows plans for sighing surveys other than those under NEWREP-NP. A Korean sighting survey in sub-area 5 is planned in 2017 (Park *et al.*, 2016). Sighting surveys in part of Sea of Okhotsk (Sub-area 12 NE) were conducted in 2015, 2016 and are planned for 2017 (Myasnikov *et al.*, 2016; Tiupeleev *et al.*, 2016).

The area east of 170°E and north of 40°N was covered during 2010-12 POWER surveys. Future plans for 2020 and later under POWER have yet to be developed.

3. NEWREP-NP CONTRIBUTING TO ALL RMP PROCESSES INCLUDING *PRE-IMPLEMENTATION ASSESSMENT*

A member of the Panel commented that the IWC has not decided yet on conducting a RMP *Implementation* for North Pacific sei whale, and that currently the IWC SC is conducting an *in-depth assessment* of the species in the North Pacific. He further noted that before an RMP *Implementation* is decided, a *pre-Implementation assessment* should be carried out and results accepted by the IWC SC. The proponents would like to clarify that data to be collected by the NEWREP-NP is relevant to all these exercises, and will be provided to the IWC SC for its work in all those assessments before the RMP *Implementation*, including for the *pre-Implementation assessment.*

4. OCEAN BASIN *IMPLEMENTATION*

In regard to the proponents suggesting an RMP *Implementation* for the oceanic component only of the North Pacific sei whale, a query was raised by the Panel whether IWC practice is to conduct *Implementations* only on a whole Ocean basin basis. There are however precedents for the former. Thus *Implementations* have been conducted by the IWC SC for the Northeast Atlantic minke whales which considered essentially that region of the North Atlantic alone, without requiring detailed modelling in *ISTs* of all of the more westerly populations of minke whales in the North Atlantic as a whole.

5. REGARDING THE UTILITY OF AGE DATA

The SCAA assessment of Antarctic minke whale populations by Punt *et al.* (2014) was a major advance for the IWC SC because it pointed to the extent of recruitment changes that could occur, and its results did not conform closely to the behaviour predicted by the standard population models used both the assess and to provide *ISTs* for baleen whale populations. This important insight was possible only because of the availability of age data (as well as survey estimates of abundance) for these populations.

It is important that *ISTs* reflect the true dynamics of the whale populations concerned as closely as possible so that analyses for which they serve as a basis lead to the most appropriate management approaches and decisions. The example above shows that age data are needed for conditioning these trials so that recruitment and its changes may be reflected far better. This is the primary reason the proponents supported the use of age data for the conditioning of the next set of *IST*s for the North Pacific common minke whale. Naturally recruitment is hardly estimable for other than past years spanned by the collection of age data, so for future sets of *IST*s also to best reflect underlying dynamics, age data must continue to be collected.

Table 2

Dedicated sighting surveys conducted during 2010-16 and tentative plan for dedicated sighting surveys during 2017-28. JR: JARPN II, JD: Japanese dedicated sighting survey N: NEWREP-NP, KD: Korean dedicated surveys, RD: Russian dedicated surveys. P: IWC-POWER.

	NEWREP-NP									Other surveys				
	Coastal					Offshore								
	Sub-area													
Year	6E	10E	11	7CS	7CN	7WR	7E	8	9	5	6W	12NE	12SW	170°E-135°W
2010	-	-	-	-	-	-	-	-	-	-	KD	-	-	P
2011	-	-	-	-	-	-	-	JR	JR	KD	-	-	-	P
2012	-	-	-	JR	JR	JR	JR	-	-	-	KD	-	-	P
2013	-	-	-	-	-	JR	JR	JR	-	KD	-	-	-	-
2014	-	JD	JD	-	JD	-	-	-	-	KD	-	-	-	-
2015	-	-	-	-	-	-	-	-	JR	-	-	RD	-	-
2016	-	-	-	JR	JR	JR	-	-	-	-	-	RD	-	-
2017*	-	-	JD	JD	JD	-	-	-	-	KD	-	RD	-	-
2018	N	N	N	-	-	-	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	N	N	N	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-	N	-	-	-	-	-
2021	N	N	N	-	-	-	-	-	-	-	-	-	-	-
2022	-	-	N	N	N	-	-	-	-	-	-	-	-	-
2023	-	-	N	N	N	-	-	-	-	-	-	-	-	-
2024	N	N	N	-	-	-	-	-	-	-	-	-	-	-
2025	-	-	-	-	-	N	N	N	-	-	-	-	-	-
2026	-	-	-	-	-	-	-	-	N	-	-	-	-	-
2027	N	N	N	-	-	-	-	-	-	-	-	-	-	-
2028	-	-	N	N	N	-	-	-	-	-	-	-	-	-

*Sighting surveys are planned to start in May.

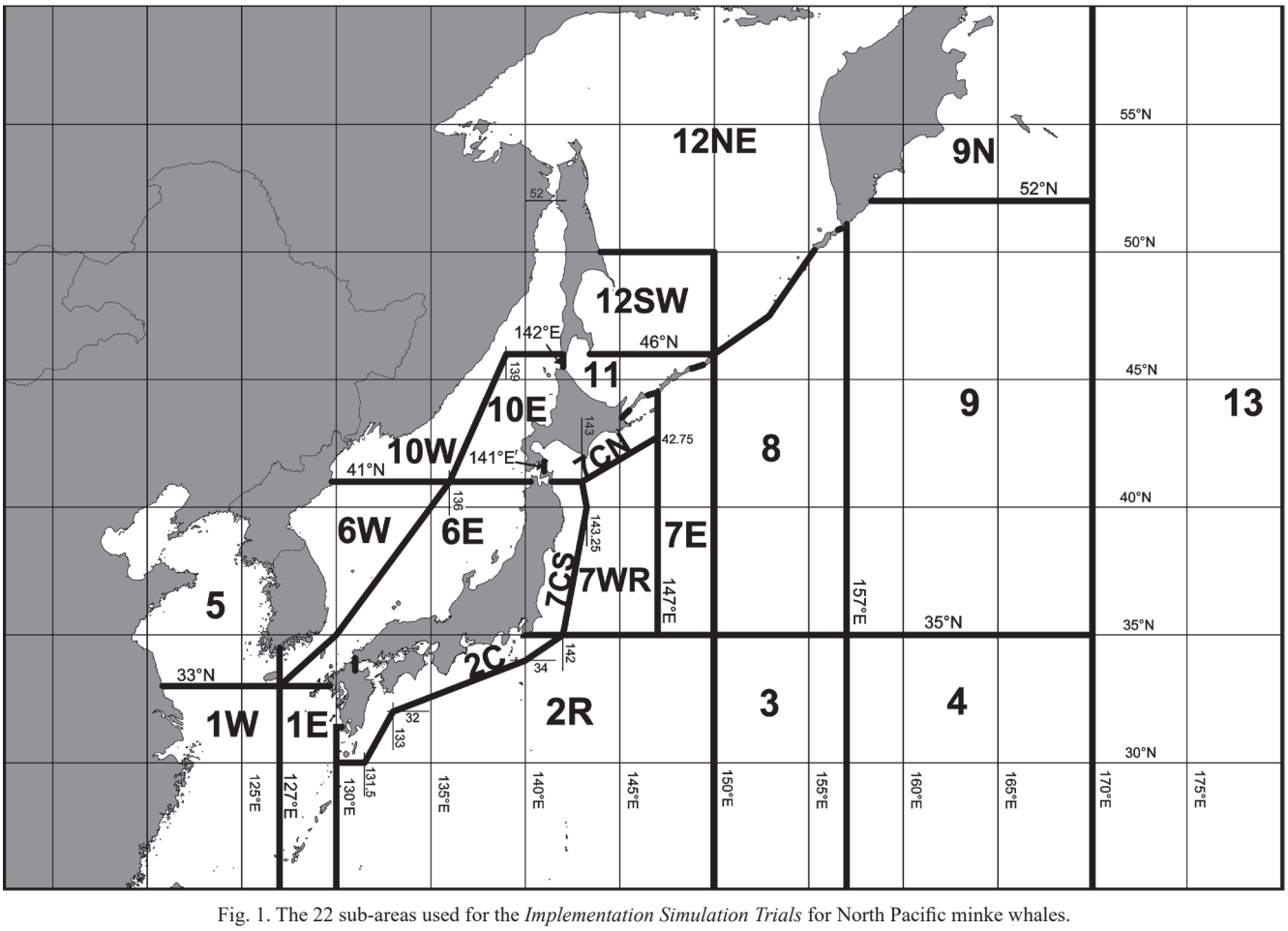


Fig. 1. The 22 sub-areas used for the *Implementation Simulation Trials* for North Pacific minke whales.

Table 3

Abundance estimates for common minke whales used to condition the *IST*s (from IWC, 2014).

Sub-area	Year	Season	Survey type[1]	Mode[2]	Areal coverage (%)	STD estimate[3]	CV[4]	Conditioning	Source
5	2001	Apr.-May	KD	NC	13.0	1,534	0.523	Min	An *et al.* (2010)
	2004	Apr.-May	KD	NC	13.0	799	0.321	Min	Ditto
	2008	Apr.-May	KD	NC	13.0	680	0.372	Min	Ditto
6W	2000	Apr.-May	KD	NC	14.3	549	0.419	Min	Ditto
	2002	Apr.-May	KD	NC	14.3	391	0.614	Min	Ditto
	2003	Apr.-May	KD	NC	14.3	485	0.343	Min	Ditto
	2005	Apr.-May	KD	NC	14.3	336	0.317	Min	Ditto
	2006	Apr.-May	KD	NC	14.3	459	0.516	Min	Ditto
	2007	Apr.-May	KD	NC	14.3	574	0.437	Min	Ditto
	2009	Apr.-May	KD	NC	14.3	884	0.286	Min	Ditto
6E	2002	May-Jun.	JD	NC	79.1	891	0.608	Yes (see #)	Miyashita (2010)
	2003	May-Jun.	JD	NC	79.1	935	0.357	Yes (see #)	Ditto
	2004	May-Jun.	JD	NC	79.1	727	0.372	Yes (see #)	Ditto
7CS	2004	May	JR	NC	100.0	886	0.502	Yes	Hakamada and Kitakado (2010) (rev)
	2006	Jun.-Jul.	JR	NC	100.0	3,690	1.199	Yes	Hakamada and Kitakado (2010) (rev)
7CN	2003	May	JR	NC	75.4	184	0.805	Yes	Hakamada and Kitakado (2010) (rev)
7WR	2003	May-Jun.	JR	NC	54.2	524	0.700	Min	Hakamada and Kitakado (2010) (rev)
	2004	May-Jun.	JR	NC	88.8	863	0.648	Yes	Hakamada and Kitakado (2010) (rev)
	2007	Jun.-Jul.	JR	NC	88.8	546	0.953	Yes	Hakamada and Kitakado (2010) (rev)
7E	2004	May-Jun.	JR	NC	57.1	440	0.779	Yes	Hakamada and Kitakado (2010) (rev)
	2006	May-Jun.	JR	NC	57.1	247	0.892	Yes	Hakamada and Kitakado (2010) (rev)
8	1990	Aug.-Sep.	JD	NC	61.8	1,057	0.705	Yes	IWC (2004, p.124)
	2002	Jun.-Jul.	JR	NC	65.0	0	482[5]	Yes	Hakamada and Kitakado (2010) (rev)
	2004	Jun.	JR	NC	40.5	1,093	0.576	Yes	Ditto
	2005	May-Jul.	JR	NC	65.0	132	1.047	Yes	Ditto
	2006	May-Jul.	JR	NC	65.0	309	0.677	Yes	Ditto
7E+8	2007	Jun.-Jul.	JR	NC	65.0	391[6]	1.013	Yes	Ditto
9	1990	Aug.-Sep.	JD	NC	35.0	8,264	0.396	Yes	IWC (2004, p.124)
	2003	Jul.-Sep.	JR	NC	33.2	2,546	0.276	Min	Hakamada and Kitakado (2010) (rev)
9N	2005	Aug.-Sep.	JD	IO-PS	67.8	420	0.969	Yes	Extract from Miyashita and Okamura (2011)
10W	2006	May-Jun.	JD	IO-PS	59.9	2,476	0.312	Yes	Ditto
10E	2002	May-Jun.	JD	NC	100.0	816	0.658	Yes	Miyashita (2010)
	2003	May-Jun.	JD	NC	100.0	405	0.566	Yes	Ditto
	2004	May-Jun.	JD	NC	100.0	474	0.537	Yes	Ditto
	2005	May-Jun.	JD	NC	100.0	666	0.444	Yes	Ditto
11	1990	Aug.-Sep.	JD	NC	100.0	2,120	0.449	Yes	IWC (2004, p.124)
	1999	Aug.-Sep.	JD	NC	100.0	1,456	0.565	Yes	Ditto
	2003	Aug.-Sep.	JD	IO-AC	33.9	882	0.820	Yes	Extract from Miyashita and Okamura (2011)
	2007	Aug.-Sep.	JD	IO-PS	20.2	377	0.389	Min	Ditto
12SW	1990	Aug.-Sep.	JD	NC	100.0	5,244	0.806	Yes	IWC (2004, p.124)
	2003	Aug.-Sep.	JD	IO-AC	100.0	3,401	0.409	Yes	Extract from Miyashita and Okamura (2011)
12NE	1990	Aug.-Sep.	JD	NC	100.0	10,397	0.364	Yes	IWC (2004, p.124) extract from SC/46/NP6
	1999	Aug.-Sep.	JD	NC	89.4	11,544	0.380	Yes	Ditto
	2003	Aug.-Sep.	JD	IO-AC	46.0	13,067	0.287	Yes	Extract from Miyashita and Okamura (2011)
# Trial 19: Use estimates in full area in 2002 & 2003 (originally 100% coverage) and one extrapolated to the full area in 2004 (79.1% coverage)									
6E	2002	May-Jun.	JD	NC	100.0	1,795	0.458	Yes	Miyashita (2010)
	2003	May-Jun.	JD	NC	100.0	1,059	0.322	Yes	Ditto
	2004	May-Jun.	JD	NC	100.0	919	0.372	Yes	Ditto
Trial 20: Use only in sensitivity as an estimate extrapolated to the full area									
10E	2007	May-Jun	JD	IO-PS	100.0	552	0.159	Yes	From Miyashita

[1]KD=Korean dedicated survey, JD=Japanese dedicated survey, JR=JARPN II. [2]NC=Normal-closing, IO-PS=Passing with IO mode, IO-AC=Abeam-closing with IO mode. (STD estimates by different modes, NC, IO-AC, IO-NC, are considered comparable.). [3]Standard (STD) estimate based on 'Top and Upper bridge', which will be corrected by estimate of $g(0)$ for the combined platform 'Top and Upper bridge'. [4]CV does not consider any process errors. [5]Average of the SEs for the non-zero estimates. [6]The estimate of 0 from sub-area 7E was combined with the estimate of 391 from sub-area 8.

References [from original table]

An, Y.R., Choi, C.D., Moon, D.Y. and Park, K.H. 2010. Summary of the information on Korean dedicated sighting surveys for abundance estimates of common minke whales. Paper SC/D10/NPM15 presented to the First Intersessional Workshop for Western North Pacific Common Minke Whales, 14-17 December 2010, Pusan, Republic of Korea (unpublished). 7pp. [Paper available from the Office of this Journal].

Hakamada, T. and Kitakado, T. 2010. Summary of the information on dedicated sighting surveys for abundance estimation in JARPN and JARPN II. Paper SC/D10/NPM12rev presented to the First Intersessional Workshop for Western North Pacific Common Minke Whales, 14-17 December 2010, Pusan, Republic of Korea (unpublished). [Paper available from the Office of this Journal].

International Whaling Commission. 2004. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 6:75-184.

International Whaling Commission. 2014. Report of the Scientific Committee. Annex D1. Report of the Working Group on the *Implementation Review* for Western North Pacific Common Minke Whales. *J. Cetacean Res. Manage. (Suppl.)* 15:112-88.

Miyashita, T. 2010. Summary of the information on Japanese dedicated sighting surveys for abundance estimation. Paper SC/D10/NPM11 presented to the First Intersessional Workshop for Western North Pacific Common Minke Whales, 14-17 December 2010, Pusan, Republic of Korea (unpublished). 6pp. [Paper available from the Office of this Journal].

Miyashita, T. and Okamura, H. 2011. Abundance estimates of common minke whales using the Japanese dedicated sighting survey data for RMP *Implementation* and CLA - Sea of Japan and Sea of Okhotsk. Paper SC/63/RMP11 presented to the IWC Scientific Committee, June 2011, Tromsø, Norway (unpublished). 34pp. [Paper available from the Office of this Journal].

Furthermore, given the greater importance that now needs to be placed on possible recruitment changes, it becomes more important to estimate natural mortality M. That is because it is the value of M that determines how fast or slowly a population can respond to changes, as for example in recruitment (i.e. it plays a major role in determining how long transient effects in the population will persist). *ISTs* need to capture such effects accurately. Fisheries scientists would never consider managing sardine and cod the same way, yet in relative terms the difference between M values for minke and bowhead whales are probably greater than the difference between those values sardine and cod. This is why having information on M for whales has become more important.

De la Mare's paper and presentation have reflected a number of mis-statements and misunderstandings. In the context above, his paper stated that:

These analyses illustrate that the prospects of reliably estimating MSYR and/or M from the amount of data proposed is remote. This is not surprising since this was also attempted in JARPA with results that lacked useful precision'.

This statement is incorrect as the analyses concerned showed that JARPA data provided reasonably precise estimates of M, as well as estimates of historical increase rates that inform a lower bound on Antarctic minke whale productivity (Punt *et al.*, 2014).

Then in his presentation De la Mare criticised the proponents' analyses of the sample size for sei whales because they had failed to provide a demonstration that estimates of MSYR would be improved. Estimating MSYR is certainly important, but that was not the intended focus of the analyses presented, because those related to estimation after 12 years only of NEWREP-NP, and it was evident to the proponents that that would be too short a period to achieve MSYR estimation satisfactorily. Instead the proponents addressed the question of estimating M within the framework of the current standard approach to *IST*s, which is to condition each on a fixed MSYR. Estimation of M was considered within that framework, given its growing importance for the reasons explained above. The process followed was perfectly appropriate for that context and yielded results on bias and precision to be expected after 12 years of survey and age data from NEWREP-NP, finally advocating a sample size on that basis.

However, a data input error to these calculations has been identified very recently. A presentation later today will explain that and the consequent action planned.

6. AIMS OF THE WORK ON THE EFFECT OF 'REGIME SHIFT' ON WHALE STOCKS

A member of the Panel raised a question about wording: 'regime shift'. Although there are many definitions of regime shift, the study group of fisheries and ecosystem responses to a recent regime shift under PICES (North Pacific Marine Science Organization) defined regime shift as 'a relative rapid change from one decadal-scale period of a persistent state to another decadal-scale period of persistent state' (King, 2005).

However, the objective under NEWREP-NP is not to detect a regime shift directly. Rather, this aspect of the NEWREP-NP will be focused on following two issues (see Annex 11).

(a) Contribution to the understanding of a regime shift based on phenomena such as the change in distribution of whales and their prey species.
(b) Data collection for elucidation of the cause of the change in distribution of whales and their prey species.

Proponents had the same intent with the expression 'Regime shift' as 'Major environmental change'. Proponents will modify 'Regime shift' to 'Major environmental change (e.g. regime shift)'. The proponents will focus on following two issues.

(a) Contribution to the understanding of the major environmental change (e.g. regime shift) based on phenomena such as the change in distribution of whales and their prey species.
(b) Data collection for elucidation of the cause of the change in distribution of whales and their prey species.

The research will contribute to the scientific understanding of the impact of prey shift on common minke and

Table 4

NEWREP-NP contributing to all RMP processes including *pre-Implementation assessment.*

Year	Source	April	May	June	July	August	September	October	November	Total
1984	Commercial	13	24				2			46
1985	Commercial	13								13
1986	Commercial	13	10	6		2				31
1987	Commercial	13	4	6	1	2	3			31
1996	JARPN					30				30
1999	JARPN				50					50
2001	Bycatch						2	1		3
2002	Bycatch		1		1			1	2	5
2003	Bycatch			1				3	4	8
2004	Bycatch		2	1						3
2005	Bycatch		1	2					3	6
2006	Bycatch			1				2		3
2007	Bycatch		1	1				2	2	6
2008	Bycatch		1					1	1	3
2009	Bycatch								1	1
2010	Bycatch		1	2			1			4
2011	Bycatch			1						1
2012	Bycatch		1	2					1	4
2014	Bycatch		1		1					2
2017	NEWREP-NP				47					47
2018	NEWREP-NP						47			47
2019	NEWREP-NP			47						47
2020	NEWREP-NP						47			47
2021	NEWREP-NP			47						47
2022	NEWREP-NP						47			47

*DNA and other biological data from whales sampled in a given year will be available in the next year.

sei whales and their geographical movements in the western North Pacific during the long-term research activity of NEWREP-NP. For example, changes are currently being observed in migration timing and nutritional condition that may be caused by changes in prey availability because of a major environmental change (e.g. regime shift).

7. NUMBER OF HISTORICAL AND FUTURE SAMPLE/DATA OF COMMON MINKE WHALES IN SUB-AREA 11

See Table 4.

8. CLARIFICATION OF SECONDARY OBJECTIVE II (III) ON STOCK STRUCTURE OF THE SEI WHALE, AND EASTERN BOUNDARY FOR THE OFFSHORE SURVEY

The survey design in p.132 of the NEWREP-NP research plan indicates that the western boundary of the offshore survey is approximately at 142°E. This coincides approximately with the western boundary of the DNA analysis of the sei whale (143°E) conducted under the JARPN II. No sei whale has been sighted by sighting surveys conducted west of 143°E. The area of the offshore survey coincides with part of the tentative area of the 'pelagic stock' under one of the stock structure hypotheses for the North Pacific sei whale.

The analyses on stock structure under the NEWREP-NP have as their main purpose to verify that whales in the area of the offshore survey (see map on p.132) correspond to a single stock. This will be verified by conducting additional analyses recommended by the JARPN II Review Workshop and the IWC SC in 2016, and by investigating movement (within the feeding grounds and between feeding grounds and breeding ground) using satellite tracking.

9. AIM OF THE ANCILLARY OBJECTIVE I

A member of the Panel pointed out that Ancillary Objective I could not be achieved by the design of NEWREP-NP, because the sample size is not large enough to assess adverse effects such as immunosuppression to PCBs on whale 'stocks'. The proponents would like to clarify that the objective here is not a comprehensive assessment of adverse effects of pollutants on whale 'stocks'. Rather the objective is monitoring of possible adverse effects of pollutants, species differences in sensitivity and response to pollutants, and unknown risk for novel chemicals at the individual level, not the 'stock' level. This is a basic topic in environmental toxicology.

Another member of the Panel asked whether there is any pollutant-specific adverse effect on whales. OMICS approach mentioned in research item (ii) of this ancillary objective can be used to identify pollutant-specific effect on whales.

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Morning Paper, 2 Feb 2017-A: Overview of the Proponents' views related to age data

Note: This overview largely repeats comments already made/documented by the proponents. The reason for its preparation in this form is to consolidate material related to age data and simulation studies presented to the review meeting, and in particular to address queries which were raised during the discussions under agenda item 4.2.1.

(1) The SCAA assessment of Antarctic minke whale populations by Punt *et al.* (2014) was a major advance for the IWC SC because, through its ability to take account of age in addition to survey abundance data, it pointed to the extent of recruitment changes that could occur, and its results did not conform closely to the behaviour predicted by the standard population models used to assess and hence to provide *IST*s for baleen whale populations.

(2) This has been 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 (as is the AWMP) rather than generic as at present. Age data contribute to this better conditioning 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. The NEWREP-NP proposal, with its analyses, has the intent that the age data to be collected will contribute to this evolutionary process.

(3) It is important that *IST*s reflect the true dynamics of the whale populations concerned as closely as possible, so that the analyses for which they serve as a basis lead to choices of the most appropriate management approaches and decisions. The Antarctic minke whale example above showed that age data are needed for conditioning those trials so that recruitment and its changes may be reflected far better.

(4) This is the primary reason that justifies the decision to use age data for the conditioning of the next set of *IST*s for the North Pacific common minke whale. Naturally recruitment is hardly estimable for other than the past years spanned by the collection of age data, so that for future sets of *IST*s also to best reflect underlying dynamics, age data must continue to be collected for those updated *IST*s to include recruitment estimates for the most recent years.

(5) The only question that then remains is how much age data are 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 *IST*s, and consequently must await completion of that exercise which is the responsibility of the IWC Scientific Committee.

(6) In the interim, calculations based on a restricted simpler model related to the previous *IST*s were carried out as an illustration. Given their illustrative nature, and pending the conditioning update of the NP minke trials, it was unnecessary for this model to attempt to include 'every'

factor that might play some role in MP performance (such as selectivity doming or inter-annual variation). The intent of the exercise (which was successfully achieved) was to ascertain whether the proposed level of sampling was at about that which would provide meaningful improvement in the conditioning. Once the updated conditioning is complete, that could be used to update this sampling level, though any difference would not be expected to be large.

(7) Comments were made that the associated simulations presented for North Pacific minke whales extended beyond the 12 years duration of the current proposal. 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, so that there is a need to show results for projections over a number of decades. 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.

(8) Given the greater importance that now needs to be placed on possible recruitment changes, it becomes more important to estimate natural mortality M. That is because it is the value of M that determines how fast or slowly a population can respond to changes, as for example in recruitment (i.e. it plays a major role in determining how long transient effects in the population will persist). *IST*s need to capture such effects accurately for subsequent improved choices amongst management procedures. Fisheries scientists would never consider managing sardine and cod the same way, yet in relative terms the difference between M values for minke and bowhead whales is probably greater than the difference between those values for sardine and cod. This is why having information on M for whales has become more important with the necessary move towards improved operating models for *IST*s that has become possible as age data have become available for conditioning.

(9) In his presentation De la Mare criticised the proponents' analyses of the sample size for sei whales because they had failed to provide a demonstration that estimates of MSYR would be improved. Estimating MSYR is certainly important, but that was not the intended focus of the analyses presented, because those analyses related to estimation after 12 years only of NEWREP-NP, and it was evident to the proponents that that would be too short a period to achieve satisfactory MSYR estimation. Instead the proponents addressed the question of estimating M within the framework of the current standard approach to *IST*s, which is to condition each on a fixed value MSYR. Estimation of M was considered within that framework, given its growing importance for the reasons explained above. The process followed was completely appropriate for that (interim) context.

REFERENCE

Punt, A., Hakamada, T., Bando, T. and Kitakado, T. 2014. Assessment of Antarctic minke whales using statistical catch-at-age analysis (SCAA). *J. Cetacean Res. Manage.* 14: 93-116.

Morning Paper, 2 February 2017-B: Issues raised during discussion of Agenda item 4.2.1

1. ISSUES ABOUT FEEDING ECOLOGY STUDY

The Panel raised questions regarding major environmental change (e.g. regime shift) and geographical heterogeneity of stomach contents and the amount of consumption.

Major environmental changes

The objective under NEWREP-NP is not to detect a major environmental change (e.g. regime shift) directly. However, the proponents plan to cover almost the whole research area every season.

It will be useful for the understanding of the regime shift based on phenomena such as the change in distribution of whales and their prey species. The proponents also consider that detection of effect of the major environmental changes (e.g. regime shift) on whales (e.g. change in prey species composition) can be achieved through investigation by post hoc analysis rather than a priori analysis, because these changes are difficult to predict and usually occur non-linearly.

Investigation on the effect of environmental variability on various pelagic fish (e.g. anchovy, sardine) in North Pacific has been conducted in a retrospective manner (Yatsu *et al.*, 2008), where their study was a qualitative rather than quantitative assessment.

Geographical heterogeneity of feeding habit of whales

Geographical heterogeneity of stomach contents and the amount of consumption will be investigated based on a model based approach (i.e. spatial modelling) and preliminary results were presented to the final Review Workshop on JARPN II (Tamura *et al.*, 2016).

Fig. 1 shows as an example one case of spatial distribution of estimated amount of euphausiids consumed by sei whales (t/day) in 1×1 longitude and latitude grids from May to September.

The proponents will apply the spatial model-based approach for the objectives I (v) and II (v) using sighting data and observed stomach contents data.

2. ISSUES ABOUT SAMPLING SURVEY DESIGN

The Panel raised some questions about the design of the sampling survey.

The proponents described the sampling survey design for the coastal component (common minke whale) in Annex 6 of SC/J17/JR01 and that for the offshore component (common minke and sei whales) in Annex 13. Some clarifications are included below.

(i) Sampling in sub areas 7CN, 7CS and 11 (see Annex 6)

A land-based operation system will be incorporated for whale sampling in the coastal sub-areas. Basically the vessels depart the port every morning, and return to the port every night. In order to cover a larger area within sub areas 7CS and 7CN (excluding the EEZ zones of foreign countries), establishing a new land-based research station in northern Sanriku region is under consideration.

In JARPN II, surveys were mainly conducted within a 30 nautical miles radius from the port in respective area (the Kushiro port or the Ayukawa port), and limited within the maximum of 50 n.miles radius from the port so as to

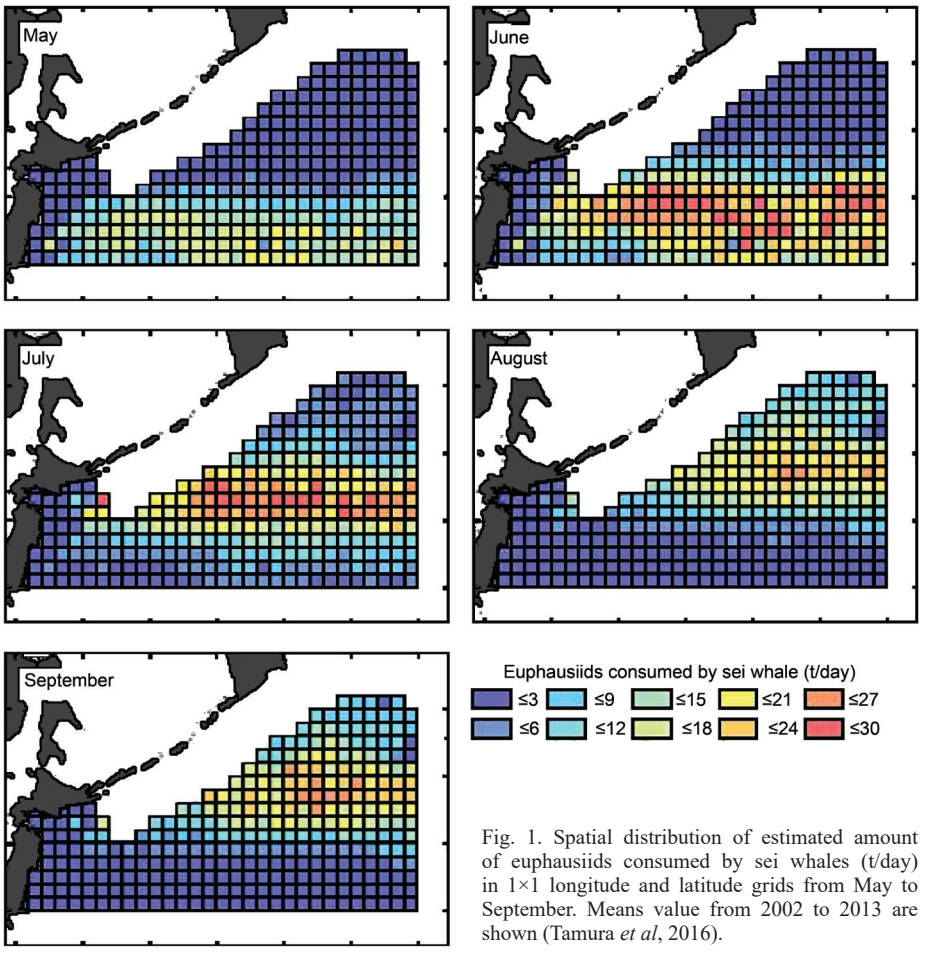

Fig. 1. Spatial distribution of estimated amount of euphausiids consumed by sei whales (t/day) in 1×1 longitude and latitude grids from May to September. Means value from 2002 to 2013 are shown (Tamura *et al*, 2016).

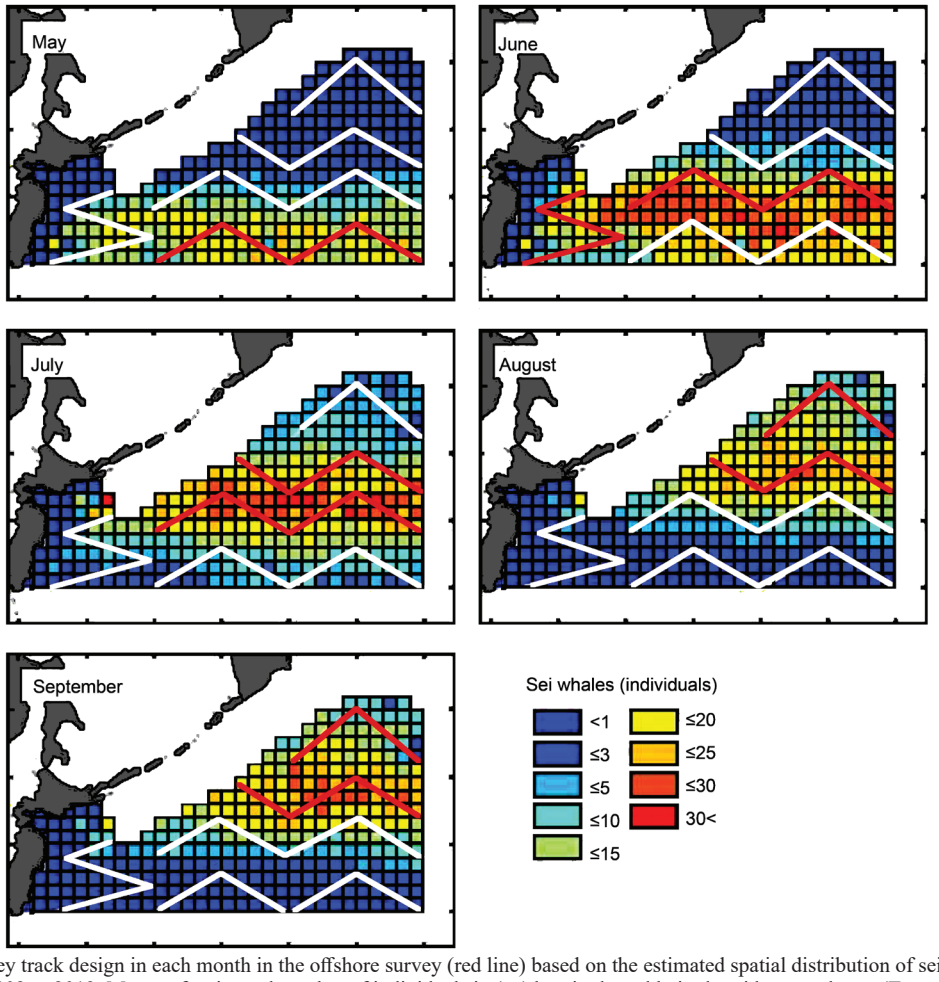

Fig. 2. The tentative survey track design in each month in the offshore survey (red line) based on the estimated spatial distribution of sei whales from May to September from 2002 to 2013. Means of estimated number of individuals in 1×1 longitude and latitude grids were shown (Tamura *et al,* 2016).

keep the stomach contents fresh enough for feeding ecology study. However, in NEWREP-NP, the sampling area is no limited. The proponents plan to cover almost whole survey area (7CN, 7CS and 11).

Note that this sampling design may not achieve random sampling of these areas, which is not a requirement for nearly all analyses. While that is desirable for some approaches to the analysis of age data, it is not essential for SCAA because under the likely reasonable assumption of full selectivity at the largest ages, non-randomness is taken into account through the estimation of the rest of the selectivity function.

(ii) Sampling in sub-areas 7WR, 7E, 8 and 9 (see Annex 13)
Sampling of common minke whales and sei whales in offshore waters will be carried out by the sampling and sighting vessels attached to the research base *Nisshin Maru*.

The tracklines and the allocation of vessels will be set in a similar manner as in previous JARPN II surveys. A zigzag-shaped track line will be set in the research area. The proponents plan to cover almost all the whale research area every season, and the design will consider the seasonal distribution of common minke and sei whales. An ideal sampling design is shown in Fig. 2. The proponents will consider adjustment to track line in cases of bad weather (e.g. typhoon and/or dense fog). All sei whales and common minke whales sighted as primary and secondary sightings, excluding cow and calf pairs, will be targeted for sampling.

3. SIGHTING SURVEY DESIGNS

In general the protocol for conducting sighting surveys will follow that used during the IWC SC POWER survey. Sighting survey plans will be presented to the Annual Meeting of the IWC SC to ensure that they follow the guidelines of the Committee.

Trackline design

Cruise track for the dedicated sighting survey will be designed by using the programme DISTANCE (Ver. 6.2) following the Requirements and Guidelines for Surveys under the RMP (IWC, 2012), in particular information on the distribution of the common minke and the sei whales will be taken into account in the design of the survey. Fig. 3 shows examples of cruise tracks to be implemented in NEWREP-NP, which are the same as were used in previous sighting surveys endorsed by the IWC SC and with IWC oversight.

Survey direction

Arrows in Fig. 3 show the survey order. Given that common minke whales migrate from south to north in spring and summer, in principle surveys will be conducted from north to south to avoid double counting. For sub-areas 7WR, 7E, 8 and 9, the pattern of cruise track design used in the 2013 dedicated sighting surveys will be repeated. The 2013 survey had oversight by IWC/SC (IWC, 2014).

IO mode

Sighting survey in IO mode will be conducted sub-area 11 as in previous surveys. Proponents understand importance of estimating $g(0)$ for situations of bad weather condition, and therefore, the proponents will consider to conduct the surveys in IO mode in other sub-areas.

Time allocations for experiments

Allocation of time for experiments such as photo-id and biopsy will be assigned following the criteria used for the IWC POWER surveys (IWC, 2017), and will be decided by the cruise leader.

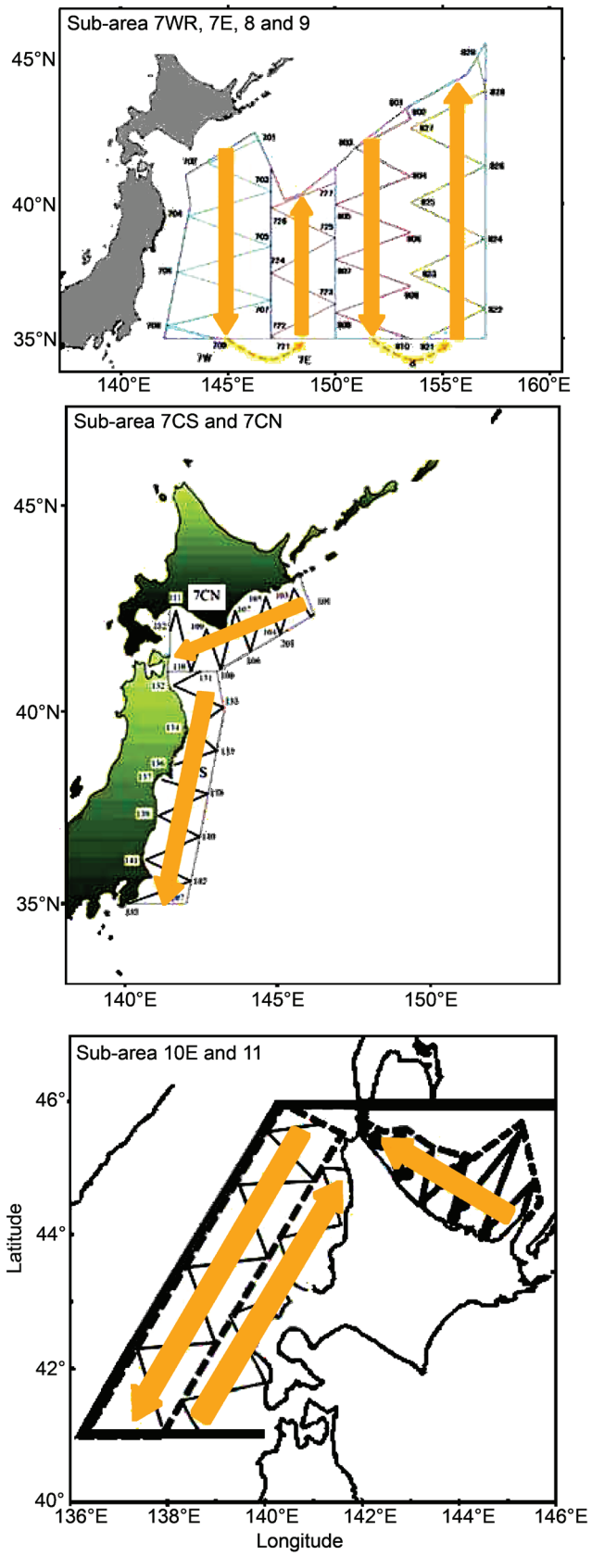

Fig. 3. Examples of previous trackline designs in sub-areas 7CS, 7CN, 7WR, 7E, 8, 9, 10E and 11. Arrows indicate survey order which were endorsed by the IWC SC. These will be followed for NEWREP-NP.

4. DETAILED INFORMATION OF HISTORICAL AND FUTURE BIOLOGICAL DATA

See tables on following pages.

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Table 1

Common minke whale - number of samples on body length and sexual maturity by JARPN.

Research year	Total	Sub-areas																		
		1W	1E	2R	3	4	5	6E	6W	10E	11	7CS	7CN	7WR	7E	8	9	12NE	12SW
1994-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1994-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1994-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1994-7	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-
1994-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-
1994-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
1994-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1994-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-
1995-7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61	-	-
1995-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-
1995-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-7	77	-	-	-	-	-	-	-	-	-	-	-	-	1	-	11	-	-	-
1996-8		-	-	-	-	-	-	-	-	-	30	-	15	-	-	5	-	-	-
1996-9		-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-
1996-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-	-
1997-6		-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	40	-	-
1997-7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	-	-	-
1997-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-5		-	-	-	-	-	-	-	-	-	-	-	-	25	31	8	-	-	-
1998-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	-	-
1998-7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-6		-	-	-	-	-	-	-	-	-	-	1	47	2	-	-	-	-	-
1999-7	100	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-
1999-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2.1

Common minke whale - number of samples on body length and sexual maturity by JARPNII.

Research year	Total	Sub-areas																	
		1W	1E	2R	3	4	5	6E	6W	10E	11	7CS	7CN	7WR	7E	8	9	12NE	12SW
2000-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-7	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-8		-	-	-	-	-	-	-	-	-	-	4	2	-	-	-	16	-	-
2000-9		-	-	-	-	-	-	-	-	-	-	1	17	-	-	-	-	-	-
2000-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001-5		-	-	-	-	-	-	-	-	-	-	14	-	14	-	-	-	-	-
2001-6		-	-	-	-	-	-	-	-	-	-	-	10	5	7	-	-	-	-
2001-7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	24	-	-
2001-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
2001-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-7	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-	-
2002-8		-	-	-	-	-	-	-	-	-	-	-	5	1	-	7	5	-	-
2002-9		-	-	-	-	-	-	-	-	-	-	-	91	-	-	1	6	-	-
2002-10		-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-
2002-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-4		-	-	-	-	-	-	-	-	-	-	49	-	-	-	-	-	-	-
2003-5		-	-	-	-	-	-	-	-	-	-	13	-	5	5	19	-	-	-
2003-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	11	-	-
2003-7	150	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
2003-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	-	-
2003-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-7	159	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	-
2004-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	-	-
2004-9		-	-	-	-	-	-	-	-	-	-	-	51	-	-	-	-	-	-
2004-10		-	-	-	-	-	-	-	-	-	-	-	24	-	-	-	-	-	-
2004-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2005-4		-	-	-	-	-	-	-	-	-	-	32	-	-	-	-	-	-	-
2005-5		-	-	-	-	-	-	-	-	-	-	28	-	-	-	10	10	-	-
2005-6		-	-	-	-	-	-	-	-	-	-	5	9	-	-	-	3	-	-
2005-7	220	-	-	-	-	-	-	-	-	-	-	-	17	1	-	4	3	-	-
2005-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-	-
2005-9		-	-	-	-	-	-	-	-	-	-	-	35	-	-	-	-	-	-
2005-10		-	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-	-	-
2005-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2.2

Common minke whale - number of samples on body length and sexual maturity by JARPNII.

Research year	Total	Sub-areas 1W	1E	2R	3	4	5	6E	6W	10E	11	7CS	7CN	7WR	7E	8	9	12NE	12SW
2006-4		0	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-
2006-5		-	-	-	-	-	-	-	-	-	-	54	-	3	-	-	-	-	-
2006-6		-	-	-	-	-	-	-	-	-	-	3	-	6	2	26	10	-	-
2006-7	195	-	-	-	-	-	-	-	-	-	-	-	10	1	-	12	14	-	-
2006-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2006-9		-	-	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	-
2006-10		-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-
2006-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007-4		-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
2007-5		-	-	-	-	-	-	-	-	-	-	47	-	-	-	1	1	-	-
2007-6		-	-	-	-	-	-	-	-	-	-	40	33	6	-	14	5	-	-
2007-7	207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007-9		-	-	-	-	-	-	-	-	-	-	-	21	-	-	-	-	-	-
2007-10		-	-	-	-	-	-	-	-	-	-	-	29	-	-	-	-	-	-
2007-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2008-4		-	-	-	-	-	-	-	-	-	-	37	-	-	-	-	-	-	-
2008-5		-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-
2008-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	3	-	-
2008-7	169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-	-
2008-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-
2008-9		-	-	-	-	-	-	-	-	-	-	-	32	-	-	-	-	-	-
2008-10		-	-	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-	-
2008-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009-4		-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-
2009-5		-	-	-	-	-	-	-	-	-	-	45	-	-	4	1	3	-	-
2009-6		-	-	-	-	-	-	-	-	-	-	1	2	8	-	-	4	-	-
2009-7	162	-	-	-	-	-	-	-	-	-	-	-	4	-	-	16	-	-	-
2009-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009-9		-	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-	-	-
2009-10		-	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-	-	-
2009-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010-4		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
2010-5		-	-	-	-	-	-	-	-	-	-	36	-	-	-	-	-	-	-
2010-6		-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
2010-7	119	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-
2010-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2010-9		-	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-
2010-10		-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
2010-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011-5		-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-
2011-6		-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-
2011-7	126	-	-	-	-	-	-	-	-	-	-	23	24	-	-	-	-	-	-
2011-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2011-9		-	-	-	-	-	-	-	-	-	-	-	31	-	-	-	-	-	-
2011-10		-	-	-	-	-	-	-	-	-	-	-	29	-	-	-	-	-	-
2011-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012-4		-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-
2012-5		-	-	-	-	-	-	-	-	-	-	76	32		-	-	-	-	-
2012-6		-	-	-	-	-	-	-	-	-	-	-	9	5	-	3	-	-	-
2012-7	182	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012-9		-	-	-	-	-	-	-	-	-	-	-	26	-	-	-	-	-	-
2012-10		-	-	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	-
2012-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2013-4		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
2013-5		-	-	-	-	-	-	-	-	-	-	28	-	-	-	-	-	-	-
2013-6		-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
2013-7	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2013-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
2013-9		-	-	-	-	-	-	-	-	-	-	-	46	-	-	-	-	-	-
2013-10		-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-
2013-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014-4		-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-
2014-5		-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-
2014-6		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
2014-7	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014-9		-	-	-	-	-	-	-	-	-	-	-	51	-	-	-	-	-	-
2014-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015-4		-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-
2015-5		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
2015-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015-7	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015-9		-	-	-	-	-	-	-	-	-	-	-	33	-	-	-	-	-	-
2015-10		-	-	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-	-
2015-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016-4		-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-
2016-5		-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-
2016-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016-7	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016-9		-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-
2016-10		-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
2016-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3

Common minke whale - number of samples on body length and sexual maturity by NEWREP-NP.

Research year	Total	Sub-areas 1W	1E	2R	3	4	5	6E	6W	10E	11	7CS	7CN	7WR	7E	8	9	12NE	12SW
2017-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017-6		-	-	-	-	-	-	-	-	-	47	-	-					-	-
2017-7	174	-	-	-	-	-	-	-	-	-	-	-	-			27		-	-
2017-8		-	-	-	-	-	-	-	-	-	-	-						-	-
2017-9		-	-	-	-	-	-	-	-	-	-	100						-	-
2017-10		-	-	-	-	-	-	-	-	-	-				-	-	-	-	-
2017-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2018-5		-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-
2018-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2018-7	174	-	-	-	-	-	-	-	-	-	-		-			27		-	-
2018-8		-	-	-	-	-	-	-	-	-	47	-						-	-
2018-9		-	-	-	-	-	-	-	-	-	-	-	50					-	-
2018-10		-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-
2018-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2019-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2019-5		-	-	-	-	-	-	-	-	-	47	50	-	-	-	-	-	-	-
2019-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2019-7	174	-	-	-	-	-	-	-	-	-	-		-			27		-	-
2019-8		-	-	-	-	-	-	-	-	-	-	-						-	-
2019-9		-	-	-	-	-	-	-	-	-	-	-	50					-	-
2019-10		-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-
2019-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2020-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2020-5		-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-
2020-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2020-7	174	-	-	-	-	-	-	-	-	-	-		-			27		-	-
2020-8		-	-	-	-	-	-	-	-	-	47	-						-	-
2020-9		-	-	-	-	-	-	-	-	-	-	-	50					-	-
2020-10		-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-
2020-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2021-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2021-5		-	-	-	-	-	-	-	-	-	47	50	-	-	-	-	-	-	-
2021-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2021-7	174	-	-	-	-	-	-	-	-	-	-		-			27		-	-
2021-8		-	-	-	-	-	-	-	-	-	-	-						-	-
2021-9		-	-	-	-	-	-	-	-	-	-	-	50					-	-
2021-10		-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-
2021-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2022-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2022-5		-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-
2022-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2022-7	174	-	-	-	-	-	-	-	-	-	-		-			27		-	-
2022-8		-	-	-	-	-	-	-	-	-	47	-						-	-
2022-9		-	-	-	-	-	-	-	-	-	-	-	50					-	-
2022-10		-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-
2022-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4

Common minke whale - number of age data by JARPN.

Research year	Total	Sub-areas																		
		1W	1E	2R	3	4	5	6E	6W	10E	11	7CS	7CN	7WR	7E	8	9	12NE	12SW
1994-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1994-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1994-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1994-7	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
1994-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
1994-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
1994-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1994-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
1995-7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	-
1995-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-
1995-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-7	77	-	-	-	-	-	-	-	-	-	-	-	-	1	-	6	-	-	-
1996-8		-	-	-	-	-	-	-	-	-	15	-	5	-	-	4	-	-	-
1996-9		-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-
1996-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-
1997-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-
1997-7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-
1997-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-5		-	-	-	-	-	-	-	-	-	-	-	-	13	9	1	-	-	-
1998-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-
1998-7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-6		-	-	-	-	-	-	-	-	-	-	-	21	-	-	-	-	-	-
1999-7	100	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	-	-	-
1999-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5.1

Common minke whale - number of age data by JARPNII.

Research year	Total	Sub-areas																	
		1W	1E	2R	3	4	5	6E	6W	10E	11	7CS	7CN	7WR	7E	8	9	12NE	12SW
2000-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-7	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-8		-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-
2000-9		-	-	-	-	-	-	-	-	-	-	1	9	-	-	-	-	-	-
2000-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001-5		-	-	-	-	-	-	-	-	-	-	5	-	6	-	-	-	-	-
2001-6		-	-	-	-	-	-	-	-	-	-	-	9	3	3	-	-	-	-
2001-7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	7	-	-
2001-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2001-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-7	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-
2002-8		-	-	-	-	-	-	-	-	-	-	-	1	-	-	6	2	-	-
2002-9		-	-	-	-	-	-	-	-	-	-	-	34	-	-	-	1	-	-
2002-10		-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-
2002-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-4		-	-	-	-	-	-	-	-	-	-	18	-	-		-	-	-	-
2003-5		-	-	-	-	-	-	-	-	-	-	3	-	4	4	10	-	-	-
2003-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	6	-	-
2003-7	150	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
2003-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-
2003-9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-7	159	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-
2004-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-	-
2004-9		-	-	-	-	-	-	-	-	-	-	-	26	-	-	-	-	-	-
2004-10		-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-
2004-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2005-4		-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-
2005-5		-	-	-	-	-	-	-	-	-	-	13	-	-	-	3	4	-	-
2005-6		-	-	-	-	-	-	-	-	-	-	3	4	-	-			-	-
2005-7	220	-	-	-	-	-	-	-	-	-	-	-	10	1	-	2	1	-	-
2005-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-
2005-9		-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-
2005-10		-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
2005-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5.2

Common minke whale - number of age data by JARPNII.

Research year	Total	Sub-areas																		
		1W	1E	2R	3	4	5	6E	6W	10E	11	7CS	7CN	7WR	7E	8	9	12NE	12SW
2006-4		-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-
2006-5		-	-	-	-	-	-	-	-	-	-	33	-	2	-	-	-	-	-
2006-6		-	-	-	-	-	-	-	-	-	-	1	-	2	2	7	4	-	-
2006-7	195	-	-	-	-	-	-	-	-	-	-	-	6	1	-	6	7	-	-
2006-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2006-9		-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-
2006-10		-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
2006-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007-4		-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
2007-5		-	-	-	-	-	-	-	-	-	-	18	-	-	-	1		-	-
2007-6		-	-	-	-	-	-	-	-	-	-	23	15	4	-	11	1	-	-
2007-7	207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007-9		-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-
2007-10		-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
2007-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2008-4		-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-
2008-5		-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-
2008-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-
2008-7	169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-
2008-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-
2008-9		-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-
2008-10		-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
2008-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009-4		-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-
2009-5		-	-	-	-	-	-	-	-	-	-	14	-	-	2	-	-	-	-
2009-6		-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	1	-	-
2009-7	162	-	-	-	-	-	-	-	-	-	-	-	3	-	-	10	-	-	-
2009-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009-9		-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-
2009-10		-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-
2009-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010-4		-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
2010-5		-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-
2010-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010-7	119	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-
2010-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2010-9		-	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-
2010-10		-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
2010-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011-5		-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
2011-6		-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
2011-7	126	-	-	-	-	-	-	-	-	-	-	10	13	-	-	-	-	-	-
2011-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2011-9		-	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-
2011-10		-	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-
2011-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012-4		-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
2012-5		-	-	-	-	-	-	-	-	-	-	27	15	-	-	-	-	-	-
2012-6		-	-	-	-	-	-	-	-	-	-	-	2	3		2	-	-	-
2012-7	182	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012-9		-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-
2012-10		-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-
2012-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2013-4		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-		-	-
2013-5		-	-	-	-	-	-	-	-	-	-	11	-	-	-	-		-	-
2013-6		-	-	-	-	-	-	-	-	-	-	1	-	-	-	-		-	-
2013-7	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
2013-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2013-9		-	-	-	-	-	-	-	-	-	-	-	24	-	-	-		-	-
2013-10		-	-	-	-	-	-	-	-	-	-	-	7	-	-	-		-	-
2013-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
2014-4		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
2014-5		-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-
2014-6		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
2014-7	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014-9		-	-	-	-	-	-	-	-	-	-	-	21	-	-	-	-	-	-
2014-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015-4		-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-
2015-5		-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
2015-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015-7	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015-9		-	-	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	-
2015-10		-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-
2015-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016-4		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
2016-5		-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
2016-6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016-7	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016-8		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016-9		-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-
2016-10		-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
2016-11		-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-

Table 6

Common minke whale - number of age data by NEWREP-NP.

Research year	Total	Sub-areas																		
		1W	1E	2R	3	4	5	6E	6W	10E	11	7CS	7CN	7WR	7E	8	9	12NE	12SW
2017-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017-6		-	-	-	-	-	-	-	-	-	21	-	-					-	-
2017-7	174	-	-	-	-	-	-	-	-	-	-	-	-		12			-	-
2017-8		-	-	-	-	-	-	-	-	-	-							-	-
2017-9		-	-	-	-	-	-	-	-	-	-	45						-	-
2017-10		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2017-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018-4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018-5		-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-
2018-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2018-7	174	-	-	-	-	-	-	-	-	-	-		-		12			-	-
2018-8		-	-	-	-	-	-	-	-	-	21	-						-	-
2018-9		-	-	-	-	-	-	-	-	-	-	-	23					-	-
2018-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2019-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2019-5		-	-	-	-	-	-	-	-	-	21	23	-	-	-	-	-	-	-
2019-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2019-7	174	-	-	-	-	-	-	-	-	-	-		-		12			-	-
2019-8		-	-	-	-	-	-	-	-	-	-	-						-	-
2019-9		-	-	-	-	-	-	-	-	-	-	-	23					-	-
2019-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2019-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2020-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2020-5		-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-
2020-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2020-7	174	-	-	-	-	-	-	-	-	-	-		-		12			-	-
2020-8		-	-	-	-	-	-	-	-	-	21	-						-	-
2020-9		-	-	-	-	-	-	-	-	-	-	-	23					-	-
2020-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2020-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2021-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2021-5		-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-
2021-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2021-7	174	-	-	-	-	-	-	-	-	-	-		-		12			-	-
2021-8		-	-	-	-	-	-	-	-	-	-	-						-	-
2021-9		-	-	-	-	-	-	-	-	-	-	-	23					-	-
2021-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2021-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2022-4		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
2022-5		-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-
2022-6		-	-	-	-	-	-	-	-	-	-		-					-	-
2022-7	174	-	-	-	-	-	-	-	-	-	-		-		12			-	-
2022-8		-	-	-	-	-	-	-	-	-	21	-						-	-
2022-9		-	-	-	-	-	-	-	-	-	-	-	23					-	-
2022-10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2022-11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 7

Sei whales - number of samples on body length and sexual maturity by JARPNII.

Research year	Total	Sub-areas 7	8	9	Research year	Total	Sub-areas 7	8	9
2002-5		-	-	-	2010-5		-	-	-
2002-6		-	-	-	2010-6		10	9	18
2002-7	39	-	4	32	2010-7	100	-	6	29
2002-8		-	-	-	2010-8		-	-	28
2002-9		-	3	-	2010-9		-	-	-
2003-5		-	3	-	2011-5		-	-	-
2003-6		1	16	11	2011-6		-	5	26
2003-7	50	4	-	12	2011-7	95	-	11	11
2003-8		-	-	3	2011-8		1	13	28
2003-9		-	-	-	2011-9		-	-	-
2004-5		-	-	-	2012-5		-	-	-
2004-6		-	2	9	2012-6		-	31	21
2004-7	100	-	-	36	2012-7	100	-	3	45
2004-8		-	-	27	2012-8		-	-	-
2004-9		-	-	26	2012-9		-	-	-
2005-5		-	12	5	2013-5		-	-	-
2005-6		-	3	41	2013-6		-	-	-
2005-7	100	-	16	17	2013-7	100	-	-	-
2005-8		-	-	6	2013-8		-	10	36
2005-9		-	-	-	2013-9		-	-	54
2006-5		-	-	-	2014-5		-	3	13
2006-6		1	19	19	2014-6		-	10	49
2006-7	100	4	29	5	2014-7	90	-	8	7
2006-8		-	-	23	2014-8		-	-	-
2006-9		-	-	-	2014-9		-	-	-
2007-5		-	16	22	2015-5		-	-	-
2007-6		2	2	23	2015-6		-	7	-
2007-7	100	4	6	16	2015-7	90	-	10	44
2007-8		-	-	9	2015-8		-	-	29
2007-9		-	-	-	2015-9		-	-	-
2008-5		-	-	-	2016-5		4	6	12
2008-6		-	24	35	2016-6		-	4	48
2008-7	100	-	9	15	2016-7	90	-	16	-
2008-8		-	-	17	2016-8		-	-	-
2008-9		-	-	-	2016-9		-	-	-
2009-5		-	11	18					
2009-6		-	1	38					
2009-7	100	-	19	13					
2009-8		-	-	-					
2009-9		-	-	-					

Table 9

Sei whales - number of age data by JARPNII.

Research year	Total	Sub-areas 7	8	9	Research year	Total	Sub-areas 7	8	9
2002-5		-	-	-	2010-5		-	-	-
2002-6		-	-	-	2010-6		5	4	14
2002-7	39	-	2	23	2010-7	100	-	5	20
2002-8		-	-	-	2010-8		-	-	22
2002-9		-	1	-	2010-9		-	-	-
2003-5		-	1	-	2011-5		-	-	-
2003-6		-	11	8	2011-6		-	4	16
2003-7	50	3	-	9	2011-7	95	-	9	8
2003-8		-	-	2	2011-8		-	8	24
2003-9		-	-	-	2011-9		-	-	-
2004-5		-	-	-	2012-5		-	-	-
2004-6		-	-	8	2012-6		-	22	16
2004-7	100	-	-	18	2012-7	100	-	2	27
2004-8		-	-	18	2012-8		-	-	-
2004-9		-	-	15	2012-9		-	-	-
2005-5		-	9	4	2013-5		-	-	-
2005-6		-	3	25	2013-6		-	-	-
2005-7	100	-	11	12	2013-7	100	-	-	-
2005-8		-	-	4	2013-8		-	6	21
2005-9		-	-	-	2013-9		-	-	39
2006-5		-	-	-	2014-5		-	3	8
2006-6		1	8	8	2014-6		-	7	39
2006-7	100	2	10	-	2014-7	90	-	6	6
2006-8		-	-	11	2014-8		-	-	-
2006-9		-	-	-	2014-9		-	-	-
2007-5		-	11	15	2015-5		-	-	-
2007-6		2	2	16	2015-6		-	4	-
2007-7	100	1	3	6	2015-7	90	-	7	24
2007-8		-	-	3	2015-8		-	-	18
2007-9		-	-	-	2015-9		-	-	-
2008-5		-	-	-	2016-5		-	-	-
2008-6		-	14	20	2016-6		-	-	-
2008-7	100	-	4	8	2016-7	90	-	-	-
2008-8		-	-	8	2016-8		-	-	-
2008-9		-	-	-	2016-9		-	-	-
2009-5		-	8	11					
2009-6		-	1	29					
2009-7	100	-	12	10					
2009-8		-	-	-					
2009-9		-	-	-					

Table 8

Sei whales - number of samples on body length and sexual maturity by NEWREP-NP.

Research year	Total	Sub-areas 7	8	9
2017-5				
2017-6				
2017-7	140		140	
2017-8				
2017-9				
2018-5				
2018-6				
2018-7	140		140	
2018-8				
2018-9				
2019-5				
2019-6				
2019-7	140		140	
2019-8				
2019-9				
2020-5				
2020-6				
2020-7	140		140	
2020-8				
2020-9				
2021-5				
2021-6				
2021-7	140		140	
2021-8				
2021-9				
2022-5				
2022-6				
2022-7	140		140	
2022-8				
2022-9				

Table 9

Sei whales - number of age data by NEWREP-NP.

Research year	Total	Sub-areas 7	8	9
2017-5				
2017-6				
2017-7	140		90	
2017-8				
2017-9				
2018-5				
2018-6				
2018-7	140		90	
2018-8				
2018-9				
2019-5				
2019-6				
2019-7	140		90	
2019-8				
2019-9				
2020-5				
2020-6				
2020-7	140		90	
2020-8				
2020-9				
2021-5				
2021-6				
2021-7	140		90	
2021-8				
2021-9				
2022-5				
2022-6				
2022-7	140		90	
2022-8				
2022-9				

Morning Paper, 3 February 2017: Issues raised of non-lethal techniques and sample sizes (Responses to questions from one Panel member)

(1) Improving the feasibility of non-lethal technique is not one of the objectives of NEWREP-NP. Rather, it is a challenge for the whole SC. However, we will continue our efforts in the feasibility study regarding non-lethal techniques with the intention to contribute to the IWC SC efforts in this field.
(2) The effort to be allocated to the feasibility study on biopsy sampling of common minke whale under the NEWREP-NP will depend on the results of the analyses recommended by the Review Panel. Results from some preliminary analyses were presented as a Morning Paper of 31 January 2017.
(3) Only experienced persons participated (and will participate) in the feasibility study (see Morning Paper of 31 January 2017).
(4) The design and results of the Icelandic exercise will be taken into account in the design, implementation and interpretation of results of the NEWREP-NP feasibility studies. However the biological and oceanographic conditions in the western North Pacific and eastern North Atlantic are different, and therefore region-specific design and results are to be expected.
(5) The types of analyses to be conducted are similar to those already presented to the Review Panel (see Morning Paper of 31 January 2017).