Technical Reports of the Institute of Cetacean Research (2020) pp. 12–22

Technical Report (not peer reviewed)

An outline of the Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) including results of the first survey under this new research program

Tatsuya Isoda*, Taiki Katsumata, Tsutomu Tamura, Koji Matsuoka and Luis A. Pastene

Institute of Cetacean Research, 4–5 Toyomi-cho, Chuo-ku, Tokyo 104–0055, Japan

**Contact e-mail: isoda@cetacean.jp*

ABSTRACT

This paper briefly 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) and summarizes the first JASS-A survey conducted in the 2019/20 austral summer season. The main research objectives of JASS-A are i) the study of the abundance and abundance trends of large whale species, and ii) the study of the distribution, movement and stock structure of large whale species. JASS-A also has five secondary research objectives related to oceanography, marine debris and whale biology. JASS-A will be based on systematic sighting surveys utilizing the Line Transect Method, to be conducted alternatively in IWC Management 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. The first JASS-A survey was conducted in the western part of Area III (000°–015°E) for 25 days, from 13 January to 6 February 2020. Systematic sighting and oceanographic data were obtained. Also biopsy, photo-identification and satellite tracking experiments were conducted successfully.

INTRODUCTION

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) between 1978/79 and 2009/2010 (Matsuoka *et al.*, 2003; IWC, 2013). 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).

The Japanese Whale Research Programs under Special Permit in the Antarctic (JARPA/JARPAII) and the New Scientific Whale Research Program in the Antarctic Ocean (NEWREP-A) 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 of Antarctic minke whale) and non-lethal (whale sighting surveys, oceanographic surveys, photo-identification, biopsy sampling and satellite tagging of large whales) approaches. A comprehensive biological and environmental data set, including abundance trends for several whale species, was obtained from these surveys conducted between 1987/88 and 2018/19 (IWC, 2015).

Japan considered 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 an aim a new research program was designed which is called JASS-A (Japanese Abundance and Stock-structure Surveys in the Antarctic). The JASS-A program was presented to the 2019 meeting of IWC SC (GOJ, 2019a), to the 2019 meeting of Commission for the Conservation of Antarctic Marine Living Resources-Working Group on Ecosystem Monitoring and Management (CCAMLR-EMM) (GOJ, 2019b), and to the meeting of the North Atlantic Marine Mammal Commission Scientific Committee (NAMMCO SC) (GOJ, 2019c). JASS-A was positively evaluated at these international forums.

The objectives of this paper are, i) to present a brief outline of the objectives, methodology and research schedule of JASS-A, and ii) to summarize the results of

the first JASS-A survey in the Indo-Pacific region of the Antarctic in the 2019/20 austral summer season.

OUTLINE OF JASS-A

Objectives of the JASS-A

The main research objectives (MO) of the JASS-A are:

MO1: Study of the abundance and abundance trends of 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 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.

JASS-A, in conjunction with the work already conducted 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 future policies on conservation and sustainable utilization.

The secondary objectives (SO) of JASS-A are:

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

Oceanographic structure and dynamics provide important information in interpreting changes in the Antarctic ecosystem. Changes in oceanographic conditions will affect krill distribution and biomass and, in turn, the abundance and distribution of whales. Changes in oceanographic conditions can be related to climate changes.

SO2: Investigation of the spatial and temporal trends 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, Antarctic islands and the Antarctic. 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 genetic 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., polynyas, 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 objectives of the NEWREP-A on Antarctic minke whales, e.g., progesterone analysis in blubber to investigate reproductive status (Inoue *et al.*, 2019), and stable isotopes to investigate whales' prey items. There is the need to continue with the investigation on the utility of such techniques for large whales.

SO5: Feasibility study on the utility of Unmanned Aerial Vehicle (UAV) for obtaining information relevant for abundance estimate of large whales

In particular this technique could be used to determine the number of individuals in the schools, which is information highly relevant for the abundance estimates.

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 spe-

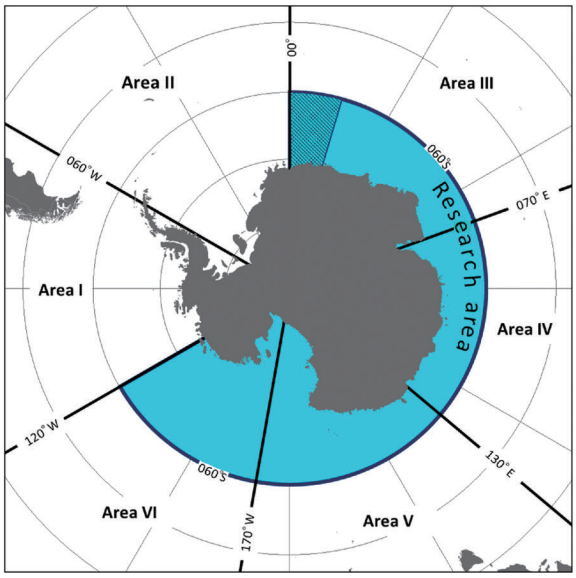

Figure 1. Research area of JASS-A. The shaded area (000°–015°E) indicates the surveyed area in the 2019/20 austral summer season.

cialized vessels, and the tentative length for JASS-A will be eight years (2019/20–2026/27), 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 funding availability and therefore some level of flexibility is required.

Survey and analytical procedures

Abundance and abundance trends (MO1)

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 for $g(0)$ estimates, Passing with abeam Closing mode (NSP) 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. 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).

Distribution, movement and stock structure (MO2)

Distribution and movement of individual humpback, blue, southern right and fin whales will be investigated primarily by photo-id and genetic tagging. Photo-id pictures in conjunction with pictures obtained in previous programs will be used for the matching exercise to investigate distribution and movement of those large whales. Studies on stock structure in humpback, blue, southern right and fin whales will be based on genetic analyses of previous biopsy samples as well as additional biopsy samples collected during the new research program. Refinement of the stock structure of the Antarctic minke whales (e.g., Pastene and Goto, 2016) will continue under the new research program based on the large genetic sample set collected under JARPA/JARPAII and NEWREP-A.

Genetic markers such as mtDNA control region sequencing and microsatellite DNA will be used. 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 also be used. The final analytical procedure will be determined depending on the amount and nature of the data collected for each species.

Oceanographic surveys (SO1)

Oceanographic surveys will be conducted at one station per day, at least, using eXpendable Conductivity, Temperature and Depth (XCTD). Oceanographic stations will be deployed at equal intervals along the track-lines defined for the sighting surveys.

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).

Feasibility studies to evaluate the utility of genetic data to estimate abundance (SO3)

Approaches based on mark-recapture of genetically identified individuals will be used. Individual identification will be based on the genotype profile of a set of microsatellite loci. Studies have already started for southern right whales based on biopsy sampling (see details in Pastene *et al.*, 2018). Other potential target species are the blue and humpback whales as a considerable number of biopsy samples are already available.

Antarctic minke whales will also be a target species for paternity analyses based on the substantial amount of genetic and other biological data from JARPA/JARPAII and NEWREP-A.

Table 1

An overview of previous surveys with abundance estimates (AE) and tentative plans for future surveys in Areas III, IV, V and VI under the JASS-A (GOJ, 2019a).

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

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

Progesterone analyses of blubber (SO4-A)

Inoue *et al.* (2019) studied the feasibility of analyses of progesterone in blubber as an indicator of the reproduc-

Table 2
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
MO1 Abundance and trends								
Blue whale		○			○			○
Fin whale		○			○			○
Antarctic minke whale			○			○		○
Humpback whale			○			○		○
Southern right whale				○			○	○
Sperm whale				○			○	○
Southern bottlenose whale				○			○	○
MO2 Stock structure								
Blue whale								○
Fin whale								○
Antarctic minke whale		○						
Humpback whale		○						
Secondary Objectives								
Oceanography				○ [1]				○ [2]
Marine debris				○ [3]				○ [4]
Abundance genetics			○ [5]					○ [6]
Feasibility non-lethal (progesterone)				○ [7]				○ [8]
Feasibility non-lethal (stable isotope)				○ [9]				○ [10]
UAV experiments								○

[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

tive status of Antarctic minke whales. The study was possible because information on the reproductive status of each sample used was available (from lethal sampling) for comparison purposes. Efforts will be made to collect biopsy samples on an opportunistic basis so that the progesterone study for this species can continue. Another candidate species for this study is the humpback whales for which a substantial number of biopsy samples are already available.

Stable isotopes analyses (SO4-B)

Prey items of large baleen whales will be investigated based on previous samples collected lethally, 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.

Feasibility study on the utility of Unmanned Aerial Vehicle (UAV) for obtaining information relevant for abundance estimate of large whales (SO5)

Several types of UAV will be tested to investigate the utility of this technique for obtaining information relevant for abundance estimates of large whales including the number of whales in a school.

As noted above, MO and SO 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.

Research schedule

Table 2 shows the research schedule of JASS-A with proposed dates for progressing and completing the work of MO and SO. Once again some degree of flexibility is required on the schedule proposed in this table.

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 Insti-

tute of Far Seas Fisheries, and the Tokyo University of Marine Science and Technology. A domestic steering group has been formed to coordinate the research activities.

Qualified external scientists will be welcome 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.

SUMMARY OF THE FIRST JASS-A SURVEY

Research area

The research area covered by the survey was the western part of Area IIIW (000°–015°E), south of 60°S (Figure 1).

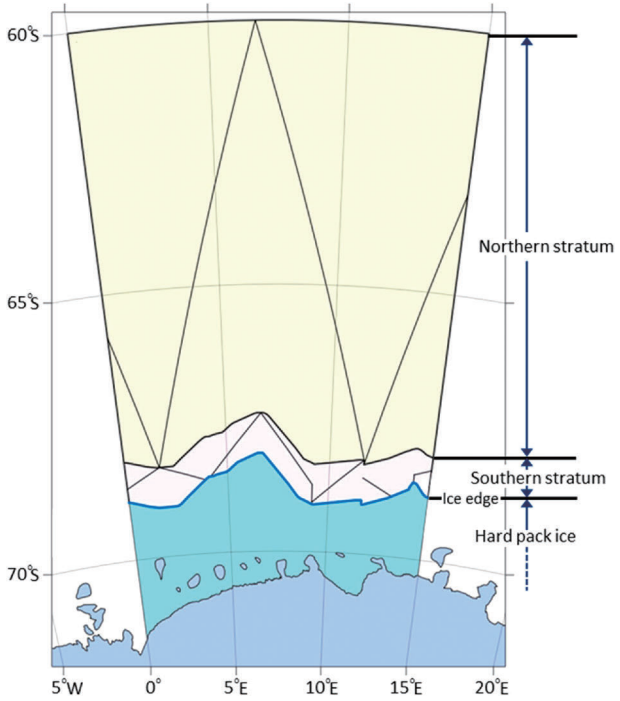

Figure 2. Research area (000°–015°E) and track-line of the JASS-A survey in 2019/20. The survey commenced at 68°40'S 000°00' and ended at 63°06'S 15°00'E.

The area was divided into northern and southern strata. The boundary between southern and northern strata was defined by a line 45 n.miles from the ice edge (Figure 2). In the northern and southern strata, the survey track-lines consisted of a zigzag course changing direction at 5°00' and 2°30' longitudinal degree intervals in a 10 degrees longitudinal band respectively. A randomized start point for survey tracks was used.

Research vessel and sighting mode

The dedicated sighting vessel (SV) *Yushin-Maru* No. 2 (747GT, 69.6 m) was engaged in the survey. Three experienced Japanese researchers on line transect surveys, biopsy sampling, photo-id, satellite tagging experiments, and oceanographic survey, were aboard. The vessel was equipped with a top barrel platform (TOP, 19.5 m), Independent Observer Platform (IOP, 13.5 m) and an upper bridge platform (UBP, 11.5 m). For NSP mode, there were two primary observers on the TOP and there was open communication between the UBP and the TOP. For IO mode, there were two primary observers on the TOP and one primary observer on the IOP. The observers on the TOP or IOP communicated to the UBP independently. Two primary observers (captain and helmsman) and researchers were at the upper bridge, regardless of the research mode (Figure 3). These observers conducted searching for cetaceans by using angle board and binoculars with reticles (7x), which include the distance estimate scales.

Research effort in the research area

The dedicated sighting vessel was engaged in the survey for 25 days. The survey commenced on 13 January at position 68°40'S 000°00' and ended on 6 February at position 63°06'S 15°00'E covering the predetermined transects. The total searching distance was 1,447.9 n. miles (2,681.5 km), including 650.3 n. miles covered in NSP mode and 797.6 n. miles in IO mode. The survey coverage

Figure 3. Sighting activity at the TOP (left); confirmation and tracking of whales including identification of duplicates at the UBP (middle); Researcher recording a sighting and inputting data at the UBP (right).

Table 3
Number of sightings in the research area, by stratum and species.

Species	Western part of Area IIIW: 000°–015°E								Sub-total				Total	
	Southern stratum				Northern stratum									
	Prim.		Second.		Prim.		Second.		Prim.		Second.			
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Blue whale	11	11	2	2	6	7	0	0	17	18	2	2	19	20
Fin whale	7	16	1	6	63	113	1	1	70	129	2	7	72	136
Like fin	0	0	1	3	2	3	0	0	2	3	1	3	3	6
Antarctic minke whale	51	106	14	15	48	73	6	9	99	179	20	24	119	203
Like minke	5	6	1	1	4	4	0	0	9	10	1	1	10	11
Humpback whale	13	22	12	16	62	123	3	7	75	145	15	23	90	168
Like humpback	0	0	0	0	2	2	0	0	2	2	0	0	2	2
Baleen whale	2	3	1	1	5	6	1	1	7	9	2	2	9	11
Sperm whale	0	0	0	0	5	5	0	0	5	5	0	0	5	5
Killer whale	1	1	0	0	0	0	0	0	1	1	0	0	1	1
Southern bottlenose whale	4	10	0	0	3	12	0	0	7	22	0	0	7	22
Ziphiidae	1	2	0	0	13	22	0	0	14	24	0	0	14	24
Unidentified whale	1	1	0	0	3	3	0	0	4	4	0	0	4	4

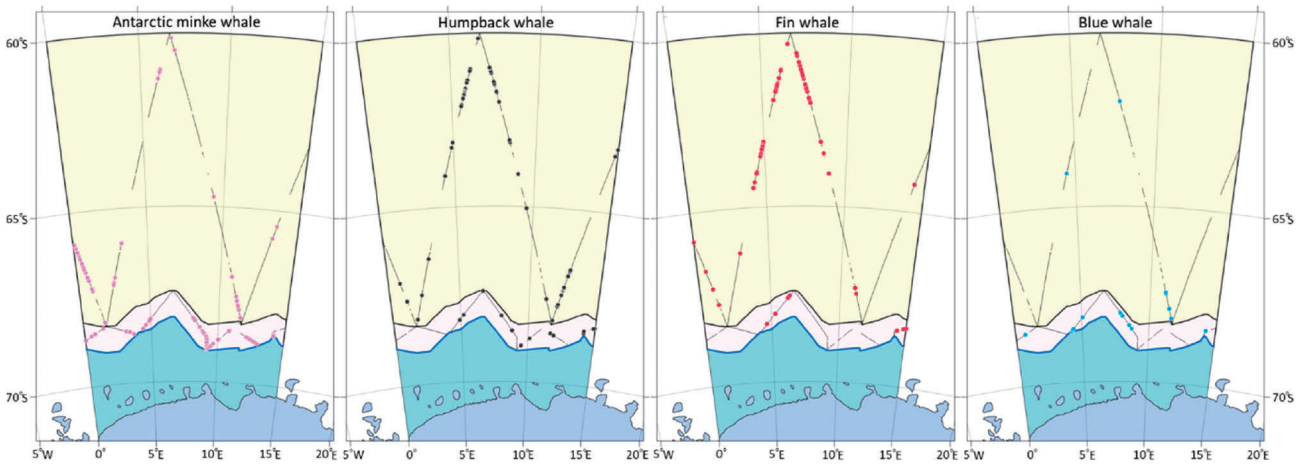

Figure 4. Position of primary sightings of Antarctic minke, humpback, fin, and blue whales with information of the surveyed transects.

was 71% in the northern stratum and 83% in the southern stratum. The total experimental time for photo-id, biopsy sampling, satellite tagging and distance and angle experiment was 26 hours and 49 minutes.

Whale sighting in the research area

Four baleen whale species, blue (19 schools/20 individuals), fin (72/136), Antarctic minke (119/203), humpback (90/168) whales and at least three toothed whale species, sperm (5/5), southern bottlenose (7/22) and killer (1/1) whales, were sighted (Table 3).

Antarctic minke whales

This species was the most frequently sighted. Density index (DI: schools sighted/100 n.miles searching distance) based on primary sightings was 0.04 in the northern stratum and 0.14 in the southern stratum. In this survey, the sightings of Antarctic minke whales were abundant near the ice edge. In addition, many sightings occurred in the western side of the northern stratum (Figure 4).

Humpback whales

This species was the second most frequently sighted. It was widely distributed in the research area (Figure 4). The DI based on primary sightings was 0.06 in the northern stratum and 0.03 in the southern stratum. The distribution was concentrated between 61°S and 62°S. The pattern of distribution and density of this species in this

survey seems to be different from those in past surveys in the Area III.

Fin whales

This species was the third most frequently sighted. It was found mainly north of 64°S (Figure 4). The number of sightings were larger than in previous surveys in the same area.

Blue whales

This species was found mainly in the southern stratum of the research area (Figure 4). In this survey, 13 schools (13 individuals) were distributed in the southern stratum, similar to the situation in previous surveys. A total of 6 schools (7 individuals) was distributed in the northern stratum.

Duplicate sightings

Duplicates were recorded for a total of 75 sightings (involving several whale species) during the IO mode survey, and these data will be used to estimate whale abundance while taking estimated $g(0)$ into consideration.

Figure 5. Photo-id experiments on humpback whales from the bow deck of the vessel (left); details of the ventral fluke pigmentation (right).

Figure 6. Biopsy sampling of blue whale (left) and skin/blubber sample of blue whale obtained by biopsy sampling (right).

Figure 7. Satellite tagging and biopsy sampling of fin (left) and Antarctic minke (right) whales.

Sighting survey in the transit area

The sighting survey was conducted between 10°S and the research area, excluding the areas of foreign countries' EEZs. Only NSP mode was used. The searching effort was 2,539.9 n.miles and total sightings included blue (3/4), fin (9/14), Antarctic minke (5/8), humpback (12/23), sperm (9/10), southern bottlenose (2/8) and killer whales Type A (1/17) whales.

Other research activities

Sighting distance and angle experiment

The sighting distance and angle experiment was conducted in order to evaluate the accuracy of sighting distance and angle provided by primary observers. The results of this experiment will be used for the calculation of abundance estimates. A training for this experiment was carried out on 15 January. The actual experiment was conducted on 30 January and 144 trials were completed successfully.

Photo-id (Figure 5)

A total of 20 blue, 14 humpback and 5 killer whales (Type A) were successfully photo-identified during the survey. These data will be registered into the ICR photo-id catalogue (e.g., Matsuoka and Pastene, 2014).

Biopsy sampling for large whales (Figure 6)

A total of 29 biopsy samples were collected, including 10 blue, 11 fin, and 8 Antarctic minke whales, using the Larsen system (Larsen, 1998). Satellite tags were attached on eight biopsied Antarctic minke whales and seven of the 11 biopsied fin whales. Biopsy samples were stored at −20°C. These samples will be used in genetic analyses and studies to evaluate the utility of non-lethal techniques for whale biological research.

Figure 8. Oceanographic survey by XCTD.

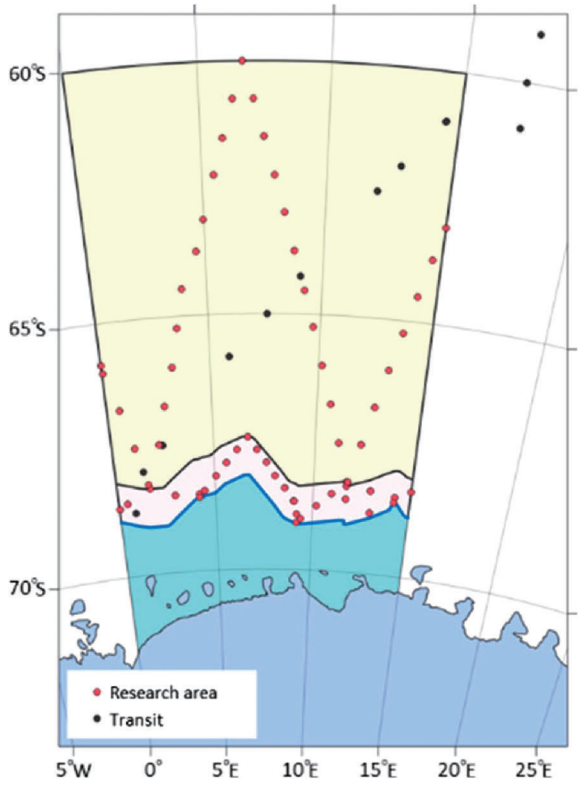

Figure 9. Oceanographic observation stations (XCTD casting points).

Figure 10. Image of two blue whales taken using a small UAV in the research area.

Satellite tagging (Figure 7)
The satellite-monitored tags (SPOT6, Wildlife Computers, Redmond, Washington, USA) were deployed with the Air Rocket Transmitter System (ARTS) (LK-ARTS, Skutvik, Norway). The details of the deployment system and protocols is described in Konishi *et al.* (2020). The tags were successfully deployed on 10 fin and 8 Antarctic minke whales (see Konishi *et al.*, this issue).

Oceanographic survey
Oceanographic survey was conducted by XCTD (Figure 8) at 75 stations on the survey track-lines, including transit survey (Figure 9). Oceanographic data will be analyzed to study the oceanographic structure of the research area and the relationship with whale distribution (Watanabe *et al.*, 2014). In addition, an Argo float, under the Argo oceanographic program (JAMSTEC, 2020), was successfully deployed on 4 January, during the transit to the Antarctic.

Marine debris observation
A total of three marine debris objects, comprising two plastic bottles and a fishing buoy, were observed during the survey in the research area. These data will be registered into the ICR database and reported in the future (e.g., Isoda *et al.*, 2018).

Feasibility study on the utility of UAV
A preliminary experiment was conducted for collecting aerial images of whale using a small UAV (Phantom 4 Pro; DJI, Shenzhen, China). A total of two blue (Figure 10) and three humpback whales were photographed using the UAV. These data will be registered into the photo-id catalogue of ICR.

Data and samples collected in this survey were validated and stored at the ICR, and will be analyzed in conjunction with data and samples obtained during past research programs in the Antarctic (JARPA, JARPAII, NEWREP-A), in the context of the primary and secondary objectives of the JASS-A. Data will be available to the national and international scientific community through established data access protocols of ICR.

ACKNOWLEDGEMENTS

We thank the captain, crew members and researchers who participated in the 2019/20 JASS-A survey for their effort in the collection of data and samples. Thanks also to Yoshihiro Fujise (ICR), project leader of the cruise, for valuable suggestions and the staff of ICR for logistic support. Kyodo Senpaku Co. Ltd. is acknowledged for logistic arrangements and support. Thanks also to Kenji Konishi (ICR) for planning and assisting the satellite tagging experiments. Finally, we thank the Fisheries Agency of Japan for the funding support for the JASS-A program.

REFERENCES

Branch, T.A. and Butterworth, D.S. 2001. Estimates of abundance south of 60°S for cetacean species sighted frequently on the 1978/79 to 1997/98 IWC/IDCR-SOWER sighting surveys. *J. Cetacean Res. Manage*. 3 (3): 251–270.

Government of Japan. 2019a. 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. Paper SC/68a/ASI8 presented to the IWC Scientific Committee, May 2019 (unpublished). 16 pp. [Available from the IWC Secretariat].

Government of Japan. 2019b. 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. Paper WG-EMM-2019/68 presented to CCAMLR meeting of Working Group on Ecosystem Monitoring and Management, June–July 2019 (unpublished). 16 pp.

Government of Japan. 2019c. 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 (revised version of document SC/68a/ASI08 presented to the IWC SC 2019 meeting). Paper SC/26/NPR-JP presented to the 26th meeting of the NAMMCO Scientific Committee, October-November 2019 (unpublished). 16 pp.

Hakamada, T., Matsuoka, K., Nishiwaki, S. and Kitakado, T. 2013. Abundance estimates and trends for Antarctic minke whales (*Balaenoptera bonaerensis*) in Antarctic Areas IV and V based on JARPA sighting data. *J. Cetacean Res. Manage.* 13 (2): 123–151.

International Whaling Commission. 2012. Requirements and guidelines for conducting surveys and analyzing data within the Revised Management Scheme. *J. Cetacean Res. Manage.* (Suppl.) 13: 507–517.

International Whaling Commission. 2013. Report of the Scientific Committee. *J. Cetacean Res. Manage*. (Suppl.) 14: 1–102.

International Whaling Commission. 2015. Report of the Expert Workshop to Review the Japanese JARPAII Special Permit Research Programme. *J. Cetacean Res. Manage*. (Suppl.) 16: 369–409.

Inoue, S., Yasunaga, G. and Pastene, L.A. 2019. Comparison of progesterone concentrations in blubber and plasma among female Antarctic minke whales of known reproductive status. *Fish Sci* 85: 971–977.

Isoda, T., Tamura, T. and Pastene, L.A. 2018. Using JARPA and JARPAII platforms for investigating the occurrence of marine debris in the Indo-Pacific region of the Antarctic. *Technical Reports of the Institute of Cetacean Research (TEREP-ICR)* No. 2: 64–73.

Japan Agency for Marine-Earth Science and Technology. 2020. Japan Argo-part of the integrated global observation strategy. http://www.jamstec.go.jp/J-ARGO/index_j.html. Accessed 1 May 2020.

Konishi, K., Isoda, T., Bando, T., Minamikawa, S. and Kleivane, L. 2020. Antarctic minke whales find ice gaps along the ice edge in foraging grounds of the Indo-Pacific sector (60°E and 140°E) of the Southern Ocean. *Polar Biol*. 43 (4): 343–357.

Larsen, F. 1998. Development of a biopsy system primarily for use on large cetaceans. Paper SC/50/O15 presented to the IWC Scientific Committee, May 1998 (unpublished). 8 pp. [Available from the IWC Secretariat].

Matsuoka, K., Ensor, P., Hakamada, T., Shimada, H., Nishiwaki, S., Kasamatsu, F. and Kato, H. 2003. Overview of minke whale sightings surveys conducted on IWC/IDCR and SOWER Antarctic cruises from 1978/79 to 2000/01. *J. Cetacean Res. Manage.* 5 (2): 173–201.

Matsuoka, K. and Pastene, L.A. 2014. Summary of photo-identification information of blue, southern right and humpback whales collected by JARPA/JARPAII. Paper SC/F14/J34 presented to the IWC Scientific Committee, February 2014 (unpublished). 11 pp. [Available from the IWC Secretariat].

Mitani, Y., Bando, T., Takai, N. and Sakamoto, W. 2006. Patterns of stable carbon and nitrogen isotopes in the baleen of common minke whale *Balaenoptera acutorostrata* from the western North Pacific. *Fish Sci.* 72: 69–76.

Okamura, H. and Kitakado, T. 2012. Abundance estimates of Antarctic minke whales using the OK method. Paper SC/64/IA2 presented to IWC Scientific Committee, June 2012 (unpublished). 24 pp. [Available from the IWC Secretariat].

Pastene, L.A. and Goto, M. 2016. Genetic characterization and population genetic structure of the Antarctic minke whale *Balaenoptera bonaerensis* in the Indo-Pacific region of the Southern Ocean. *Fish Sci.* 82: 873–886.

Pastene, L.A., Goto, M., Acuna, P., Taguchi, M., Hakamada, T. and Matsuoka, K. 2018. Population identity, site-fidelity, movement ranges and preliminary estimates of abundance of southern right whales in the Antarctic Indian sector inferred from genetic markers. Document WG-EMM-18/18 presented to the CCAMLR Working Group on Ecosystem Monitoring and Management, July 2018. 13 pp.

Watanabe, T., Okazaki, M. and Matsuoka, K. 2014. Results of oceanographic analyses conducted under JARPA and JARPAII and possible evidence of environmental changes. Paper SC/F14/J20 presented to the JARPAII review Workshop, February 2014 (unpublished). 10 pp. [Available from the IWC Secretariat].