Technical Report (not peer reviewed)

Results of the dedicated sighting survey under the Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) in a part of Area VI in the 2022/2023 austral summer season

Tatsuya ISODA*, Taiki KATSUMATA, Yujin KIM and Koji MATSUOKA

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

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

ABSTRACT

The results of the sighting survey of the Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) in the 2022/2023 austral summer season are reported. Two dedicated sighting vessels were engaged in the line transect method survey in a part of Antarctic Area VI (145°W–130°W) for 28 days, from 10 January to 6 February 2023. For the survey, the research area was divided into northern and southern strata. In addition, surveys were conducted successfully in coastal ice-free waters, south of 71°30'S, an area that is normally covered by pack-ice and difficult for vessels to access. The total searching distance in the research area was 2,168.6 n.miles (4,016.2 km). Four baleen whale species and at least two toothed whale species were sighted in the research area. Other research activities such as biopsy sampling, photo-ID, satellite tagging and oceanographic observations were also conducted. The data and samples collected are required for the main and secondary research objectives of JASS-A.

INTRODUCTION

Long-term systematic surveys on whales and the ecosystem in the Antarctic, such as the JARPA/JARPAII[1], NEWREP-A[2] and IWC IDCR/SOWER[3], obtained important data pertaining to the study of abundance and abundance trends of large whales and their biology as well as the role of whales in the Antarctic ecosystem. All these research programs have been terminated. The last NEWREP-A survey was carried out in the 2018/2019 austral summer season.

The Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) commenced in the 2019/2020 austral summer season because it was considered important to continue with the whale and ecosystem surveys in the Indo-Pacific region of the Antarctic Ocean through dedicated sighting surveys and other non-lethal research techniques. JASS-A has two main research objectives, 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 several secondary research objectives related to oceanography, marine debris, genetic data to estimate abundance, whale biology and study on the utility of Unmanned Aerial Vehicle (UAV). The JASS-A program was presented to the 2019 meeting of IWC SC[4] (GOJ, 2019a), the 2019 meeting of CCAMLR-EMM[5] (GOJ, 2019b) and the 2019 meeting of NAMMCO SC[6] (GOJ, 2019c).

The approach of JASS-A is systematic vessel-based sighting surveys utilizing the line transect method. Surveys are designed and conducted following the protocols included in the 'Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme' (IWC, 2012). Sighting protocols are the same as those used in the former IDCR/SOWER surveys (Matsuoka *et al.*, 2003; IWC, 2008). The JASS-A surveys are conducted alternatively in IWC Management Areas III, IV, V and VI by one or two specialized vessels, over a tentative period of eight austral summer seasons.

The first to third JASS-A surveys were carried out in the

[1] Japanese Whale Research Programs under Special Permit in the Antarctic, Phases I and II

[2] New Scientific Whale Research Program in the Antarctic Ocean

[3] International Decade for Cetacean Research/Southern Ocean Whale and Ecosystem Research

[4] International Whaling Commission-Scientific Committee

[5] Commission for the Conservation of Antarctic Marine Living Resources-Working Group on Ecosystem Monitoring and Management

[6] North Atlantic Marine Mammal Commission-Scientific Committee

2019/2020, 2020/2021 and 2021/2022 austral summer seasons, respectively, and covered the sector 000°–035°E of Antarctic Area III West and 130°W–120°W of Antarctic Area VI East.

The fourth JASS-A survey was carried out in the 2022/2023 season and covered the sector 145°W–130°W of Antarctic Area VI. This paper presents a summary of the 2022/2023 JASS-A survey results.

SURVEY DESIGN

Research area

The research area of JASS-A is comprised of IWC Management Areas III, IV, V and VI, south of 60°S (Figure 1). The research area in the 2022/2023 season was a part of Antarctic Area VI (145°W–130°W), south of 60°S (Figure 1). The area was divided into northern and southern strata. The boundary between these strata was defined by a line 45 n.miles from the northern edge of the pack-ice (Figure 2). In addition, the sea ice on the coastal area opened and formed ice-free waters in early January. The ice-free waters (in the range of 145°W to 130°W) became accessible to the vessel in early February. Details of the ice configuration are shown in Figure 3.

Research vessels

The dedicated sighting vessels *Yushin-Maru* No. 2 (*YS2*) and *Yushin-Maru* No. 3 (*YS3*) were engaged in the survey. The specifications for both vessels are the same and are shown in Figure 4. Eight researchers participated in the survey, four in *YS2* and four in *YS3*. They had experience in conducting line transect surveys, biopsy sampling, photo-identification (photo-ID), satellite tagging and oceanographic survey through the previous JARPA/JARPAII, NEWREP-A and previous JASS-A surveys.

Sighting procedures and experiments

The procedures for sighting and experiments were the same as in previous JASS-A surveys. See Isoda *et al.* (2023) for details of the procedures used for sighting surveys and other research activities such as sighting distance and angle experiment, photo-ID, biopsy sampling, satellite tagging, oceanographic survey, marine debris observation and survey using UAV.

RESULTS OF THE SURVEY

Narrative of the survey

Table 1 shows the itinerary of the survey. The duration of this cruise was 99 days (*YS2*) and 97 days (*YS3*). The *YS2* and *YS3* departed Japan on 5 and 7 December 2022, respectively. They arrived at the home port on 22 December. The *YS2 and YS3* started the sighting survey in Antarctic Area VI at 65°41′S; 130°00′W on 11 January, and at

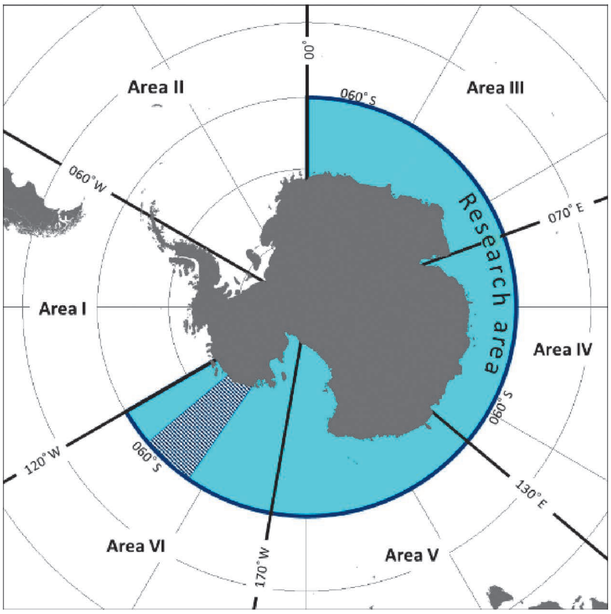

Figure 1. Research area of JASS-A. The shaded area (145°W–130°W) indicates the surveyed area in the 2022/2023 austral summer season.

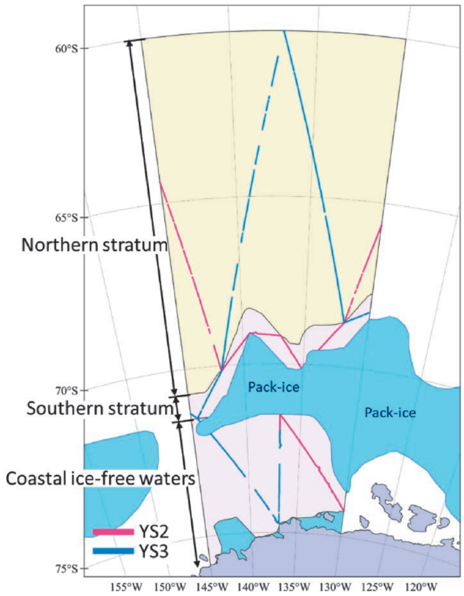

Figure 2. Research area (145°W–130°W) indicating northern, southern strata, and coastal ice-free waters searching efforts (red and blue lines for *Yushin-Maru* No. 2 (*YS2*) and *Yushin-Maru* No. 3 (*YS3*), respectively) of the JASS-A survey in the 2022/2023 austral summer season. The research commenced with *YS2* at 65°41′S; 130°00′W and *YS3* at 68°17′S; 130°00′W, and ended with *YS2* at 74°14′S; 130°00′W and with *YS3* at 72°59′S; 143°21′W. Note the ice-free waters south of 71°30′S.

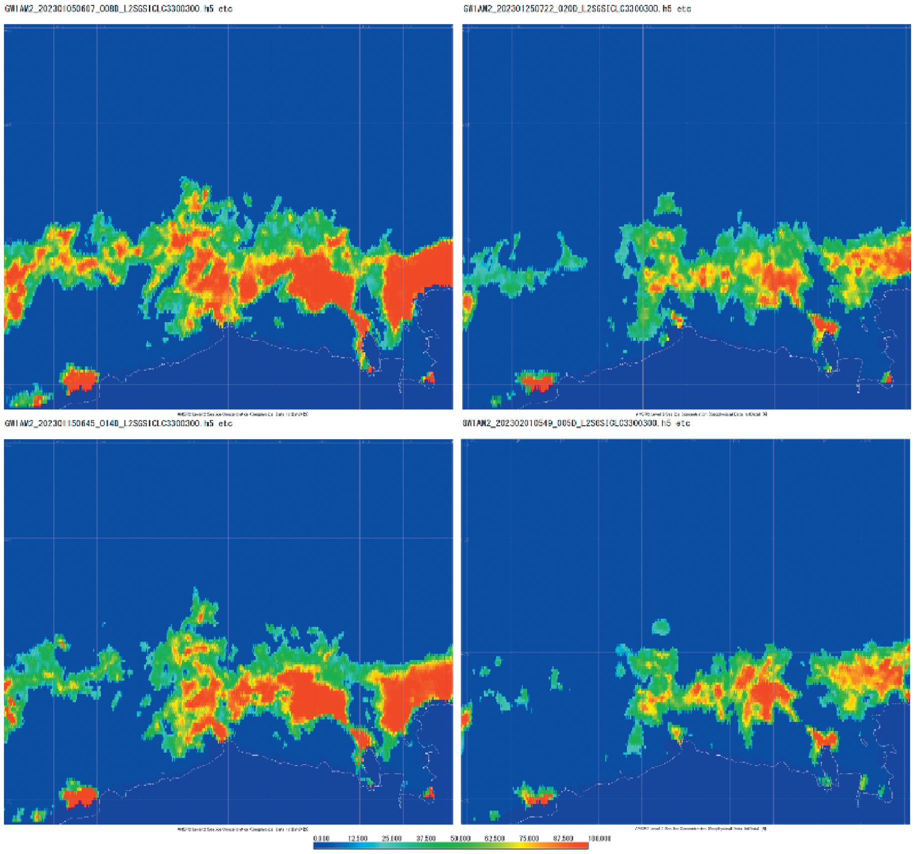

Figure 3. Maps of the pack-ice distributions in the research area for dates 5 January (upper left), 15 January (lower left), 25 January (upper right) and 1 February (lower right) 2023, constructed by Japan Aerospace Exploration Agency (JAXA), based on observational data acquired by the Advanced Microwave Scanning Radiometer 2 (AMSR2). Note that the ice-free waters became accessible to the vessel in early February.

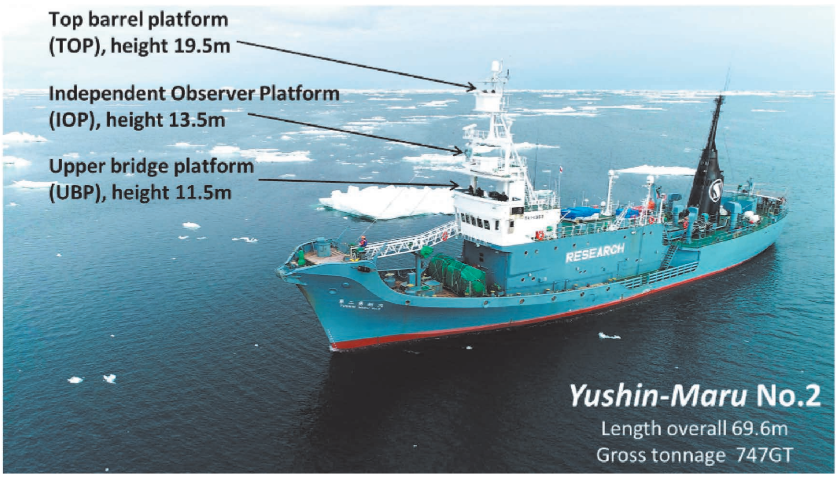

Figure 4. Specifications of the dedicated sighting vessel *Yushin-Maru* No. 2, which is similar to *Yushin-Maru* No. 3.

68°17′S; 130°00′W on 10 January 2023, respectively. The *YS2* and *YS3* completed the surveys at position 74°14′S; 130°00′W and 72°59′S; 143°21′W respectively, on 6 February. The *YS2* and *YS3* arrived at the home port on 22 February, and finally in Japan on 13 March.

Research effort in the research area

Table 2 shows a summary of the searching effort spent during the survey. The *YS2* and *YS3* were engaged in the research for 27 days and 28 days, respectively. The total searching effort of both vessels was 2,168.6 n.miles (4,016.2 km); 1,051.1 n.miles in NSP mode during

Table 1
Itinerary of the 2022/2023 JASS-A dedicated sighting survey.

Date (y/m/d)	Event
2022/11/16	Planning meeting at Tokyo, Japan
2022/12/2	Pre-cruise meeting at Shiogama, Japan
2022/12/5	*YS2* departed Shiogama, Japan
2022/12/7	*YS3* departed Shiogama, Japan
2022/12/7	*YS2* started transit survey at 31°20′N; 145°35′E (high sea)
2022/12/8	*YS3* started transit survey at 35°20′N; 143°20′E (high sea)
2022/12/22	*YS2* and *YS3* arrived in the home port (Suva, Fiji)
2023/1/10	*YS3* finished transit survey and started survey in the research area at 68°17′S; 130°00′W
2023/1/11	*YS2* finished transit survey and started survey in the research area at 65°41′S; 130°00′W
2023/2/6	*YS2* and *YS3* completed surveys in the research area (27 days and 28 days, respectively) and started transit survey at 74°14′S; 130°00′W and at 72°59′S; 143°21′W, respectively
2023/2/22	*YS2* and *YS3* arrived in the home port (Suva, Fiji)
2023/3/10	*YS2* and *YS3* finished transit survey at 31°05′N; 145°44′E and at 27°59′N; 138°11′E, respectively
2023/3/13	*YS2* and *YS3* arrived in Japan and post cruise meetings at Shiogama and Shimonoseki, Japan, were carried out respectively

98 hours 2 minutes of research and 1,117.4 n.miles in IO mode during 104 hours 33 minutes of research.

In the northern stratum, the total searching effort was 1,295.8 n.miles (NSP: 637.8 n.miles; IO: 658.0 n.miles), and the searching effort coverage was 76%. In the southern stratum, the total searching effort was 393.3 n.miles (NSP: 209.3 n.miles; IO: 184.0 n.miles), and the searching effort coverage was 91%. In the coastal ice-free waters, the total searching effort was 479.4 n.miles (NSP: 203.8 n.miles; IO: 275.6 n.miles), and the searching effort coverage was 75%.

Therefore, a good distribution of effort within all strata and survey mode was achieved. The total experimental time for photo-ID, biopsy sampling, tagging and distance and angle experiment was 45 hours 26 minutes.

Whale sightings in the research area

Four baleen whale species and at least two toothed whale species were sighted in the research area. The dominant whale species in the research area was the Antarctic minke whale (242 schools/521 individuals) followed by the fin whale (59/137). Sightings of other species were as follows; humpback (21/46), Antarctic blue (20/31), sperm (7/7), killer (11/117, including Type A, Type B, Type C and undetermined type) and Ziphiidae (1/2) whales (Table 3).

Antarctic minke whales

Antarctic minke whales were widely distributed in the research area including in the coastal ice-free waters (Figure 4). This result is consistent with the interpretation of Fujise and Pastene (2021) that larger number of this species are being distributed in polynyas within the pack-ice in recent years, possibly in searching of alternative feeding areas in response to the increase in abundance and geographical expansion of other large whale species (e.g. humpback and fin whales). On the other hand, a sighting survey using an icebreaker vessel found no Antarctic minke whales within coastal polynyas in a similar location to that surveyed in the present survey (Ainley *et al.*, 2007). However, this survey was conducted in 1994 and it was suggested that the distribution of this species has changed in recent years.

The Amundsen Sea Coastal Polynya overlaps partially with the eastern side of Antarctic Area VI East. Here high densities of the ice krill (*Euphausia crystallorophias*) were observed along the ice shelf and near the boundary between pack-ice and coastal polynya. These high densities are an order of magnitude higher than recorded previously in the Ross Sea Polynya (La *et al.*, 2015). The ice krill is the predominant prey species on coastal (shallow) area on continental shelf (Tamura and Konishi, 2009). The high density of Antarctic mink whale in coastal ice-free waters in the 2021/2022 and 2022/2023 seasons might be related to high densities of this prey species.

Fin whales

Fin whales were widely distributed only in the northern stratum (Figure 4). The density was higher than that in the previous 2000/2001 IWC-SOWER survey in the sector 140°W–120°W (Ensor *et al.*, 2001). An increasing trend in abundance of this species was already suggested for in the area adjacent to the west side: Areas V+VI West (Matsuoka and Hakamada, 2014).

Table 2
Summary of searching effort and time spent by *YS2* and *YS3* during the 2022/2023 JASS-A survey.

Vessel: ***YS2***	Date and time		Searching effort (distance [n.miles] and time [hours: minutes: seconds])				Experiments time (hours: minutes: seconds)	
Survey Sections	Start	End	NSP		IO		Photo-ID, Biopsy, Satellite tagexperiment	Estimated angle and distance training/ experiment
Transit survey (Shiogama-Equator)	2022/12/07 07 : 05	2022/12/15 12 : 46	473.1	40 : 57 : 38	—	—	02 : 54 : 49	—
Transit survey (Equator-Research area)	2022/12/15 12 : 47	2023/1/10 18:00	519.7	45 : 42 : 44	—	—	04 : 13 : 33	—
Research area (Area VIE 145°W-130°W)	2023/1/11 06 : 00	2023/2/1 12 : 15	347.5	31 : 48 : 56	342.7	31 : 36 : 47	16 : 27 : 28	05 : 27 : 16
Coastal ice-free waters, south of 71°30'S (145°W-130°W)	2023/2/1 12 : 16	2023/2/6 16 : 19	99.1	09 : 31 : 03	122.9	12 : 00 : 45	01 : 38 : 25	—
Transit survey (Research area-Equator)	2023/2/6 16 : 20	2023/3/2 09 : 20	709.7	60 : 53 : 25	—	—	01 : 35 : 15	—
Transit survey (Equator-Shiogama)	2023/3/3 06 : 00	2023/3/10 16 : 20	305.9	25 : 33 : 15	—	—	00 : 42 : 28	—
Total			2455.0	214 : 27 : 01	465.6	43 : 37 : 32	27 : 31 : 58	05 : 27 : 16

Vessel: ***YS3***	Date and time		Searching effort (distance [n.miles] and time [hours: minutes: seconds])				Experiments time (hours: minutes: seconds)	
Survey Sections	Start	End	NSP		IO		Photo-ID, Biopsy, Satellite tag experiment	Estimated angle and distance training/ experiment
Transit survey (Shiogama-Equator)	2022/12/8 07 : 25	2022/12/16 14:00	436.3	36 : 25 : 34	—	—	00 : 46 : 01	—
Transit survey (Equator-Research area)	2022/12/16 14:01	2023/1/9 18:00	472.5	40 : 20 : 53	—	—	01 : 20 : 18	—
Research area (Area VIE 145°W-130°W)	2023/1/10 06 : 00	2023/1/31 16 : 42	499.7	46 : 11 : 38	499.2	46 : 23 : 09	14 : 10 : 21	01 : 29 : 12
Coastal ice-free waters, south of 71°30'S (145°W-130°W)	2023/1/31 16 : 42	2023/2/6 17 : 10	104.8	10 : 30 : 23	152.7	14 : 32 : 19	02 : 00 : 09	04 : 12 : 48
Transit survey (Research area-Equator)	2023/2/7 06 : 00	2023/3/2 15 : 20	794.8	67 : 29 : 11	—	—	03 : 01 : 48	—
Transit survey (Equator-Shimonoseki)	2023/3/3 06 : 00	2023/3/10 16 : 50	295.5	24 : 46 : 55	—	—	00 : 00 : 00	—
Total			2,603.6	225 : 44 : 34	651.9	60 : 55 : 28	21 : 18 : 37	05 : 42 : 00

Humpback whales

Humpback whales were widely distributed in the northern stratum with higher concentrations observed in the northern part of this stratum (Figure 4). The density was slightly higher than that in the 2000/2001 IWC-SOWER cruise in the same sector (Ensor *et al.*, 2001). This result suggests that abundance of this species is relatively stable in this area.

Antarctic blue whales

Antarctic blue whales were sighted in the northern and southern strata with higher densities in the former stratum (Figure 4). Four mother and calf pairs were observed. There were only two schools (four individuals) in the 2000/2001 IWC-SOWER cruise in the same sector (Ensor *et al.*, 2001). This information is crucial for monitoring the Antarctic blue whale population recovery.

Table 3
Number of sightings made during the 2022/2023 JASS-A survey in the research area, by stratum and species.

Species	Western part of Area VIE (145°W–130°W)												Sub-total				Total	
	Southern stratum				Northern stratum				Coastal ice-free waters, south of 71°30'S									
	Prim.		Second.		Prim.		Second.		Prim.		Second.		Prim.		Second.			
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Antarctic blue whale	2	2	0	0	17	27	1	2	0	0	0	0	19	29	1	2	20	31
Fin whale	0	0	0	0	50	117	9	20	0	0	0	0	50	117	9	20	59	137
Antarctic minke whale	48	85	17	31	48	101	6	9	102	238	21	57	198	424	44	97	242	521
Like minke whale	3	3	1	10	2	3	1	1	8	8	2	3	13	14	4	14	17	28
Like Antarctic minke whale	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	1	1
Humpback whale	0	0	0	0	20	36	1	10	0	0	0	0	20	36	1	10	21	46
Baleen whales	2	2	0	0	9	9	1	1	2	2	0	0	13	13	1	1	14	14
Sperm whale	1	1	0	0	6	6	0	0	0	0	0	0	7	7	0	0	7	7
Killer whale (Undetermined)	1	3	0	0	1	9	0	0	2	7	0	0	4	19	0	0	4	19
Killer whale (Type A)	0	0	0	0	1	8	0	0	0	0	0	0	1	8	0	0	1	8
Killer whale (Type B)	0	0	0	0	1	13	0	0	2	21	1	9	3	34	1	9	4	43
Killer whale (Type C)	0	0	0	0	0	0	0	0	2	47	0	0	2	47	0	0	2	47
Ziphiidae	0	0	0	0	1	2	0	0	0	0	0	0	1	2	0	0	1	2
Unidentified whales	1	1	0	0	4	4	0	0	3	3	0	0	8	8	0	0	8	8

Prim.: Primary sighting, Second.: secondary sighting, Sch.: Schools, Ind.: individuals

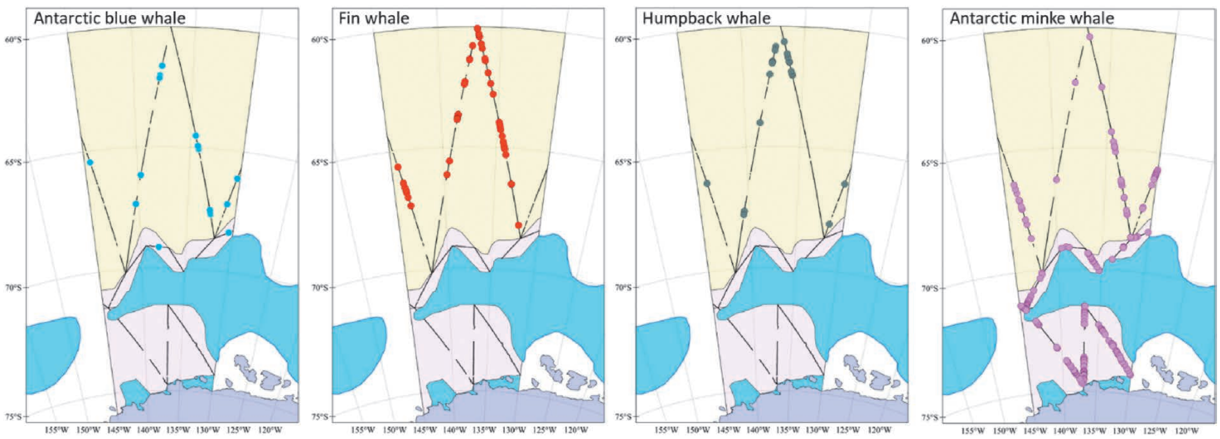

Figure 4. Geographical distribution of primary sightings of Antarctic blue, fin, humpback, and Antarctic minke whales during the 2022/2023 JASS-A survey.

Duplicate sightings

Duplicates sightings were those sightings made concurrently by both the IOP and TOP barrel observers during the IO mode survey. These data will be used to estimate *g*(0), which in turn will be used to adjust estimates of abundance. There was a total of 63 duplicates involving several whale species.

Other research activities

Table 4 shows a summary of results of different experiments.

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. The actual experiments were successfully completed on 1 February for 120 trials in *YS2*, and on 4 February for 128 trials in *YS3*.

Photo-ID

Photo-ID data is used for individual matching exercise to investigate distribution and movement of large whales. A total of 26 Antarctic blue, 11 humpback and 37 killer

Table 4
Summary of the results of experiments conducted during the 2022/2023 JASS-A survey.

Experiments	Results and descriptions
Sighting distance and angle experiment	248 trials completed
Photo-ID	Obtained from 26 Antarctic blue, 11 humpback and 37 killer whales
Biopsy sampling	Collected from 8 Antarctic blue, 20 fin, 28 Antarctic minke, 6 sei, 16 humpback, 2 pygmy right and 9 killer whales
Satellite tagging	Deployed on 8 fin, 25 Antarctic minke, 2 sei, 2 humpback and 1 pygmy right whales
Oceanographic survey	137 XCTD casts
Marine debris observation	8 fishing buoy and 1 plastic tank were observed in the research area
UAV	Aerial images collected from 6 Antarctic blue, 7 Antarctic minke and 1 pygmy right whales

whales were successfully photo-identified during the entire survey. These data will be registered into the Institute of Cetacean Research (ICR) database (see Matsuoka and Pastene, 2014).

Biopsy sampling
Biopsy samples are used for genetic studies on stock structure of large whales and for other feasibility studies related to the specific objectives of the JASS-A. For the entire survey, a total of 89 biopsy samples were collected from 8 Antarctic blue, 20 fin, 28 Antarctic minke, 6 sei, 16 humpback, 2 pygmy right and 9 killer whales, using the Larsen system (Larsen, 1998). Biopsy samples were stored at −20°C.

Satellite tagging
Satellite tagging is used for the study of movement, distribution and stock structure of whales. The satellite-monitored tags (SPOT and SPLASH-types, Wildlife Computers, Redmond, Washington, USA) were deployed with the Air Rocket Transmitter System (ARTS) (LK-ARTS, Skutvik, Norway). The detail of deployment system, protocols and research results to date were described in Konishi *et al.* (2020). During the whole survey, 8 fin, 25 Antarctic minke, 2 sei, 2 humpback and 1 pygmy right whales were tagged.

Oceanographic survey
Oceanographic observations are important to understand the relationship of whales and the physical environment. The vertical distribution of water temperature and salinity were recorded from sea surface to 1,850 m water depth using XCTD system (eXpendable Conductivity, Temperature and Depth profiler, Tsurumi-Seiki Co., Ltd., Yokohama, Japan; probe type: XCTD-4N) with Digital Converter MK-150P (*YS2*) and MK-150N (*YS3*) at 137 stations (Figure 5a).

The vertical structure of temperature and salinity between 5 m and 800 m were illustrated in Figure 5b. In the offshore area, cold water was distributed at 50 to 150 m, while in the coastal area cold water was distributed at 100 to 300 m. Oceanographic data will be analysed to study the oceanographic structure of the research area and the relationship with whale distribution.

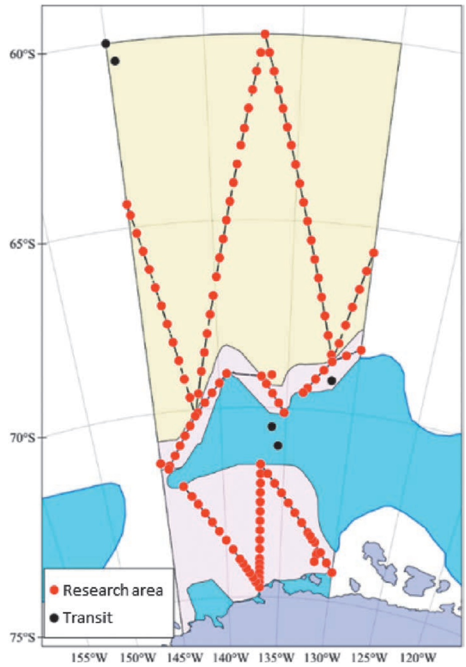

Figure 5a. Oceanographic stations (XCTD casting points) at the 2022/2023 JASS-A survey. Red circle: stations at the research area; black circle: stations at the transit area.

Marine debris observation
Studies on marine debris in the Antarctic are very scarce. It is therefore important to continue with this kind of survey in order to monitor future trends in the occurrence of marine debris. Eight fishing buoys and one plastic tank were observed in the research area. These data will be registered into the ICR database and reported in the fu-

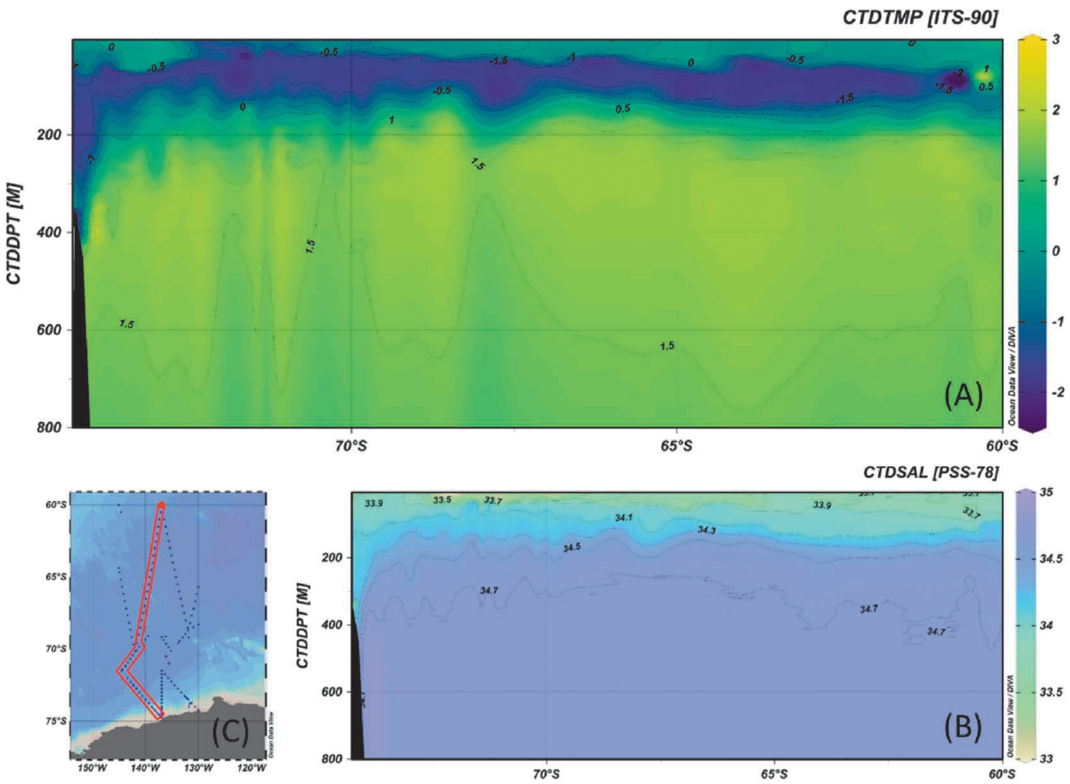

Figure 5b. Preliminary analysis of the latitude-depth sections of temperature (°C) (A) and salinity (PSU) (B), along a track line between 60°00' and 74°45'S (C) using data obtained during the 2022/2023 JASS-A survey. Figures were generated using Ocean Data View (Schlitzer, 2020).

ture (e.g. Isoda *et al.*, 2021).

Feasibility study on the utility of UAV

UAV will be used to refine observations related with whale abundance and distribution, e.g. determine the number of individuals in the schools. The technique can be used also for photogrammetry studies. Aerial images were collected for a total of 6 Antarctic blue, 7 Antarctic minke and 1 pygmy right whales, using a small UAV, Inspire 2 Pro and DJI phantom 4 Pro (video clips can be accessed at https://www.youtube.com/channel/UCz3c9I-IMiQPVeryAogmJIig). These data will be registered into the photo-ID catalogue of ICR.

This UAV ASUKA is being developed to collect information on whales in areas of difficult access to the vessels e.g. ice-bound seas in the Antarctic (Matsuoka and Yoshida, 2021; Katsumata and Yoshida, 2023). In this survey, the UAV ASUKA departed and arrived using the platform of the research vessel. UAV ASUKA operated for an approximate time of 32 h during the daytime. Basic data for improving UAV ASUKA flight performance in the polar regions were obtained.

Sighting survey in low-middle latitude area

Sighting surveys in low-mid latitude areas have the potential to collect data on seasonal movement and possible breeding grounds of whale species. JASS-A has been collecting information on cetaceans by conducting sighting surveys in the low-middle latitude area using the opportunity of a round-trip cruise to the Antarctic, excluding waters of foreign countries EEZs. In transit from Japan to the equator, the total searching effort was 909.3 n.miles (Table 2). Bryde's (3/3), sei (4/6), fin (2/2), sperm (10/17), Ziphiidae (6/16) and *Mesoplodon* (2/4) whales were sighted. Biopsy samples were collected from four sei whales and satellite tags were attached on two sei whales.

In transit from the equator to the starting position in the Antarctic research area, the total searching effort was 992.2 n.miles (Table 2). Fin (30/61), sei (5/6), Bryde's (1/1), Antarctic minke (7/9), humpback (4/7), sperm (3/3), Ziphiidae (1/1) and *Mesoplodon* (5/10) whales were sighted. Biopsy samples were collected from 4 fin, 1 sei, 3 Antarctic minke and 1 humpback whale, and satellite tags were attached on 3 Antarctic minke whales.

In transit from the ending position in the Antarctic research area to the equator, the total searching effort was 1,504.4 n.miles (Table 2). Fin (2/3), Antarctic minke (30/45), humpback (1/2), sei (1/1), pygmy right (2/2), sperm (1/3), southern bottlenose (1/2), killer (Type A)

(1/13), Ziphiidae (10/22) and *Mesoplodon* (5/13) whales were sighted. Biopsy samples were collected from 1 fin, 3 Antarctic minke, 1 sei, 2 humpback and 2 pygmy right and 2 killer whales. Satellite tags were attached to 3 Antarctic minke whales and 1 pygmy right whale.

In transit from the equator to Japan, the total searching effort was 601.4 n.miles (Table 2). Fin (1/1) and Ziphiidae (1/1) whales were sighted.

HIGHLIGHTS OF THE SURVEY

The 2022/2023 JASS-A survey covered a part of Area VI (145°W–130°W) and succeeded in collecting sighting data necessary for the abundance estimation of cetaceans in this area. Of particular importance was the survey conducted in ice-free waters south of 71°30'S, same as in the 2021/2022 season. Several other data necessary for understanding stock structure, movement and the environment of whales were collected during the survey. The data collected through the JASS-A will be analysed in conjunction with the data collected by the previous JARPA/JARPAII, NEWREP-A and IDCR/SOWER surveys in the same region so that the analyses can be based on a long and consistent data set.

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Appendix 1.

Photographs from the 2022/2023 JASS-A survey in Antarctic Area VI

Photo 1. Antarctic blue whale.

Photo 2. Antarctic blue whale mother and calf.

Photo 3. Fin whale.

Photo 4. A large school of Antarctic minke whales observed in the coastal ice-free waters.

Photo 5. Humpback whale.

Photo 6. Killer whales (type A).

Photo 7. Pigmy right whale sighted during the low-middle latitude area survey.

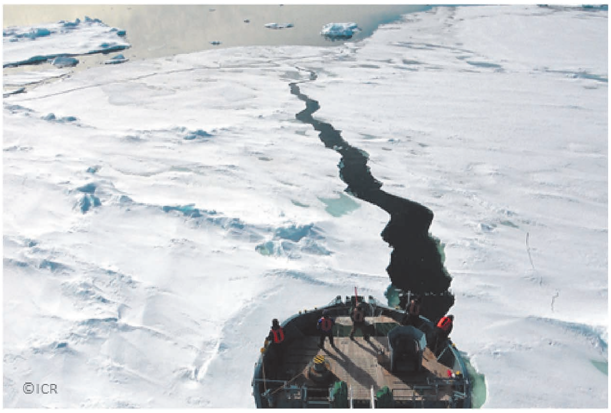

Photo 8. Navigating within the pack-ice.

Photo 9. Sighting activity at top barrel platform.

Photo 10. Buoy used in the angle and distance experiment.

Photo 11. Biopsy and satellite tagging experiments.

Photo 12. VTOL-UAV ASUKA takes off from the vessel.