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Outline of a research program to investigate the abundance, abundance trends and stock structure of large whales in the Indo-Pacific region of the Antarctic, including a survey plan for the 2019/20 austral summer season

Government of Japan

INTERNATIONAL
WHALING COMMISSION

Outline of a research program to investigate the abundance, abundance trends and stock structure of large whales in the Indo-Pacific region of the Antarctic, including a survey plan for the 2019/20 austral summer season

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ABSTRACT

This paper outlines the objectives, survey and analytical procedures and work schedule of a new research program on whales and the ecosystem in the Indo-Pacific region of the Antarctic (JASS-A= Japanese Abundance and Stock structure Surveys in the Antarctic). The main research objectives are i) the study of the abundance and abundance trends of Antarctic minke and other large whale species, and ii) the study of the distribution, movement and stock structure of Antarctic minke and other large whale species. JASS-A also has several secondary research objectives related to oceanographic, marine debris and whale biology. The research program will be based on systematic sighting surveys utilizing the Line Transect Method, to be conducted alternatively in IWC Areas III, IV, V and VI by one or two specialized vessels, during a tentative period of eight austral summer seasons. Analyses related to main and secondary objectives will be conducted based on new as well previous data collected by JARPA/JARPAII and NEWREP-A in the same research area. Therefore the analyses under each of the objectives will be based on large and consistent data sets. The survey plan for the 2019/20 austral summer season is presented as an appendix to this document.

INTRODUCTION

The Antarctic marine ecosystem is a very dynamic one with changes in species composition and habitat occurring through time. Changes in the Antarctic ecosystem can be derived from human interventions or from natural causes. The Antarctic krill is a key prey species supporting different species of baleen whales, pinnipeds, birds and fish. For the conservation and rational use of Antarctic marine living resources it is very important to investigate changes in the ecosystem expressed for example as temporal changes in species composition and abundance. Given their large biomass, large baleen whales have an important role in the Antarctic marine ecosystem.

Long-term research surveys in the Antarctic are scarce. Circumpolar whale sighting surveys were conducted during the International Decade for Cetacean Research/Southern Ocean Whale and Ecosystem Research (IDCR/SOWER) under the auspices of the International Whaling Commission Scientific Committee (IWC SC) for decades (Matsuoka *et al*., 2003). These surveys produced important sighting data to study the abundance and abundance trends of large whales in different IWC Management Areas (Branch and Butterworth, 2001; IWC, 2013). During those surveys, a substantial number of biopsy samples and photo-id data were also obtained, which contributed to the study of distribution, movement and the stock structure of cetaceans (Pastene, *in press*).

The Japanese Whale Research Programs under Special Permit in the Antarctic (JARPA/JARPAII) involved comprehensive long-term systematic surveys in the Indo-Pacific region of the Antarctic that collected biological information from whales and data from its environment, using lethal (biological sampling from Antarctic minke whale) and non-lethal (whale sighting surveys, oceanographic surveys, photo-identification and biopsy sampling of large whales) approaches. The comprehensive biological and environmental data, including abundance trends for several whale species, were collected for around 27 years. Reviews of the data collected and results obtained by JARPA and JARPAII were reviewed by the IWC SC (IWC, 2008; 2015).

Subsequently the New Scientific Whale Research Program in the Antarctic Ocean (NEWREP-A) was started in 2015/2016 with two main research objectives: 'Improvements in the precision of biological and ecological information for the application of the RMP to the Antarctic minke whales', and 'Investigation of the structure and dynamics of the Antarctic marine ecosystem through building ecosystem models'. In 2018 Japan decided to

halt the NEWREP-A in the Antarctic, and as a consequence the 2018/19 survey was the last one conducted under this research program. The decision to halt the NEWREP-A was taken after Japan's notification of its withdrawal from the International Convention for the Regulation of Whaling (ICRW) in December 2018, which will become effective on 30 June 2019. Japan was conducting the NEWREP-A under the Article VIII of the ICRW.

For the reason stated above, Japan considers it important to continue whale and ecosystem surveys in the Indo Pacific region of the Antarctic through dedicated sighting surveys and other non-lethal techniques to investigate primarily abundance, abundance trends and stock structure of large whales. For such aim a new research program has been designed which is called JASS-A (Japanese Abundance and Stock-structure Surveys in the Antarctic).

The main research objectives of JARPA/JARPAII and NEWREP-A in the Indo-Pacific region of the Antarctic included sub-objectives related to stock structure and abundance estimates of large whales, and relevant data and samples were collected for a long period of time in a systematic and consistent way. The data collected through the JASS-A can be analyzed in conjunction with the data collected by the previous JARPA/JARPA and NEWREP-A in the same region so that the analyses can be based on a long and consistent data set.

The objective of this paper is to outline the objectives, methodology and research schedule of JASS-A in the Indo-Pacific region of the Antarctic.

RESEARCH OBJECTIVES AND RELEVANCE

Main Objectives

The main research objectives of the JASS-A are:

MO1: Study of the abundance and abundance trends of Antarctic minke whale and other large whale species in the Indo-Pacific region of the Antarctic.

Abundance and abundance trends of whales in the Antarctic is essential for conservation and management purposes. Many whale species were depleted in the past. Some of them have shown signs of recovery in recent years, and it is important to monitor their recovery process and how such recovery could affect other whale species in the ecosystem.

MO2: Study of the distribution, movement and stock structure of Antarctic minke and other large whale species in the Indo-Pacific region of the Antarctic.

Stock structure information is important to interpret distribution and abundance data. Genetic stocks are demographically independent units and therefore each stock will respond in a different way to changes that have occurred in the ecosystem. Ideally abundance estimates should be based on the geographical and temporal boundaries of genetic stocks.

Overall JASS-A, in conjunction with the work already done under the previous research programs, will provide information to allow the determination of the status of the stocks of large whales that are found in waters of the Indo-Pacific region of the Antarctic in summer, and provide the necessary scientific background for appropriate conservation and management actions.

Secondary Objectives

The secondary objectives of JASS-A are:

SO1: Investigation of the oceanographic conditions in the Indo-Pacific region of the Antarctic.

Oceanographic structure and dynamics are important information to interpret changes in the Antarctic ecosystem. Changes in oceanographic conditions will affect distribution and krill biomass and in turn the abundance and distribution of whales. Changes in oceanographic conditions might indicate an effect of climate changes.

SO2: To investigate the spatial and temporal trend of marine debris on sea surface.

Studies on marine debris in the Antarctic are very scarce with only a few records made in sub-Antarctic and Antarctic islands and a single systematic survey in the Antarctic waters. It is important to continue with this kind of survey to monitor the future trends in the occurrence of marine debris.

SO3: To conduct feasibility studies to evaluate the utility of genetics data to estimate abundance.

Systematic sighting surveys utilizing the Line Transect Method is the most used method to estimate abundance of whales. Basic line-transect surveys however, are not always appropriate, especially for rare species/populations. Also in the case of the Antarctic it is not possible to utilize line-transect methodology for areas inside the pack-ice e.g. polynias where whales are also distributed. Genetic-based methods can assist in the abundance estimates in such cases.

SO4: To continue with feasibility studies to evaluate the utility of non-lethal techniques for whale biological research.

During the NEWREP-A several studies were carried out to investigate the feasibility of novel non-lethal approaches to address some of the main objective of the NEWREP-A on Antarctic minke whale e.g. progesterone analysis in blubber to investigate reproductive status (Inoue, *in review*), and stable isotopes for investigation whale's prey items. There is the need to continue with the investigation on the utility of such techniques in large whales.

RESEARCH AREA, SEASON, VESSELS AND PERIOD

The research area of JASS-A will be comprised by IWC Management Areas III, IV, V and VI, south of 60°S (Figure 1). This will allow for continuity and consistency with data already collected by JARPA/JARPAII, NEWREP-A and IDCR/SOWER surveys in those Management Areas.

The period of the annual surveys will be the austral summer season (January-February), which is the same as in the previous JARPA/JARPAII, NEWREP-A and IDCR/SOWER surveys.

Surveys will be carried out in principle by one or two specialized vessels, and the tentative length for JASS-A will be eight years (2019/20-2026/28), a period required to cover half of each Area once (Table 1). The final determination of the period and number of vessels will depend on the funding availability and therefore some level of flexibility is required.

SURVEY AND ANALYTICAL PROCEDURES

Abundance and abundance trends (MO1)

As noted above, obtaining abundance estimates of Antarctic minke whales and other large whale species was among the sub-objectives under JARPA/JARPAII and NEWREP-A (*e.g.* Matsuoka *et al*., 2011; Hakamada *et al*., 2013). Therefore abundance estimates of whale species under the new research program can be considered a continuation of the studies conducted in the previous research programs.

The approach will be systematic vessel-based sighting surveys utilizing the Line Transect Method. Surveys will be designed and conducted following the protocols included in the 'Requirements and Guidelines for Conducting Surveys and analyzing data within the Revised Management Scheme' (IWC, 2012). Sighting protocols will be the same as those used in the former IDCR/SOWER surveys (Matsuoka *et al*., 2003). Two sighting modes will be used, Closing Mode (NSC) and Passing with Independent Observer mode (IO). The OK model (Okamura and Kitakado, 2012) will be used to estimate abundance taking $g(0)$ estimates into account. The $g(0)$ estimates will be based on the sighting data obtained in NSC and IO modes.

Table 1 shows an overview of the past and proposed future surveys in the Indo-Pacific region of the Antarctic. As stated above, the new data will be analyzed in conjunction with previous data in those Areas (Table 1). Log-linear models will be used to estimate abundance trends (see details in Hakamada *et al*., 2013).

As part of the research on abundance estimates, school size estimation will be investigated using the Unmanned Aerial Vehicle (UAV) especially when large school of whales are observed.

Distribution, movement and stock structure (MO2)

Antarctic minke whale
Distribution and movement of individual whales will be investigated primarily by satellite tagging. Experiments conducted under the NEWREP-A demonstrated that such approach is feasible and useful to study the movement of Antarctic minke whales within the feeding ground as well between the feeding grounds and lower latitude waters (see Appendix 2 of Mogoe *et al*., 2018).

As noted above, stock structure of Antarctic minke whales was among the sub-objectives under JARPA/JARPAII and NEWREP-A (e.g. Pastene and Goto, 2016). Refinement of the stock structure of this species will continue under the new research program based on the large genetic sample set collected under the JARPA/JARPAII and NEWREP-A. Genetic markers such as mtDNA control region sequencing and microsatellite DNA will be used. Of particular importance are the genetic samples collected by NEWREP-A in Areas VIE (Bando *et al*., 2018) and IIIW (Bando *et al*., 2019), which will allow the investigation of boundaries of the P and I stocks in the feeding grounds (Pastene and Goto, 2016).

Standard genetic analyses based on hypothesis testing, heterozygosity, diversity, and related measures will be used. Principal Component Analysis (PCA), Discriminant Analysis of Principal Component (DAPC) as well the Bayesian approach STRUCTURE will be also used. The final analytical procedure will be determined depending on the amount and nature of the data collected.

Other large whale species
Distribution and movement of individuals will be investigated primarily by photo-ID and genetic tagging (see SO3 below). A considerable amount of photo-id pictures of Antarctic blue, humpback and southern right whales were obtained during the JARPA/JARPAII and NEWREP-A (Table 2). These pictures in conjunction with pictures to be obtained in the new research program will be used for matching exercise to investigate distribution and movement of those large whales. Effort will be spent to start or continue collaboration with other international photo-id catalogues (*e.g.* Olson *et al*., 2018). Satellite tagging will be attempted on fin and southern right whales recognizing that the highest priority species for this experiment is the Antarctic minke whale (see above).

Stock structure of other large whale species was not a particular sub-objective of the previous research programs. However a substantial amount of biopsy samples were collected under JARPA/JARPAII and NEWREP-A, on an opportunistic basis. Studies on stock structure in large baleen whales other than Antarctic minke whale will be based on those previous biopsy samples (Table 3) as well on additional biopsy samples collected during the new research program. Genetic markers such as mtDNA control region sequencing and microsatellite DNA will be used. Target species will be the blue, fin, humpback and southern right whales for which biopsy sampling is feasible and some preliminary studies have already started.

Standard genetic analyses based on hypothesis testing, heterozygosity, diversity, and related measures will be used. Principal Component Analysis (PCA), Discriminant Analysis of Principal Component (DAPC) as well the Bayesian approach STRUCTURE will be also used. The final analytical procedure will be determined depending on the amount and nature of the data collected.

Oceanographic surveys (SO1)
Oceanographic surveys will be conducted in the same manner as in the NEWREP-A (Wada *et al*., 2018). Oceanographic stations will be determined along the track-lines defined for the sighting surveys. Hydraulic pressure, temperature, salinity, chlorophyll-a and dissolved oxygen will be recorded at those stations from the sea surface to 500m depth using Conductivity-Temperature-Depth profiler (CTD) SBE 19 plus V2 SeaCAT (Sea-Bird Electronics, USA). Seawater will be sampled for the purpose of calibration of CTD sensors. Echo-sound survey will be also conducted to detect the presence of whale's preys at the place of the oceanographic stations (see details in Wada *et al*., 2018).

Data will be analyzed in conjunction with the large data sets produced by JARPA/JARPAII and NEWREP-A in the Indo-Pacific region of the Antarctic.

Spatial and temporal trend of marine debris (SO2)
Observation of marine debris on the sea surface will be made by visual observation along the track lines of sighting surveys, the same as was done in JARPA/JARPAII and NEWREP-A. Details of the methodology can

be found in Isoda *et al*. (2018). Data will be analyzed in conjunction with the large data sets produced by JARPA/JARPAII and NEWREP-A in the Indo-Pacific region of the Antarctic.

Feasibility studies to evaluate the utility of genetics data to estimate abundance (SO3).
Approaches based on mark-recapture of genetic-identified individuals will be used. Individual identification will be based on genotype profile of a set of microsatellite loci. Studies have already been started for southern right whales (see details in Pastene *et al*., 2018). Other potential target species are the blue and humpback whales as a considerable number of biopsy samples is already available.

Antarctic minke whale will also be a target species for this study based on the substantial amount of genetic and other biological data from JARPA/JARPAII and NEWREP-A. Kanda *et al*. (2014) investigated the potential fathers based on the genetic profiles of mother and fetus of Antarctic minke whale in the catches. From this information they obtained a preliminary estimate of abundance of the male component of the population. These studies will continue under this program.

Feasibility studies on the utility of non-lethal techniques to get biological and feeding ecology information from large whales (SO4)

Progesterone analyses of blubber
Inoue *et al*. (in review) studied the feasibility of analyses of progesterone in blubber as an indicator of the reproductive status of the Antarctic minke whale. The study was possible because information on reproductive status of each sample used was available (from lethal sampling) for comparison purposes. Effort will be made to collect biopsy samples on an opportunistic basis so that the progesterone study in this species can be continued.

Another candidate species for this study is the Antarctic humpback whale. Pallin *et al*. (2018a) provided an equation to calculate the probability of an animal being pregnant based on progesterone concentrations in biopsy (blubber) samples in humpback whales. The approach was validated based on life history data of the whales examined, which were obtained from photo-id surveys. Subsequently Pallin *et al*. (2018b) applied this method to investigate pregnancy rates in humpback whales around the Western Antarctic Peninsula. The same method can be applied to investigate pregnancy rates in humpback whales in the Indo-Pacific region of the Antarctic (Stocks D and E) based on the level of progesterone in blubber of Antarctic humpback whale for which a substantial number of biopsy samples are already available.

Stable isotopes analyses
Prey items of large baleen whales will be investigated based on previous lethal-obtained samples, and biopsy samples (old and new samples) and stable isotope analyses (see details of the method in Mitani *et al*., 2006). Priority species for this study will the Antarctic minke, fin and southern right whales. Fin and southern right whales distribute mainly around or north of 60°S. For southern right whales there are previous reports indicating that prey species are different according the latitudinal area where they are distributed.

RESEARCH SCHEDULE AND SURVEY PLAN FOR THE 2019/20 AUSTRAL SUMMER SEASON

Table 4 shows the research schedule of JASS-A with proposed dates for progressing and completing the work of main and secondary objectives.

The work on abundance and abundance trend studies has already started for different species based on data from previous surveys. Results on abundance will be presented annually for different species, and results on abundance trends based on the data shown in Table 1, will be presented after the first phase has been completed.

Studies on stock structure in Antarctic minke and humpback whales have progressed substantially based on samples collected in previous surveys, and final results will be presented early in the first phase of this new research program (Table 4). Analyses of Antarctic blue and fin whales stock structure require larger sample sizes and therefore final results will be presented at the end of the first phase.

Oceanographic and marine debris surveys require a long-term data series and therefore final results will be presented at the end of the first phase with preliminary results presented earlier (Table 4).

The study on abundance based on genetic mark-recapture in southern right whale (biopsy) has progressed substantially and therefore results will be presented earlier in the first phase. Results for humpback (biopsy) and Antarctic minke (lethal sampling from previous surveys) will be presented at the end of the first phase (Table 4).

Results of progesterone analysis in Antarctic minke and humpback whales and stable isotope analyses in Antarctic minke, fin and southern right whales will be presented in two stages (Table 4).

The field survey plan for the 2019/20 austral summer season is presented in the Appendix.

ORGANIZATION OF JASS-A AND OPPORTUNITIES FOR RESEARCH COLLABORATION

Scientists from the Institute of Cetacean Research (ICR) will play the leading role in order to pursue the research activities and achieve the research objectives of JASS-A, in collaboration with scientists from other domestic research organizations such as the National Research Institute of Far Seas Fisheries, and the Tokyo University of Marine Science and Technology.

Three aspects of the organization are considered important for making JASS-A a useful and successful research program:

i) The establishment of a domestic Steering Group.
ii) The scientific input from external scientists (national and international).
iii) An international workshop to review the final data and results of JASS-A.

i) A domestic Steering Group will be formed with the following Terms of References: *to ensure that the research work is conducted in line with the main and secondary objectives of JASS-A, and according to the agreed schedule (Table 4 of the main report). For this aim, the Steering Group should consider logistic and scientific matters, and therefore it should be composed of scientists (with field and analytical expertise), and managers.*

ii) Scientific inputs from external scientists will be possible in two ways: a) the research plan of JASS-A, annual cruise reports, and preliminary analytical results will be presented to annual meetings of the IWC SC, CCAMLR-EMM, NAMMCO SC, among others. Scientists from those organizations will have the opportunity to comment and provide suggestions during the discussions of the reports; b) qualified external scientists are welcomed to participate in the field and analytical works of JASS-A. Qualified external scientists can submit field or analytical research proposals for consideration of the domestic Steering Group. To facilitate the process, the Steering Group will prepare guidelines for the submission process.

iii) In the case of the previous research programs JARPA, JARPAII and NEWREP-A, the IWC SC carried out scientific reviews of ongoing and final results, which were extremely useful for the proponents of those programs. Data and results obtained by JASS-A will be reviewed by a review panel composed of scientists involved in the research, and experts invited by the Steering Group.

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Table 1. An overview of previous surveys with abundance estimates (AE) and tentative plan for future surveys in Areas III, IV, V and VI.

No.	No.	Program	Season	IIIW	IIIE	IVW	IVE	VW	VE	VIW	VIE	Remarks
1	1	JARPA	1987/88	-	-	AE	-	-	-	-	-	-
2	2	JARPA	1988/89	-	-	-	-	-	AE	-	-	-
3	3	JARPA	1989/90	-	-	AE	AE	-	-	-	-	-
4	4	JARPA	1990/91	-	-	-	-	AE	AE	-	-	-
5	5	JARPA	1991/92	-	-	AE	AE	-	-	-	-	-
6	6	JARPA	1992/93	-	-	-	-	AE	AE	-	-	-
7	7	JARPA	1993/94	-	-	AE	AE	-	-	-	-	-
8	8	JARPA	1994/95	-	-	-	-	AE	AE	-	-	-
9	9	JARPA	1995/96	-	AE	AE	AE	-	-	-	-	-
10	10	JARPA	1996/97	-	-	-	-	AE	AE	AE	-	-
11	11	JARPA	1997/98	-	AE	AE	AE	-	-	-	-	-
12	12	JARPA	1998/99	-	-	-	-	AE	AE	AE	-	-
13	13	JARPA	1999/2000	-	AE	AE	AE	-	-	-	-	-
14	14	JARPA	2000/01	-	-	-	-	AE	AE	AE	-	-
15	15	JARPA	2001/02	-	AE	AE	AE	-	-	-	-	-
16	16	JARPA	2002/03	-	-	-	-	AE	AE	AE	-	-
17	17	JARPA	2003/04	-	AE	AE	AE	-	-	-	-	-
18	18	JARPA	2004/05	-	-	-	-	AE	AE	AE	-	-
19	1	JARPAII	2005/06	-	AE	AE	AE	-	-	-	-	-
20	2	JARPAII	2006/07	-	-	-	-	AE	AE	AE	-	-
21	3	JARPAII	2007/08	-	AE	AE	AE	-	-	-	-	-
22	4	JARPAII	2008/09	-	-	-	-	AE	AE	AE	-	-
23	5	JARPAII	2009/10	-	-	-	-	-	-	-	-	Canceled
24	6	JARPAII	2010/11	-	-	-	-	-	-	-	-	Canceled
25	7	JARPAII	2011/12	-	-	-	-	-	-	-	-	Canceled
26	8	JARPAII	2012/13	-	-	-	-	-	-	-	-	Canceled
27	9	JARPAII	2013/14	-	-	-	-	-	-	-	-	Canceled
28	1	JASS	2014/15	-	-	AE	-	-	-	-	-	-
29	1	NEWREP-A	2015/16	-	-	-	AE	-	-	-	-	-
30	2	NEWREP-A	2016/17	-	-	-	-	AE	-	-	-	-
31	3	NEWREP-A	2017/18	-	-	-	-	-	AE	AE	-	-
32	4	NEWREP-A	2018/19	-	AE	-	-	-	-	-	-	-
33	1	JASS-A	2019/20	Plan	-	-	-	-	-	-	-	
34	2	JASS-A	2020/21	-	-	-	-	-	-	-	Plan	
35	3	JASS-A	2021/22	-	-	Plan	-	-	-	-	-	
36	4	JASS-A	2022/23	-	-	-	Plan	-	-	-	-	
37	5	JASS-A	2023/24	-	-	-	-	Plan	-	-	-	
38	6	JASS-A	2024/25	-	-	-	-	-	Plan	-	-	
39	7	JASS-A	2025/26	-	-	-	-	-	-	Plan	-	
40	8	JASS-A	2026/27	-	Plan	-	-	-	-	-	-	
		JASS-A: Japanese Abundance and Stock structure Survey in the Antarctic										

Table 2. The number of photo-id pictures obtained during the JARPA, JARPAII and NEWREP-A between 1987/88 and 2018/19, by whale species and Management Area

Area	III	IV	V	VI	Total
Blue	164	3,605	1,103	219	5,091
Humpback	48	1,144	390	83	1,665
S.Right	12	3,912	200	0	4,124
Total	224	8,661	1,693	302	10,880

Table 3. The number of available biopsy samples obtained during JARPA, JARPAII and NEWREP-A between 1987/88 and 2016/17, by whale species and Management Area.

Area	III	IV	V	VI	Total
Blue	8	24	15	4	51
Fin	9	14	21	0	44
Humpback	70	185	172	49	476
S.right	2	103	9	0	114
Sei	3	0	0	0	3
Total	92	326	217	53	688

Table 4: Tentative schedule for the work on main and secondary objectives of JASS-A.

Season	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Abundance and trends								
Blue whale		O			O			O
Fin whale		O			O			O
Antarctic minke whale			O			O		O
Humpback whale			O			O		O
S. right whale				O			O	O
Sperm whale				O			O	O
S. bottlenose whale				O			O	O
Stock structure								
Blue whale								O
Fin whale								O
A. minke whale		O						
Humpback whale		O						
Secondary Objectives								
Oceanography				O[1]				O[2]
Marine debris				O[3]				O[4]
Abundance genetics			O[5]					O[6]
Feasibility non-lethal (progesterone)				O[7]				O[8]
Feasibility non-lethal (stable isotope)				O[9]				O[10]

[1]Preliminary results oceanography
[2]Complete the work, oceanography
[3]Preliminary results marine debris
[4]Complete the work, marine debris
[5]Complete the work, southern right whale
[6]Complete the work, humpback and Antarctic minke whale
[7]Preliminary results for humpback whale
[8]Complete the work, humpback whale and Antarctic minke whale
[9]Preliminary results for Antarctic minke, fin and southern right whales
[10]Complete the work, Antarctic minke, fin and southern right whales

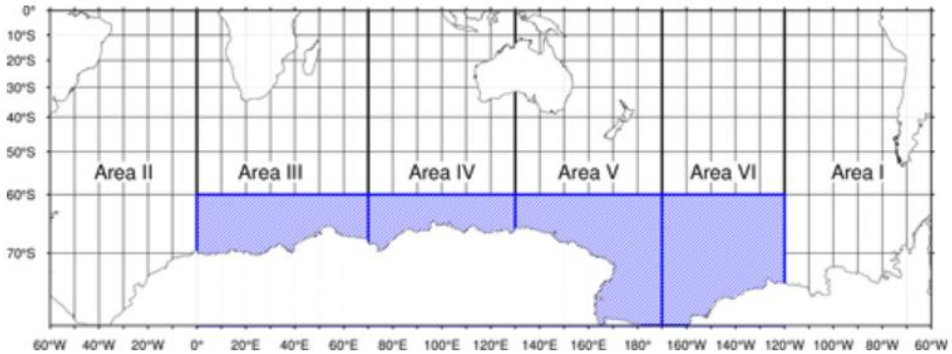

Figure 1. Research area for the Japanese dedicated whale sighting surveys.

Appendix

Research plan for the 2019/2020 JASS-A in Area IIIW

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This appendix outlines the research plan for the 2019/20 dedicated sighting survey.

Research area
IWC Management Area IIIW (0°E-35°E).

Research period and schedule
The duration of the survey including transit is planned to be 110 days. The home port will be Cape Town, South Africa. The number of days dedicated to research in Antarctic waters is planned to be 40 days. The tentative schedule of the survey is as follows:

Survey schedule for the 2019/2020 survey.

Date	***Yushin-Maru No.2 (YS2)***
2 December 2019	Vessel departs Shiogama
3 January 2020	Vessel arrives in Cape Town (South Africa)
6 January 2020	Vessel departs Cape Town
13 January 2020	Vessel starts survey in research area
7 February 2020	Vessel completes survey in research area
14 February 2020	Vessel arrives in Cape Town
16 February 2020	Post-cruise meeting
17 February 2020	Vessel leaves Cape Town
19 March 2020	Vessel arrives Shiogama, Japan

Research vessel
One vessel will be used for this survey, the *Yushin-Maru No. 2* (*YS2*) (Table 1 and Figure 1). This vessel is equipped with top barrel (TOP), independent observer platform (IOP) and upper bridge platform (UBP). The vessel will be also equipped with instruments required for the oceanographic survey.

Researchers on board
Two or three experienced researchers are required to conduct sightings, photo-id, biopsy and tagging experiments and the oceanographic survey.

Sighting survey

Guidelines for sighting survey
The plan outlined here follows the 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme (RMS)' (IWC, 2012).

Stratification of the research area
Area IIIW will be divided into southern and northern strata. The boundary between southern and northern strata is defined by a line 45n.miles from the ice-edge (Figures 2 and 3).

Track line design
Basically, the survey track line for thevessel will consist of two legs in the northern stratum at 5° longitudinal degree intervals and four legs in the southern stratum at 2°30' longitudinal degree intervals in a 10 degrees longitudinal band following Nishiwaki *et al*. (2014). Usually the vessel alternately survey the northern and southern strata each crossing the track line at the way-point between two strata (Figure 4).

For the 2019/20 survey, one vessel (*YS2*) will be used, which will survey the original track line (e.g. red line on Figure 4). Track lines are decided based on the original longitudinal line, which is selected at random. The interval of legs and number of legs in each stratum could be changed in consideration of delay caused by bad weather conditions and other factors. The proposed track lines (given an assumed ice edge) and strata are shown in Figure 4. Note that these tracks are based on 'guess estimated' ice conditions in an unpredictable area. Considerable flexibility may be needed by the Cruise Leader in determining the final cruise tracks (Figure 4).

Research hours, acceptable weather conditions and number of observers on effort
Research hours will be consistent with those in previous IWC/SOWER surveys. Research will start 60 minutes after sunrise and will end 60 minutes before sunset, with a maximum 12-hour research day (approximately 06:00-18:00). Time-zone changes will be recorded in 30-minute intervals, effective from 01:00h. Schedules will adhere to local 'ship' time ranging between +9.0 and +12.0 GMT. Data collected throughout the survey and all associated reporting will be in accord with the local 'ship' time. The searching activity will be conducted when the weather conditions are suitable for observations: visibility (minke whale visibility) better than 1.5n. miles and the wind speed less than 21 knots in the northern stratum and less than 26 knots in southern stratum.

The vessel speed during the survey will be 11.5 knots with slight adjustments to avoid vibration of the vessels.

Survey modes
Sighting activities onboard the vessels will be classified into two principal types: 'On-effort' and 'Off-effort'. On-effort means sightings activities executed under weather and sea state conditions considered acceptable. Off-effort means all activities that are not On-effort. All sightings to be recorded On-effort will be classified as 'Primary sightings'. All other sightings will be classified as 'Secondary sightings'. Sighting effort will be conducted by the boatswain and topmen from the top barrel (there will be always two primary observers on the top barrel) and the upper bridge where the helmsman, captain or officer-on-watch, researchers, and the chief engineer (or second engineer) will be also present (always two primary observers and four secondary observers). The sighting survey will be conducted using (1) Passing with abeam Closing mode (NSP) and (2) Passing with Independent Observer (IO) mode in order to estimate whale abundance considering estimated $g(0)$. Both survey modes follow the protocol endorsed for the IWC/SOWER surveys (e.g. Matsuoka *et al.*, 2003; IWC, 2008).

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

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

IO data will be obtained on both Antarctic minke and other large whale species.

Number of primary observers
For consistency, the number of primary observers will be the same as in previous IWC/IDCR-SOWER and NEWREP-A surveys:

TOP: Two topmen (primary observer) observe from the TOP barrel at all times using reticles binoculars with the angle board, regardless of the research mode is conducted.

IOP: One topman (primary observer) will be in the IOP barrel whenever full searching effort using reticles binoculars with the angle board is conducted during the IO mode.
UPPER BRIDGE (UBP): Captain and helmsman (primary observers) will be at the upper bridge using binoculars with reticles, regardless of the research mode. Also present on the upper bridge, whenever the

sighting survey is conducted, will normally be the chief engineer (or an alternate). There will be four researchers on the vessel.

During survey, the number of researchers searching from the Upper Bridge should be standardised.

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

Identification of species
Guidelines for species identification will be the same as those used during the IWC-SOWER surveys:

'Positive identification of species is based on multiple clues and usually requires the clear observation of the whale's body. Occasionally, repeated observations of the shape of the blow, surfacing and other behavioural patterns may also be sufficient; this judgment should be made only by the Senior Scientist or other designated researcher.' (IWC, 2008).

'Probable identification of species is based on multiple clues, which are nevertheless insufficient to be absolutely confident in identification. This usually occurs when blows are seen, the surfacing pattern is correct, but the whale's body cannot be seen or clearly seen' (IWC, 2008).

Determination of group size
The following guidelines will be used in determining group size:

'Schools where the number of animals, or an accurate estimated range of the number of animals, is determined are classified as confirmed schools. The data from the confirmed schools are used in the analysis to determine a mean school size. Therefore it is critical that the schools that are confirmed are representative in size of the schools that are in the survey area. Normally, schools believed to be confirmed for school size are approached to within 1n.mile for large whales and to within 0.3 n.miles for minke whales. Obviously, there are differences in the environmental conditions and behaviour of the animals for every sighting, however, (with particular reference to minke whale sightings) every effort should be made to be as consistent as possible in regard to the maximum time spent on identification of species and confirmation of numbers. Normally, if the sighting is thought to be minke whales, no more than 20 minutes (after closure has been completed) should be spent trying to complete these tasks. (Otherwise there is the potential for confusion with other sightings in the vicinity).' (IWC, 2008).

Other field research activities

Photo-id and biopsy
Photo-identification and biopsy sampling experiments will be carried out on an opportunistic basis based on the same protocols and equipment used during NEWREP-A surveys. Target species will be the blue, fin, humpback and southern right whales. Priority species for photo-id and biopsy sampling in this survey will be the blue and humpback whales, and blue and fin whales, respectively.

Satellite tagging
Routine telemetry experiments will be conducted following the same protocols and equipment used during the NEWREP-A surveys. The target species for this experiment will be the Antarctic minke whale. To investigate the breeding areas of this species in the low latitudes, tagging will be attached to the whales in the Antarctic during late period of this cruise as much as possible (e.g. between end of January and early February).

Oceanographic survey
Oceanographic surveys will be conducted following the same protocols and equipment used during the NEWREP-A surveys. Observation would be conducted at least at one station per day using memory type conductivity-temperature-depth profilers (CTD) (down to 500 m depth).

Marine debris observation
During the research time, marine debris on the sea surface will be recorded during the normal sighting surveys. Date of the observation, geographical location (longitude and latitude) of the observation and type of debris will be recorded.

Data and reports

Data format
The survey will be conducted using the same data forms as on the NEWREP-A survey (Matsuoka *et al*., 2016).

Data entry system
Researchers will input the data collected on weather, effort, sighting and experiments into the computer onboard the vessel, using the 'onboard data collecting system' (ICR, 2013). Survey modes and effort codes definitions for this survey correspond to those used in the NEWREP-A surveys. The data will be validated and stored at the Institute of Cetacean Research (ICR).

Cruise report
A cruise report will be prepared once the survey is completed, which will include a narrative of the survey, an evaluation on whether the survey was conducted under the original guidelines, and a list of the samples and data collected during the survey.

Others

Identification of home port organiser
It will be the responsibility of the Japanese scientists to identify a port organizer in Cape Town, South Africa.

Necessary permits
CITES permits will also be required to ship the all biopsy samples to ICR from the high sea.

Meetings
Arrangements for pre- and post-cruise meetings will be the responsibility of Japanese scientists.

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Nishiwaki, S., Ishikawa, H., Goto, M., Matsuoka, K. and Tamura, T. 2014. Review of general methodology and survey procedures under the JARPAII. Paper SC/F14/J2 presented to the JARPAII review workshop, February 2014 (unpublished). 34pp. [Paper available at the IWC Office].

Table 1. Specifications of the vessel to be engaged in the 2019/20 season dedicated sighting survey under the JASS-A.

	Yushin-Maru No.2
Call sign	JPPV
Length overall [m]	69.61
Molded breadth [m]	10.8
Gross tonnage [GT]	747
Top barrel height [m]	19.5
IO platform height [m]	13.5
Upper bridge height [m]	11.5
Bow height [m]	6.5
Engine power [PS/kW]	5,280/3,900

Figure 1. Research vessel to be used in the dedicated sighting survey: *Yushin-Maru No. 2.*

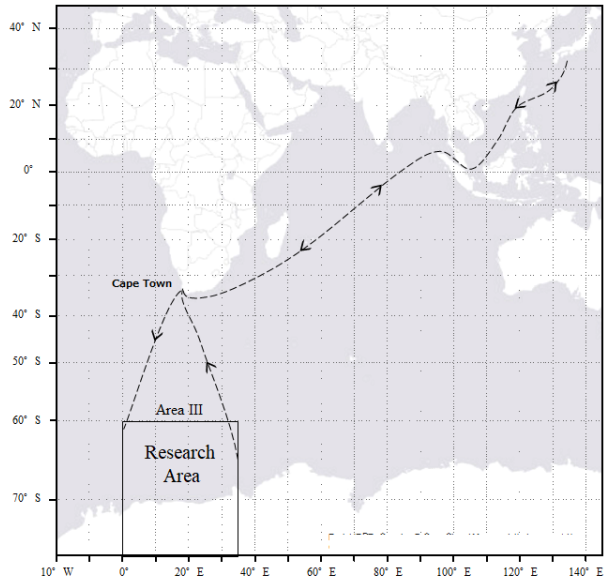

Figure 2. Research area and the transit survey between home port (Cape town, South Africa) and the research area in Area IIIW (0^{o}E-35^{o}E) in 2019/20 JASS-A.

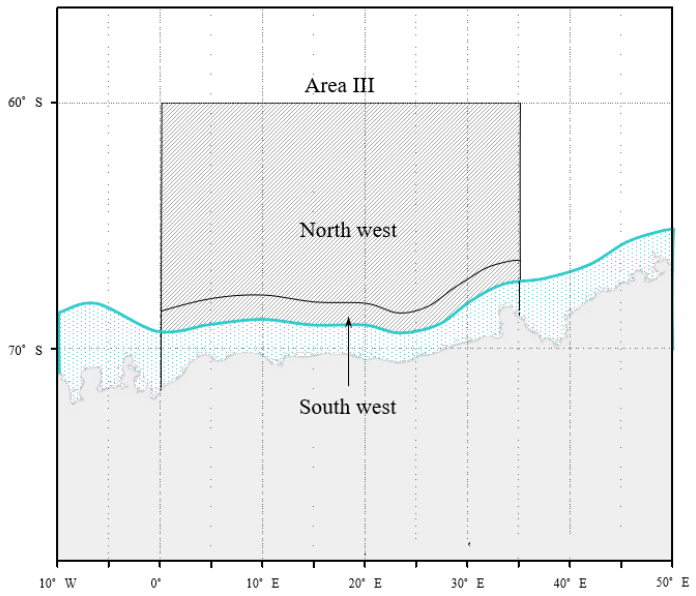

Figure 3. Sectors and strata to be covered by the dedicated sighting survey in Area IIIW (0°E-35°E) in 2019/20 JASS-A. Blue line indicates assumed ice edge line.

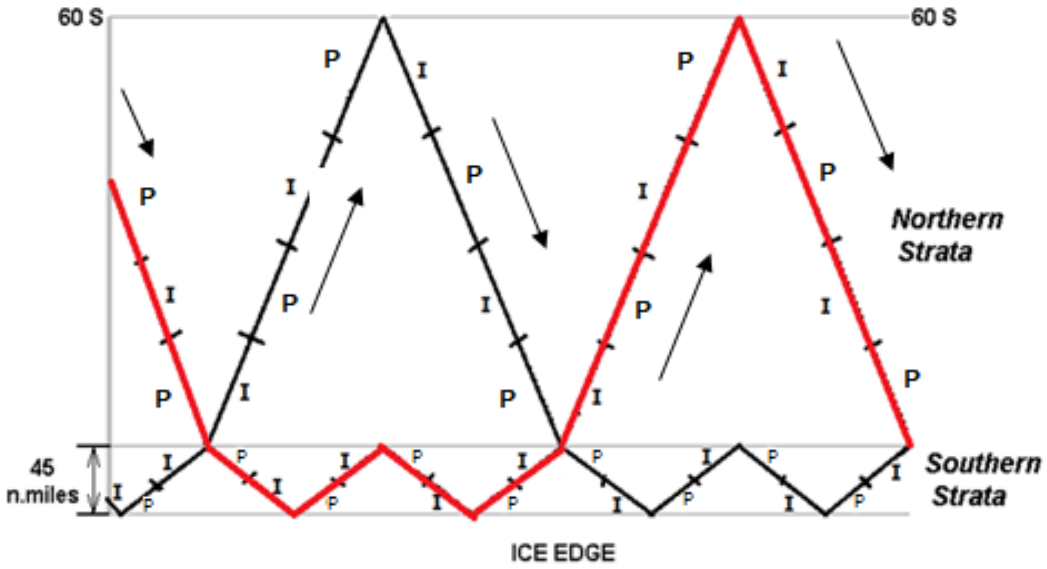

Figure 4. Basic design for pre-determined cruise track lines in the Antarctic when using two vessels. For the 2019/20 survey, one vessel (*YS2*) will be used, which will survey the original track line (e.g. red line). Track lines are decided based on the original longitudinal line, which is selected at random. The interval of legs and number of legs in each stratum could be changed in consideration of delay caused by bad weather conditions and other factors. 'I' indicates that the survey will be conducted under IO mode and 'P' indicates that the survey will be conducted in NSP mode (passing mode with abeam closing mode). Considerable flexibility may be needed by the Cruise Leader in determining the final cruise tracks.