

SC/66a/SP/2

Addendum to the proposed research plan
for New Scientific Whale Research
Program in the Antarctic Ocean
(NEWREP-A)

Government of Japan



INTERNATIONAL
WHALING COMMISSION

Addendum to the Proposed Research Plan for New Scientific Whale Research Program in the Antarctic Ocean (NEWREP-A)

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INTRODUCTION

The International Whaling Commission's Scientific Committee (IWC SC) convened a workshop to review the Proposed Research Plan for New Scientific Whale Research Program in the Antarctic Ocean (NEWREP-A), which was submitted by the Government of Japan to the Secretary to the IWC and the Chair of the IWC SC in November 2014 in conformity with paragraph 30 of the Schedule to the ICRW and Annex P (IWC, 2013). An international expert panel ('Review Panel') carried out the review on the basis of the proposed research plan and nine papers prepared by IWC SC members and NEWREP-A scientists ('proponents'). The report of the Review Panel is presented in document SC/66a/Rep06, and the proponents' comments and responses to the Review Panel's evaluation and recommendations included in the report are presented in document SC/66a/SP1. This document lists revisions of and supplementary information regarding the Proposed Research Plan for NEWREP-A ('original NEWREP-A plan') taking account of the conclusions and recommendations by the Review Panel. Japan has not yet completed its process for evaluating the content of special permits research plan under Article VIII, paragraph 1, of the ICRW and it welcomes outside comments on this proposed plan that are based upon scientific consideration. It will give due regard to such comments in the course of further examination of the proposed plan and then finalize it as appropriate after the review of the upcoming IWC SC.

SPECIFIC REVISIONS AND SUPPLEMENTARY INFORMATION TO THE PROPOSED RESEARCH PLAN FOR NEWREP-A

The revisions and supplementary information to the original NEWREP-A plan taking account of the conclusion and recommendations by the Review Panel are listed as follows.

Revision and supplementary information to sections 2.1.3 and 3.2.3, and Appendix 3 of the original NEWREP-A plan:

- Sighting survey design and method

The survey plan for each austral summer season including details of the survey design, will be presented to the annual IWC SC meetings. The survey design will take into account the specific research activities planned for a particular Area and austral summer season, and will follow the seven guidelines or suggestions provided by the Review Panel regarding survey design. Detailed track-lines will be included. In this way the proponents will respond to the Review Panel recommendations to work closely with the IWC SC before finalizing the survey approaches and to ensure that future survey plans follow fully the IWC SC guidelines for such survey plans.

The survey design for the first two-three years will include feasibility studies on biopsy sampling of and telemetry for Antarctic minke whales, on which the Review Panel made specific recommendations (see below).

The survey plan for the 2015/16 austral summer season will be presented to the 2015 IWC SC meeting.

Revision and supplementary information to section 2.1.3 and Appendix 5 as well as section 3.3 and Appendix 13 of the original NEWREP-A plan:

- Level of improvement that might be expected either in the SCAA or in RMP performance by improved precision in biological parameters using simulation studies including updated *ISTs*
- Identification of the data to be used to inform the time-varying natural mortality in the SCAA and analysis of existing data to determine the feasibility and accuracy of obtaining such estimates

- Development of metrics to evaluate the benefits of including time-varying ASM data in SCAA
- Outline on how improvements in estimating ASM will lead to improvements in management and conservation
- Evaluation of the effect on SCAA of assuming ‘resting’ females are immature females
- Update SCAA with respect to density-dependence, and stock mixing based on existing data
- Power analysis to detect changes in ASM

The following plan is provided as supplementary information to the original NEWREP-A plan, for addressing the recommendations provided by the Review Panel on Objective I (ii) ‘Improvement of precision of biological and ecological parameters’ and on sample size. The plan covers all the recommendations or topics listed above related to this objective.

- Prepare a document describing a specification of calculation to be used for this evaluation process (which will be based on the SCAA framework).
- Using existing data, assess how the biological parameters such as change in the ASM give impacts on the estimation outcomes in the SCAA through some possible metrics [recommendation on metrics above].
- Using existing data, conduct SCAA analysis with consideration on the existing mixing information [recommendation on stock mixing above].
- Conduct additional simulation tests with a more realistic model to assess the sample size using data generated from the SCAA [recommendation on power analysis above].
- Conduct simulation performance tests to evaluate the level of improvement in the precision of quantities estimated by the SCAA during the period of NEWREP-A given the proposed sample size (or a modified one).
- Using existing data, assess how the assumptions made such as “resting females are immature females” give impacts on the estimation outcomes in the SCAA [recommendation on ‘resting’ females above].
- Using existing data, assess if the estimation of time-varying natural mortality is feasible in the existing SCAA [recommendation on time-varying natural mortality above].
- Conduct a simple simulation of the RMP/IST (maybe begin with a single stock hypothesis) to evaluate the extent of improvement of RMP performance).
- Conduct more simulations of the RMP/IST (some including two-stock hypotheses) to evaluate the extent of improvement of RMP performance).

Revision and supplementary information to section 2.1.3 and Appendix 6 of the original NEWREP-A plan:

- Simulation study to examine how additional sampling could be expected to improve precision and/or reduce bias in estimates of mixing rate

A simulation study will be conducted for assessing estimation performance of mixing proportion of stocks. The simulation will consider the use of a random effect model for the mixing proportions, by using the statistical principle of ‘borrowing strength’.

Supplementary information to section 2.2.2 of the original NEWREP-A plan:

- Main Objective II

The Review Panel noted that the Main Objective II of NEWREP-A (Investigation of the structure and dynamics of the Antarctic marine ecosystem through building ecosystem models) ‘relates to a field in development which makes specifying the overall outcomes in a 12-year programme more difficult than for Primary Objective I’ (Item 8.1 of SC/66a/Rep6, p39). Figures 1-3 were prepared to assist the understanding of Main Objective II as its structure is quite complex.

Figure 1 shows a schematic for the structure of models, basic analyses and required data/samples to accomplish the Main Objective II of NEWREP-A. There are two main model types under Main Objective II namely multispecies production model and spatial ecosystem models. Indicators of changes in the ecosystem e.g. temporal changes in the ASM will be examined as well, and such information can be used as ‘reality check’ of the model predictions and/or to investigate the reasons of such changes if any. Several sub-models e.g. bioenergetics model, density

surface model (DSM) and species distribution model (SDM), together with some basic analyses are required to construct the ecosystem models. Specific data/samples are required for each model/analysis.

The data to be collected and the analyses to be carried out in the context of the ecosystem modeling work under Main Objective II were already explained in the NEWREP-A plan. However we consider it convenient to provide some additional clarification. Most of the items in Figure 1 are described in the original NEWREP-A plan. However, in this addendum, four further items have been added to the program or adjusted in response to the recommendations by the Review Panel. These are age determination by using DNA methylation, a maturity status study by hormone levels, a prey study on species composition and duration in the feeding area by using stable isotopes, and a body condition study by using the total lipid content % of blubber. These four items (except the isotope analysis on baleen plates) could potentially be investigated by using non-lethal methods but first a comprehensive evaluation is required to determine whether the lethal methods are replaceable by the non-lethal methods.

A conceptual diagram explaining the flow from samples obtained from both lethal and non-lethal techniques to the ecosystem models under Main Objective II of NEWREP-A is shown in Figure 2. This figure complements Figure 1 by providing information on the relationships amongst the different components. Figure 2 shows that several kinds of input data for the ecosystem modeling exercise will be obtained through NEWREP-A in addition to existing samples and data from JARPA/JARPAII. As also indicated by Figure 1, many analyses including chemical and laboratory work (and also the analyses on the feasibility of non-lethal techniques) are needed to reach the intermediate outputs. The quality and sampling efficiency by non-lethal techniques will be evaluated in the early stage of the first six-year period of NEWREP-A. Other data for input to the ecosystem models related to other predators and prey species will be obtained from the literature at this stage.

Finally Figure 3 shows a conceptual diagram for the modelling exercises with their expected outputs and relationship. The details of each ecosystem models under Main Objective II in NEWREP-A are described in Appendices 11 and 12 of the original NEWREP-A plan. The outputs from two-types of models will be compared, and this exercise will contribute to the improvement of each model. The two types of ecosystem models, multi-species production model and whole (spatial) model, will be developed in parallel.

Revision and supplementary information to sections 2.2.3 and 3.2.5, and Appendix 8 of the original NEWREP-A plan:

- Krill surveys

Ship(s) and echosounder system(s) will be tested before steaming to the Antarctic to determine the likely effective acoustic sampling range (signal-to-noise by depth characterization) and potential for detecting krill, as recommended by the Review Panel.

To respond to a Review Panel recommendation, consideration will be given to conduct cross-calibration between the NEWREP-A and CCAMLR-type krill surveys vessels. As conducting such a calibration in the survey area is operationally difficult and costly, the proponents will carry out the calibration in waters around Japan, in a near synchronous way, as the first priority. However, the proponents might conduct the calibration in the survey area as well if conditions are met.

To respond to a Review Panel recommendation, the proponents will consider conducting a simultaneous survey by a krill survey vessel equipped with a frame-type trawl and echosounder, the dedicated sighting vessel equipped with an echosounder and the whale sampling vessels within a small-scale experimental survey area over a short time period (e.g. one week) so that comparisons among vessels/samples can be made.

Following a Review Panel recommendation, the proponents will allocate sufficient time for net sampling of krill, by following a survey design similar to those developed and implemented for CCAMR 2000, BROKE and BROKE-West. Approximately 2.5-3 hauls per day will be guidelines for net sampling frequency under the proposed CCAMLR-type krill survey.

Following a Review Panel recommendation, the proponents will give careful consideration to the scale and design of oceanographic sampling, considering the previous experience of BROKE and BROKE-West surveys. Sampling at approximately 2-3 sites per day will be the guidelines for the CTD oceanographic sampling frequency under the proposed CCAMLR-type krill survey.

Revision and supplementary information to section 3.2.3 and Appendix 9 of the original NEWREP-A plan:

- *g(0)* for baleen whale species other than Antarctic minke whale

In response to a Review Panel recommendation, identification of duplicate sightings will be also conducted for whale species other than the Antarctic minke whale during the NEWREP-A sighting surveys in IO mode. To determine whether *g(0)* is significantly different from one, analyses on duplicate sightings will be conducted for those whale species where sufficient data are obtained during the NEWREP-A program. Details will be provided in the sighting survey plans to be presented to the annual meetings of the IWC SC.

Revision and supplementary information to section 4.1 and Appendix 4 of the original NEWREP-A plan:

- DNA methylation analysis

Following the recommendations from the Review Panel, at first, the stock effect on the DNA methylation (DNA-M) technique will be examined using 50 highly readable earplugs each from I-stock animals sampled in Area IVW and P-stock animals sampled in Area VE under JARPA II, ideally from whales sampled in a same year in each Area. In the next step the effect of the period will be examined by using a similar number of samples from different austral summers. DNA methylation changes will be identified at the Antarctic minke whale genes homologous to the humpback whales. The procedure for identification of age-related DNA methylation site and measurement of methylation level will follow previous studies (Maegawa *et al.*, 2010; Bocklandt *et al.*, 2011; Polanowski *et al.*, 2014). The proponents have already contacted a specialized laboratory and a university in Tokyo so that this study can be conducted in collaboration with experts. Preliminary results will be reported to the 2017 IWC SC meeting and final results at the 2018 IWC SC meeting. In this way the proponents will respond to the Review Panel recommendation that this feasibility study be conducted early during the NEWREP-A program. The issue of interlaboratory calibration is important, and the proponents will address this in consultation with the IWC SC.

Revision and supplementary information to section 4.2 and Appendices 6 of the original NEWREP-A plan:

- Feasibility study on biopsy sampling in Antarctic minke whale

The feasibility study on biopsy sampling in Antarctic minke whale will be undertaken along with the dedicated sighting surveys, at an early stage of the first six-year period of NEWREP-A. A detailed study design will be provided in the sighting survey plan to be presented and discussed at the annual IWC SC meetings. As the program develops, the design of the feasibility study on biopsy sampling will take account of the four specific suggestions by the Review Panel [1) involve people with expertise in successfully biopsy sampling common minke whales in the North Atlantic; 2) mimic the sampling strategy developed for lethal sampling; 3) record information on time taken, sea state, swell, etc. to enable a plausible measure of effort required to be developed; and 4) consider the amount of tissue and nature of tissue required (for each analysis and in total)], as far as practicable. In planning and implementing the feasibility study, the proponents will make use of foreign (e.g. colleagues working with North Atlantic minke whale) and Japanese (e.g. colleagues working with North Pacific minke whale) experience. The “ideal” framework of the study suggested by the Review Panel (e.g. representativeness of the entire area and time period, random sampling techniques, etc.) will be considered as a second step after examining the practicability of the sampling technique itself in the initial stage. It should be noted that the value of biopsy samples for the NEWREP-A research objectives should be evaluated in parallel with the results of feasibility studies of analytical approaches that potentially could use biopsy samples (e.g. DNA-M, stable isotopes, hormones).

Revision and supplementary information to section 4.3, and Appendices 6 and 10 of the original NEWREP-A plan:

- Feasibility study on telemetry in Antarctic minke whale

The feasibility study on telemetry for Antarctic minke whale will be undertaken along the dedicated sighting surveys, at an early stage of the first six-year period of NEWREP-A. A detailed study design will be provided in the sighting survey plan to be presented and discussed at the annual IWC SC meetings. With regard field methods as well as tag types, the proponents will collaborate and consult with experienced foreign and Japanese colleagues.

Revision and supplementary information to section 4.3 and Appendix 10 of the original NEWREP-A plan:

- Stable isotopes analyses related to prey composition study

As a first step in the work to compare the overlap in diet amongst predator species using stable isotopes, the proponents will analyse prey species (krill) samples to ensure the correct determination of stable isotope baselines. This will be done during the first six-year period of NEWREP-A. Sampling of krill will be conducted in different geographical strata. At least five samples per sub area (e.g. East-South, East-North and Prydz Bay) will be analysed. Stable isotopes ratios for krill in each sub-area will be analysed each year. Accumulated information on isotope ratios in krill will be applied for the analysis of the overlap in diet amongst fin, humpback and Antarctic minke whales. After the first six years, the baseline data for krill will thus have been obtained. These results will be evaluated at the mid-term review of NEWREP-A.

Concurrently, the proponents will examine the overlap in diet amongst fin, humpback and Antarctic minke whales using stable isotope ratios in skin samples collected by lethal method (Antarctic minke whales) and by biopsy sampling (fin and humpback whales) through NEWREP-A surveys. This analysis will be carried out early in the NEWREP-A program based on the information accumulated on stable isotope baselines of krill in each area. Results will be reported to the IWC SC meeting when available during the first six-year period and evaluated during the mid-term review of NEWREP-A.

Stable isotopes analyses ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) along the edge of baleen plates will be conducted under the NEWREP-A program to estimate time spent by Antarctic minke whales in the feeding grounds. Stable isotopes in baleen plates (n=10-20) of Antarctic minke whales sampled under JARPA II will be analysed early in the research program, as an initial step. The results of the analyses will be reported to the IWC SC in 2018.

Revision and supplementary information to section 4.3 and Appendix 10 of the original NEWREP-A plan:

- Bioenergetics model related to prey consumption study

The proponents will make efforts to develop more sophisticated calculations adding some categories such as age, growth and maturity status based on energy requirements through change in blubber mass and lipid contents, as suggested by the Review Panel. It should be noted that the proponents will use the data collected previously for body weight-length relationships and maturity status as far as possible; however they also need recent data to examine the lipid content and blubber weight relationship, and to monitoring and forecast the dynamics of the Antarctic marine ecosystem from NEWREP-A samples. The use of data collected previously is important in building the basic structure of the bioenergetics model but collection of recent data is essential for monitoring and forecasting the dynamics of the Antarctic marine ecosystem. Preliminary results of the analyses will be reported to the 2016 IWC SC meeting. It should be noted that the proponents will also conduct consumption calculations based on the stomach contents in parallel.

For both calculation methods based on allometry (bioenergetics model) and stomach contents, the proponents will conduct the Monte-Carlo simulation trials which have been recommended by the JARPAII Review Panel and the IWC SC to take into account the actual range of the estimates including the uncertainties (see Tamura *et al.* 2014). In the calculation from the stomach contents, the proponents will continue to make efforts to minimize uncertainties in r (the ratio of low/high feeding intake), the length of the feeding season and the extent of night feeding for better estimation by satellite tagging, stable isotope of baleen plates and night-time sampling.

Revision and supplementary information to section 4.4 and Appendix 10 of the original NEWREP-A plan:

- Chemical markers for body condition

In response to a suggestion from the Review Panel, instead of retinol, the proponents plan to analyse the lipid content % of blubber throughout NEWREP-A research. At first, the total lipid content % of blubber from mid lateral position (near the position used in JARPA and JARPAII for the point measurement of blubber thickness), will be analysed since this position has been informative of changes of blubber thickness in relation to feeding season (Konishi *et al.*, 2008). The lipid content % of blubber will be compared to other body condition indicators such as blubber thickness and girth measurements. As an initial feasibility test, the measurements of body condition (blubber thickness, girth, total fat weight and the lipid content % of blubber) from Antarctic minke whales collected under NEWREP-A will be used. At least 50 whales for each sex and sub area will be used for this analysis.

Revision and supplementary information to section 4 of the original NEWREP-A plan:

- Progesterone analysis in blubber

To respond the recommendation from the Review Panel, the proponents will conduct progesterone analyses in

blubber tissues of Antarctic minke whales using JARPAII samples. Females with various reproductive status such as ovulating, resting and pregnant with small fetus will be selected, and hormone levels will be compared with histological information for reproductive organs. Analysis of the progesterone level for a total of 50 Antarctic minke whale samples will be assayed using the compact ELISA workstation (Crocodile, Titertek Berthold). Progesterone will be assayed with the Cayman Practice ELISA Kits (Cayman Chemical), according to the manufacturers' protocols. Preliminary results will be reported in the 2017 IWC SC meeting.

Revision and supplementary information to section 6 of the original NEWREP-A plan:

- Program management, personnel and logistic resources

As for the whole program management, the Fisheries Agency of Japan (FAJ) will assume responsibility for this including provision of the funding necessary. Regarding personnel resources to be engaged in the program, scientists from the ICR will play the leading role in order to pursue research activities and achieve the research objectives of NEWREP-A in collaboration with scientists from other domestic and/or foreign organizations, such as the Tokyo University of Marine Science and Technology, the National Research Institute of Far Seas Fisheries and the National Research Institute of Fisheries Science (ICR scientists are currently contacting foreign colleagues and relevant research institutions to discuss future collaboration under NEWREP-A).

Having said that, since it is almost impossible to fix every aspect of the program management at this initial stage, the proponents intend to provide relevant information to the IWC SC every year in an annual progress report for the SC's comments and suggestions to facilitate steady progress of the program in an open and transparent manner. This information will include progress achieved for each sub-objective as well as the involvement of external scientists/organizations and their roles. This annual update and comment process through the IWC SC will appreciably improve the management of the proposed program throughout its duration

Figure 4 shows an updated timeline of the NEWREP-A research activities that follows that presented to the NEWREP-A review workshop.

Revision and supplementary information to section 8 of the original NEWREP-A plan:

- Improvement of the plan on co-operative research

With regard the specific recommendations from the Review Panel ((1) *ad hoc* collaborations on specific issues; (2) the development of a formal protocol for outside scientists to express interest; and (3) the development of a strategy to promote incorporation of external Japanese and/or foreign scientists into the research), the proponents will proceed as follows:

Regarding the point (1), the proponents will continue contacting potential partners, and co-operative research will be identified and arranged for specific items in due course, preferably before research activities on such items start. As for point (2), the proponents will develop and post such a protocol on the website of the Institute of Cetacean Research (ICR) (both in Japanese and English) well in advance of the first research cruise under the NEWREP-A. With respect to the point (3), the proponents will: i) continue contacting specific potential collaborators directly; and ii) invite co-operative research widely through the internet (e.g. ICR's website) and at related meetings (including those of the IWC SC) indicating specific research items for collaboration. An "annual progress report" to the IWC SC (see the next item), would also help to promote research collaboration with external scientists/organizations.

With regard to collaboration with CCAMLR, the proponents will present an outline of their research plan for the CCAMLR-type krill survey (in the first 6-year period) at WG-EMM (the Working Group on Ecosystem Monitoring and Management) of SC-CAMLR to be held in Warsaw, Poland, over 6-17 July 2015, and a full survey plan to the next WG-EMM in 2016, reflecting the comments obtained from discussions at SG-ASAM, WG-EMM and SC-CAMLR in 2015.

Revision and supplementary information to Appendix 11 of the original NEWREP-A plan:

- Environmental explanatory variables for SDMs

Environmental data derived from satellites (e.g. SST, SSH and Chl-a) will be used as explanatory variables for SDMs as these data are suitable to estimate the spatial distribution of whales at a large scale (e.g. entire management area). Furthermore, climatological data and outputs from climate models will also be considered as

explanatory variables if appropriate data sets are available at the time of analysis. As climate models are now actively developed by a number of scientific institutes, the proponents will seek possible collaboration with these institutes to expand their capabilities on SDMs.

Revision and supplementary information to Appendix 12 of the original NEWREP-A plan:

- Outline of the proposed ecosystem and multi-species model structures, data gap analysis

The proponents will describe in more details the data considered for the models. Following the Review Panel suggestions, they will provide, for each species, a brief description of the underlying data and data quality together with an explanation of how the information will be acquired. Data gap will be identified.

Progress of this work will be presented to the 2016 IWC SC meeting and a final report will be presented to the 2017 IWC SC meeting.

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Figure 1. Schematic chart showing the nested structure of models, basic analyses and data/samples required to accomplish the Main Objective II of NEWREP-A. Analyses added to NEWREP-A or adjusted based on recommendations by the Review Panel are red flagged. Analyses requiring methodological development to compare lethal and non-lethal methods are blue flagged. Redundant child nodes (e.g. maturity status) are hidden (hidden nodes are indicated as circles). ASM: age at sexual maturity; AMW: Antarctic minke whale; DSM: density surface model; SDM: species distribution model.

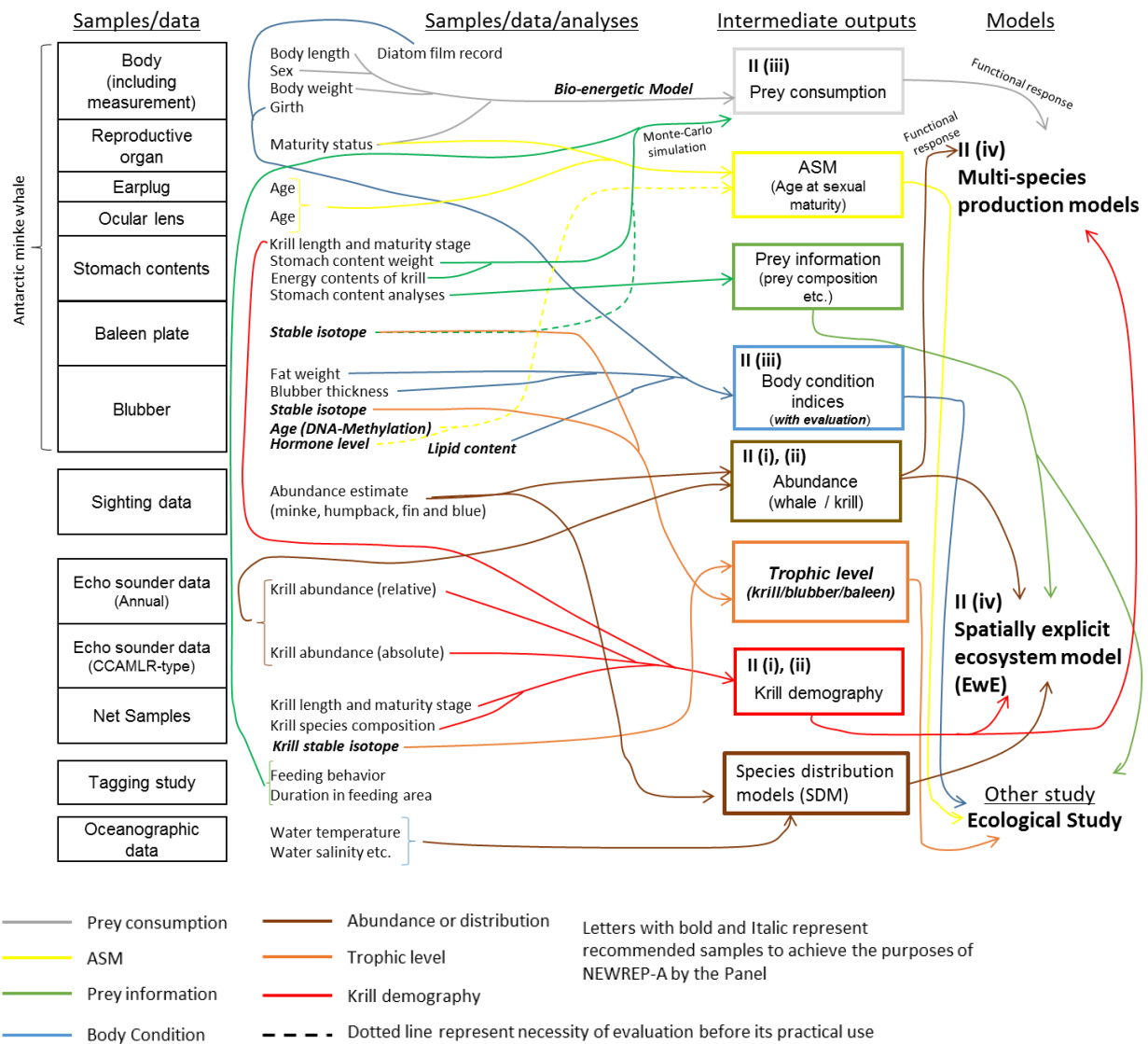


Figure 2. A schematic flow chart showing the steps from required samples and data to Modeling exercises to achieve the Main Objective II in NEWREP-A. Samples and analyses recommended by the Review Panel have been included (italic and bold letters). Non-lethal methods will be evaluated in NEWREP-A program. The absence (as yet) of established analyses or sampling is illustrated by dotted lines.

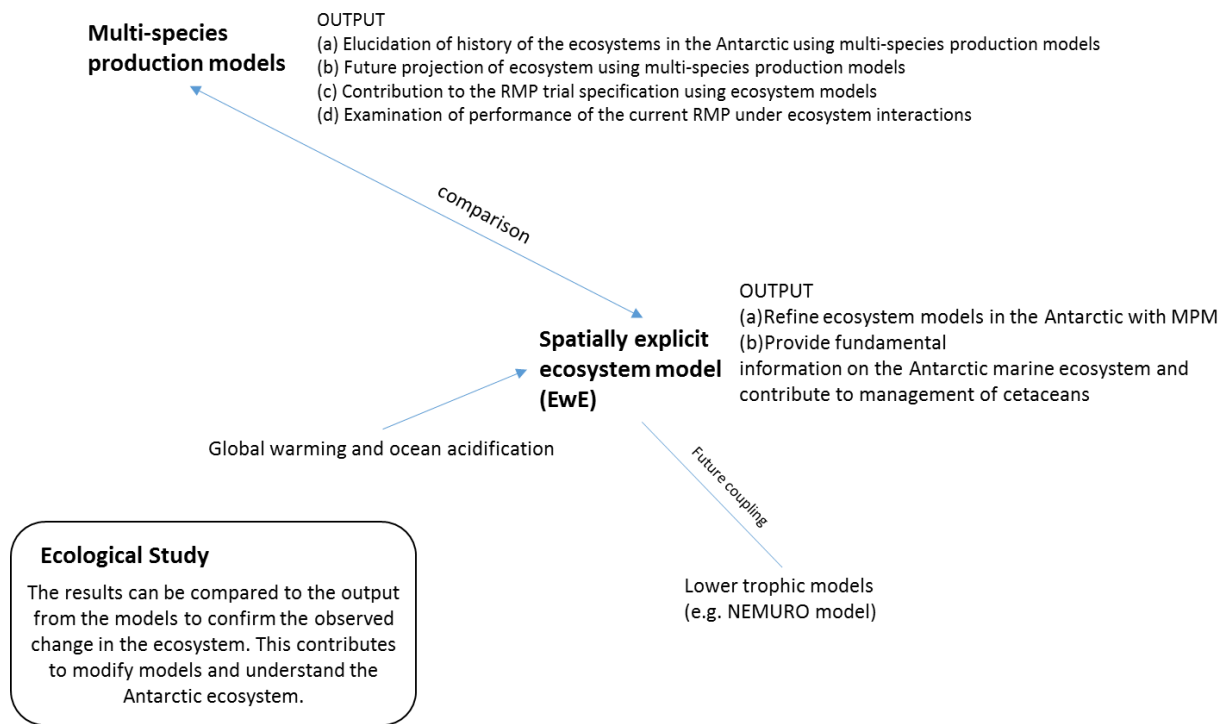
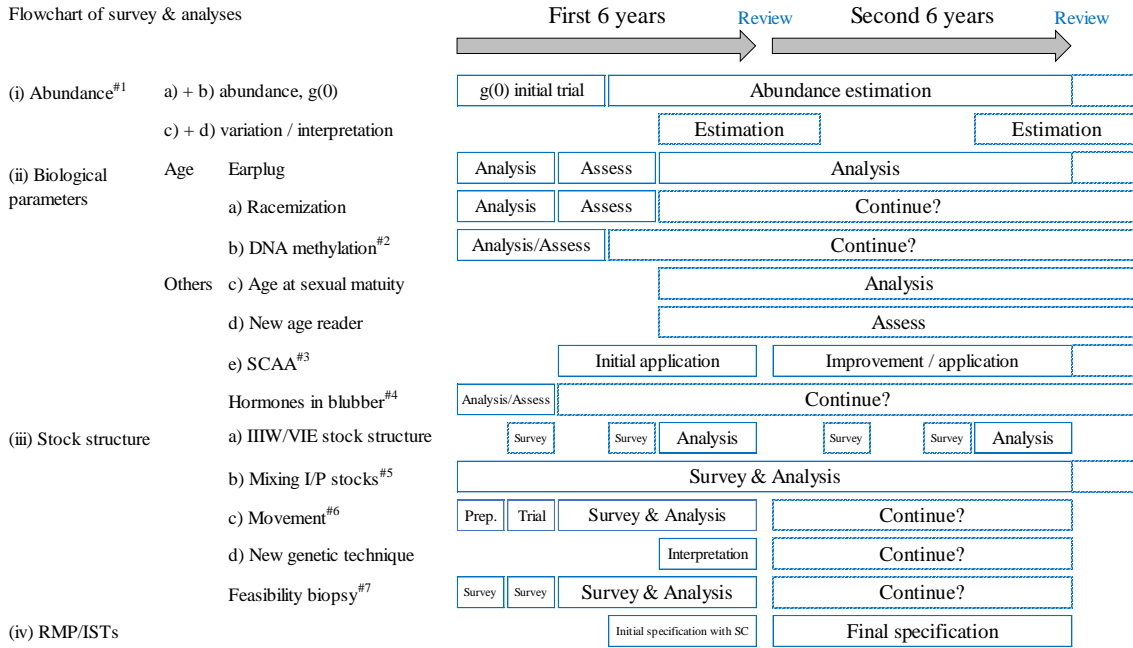


Figure 3. Investigation of the structure and dynamics of the Antarctic marine ecosystem through building ecosystem models under Main Objective II in NEWREP-A.

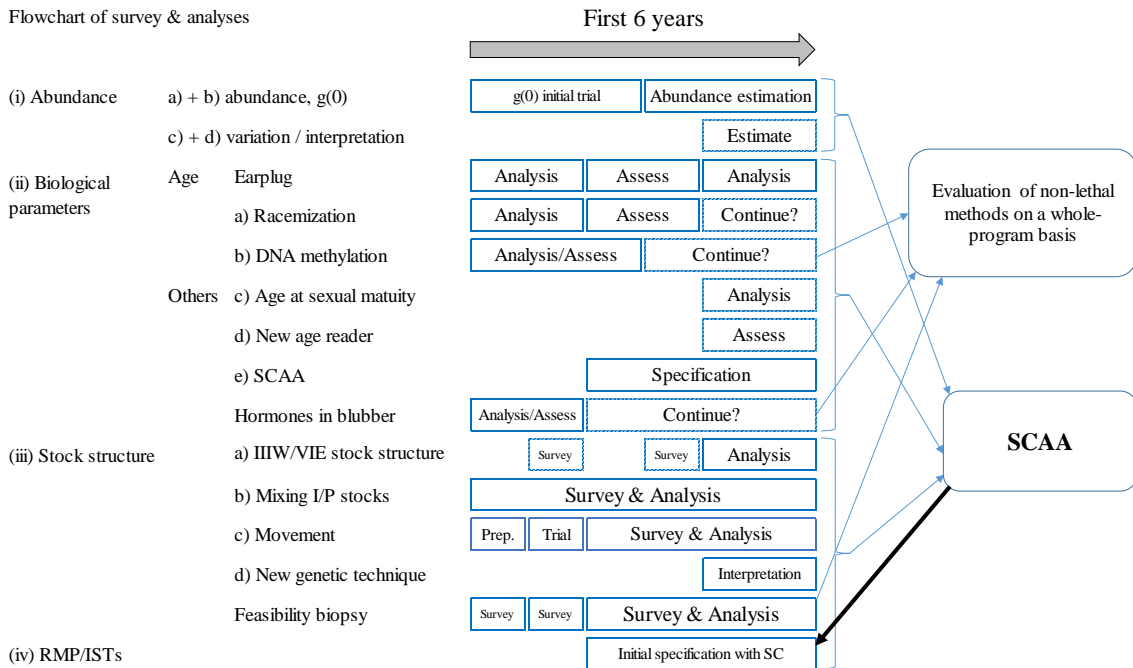
Main Objective I

Flowchart of survey & analyses



Main Objective I

Flowchart of survey & analyses



^{#1} The survey plan for each austral summer season including details of the survey design, will be presented to the annual IWC SC meetings. The survey design will take into account the specific research activities planned for a particular Area and austral summer season, and will follow the seven guidelines or suggestions provided by the Review Panel regarding survey design. The survey design for the first two-three years will include feasibility studies on biopsy sampling and telemetry of Antarctic minke whale. The survey plan for the 2015/16 austral summer season will be presented to the 2015 IWC SC meeting (see details in the main text).

^{#2} At first, the stock effect on the DNA methylation technique will be examined using 50 highly readable earplugs each from I and P-stocks. In the next step the effect of the period will be examined by using similar number of samples from different austral summers. A specialized laboratory and a university in Tokyo have been contacted so that this study can be conducted in collaboration with experts. Preliminary results will be reported to the 2017 IWC SC meeting and final results at the 2018 IWC SC meeting.

^{#3} The proponents will respond to several SCAA/RMP-related recommendations from the Review Panel through a specific plan to be implemented with the highest priority (see details in main text). A progress of the work in this plan will be presented to the 2015 IWC SC meeting, before the starting of the program.

^{#4} The proponents will conduct progesterone analyses in blubber tissues of Antarctic minke whales using JARPAII samples. Females with various reproductive status such as ovulating, resting and pregnant with small fetus will be selected, and hormone levels will be compared with histological information of reproductive organ. Analysis of progesterone level for a total of 50 Antarctic minke whale samples will be

assayed using the compact ELISA workstation (Crocodile, Titertek Berthold). Progesterone will be assayed with the Cayman Practice ELISA Kits (Cayman Chemical), according to the manufacturers' protocols. Preliminary results will be reported to the 2017 IWC SC meeting.

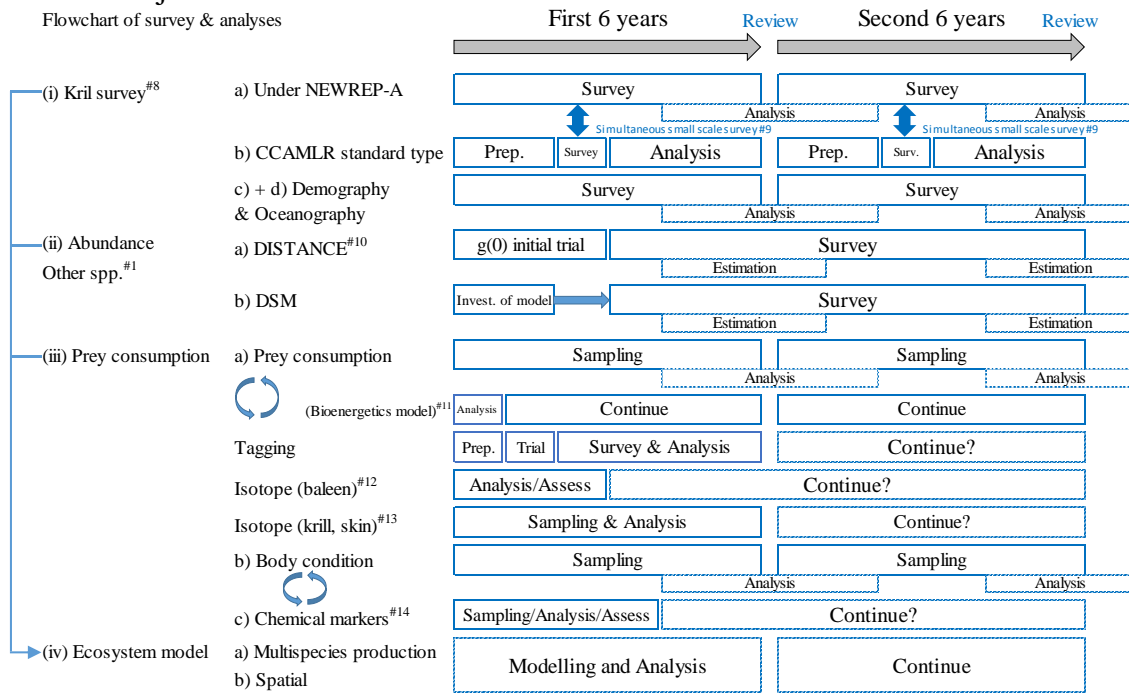
^{#5} The estimation of performance will consider the use of a random effect model for the mixing proportions, by using a statistical principle of "borrowing strength". This work will be conducted once the proponents have some progress in the tasks related to recommendations on SCAA/RMP, which have the highest priority.

^{#6} The feasibility study on telemetry in Antarctic minke whale will be undertaken along the dedicated sighting surveys, in the early stage of the first six-year period of NEWREP-A. Detailed study design will be provided in the sighting survey plan to be presented and discussed at the annual IWC SC meetings. With regard field methods as well as tag types, the proponents will collaborate and consult with experienced foreign and Japanese colleagues (see details in the main text).

^{#7} The feasibility study on biopsy sampling in Antarctic minke whale will be undertaken along the dedicated sighting surveys, in the early stage of the first six-year period of NEWREP-A. Originally the NEWREP-A plan stated that this feasibility study would be conducted in Areas IIIW and VI. Because this feasibility should be conducted early in the program, it will be conducted in the IWC Area to be covered by the sighting surveys in 2015/16, 2016/17 and 2017/18 (not necessarily in Areas IIIW and VI). Detailed study design will be provided in the sighting survey plan to be presented and discussed at the annual IWC SC meetings (see details in the main text).

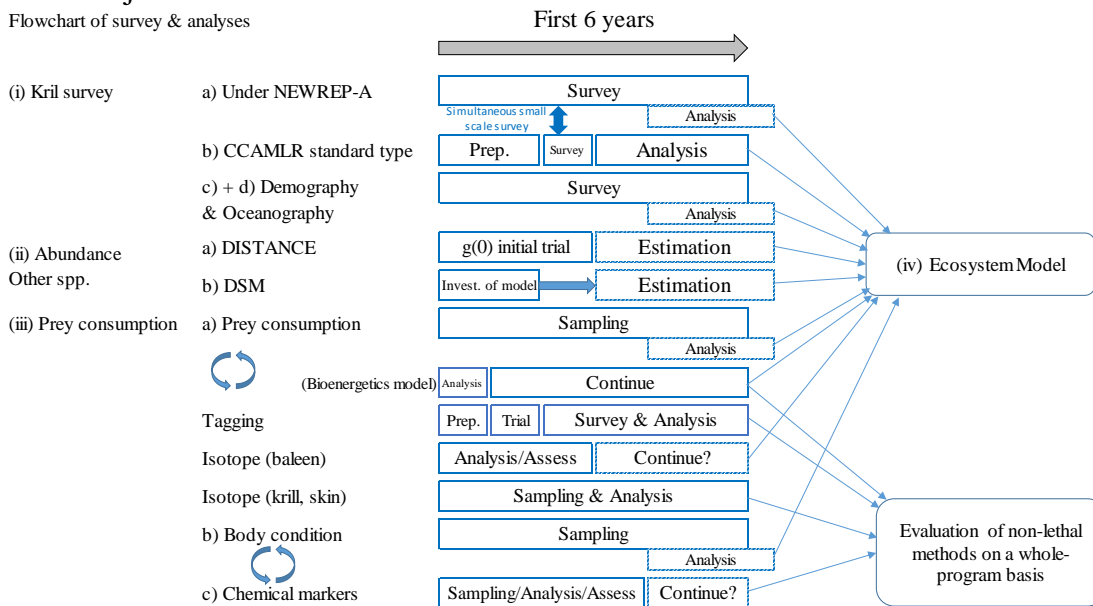
Main Objective II

Flowchart of survey & analyses



Main Objective II

Flowchart of survey & analyses



^{#8} Since the NEWREP-A review workshop, progress has been made on the installation of equipments (echosounder, Norpac net and CTD) in the research vessel that will be engaged in krill surveys under NEWREP-A. During this work the specifications made by the Review Panel for those instruments are being taken into consideration.

^{#9} The proponents will consider to conduct a simultaneous survey by a krill survey vessel equipped with a frame-type trawl and echosounder, the dedicated sighting vessel equipped with an echosounder and the whale sampling vessels within a small-scale experimental survey area over a short time period (e.g. one week) so that comparisons among vessels/samples can be made.

^{#10} Identification of duplicate sightings will be also conducted for whale species other than Antarctic minke whale during the NEWREP-A sighting surveys in IO mode. To determine whether $g(0)$ is significantly different from one, analyses on duplicate sightings will be conducted for those whale species where sufficient data are obtained during the NEWREP-A program. Details will be provided in the sighting survey plans to be presented to the annual meetings of the IWC SC.

^{#11} The proponents will make effort to build more sophisticated models adding some categories such as age, growth and maturity status based on the energy requirement by change in blubber mass and lipid contents. Previously and newly collected data will be used. Preliminary results of this work will be reported to the 2016 IWC SC meeting (see details in the main text).

^{#12} Stable isotopes analyses ($\delta^{13}C$ and $\delta^{15}N$) along the edge of baleen plates will be conducted to estimate time duration of Antarctic minke whale in the feeding grounds. Stable isotopes in baleen plates (n=10-20) of Antarctic minke whales sampled under JARPA II will be analysed early in the research program, as an initial step. The results of the analyses will be reported to the IWC SC in 2018.

^{#13} As a first step in the work to compare overlap in diet amongst fin and Antarctic minke whale using stable isotope, krill samples will be analyzed to ensure the correct determination of stable isotope baselines. This will be done during the first six-year period of NEWREP-A. Concurrently, the proponents will examine the overlap in diet amongst fin, humpback and Antarctic minke whales using stable isotope ratios in skin samples collected by lethal method (Antarctic minke whales) and by biopsy sampling (fin and humpback whales). This analysis will be carried out early in the NEWREP-A program based on the information accumulated on stable isotope baselines of krill in each area. Results will be presented to the IWC SC meeting as appropriate in the first six-year period and evaluated at the mid-term review of NEWREP-A (see details in the main text).

^{#14} At first, the total lipid content % of blubber will be compared to other body condition indicators such as blubber thickness and girth measurements. As an initial feasibility test, the measurements of body conditions (blubber thickness, girth, total fat weight and the total lipid content % of blubber) from Antarctic minke whales collected under the NEWREP-A will be used. At least 50 whales for each sex and sub areas will be used for this analysis.

Figure 1. Updated timeline of research activities under NEWREP-A's Main Objectives I and II. For both Main Objectives, the upper part of the figures shows the timeline for the research activities in the entire 12-year period. The lower parts of the figures show the timelines for the first 6-year period, specifying the outputs and evaluation to be conducted after the first period. This figure is based on that originally presented to the NEWREP-A review workshop.