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## Results of the Japanese Abundance and Stock structure Survey in the Antarctic (JASS-A) during the 2021/2022 austral summer season

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INTERNATIONAL
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**ABSTRACT**

The results of the third survey of the Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) are reported. A dedicated sighting vessel (SV) was engaged in the survey based on the line transect method for 33 days, from 11 January to 12 February 2022 in the eastern part of Area VI East (130°W–120°W). 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 72°S, an area that is normally covered by pack-ice and therefore of difficult access to vessels. The survey design was based on IWC/IDCR-SOWER survey procedures and two survey modes were used, Normal Passing mode (NSP) and Independent Observer mode (IO). The total searching distance in the research area was 1,333.5n.miles (2,469.6km), including 659.0n.miles covered in NSP mode and 674.4n.miles in IO mode. The survey coverage was 62% in the northern stratum, 92% in the southern stratum and 83% in the coastal ice-free waters. Four baleen whale species, Antarctic blue (5 schools/6 individuals), fin (44/64), Antarctic minke (83/142), humpback (26/36) and at least four toothed whale species, sperm (9/10), southern bottlenose (1/1), Arnoux's beaked (1/8) and killer (5/71) whales, were sighted in the research area. Antarctic minke whales were the most sighted whale species. This species was also frequently sighted in the coastal ice-free waters. Fin and humpback whales were the second and third most sighted species, respectively and both species were found only in the northern stratum. Estimated Angle and Distance Experiments were completed in the research area. Routine photo-ID and biopsy sampling on large whales were also conducted during the whole survey (including transit). A total of 26 photo-IDs (seven Antarctic blue, nine humpback and ten killer whales) were obtained. A total of 43 biopsy samples were collected from two Antarctic blue, 12 fin, 15 Antarctic minke, 11 humpback, one Bryde's (in the transit area) and two killer whales. Nine and 15 satellite tags were deployed on fin and Antarctic minke whales, respectively. Oceanographic observations were conducted at 116 casts using the eXpendable Conductivity, Temperature and Depth (XCTD). One marine debris was observed in the research area. Data and samples collected in this survey 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.

**KEYWORDS**: ANTARCTIC; FEEDING GROUNDS; LINE-TRANSECT; VESSEL-BASED SURVEY; ANTARCTIC BLUE WHALES; FIN WHALES; ANTARCTIC MINKE WHALES; HUMPBACK WHALES

## INTRODUCTION

The Japanese Abundance and Stock-structure Surveys in the Antarctic (JASS-A) has two main research objectives (MO) and five secondary research objectives (SO). The MO1 is '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 is '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 (Government of Japan, 2019a, 2019b, 2019c).

The SO1 of JASS-A are: 'Investigation of the oceanographic conditions in the Indo-Pacific region of the Antarctic'; SO2: 'To investigate the spatial and temporal trend of marine debris on sea surface'; SO3: 'To conduct feasibility studies to evaluate the utility of genetics data to estimate abundance'; SO4: 'To continue with feasibility studies to evaluate the utility of non-lethal techniques for whale biological research'; and SO5: 'Feasibility study

on the utility of Unmanned Aerial Vehicle (UAV) for obtaining information relevant for abundance estimate of large whales' (Government of Japan, 2019a; 2019b; 2019c).

The JASS-A was started because it was considered important to continue with the 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.

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 Analyzing 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).

The data collected through the JASS-A can be analyzed in conjunction with the data collected by the previous JARPA/JARPAII, NEWREP-A and IDCR/SOWER in the same region so that the analyses can be based on a long and consistent data set.

This paper presents the results of the third JASS-A survey conducted in the 2021/2022 austral summer season in the eastern part of Antarctic Area VI East (VIE). The plan for the survey had been presented to the 2021 IWC/SC meeting (Matsuoka *et al*., 2021) and endorsed by the SC (IWC, 2021).

## SURVEY DESIGN

### Research permits

All research activities conducted in the Antarctic and high seas international waters reported here, were authorized under permit SUIKAN 3-2124 issued by Fisheries Agency, Government of Japan.

### Research area

The research area was set in the eastern part of Area VIE (130°W–120°W), south of 60°S (Figure 1a). The area was divided into northern and southern strata. The boundary between these strata was defined by a line 45n.miles from the northern edge of the pack-ice (Figure 1b). In addition, an area in coastal ice-free waters, south of 72°S, which was formed between the southern edge of pack-ice and the ice shelf (Figure 1b), was established. In this austral season, a coastal large polynya (in the range of 125°W to 110°W) were formed in early January, and the western side of this polynyas (in the range of 130°W to 125°W) opened and formed a bay-like ice-free waters in late January (Figure 2). This ice configuration made possible a survey in an area normally closed for vessel surveys.

### Research vessel

The dedicated sighting vessel (SV) *Yushin-Maru* No.2 (*YS2*) (747GT) was engaged in the survey. This vessel was equipped with a top barrel platform (TOP), Independent Observer Platform (IOP) and an upper bridge platform. Vessel specifications and photo are provided in Appendix 1.

### Track line

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 (Figure 3a). Track line design and location of the searching effort were shown Figures 3b and 3c. A randomised start point for survey tracks was used, as for all previous IWC-SOWER surveys, based on the IWC/SC survey guidelines (IWC, 2012).

### Research hours and acceptable weather conditions

Research hours were consistent with previous IWC/SOWER survey procedures. Research effort began 60 minutes after sunrise and ended 60 minutes before sunset, with a maximum of 12–hour research per day (approximately 06:00–19:00). Time-zone changes were recorded at 30–minute intervals, effective from 01:00h. Schedules were adhered to local 'ship' time ranging between +9.0 and +15.0 UTC (Table 1a). Data collected throughout the survey and all associated reporting was in accord with the local 'ship' time. The searching activity was conducted when the weather conditions were suitable for observations: visibility (minke whale visibility) better than 1.5n.miles and the wind speed less than 21 knots in northern stratum or 26 knots in southern stratum.

The vessel speed during the sighting survey was 11.5 knots with slight adjustment to avoid vibration from the vessels.

**Survey modes**

Sighting activities were classified into two principal types: 'On-effort' and 'Off-effort'. On-effort activities were times when full search effort was being executed and conditions (such as weather and sea state) were within acceptable parameters to conduct research. Off-effort activities were all activities that were not On-effort. All sightings recorded while the vessel was On-effort were classified as 'Primary sightings'. All other sightings were classified as 'Secondary sightings'. Sighting effort was conducted by the boatswain and topmen from the TOP and by observers at the upper bridge. The sighting survey was conducted using (1) Passing with abeam Closing mode (NSP) and (2) Passing with Independent Observer (IO) mode. Both survey modes followed the protocol endorsed for the IWC/SOWER surveys (e.g. Matsuoka *et al*., 2003; IWC, 2008; 2012).

For NSP mode, there were two primary observers on the TOP. These observers conducted searching for cetaceans by using angle board and binoculars with reticles (7x), which include the distance estimate scales. Members of the two observer teams on TOP were fixed and operated in one or two hours shifts. There was open communication between the upper bridge and the TOP. These observers reported sighting-information to researchers and other observers on the upper bridge for data recording (IWC, 2008; 2012).

For IO mode, there were two primary observers on the TOP and one primary observer on the IOP. These observers on TOP and IOP platforms also conducted searching for cetaceans by using angle board and binoculars with reticles (7x). Members of the two observer teams on TOP were fixed and operated in one or two hours shifts. There was no open communication between the IOP and the TOP. The observers on the upper bridge communicated to the TOP (or IOP) independently, with the topmen required only to clarify information without distracting them from their normal search procedure. These observers reported sighting-information to the researchers and other observers on the upper bridge for data recording. In the case of sighting of some rare species (e.g. Antarctic blue and southern right whales), it was decided that the vessel would approach whales immediately to avoid losing them due to the delay of closing (IWC, 2008; 2012). Captain and helmsman (primary observers) were at the upper bridge using binoculars with reticles (7x), regardless of the research mode. Also present on the upper bridge normally was the chief engineer (or an alternate) and three researchers.

**Identification of species**

Guidelines for species identification were 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 judgement 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).

The identification between Antarctic and pygmy blue whales has also followed the distinguishing protocol of IWC-SOWER surveys (IWC, 2008).

**Determination of group size**

The following guidelines were 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 0.3n.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).

**Attending scientists and responsibilities**

Three experienced Japanese researchers participated in the survey. They had enough experience conducting line transect surveys, biopsy sampling, photo-identification (photo-ID), satellite tagging experiments and oceanographic survey in the Antarctic through the JARPA/JARPAII, NEWREP-A and JASS-A programs or other research programs. One of the co-authors (KM) was the responsible person for this survey, and same as in recent surveys, acted as the oversight person on behalf of the IWC SC.

Tatsuya ISODA- Cruise Leader, sighting, biopsy and satellite tagging
Taiki KATSUMATA - sighting, photo-ID, satellite tagging and oceanographic survey
Eisei UETA - sighting, photo-ID, biopsy and oceanographic survey

**Other research activities**

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

*Photo-ID*
Photo-ID experiments were carried out on an opportunistic basis, mainly using Canon EOS 7D Mark II with a 100–400 mm image-stabilized lens. GPS locations were recorded in the metadata of each picture by the camera's built-in GPS. Generally, whales were approached within 15–20 m. Adults, juveniles, and females accompanied by calves were approached for photo identification. Photo-ID experiments involved a minimum of one photographer (maximum three) on the bow, with additional photographers in the TOP barrel and IO barrel or upper bridge. Priority species for photo-ID were Antarctic blue, southern right and humpback whales. Photo-ID data is used for matching exercise to investigate distribution and movement of those large whales.

*Biopsy sampling*
Biopsy sampling experiments were carried out on an opportunistic basis. Priority species for biopsy sampling was Antarctic blue, fin, southern right and humpback whales. The Larsen system (Larsen, 1998) was used for all biopsy attempts on all species. The biopsy darts consisted of a carbon fibre shaft, which is high-pressure moulded to a polyethylene float that also functions as a stop to limit penetration into the tissue. In the float end of the dart, a threaded insert is used for attaching the screw-on biopsy-sampling tip. The biopsy tip is a stainless-steel cylinder with a 9 mm outer diameter, an internal diameter of 7 mm and three internal barbs for sample retention. All collected samples were stored at -20°C. Biopsy samples are used for studies on stock structure of large whale based on genetic analyses, feasibility studies to evaluate the utility of genetics data to estimate abundance and non-lethal techniques to get biological and feeding ecology information from large whale. The biopsy samples are then imported to Japan under the CITES Japan Management Authority i.e., Fisheries Agency, Government of Japan: Permit/Cert. No. SUIKAN 3-2124.

*Satellite tagging*
Satellite tagging experiment was based on a pneumatic tool (LK-ARTS, Skutvik, Norway) and a blubber penetration type satellite tag (SPOT6 and SPLASH 10-F, Wildlife computers, WA, USA) with a mount anchor system for whales. The experiments were conducted following the same protocols during the NEWREP-A surveys (Konishi *et al*., 2020). The tagged whale was also target of a biopsy sampling using the Larsen system. The target species are Antarctic minke, fin and blue whales with priority for Antarctic minke and fin whales. To investigate the breeding areas of Antarctic minke whale in the low latitudes, tagging was 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). The data of satellite tagging is used to the study of movement, distribution and the stock structure of this species. Also, the data of mean dive-time can be used for studies on feeding ecology (e.g. Friedlaender *et al*., 2014), and this is a key parameter to evaluate availability bias relevant to abundance estimates.

*Oceanographic survey*
Oceanographic observations were conducted per 30', 15' and 15' latitudinal degrees along the track lines in the northern stratum, southern stratum and the coastal ice-free waters, south of 72°S, respectively. The vertical distribution of water temperature and salinity were recorded from sea surface to 1,850 m water depth using XCTD system with Digital Converter MK-150P (eXpendable Conductivity, Temperature and Depth, Tsurumi-Seiki Co., Ltd., Yokohama, Japan) (TSK, 2020). Oceanographic surveys using XCTD system were conducted in the same protocols as in the previous JARPA/JARPAII surveys (Watanabe *et al*., 2014). The oceanographic observations are important to clarify the relationship between the oceanographic conditions and whales.

*Marine debris observation*
During the research hours, floating macro debris was recorded south of 60°S. For each recorded marine debris, the items recorded were date of the observation, angle, distance, time of initial sighting, geographical location (longitude and latitude), type of debris, size by visual observation and photographs. Floating macro debris data were registered in the ICR database, and will be analyzed in conjunction with the data sets of marine debris produced by JARPA/JARPAII and NEWREP-A in the Indo-Pacific region of the Antarctic (e.g. Isoda *et al*., 2014; Murase *et al*., 2020; Isoda *et al*., 2021).

*Feasibility study on the utility of Unmanned Aerial Vehicle (UAV)*
A preliminary experiment was conducted for collecting aerial images of whale, using a small UAV. Two types UAV, which works with GPS satellite positioning systems, were used; 1) DJI Inspire 2 Pro, onboard camera features a micro 4/3 sensor, 2) DJI phantom 4 Pro, onboard camera features a 1-inch 20MP CMOS sensor. It was launched and landed at the bow deck of *YS2*, and was operated within line-of-sight by a pilot and/or a person for supporting navigation. Images were attempted for whales lying flat at the surface with a straight body axis.

**Data entry system on board**

Researchers input the data collected on weather, effort, sighting and experiments into the computer at the field using the 'onboard data collecting system' (ICR, 2013). Survey modes and effort codes definitions for this survey correspond to those used in the IWC/SOWER surveys. The data was validated and stored at the ICR.

## RESULTS AND DISCUSSION

**Brief narrative of the survey**

The *YS2* departed Shiogama, Miyagi, Japan on 3 December 2021. The transit survey was started on 13 December, arriving in Suva, Republic of Fiji on 20 December. Transit between Suva and the Antarctic research area was conducted between 23 December and 11 January 2022. The *YS2* started the sighting survey in the northern and southern stratum in Area VIE at 68°37'S; 120°00'W on 11 January, which was finished on 1 February. Navigation/transit survey to the coastal ice-free waters was conducted between 1 and 8 February. The *YS2* started the sighting survey in the coastal ice-free waters, south of 72°S on 8 February and completed it at 73°51'S; 120°00'W on 12 February. The transit between the Antarctic research area and Suva was conducted between 12 February and 1 March. The *YS2* departed Suva on 4 March, and arrived in Shiogama on 21 March (Table 1b).

**Research effort in the research area**

The *YS2* was engaged in the research for 33 days, from 11 January to 12 February 2022. Tabulations of all track line Waypoint (WP) are shown in Tables 1c–e. The searching effort and time spent on experiments are shown in Table 1f. The track lines in the coastal ice-free waters were designed based on the starting longitudinal line in the northern and southern strata. The total searching effort was 1,333.5n.miles (2,469.6km); 659.0n.miles in NSP mode during 60 hour 27 minutes of research and 674.4n.miles in IO mode during 62 hour 21 minutes of research. In the northern stratum, the total searching effort was 731.2n.miles (NSP: 322.7n.miles; IO: 408.5n.miles), and the searching effort coverage was 62%. In the southern stratum, the total searching effort was 254.6n.miles (NSP: 145.8n.miles; IO: 108.8n.miles), and the searching effort coverage was 92%. In the coastal ice-free waters, the total searching effort was 347.7n.miles (NSP: 190.5n.miles; IO: 157.2n.miles), and the searching effort coverage was 83%. Therefore, a good distribution of effort within the research area and by survey mode was achieved.

The total experimental time for photo-ID, biopsy sampling, satellite tagging and estimated angle and distance experiment, was 22 hour 00 minutes (Table 1f). Figures 4a–c shows the breakdown of research time in hours by effort, wind speed and visibility (minke whale visibility) in the research area.

**Whale sighting in the research area**

Four baleen whale species and at least four toothed whale species were sighted in the research area. The dominant whale species in the research area was the Antarctic minke (83 schools/142 individuals) followed by the fin whale (44/64). Sightings of other species were as follows; humpback (26/36), Antarctic blue (5/6), sperm (9/10), Arnoux's beaked (1/8), southern bottlenose (1/1), killer whales (5/71, include type undetermined, Type B and Type C) and Ziphiidae (4/6) (Tables 2a–b). Figures 5a to 5d show the geographical distribution of the primary sightings in the research area for the main whales sighted.

Primary and secondary sightings of Antarctic minke whale were 79/138 and 4/4, respectively (Table 2a). This species was widely distributed in the research area (Figure 5b) and was the only baleen whale species sighted in the coastal ice-free waters. As in previous surveys, no mother and calf pair of the Antarctic minke whale was observed. Mean school size was 1.18 in the northern stratum, 1.50 in the southern stratum and 1.86 in the coastal ice-free waters. An Aggregation of 17 animals was sighted in the coastal ice-free waters at position 73°02'S 129°25'W.

The Density Index (DI: schools sighted/100n. miles searching distance) based on primary sightings in the whole research area was 5.92. In the 2000/2001 SOWER cruise, the DI in the sector 130°W–120°W was 4.33 (Ensor *et al*, 2001). Density of this species in this area appears to be increasing in recent decades. In the austral summer, the majority of Antarctic minke whales congregate in the Antarctic, with the greatest densities being close to and within the pack ice, and lower densities with increasing distance from the ice (Kasamatsu *et al*., 2000; Hakamada and Matsuoka, 2014). High density near the ice edge was reported for this species in the 2000/2001 SOWER cruise

(Ensor *et al*, 2001), which covered a very similar latitudal range of the southern stratum in this survey. The DI was different among strata, 1.50 in the northern stratum, 1.57 in the southern stratum and 18.40 in the coastal ice-free waters. The DI in the coastal ice-free waters was extremely high. 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 the distribution of this species in polynyas are reported for recent years.

Primary and secondary sightings of fin whale were 41/60 and 3/4, respectively (Table 2a). This species was widely distributed only in the northern stratum (Figure 5a). No mother and calf pairs were observed. Mean school size was 1.46. The DI based on primary sightings was 3.07 in the whole research area and 5.61 in the northern stratum, higher that that reported in the 2000/2001 SOWER cruise in the sector 130°W–120°W (northern part) (0.59) (Ensor *et al*, 2001). An increasing trend in abundance of this species was already suggested for this area (Matsuoka and Hakamada, 2014).

Primary and secondary sightings of humpback whale were 18/24 and 8/12, respectively (Table 2a). This species was widely distributed in the northern stratum with higher concentrations observed in the southern part of this stratum (Figure 5b). No mother and calf pairs were observed. Mean school size was 1.33. The DI in this survey was 1.35, higher than that in the 2000/2001 SOWER cruise in the sector 130°W–120°W (0.98) (Ensor *et al*, 2001), confirming the view that this species is increasing in this area (1.35).

Primary and secondary sightings of Antarctic blue whale were 4/5 and 1/1, respectively (Table 2a). All the sightings were in the northern stratum (Figure 5a). No mother and calf pairs were observed. The sightings comprised 4 solitary animals and one pair. The DI based on primary sightings in the whole research area was 0.30, a little higher than the DI in the same area by the 2000/2001 SOWER cruise (0.20) (Ensor *et al*, 2001).

Sperm whales were sighted as primary sightings 8/9 (Table 2a), large solitary whales and one pair of large whales. This species was found between latitude 66°S and 70°S (Figure 5c). Killer whales were sighted in the southern stratum and the coastal ice-free waters. Killer whales as primary sightings were 3/44 (type undetermined), 1/21 (type B) and 1/6 (type C) (Table 2a, Figure 5c). Southern bottlenose whales were sighted as primary sightings (1/1) in the southern stratum. Arnoux's beaked whale were sighted as primary sightings (1/8) in the coastal ice-free waters. Ziphiidae whales were sighted as primary sightings (3/4), and they were observed mainly in the northern and southern strata (Table 2a, Figure 5d).

**IO results**

Resight data were recorded for a total of 110 sightings during the IO survey mode (Table 2c). The data will be valuable when the estimations of $g(0)$. Hakamada *et al*. (2018) estimated $g(0)$ for Bryde's whale in the North Pacific using resighting data (n=31) collected during IO mode. Compared to this previous study, it seems to be possible to estimate $g(0)$ with the same procedure for Antarctic minke whale using data reported here, but the sample size is still insufficient for accurate estimation of $g(0)$, so it is necessary to pool data from other years. The same applies to species other than Antarctic minke whales, for which data need to be accumulated and pooled for analysis.

**Sighting survey in the transit area**

Sighting survey was conducted between the equator and the research area, excluding areas of the foreign countries EEZs. Sighting was made on using passing mode. In transit from the equator to the Republic of Fiji EEZ, sighting survey was conducted from 13 to 18 December (Table lb). The searching effort was 124.2n.miles (Table lf) and one Bryde's whale was sighted (Table 2b) from which a biopsy sample was collected (Table 3). In transit from the Kingdom of Tonga EEZ to the starting position in the Antarctic research area, sighting survey was conducted from 26 December to 11 January (Table lb). The searching effort was 579.9n.miles (Table lf) and total sightings included fin (4/4), Antarctic minke (4/5), humpback (1/2) and sperm whales (4/4) (Table 2b). During the transit in the research area, biopsy samples were collected from two fin, one Antarctic minke and one humpback whales (Table 3), and satellite tags were attached to the three Antarctic minke whales.

In transit from the ending position in the Antarctic research area to the Kingdom of Tonga EEZ, sighting survey was conducted from 12 to 22 February (Table lb). The searching effort was 782.2n.miles and the total sightings included fin (10/24), sei (1/1), Antarctic minke (2/2), humpback (8/15), sperm (1/1) and Arnoux's beaked (1/3) whales (Tables 1f and 2b). During the transit in the research area, two mother and calf pairs of fin whale were observed at 63°53'S; 133°34'W and 63°39'S; 133°47'W and the estimated body length of each pair were 21.5m/13.4m and 20.6m/13.1m. Also during the transit in the research area, biopsy samples were collected from two fin, one Antarctic minke and six humpback whales (Table 3), and satellite tags were attached to the three fin

and one Antarctic minke whales. In transit from the Republic of Fiji EEZ to the equator, sighting survey was conducted from 8 to 9 March. The searching effort was 177.9n.miles and no whale was sighted (Tables 1f and 2b). A total of experimental time in transit survey for photo-ID, biopsy sampling and satellite tagging was 9 hour 29 minutes.

**Other research activities**

*Estimated Angle and Distance experiment*
A training for this experiment was conducted on 7 January for 1 hour 40 minutes. The actual experiments were successfully completed on 30 January for 3 hour 44 minute (128 trials). The results of this experiment will be used for the calculation of abundance estimates.

*Photo-ID*
A total of seven Antarctic blue, nine humpback and ten killer whales were successfully photo-identified during the whole survey (Table 4). These data will be registered to the ICR catalogue. Data will be available to the national and international scientific community through established data access protocols of ICR.

*Biopsy sampling for large whales*
A total of 43 biopsy samples were collected (Table 3), including two Antarctic blue, 12 fin, 15 Antarctic minke, 11 humpback, one Bryde's and two killer whales during the whole survey. For fin whales, in nine cases both biopsy sampling and satellite tagging was conducted. For Antarctic minke whales those cases were 12. 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 (e.g. Pastene *et al*., 2014; Kanda *et al.*, 2014; Inoue *et al.*, 2019).

*Satellite tagging* (for details, see Appendix 2)
A total of 18 trials for fin whales and a total of 24 trials for Antarctic minke whales were made. Nine and 15 satellite tags were deployed on fin and Antarctic minke whales, respectively. Figure 6 shows satellite deployed positions of two species. Tracking data of both species will contribute to the elucidation of distribution, movement and the timing of departure from Antarctic feeding area to low latitude breeding area.

*Oceanographic survey*
Oceanographic observation was conducted by XCTD at 116 casts on the survey track lines, including transit survey south of 60°S (Table 5, Figure 7). Oceanographic data will be analysed in conjunction with the data collected by the previous JARPA/JARPAII, NEWREP-A, and in the same protocols as in the previous surveys (Watanabe *et al*., 2014).

*Marine debris observation*
A marine debris object, one fishing buoy, were observed during the survey in the research area (Table 6, Figure 8). This item was recorded 'on effort' (i.e., during systematic sighting survey). These data will be registered to the ICR database and reported in the future (e.g. Isoda *et al*., 2014; Murase *et al*., 2020; Isoda *et al*., 2021).

*Feasibility study on the utility of Unmanned Aerial Vehicle (UAV)*
Whale images were collected successfully by UAV from two Antarctic blue, six Antarctic minke, and three humpback whales (movies can access at https://www.youtube.com/channel/UCz3c9IIMiQPVeryAogmJIig). These data will be registered to the photo-ID catalogue of ICR and will be available to the national and international scientific community through established data access protocols of ICR.

**Report of the IWC oversight**

The oversight report was shown in Appendix 3.

**ACKNOWLEDEGMENTS**

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**TABLES AND FIGURES**

Table 1a. Summary of the 'Ship's Time Adjustment' Schedule. UTC: Coordinated Universal Time; JST: Japan Standard Time.

| Date (y/m/d) | Ah'd/Ab'k | Balance | Ship's time | Remarks |
|---|---|---|---|---|
| 2021/12/03 | - | UTC+9.0h | JST | Departed Japan (Shiogama) |
| 2021/12/11 | Ah'd 1h | UTC+10.0h | JST+1.0h | - |
| 2021/12/12 | Ah'd 1h | UTC+11.0h | JST+2.0h | - |
| 2021/12/15 | Ah'd 1h | UTC+12.0h | JST+3.0h | - |
| 2021/12/16 | Ah'd 1h | UTC+13.0h | JST+4.0h | - |
| 2021/12/24 | Ah'd 1h | UTC+14.0h | JST+5.0h | - |
| 2021/12/25 | Ah'd 1h | UTC+15.0h | JST+6.0h | - |
| 2022/02/17 | Ab'k 1h | UTC+14.0h | JST+5.0h | - |
| 2022/02/19 | Ab'k 1h | UTC+13.0h | JST+4.0h | - |
| 2022/02/21 | Ab'k 1h | UTC+12.0h | JST+3.0h | - |
| 2022/03/06 | Ab'k 0.5h | UTC+11.5h | JST+2.5h | - |
| 2022/03/07 | Ab'k 0.5h | UTC+11.0h | JST+2.0h | - |
| 2022/03/08 | Ab'k 0.5h | UTC+10.5h | JST+1.5h | - |
| 2022/03/09 | Ab'k 0.5h | UTC+10.0h | JST+1.0h | - |
| 2022/03/10 | Ab'k 0.5h | UTC+9.5h | JST+0.5h | - |
| 2022/03/11 | Ab'k 0.5h | UTC+9.0h | JST | - |
| 2022/03/21 | - | UTC+9.0h | JST | Arrived at Japan (Shiogama) |

Table 1b. Narrative of the 2021/2022 JASS-A dedicated sighting survey.

| Date (y/m/d) | Event |
|---|---|
| 2021/11/16 | Planning meeting at Tokyo, Japan |
| 2021/12/02 | Pre-cruise meeting at Shiogama, Japan |
| 2021/12/03 | *YS2* departed at Shiogama, Japan |
| 2021/12/13 | Started transit survey at 0°00'; 163°00'E (High sea) |
| 2021/12/15 | Interrupted transit survey at 06°23'S; 166°36'E (Entering Solomon Islands EEZ) |
| 2021/12/17 | Resumed transit survey at 14°34'S; 172°24'E (High sea) |
| 2021/12/18 | Interrupted transit survey at 15°50'S; 173°36'E (Entering Fiji EEZ) |
| 2021/12/20-23 | *YS2* arrived and depart Suva, Fiji (18°08'S; 178°25'E) |
| 2021/12/26 | Resumed transit survey at 27°28'S; 172°37'W (Leavening Tonga EEZ and entering high sea) |
| 2022/01/11 | Finished transit survey and started survey in northern and southern stratum in the research area at 68°37'S; 120°00'W |
| 2022/02/01 | Finished survey in northern and southern stratum in the research area at 70°41'S; 130°00'W and started navigation/transit survey to the coastal ice-free waters, south of 72°S between 72°00'S and 74°00'S |
| 2022/02/08 | Started survey in the coastal ice-free waters, south of 72°S at 72°40'S; 129°25'W |
| 2022/02/12 | Completed survey in the whole research area (33 days) and started transit survey at 73°51'S; 120°00'W |
| 2022/02/26 | Interrupted transit survey at 26°08'S; 173°48'W (Entering Tonga EEZ) |
| 2022/03/01-04 | *YS2* arrive and depart Suva, Fiji (18°08'S; 178°25'E) |
| 2022/03/08 | Resumed transit survey at 05°38'S; 166°11'E (Entering high sea) |
| 2022/03/09 | Finished transit survey at 0°00'; 163°00'E |
| 2022/03/21 | *YS2* arrived and post cruise meeting at Shiogama, Japan |

Table 1c. Way Points (WP) in the southern stratum.

| WP | Latitude | | | Longitude | | | Survey | Course | Plan | Effort | Coverage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | deg | min | N/S | deg | min | E/W | mode | | (n.miles) | (n.miles) | |
| 201 | 68 | 37.0 | S | 120 | 00.0 | W | NSP | 318° | 32.2 | 31.5 | 98% |
| 202 | 68 | 13.0 | S | 120 | 58.0 | W | IO | 318° | 32.2 | 32.0 | 99% |
| 203 | 67 | 49.0 | S | 121 | 55.0 | W | - | - | - | - | - |
| 204 | 69 | 25.0 | S | 121 | 55.0 | W | NSP | 206° | 58.4 | 46.1 | 79% |
| 205 | 70 | 17.5 | S | 123 | 08.4 | W | IO | 206° | 7.3 | 6.8 | 93% |
| 205A | 70 | 24.1 | S | 123 | 17.8 | W | - | - | - | - | - |
| 206 | 70 | 07.0 | S | 124 | 25.0 | W | NSP | 283° | 26.4 | 25.5 | 97% |
| 207 | 70 | 01.0 | S | 125 | 40.2 | W | IO | 283° | 26.4 | 18.6 | 70% |
| 208 | 69 | 55.0 | S | 126 | 55.0 | W | NSP | 239° | 29.6 | 29.5 | 100% |
| 209 | 70 | 10.0 | S | 128 | 09.5 | W | IO | 239° | 29.6 | 51.4 | 100% |
| 210A | 70 | 25.0 | S | 129 | 24.9 | W | IO | 180° | 22.0 | | |
| 210 | 70 | 47.0 | S | 129 | 25.0 | W | NSP | 300° | 13.3 | 13.2 | 99% |
| 211 | 70 | 40.3 | S | 130 | 00.0 | W | - | - | - | - | - |
| Total | | | | | | | | | 277.4 | 254.6 | 92% |

Table 1d. Way Points (WP) in the northern stratum.

| WP | Latitude | | | Longitude | | | Survey | Course | Plan | Effort | Coverage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | deg | min | N/S | deg | min | E/W | mode | | (n.miles) | (n.miles) | |
| 101 | 65 | 04.7 | S | 120 | 00.0 | W | NSP | 016° | 49.0 | 25.6 | 52% |
| 102 | 65 | 51.8 | S | 120 | 31.7 | W | IO | 016° | 61.0 | 55.8 | 92% |
| 103 | 66 | 50.4 | S | 121 | 12.5 | W | NSP | 016° | 61.0 | 48.9 | 80% |
| 104 | 67 | 49.0 | S | 121 | 55.0 | W | - | - | - | - | - |
| 105 | 69 | 25.0 | S | 121 | 55.0 | W | IO | 347° | 72.5 | 69.7 | 96% |
| 106 | 68 | 14.4 | S | 122 | 38.9 | W | NSP | 347° | 72.5 | 25.8 | 36% |
| 107 | 67 | 03.8 | S | 123 | 20.5 | W | IO | 347° | 72.5 | 60.1 | 83% |
| 108 | 65 | 53.2 | S | 124 | 00.2 | W | NSP | 347° | 72.5 | 33.8 | 47% |
| 109 | 64 | 42.6 | S | 124 | 38.1 | W | IO | 347° | 72.5 | 49.4 | 68% |
| 110 | 63 | 32.0 | S | 125 | 14.4 | W | NSP | 347° | 72.5 | 22.3 | 31% |
| 111 | 62 | 21.3 | S | 125 | 49.2 | W | IO | 347° | 72.5 | 45.0 | 62% |
| 112 | 61 | 10.7 | S | 126 | 22.7 | W | NSP | 347° | 72.5 | 21.3 | 29% |
| 113 | 60 | 00.0 | S | 126 | 55.0 | W | IO | 191° | 81.6 | 30.4 | 37% |
| 114 | 61 | 20.1 | S | 127 | 26.5 | W | NSP | 191° | 81.6 | 67.0 | 82% |
| 115 | 62 | 40.1 | S | 127 | 59.3 | W | IO | 191° | 81.6 | 69.0 | 85% |
| 116 | 64 | 00.1 | S | 128 | 33.7 | W | NSP | 191° | 81.6 | 55.6 | 68% |
| 117 | 65 | 20.1 | S | 129 | 09.7 | W | IO | 191° | 81.6 | 29.1 | 36% |
| 118 | 66 | 40.1 | S | 129 | 47.6 | W | NSP | 191° | 25.8 | 22.4 | 87% |
| 119 | 67 | 05.4 | S | 130 | 00.0 | W | - | - | - | - | - |
| Total | | | | | | | | | 1,184.8 | 731.2 | 62% |

Table 1e. Way Points (WP) in the coastal ice-free waters, south of 72°S.

| WP | Latitude | | | Longitude | | | Survey | Course | Plan | Effort | Coverage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | deg | min | N/S | deg | min | E/W | mode | | (n.miles) | (n.miles) | |
| 231 | 72 | 40.0 | S | 129 | 25.0 | W | IO | 180° | 40.0 | 33.7 | 84% |
| 232 | 73 | 20.0 | S | 129 | 25.0 | W | NSP | 180° | 40.0 | 49.5 | 74% |
| 232A | 74 | 00.0 | S | 129 | 25.0 | W | NSP | 180° | 26.8 | | |
| 233 | 74 | 26.8 | S | 129 | 25.0 | W | IO | 360° | 26.8 | 48.6 | 76% |
| 233A | 74 | 00.0 | S | 129 | 25.0 | W | IO | 036° | 37.3 | | |
| 234 | 73 | 30.0 | S | 128 | 06.7 | W | NSP | 036° | 37.3 | 33.4 | 90% |
| 235 | 73 | 00.0 | S | 126 | 50.7 | W | IO | 036° | 37.3 | 7.4 | 20% |
| 236 | 72 | 30.0 | S | 125 | 36.9 | W | NSP | 036° | 37.3 | 39.7 | 100% |
| 237 | 72 | 00.0 | S | 124 | 25.0 | W | IO | 145° | 34.0 | 33.6 | 99% |
| 238 | 72 | 27.8 | S | 123 | 21.3 | W | NSP | 145° | 34.0 | 34.0 | 100% |
| 239 | 72 | 55.6 | S | 122 | 16.0 | W | IO | 145° | 34.0 | 33.9 | 100% |
| 240 | 73 | 23.4 | S | 121 | 08.9 | W | NSP | 145° | 34.0 | 33.9 | 100% |
| 241 | 73 | 51.2 | S | 120 | 00.0 | W | - | - | - | - | - |
| Total | | | | | | | | | 418.6 | 347.7 | 83% |

Table 1f. Summary of searching effort (time and distance) and time (hours) spent on experiments.

| Survey Sections | Date and time | | Searching effort (distance [n.miles] and time [hours: minutes: seconds]) | | | | Experiments time [hours: minutes: seconds] | |
|---|---|---|---|---|---|---|---|---|
| | Start | End | NSP | | IO | | Photo-ID, Biopsy, Satellite tag experiment | Estimated angle and distance training/ experiment |
| Transit survey (0°00-Entering Fiji EEZ) | 2021/12/13 14:59 | 2021/12/18 18:00 | 124.2 | 10:44:29 | - | - | 00:14:08 | - |
| Transit survey (Leaving Tonga EEZ-Research area) | 2021/12/26 8:35 | 2022/01/11 9:02 | 579.9 | 50:46:32 | - | - | 02:55:24 | 1:40:57 |
| Research area (Area VIE 130°W-120°W) | 2022/01/11 9:02 | 2022/02/01 18:08 | 468.5 | 43:18:40 | 517.2 | 47:36:56 | 13:18:08 | 3:44:27 |
| Navigation/transit survey to the coastal ice-free waters, south of 72°S | 2022/02/01 18:08 | 2022/02/08 14:06 | - | - | - | - | 3:56:13 | - |
| Coastal ice-free waters, south of 72°S (130°W-120°W) | 2022/002/8 14:06 | 2022/02/12 10:03 | 190.5 | 17:08:29 | 157.2 | 14:44:45 | 1:02:08 | - |
| Transit survey (Research area-Entering Tonga EEZ) | 2022/02/12 10:03 | 2022/02/22 17:05 | 782.2 | 67:39:37 | - | - | 6:20:12 | - |
| Transit survey (Leaving Solomon Islands EEZ-0°00) | 2022/03/08 06:30 | 2022/03/09 12:05 | 177.9 | 14:45:22 | - | - | - | - |
| Total | 2021/12/13 14:59 | 2022/03/09 12:05 | 2323.2 | 204:23:09 | 674.4 | 62:21:41 | 27:46:13 | 5:25:24 |

Table 2a. Number of sightings in the research area, by stratum and species.

| Species | Eastern part of Area VIE (130°W-120°W) | | | | | | | | | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Southern stratum | | | | Northern stratum | | | | Coastal ice-free waters, south of 72°S | | | | Sub-total | | | | | |
| | 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 | 0 | 0 | 0 | 0 | 4 | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 5 | 1 | 1 | 5 | 6 |
| Fin whale | 0 | 0 | 0 | 0 | 41 | 60 | 3 | 4 | 0 | 0 | 0 | 0 | 41 | 60 | 3 | 4 | 44 | 64 |
| Like fin | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Antarctic minke whale | 4 | 6 | 0 | 0 | 11 | 13 | 1 | 1 | 64 | 119 | 3 | 3 | 79 | 138 | 4 | 4 | 83 | 142 |
| Like minke | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 4 |
| Humpback whale | 0 | 0 | 0 | 0 | 18 | 24 | 8 | 12 | 0 | 0 | 0 | 0 | 18 | 24 | 8 | 12 | 26 | 36 |
| Like humpback | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 |
| Baleen whale | 1 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 |
| Sperm whale | 5 | 5 | 0 | 0 | 3 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 8 | 9 | 1 | 1 | 9 | 10 |
| Southern bottlenosed whale | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Arnoux's beaked whale | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 0 | 0 | 1 | 8 | 0 | 0 | 1 | 8 |
| Killer whale (Undtermined) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 44 | 0 | 0 | 3 | 44 | 0 | 0 | 3 | 44 |
| Killer whale (Type B) | 1 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 21 | 0 | 0 | 1 | 21 |
| Killer whale (Type C) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 0 | 0 | 1 | 6 | 0 | 0 | 1 | 6 |
| Ziphiidae | 1 | 1 | 0 | 0 | 2 | 3 | 1 | 2 | 0 | 0 | 0 | 0 | 3 | 4 | 1 | 2 | 4 | 6 |
| Unidentified whale | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 |

Table 2b. Number of sightings for whale species observed during this survey including transit and research area.

| Species | Transit From 0°00 to R.A. | | | | Eastern part of Area VIE (130°W-120°W) | | | | Transit in the research area | | | | Transit From R.A. to 0°00 | | | | Sub-total | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Prim. | | Second. | | 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. | sch. | Ind. | sch. | Ind. |
| Antarctic blue whale | 0 | 0 | 0 | 0 | 4 | 5 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 5 | 2 | 2 | 6 | 7 |
| Fin whale | 3 | 3 | 1 | 1 | 41 | 60 | 3 | 4 | 0 | 0 | 0 | 0 | 9 | 23 | 1 | 1 | 53 | 86 | 5 | 6 | 58 | 92 |
| Like fin | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 |
| Sei whale | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Antarctic minke whale | 1 | 1 | 3 | 4 | 79 | 138 | 4 | 4 | 0 | 0 | 17 | 20 | 2 | 2 | 0 | 0 | 82 | 141 | 24 | 28 | 106 | 169 |
| Like minke | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 2 | 2 | 5 | 4 | 7 |
| Humpback whale | 1 | 2 | 0 | 0 | 18 | 24 | 8 | 12 | 0 | 0 | 0 | 0 | 7 | 13 | 1 | 2 | 26 | 39 | 9 | 14 | 35 | 53 |
| Like humpback | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 |
| Bryde's whale | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Baleen whale | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 4 | 4 | 0 | 0 | 4 | 4 |
| Sperm whale | 3 | 3 | 1 | 1 | 8 | 9 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 11 | 12 | 3 | 3 | 14 | 15 |
| Southern bottlenosed whale | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Arnoux's beaked whale | 0 | 0 | 0 | 0 | 1 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 2 | 11 | 0 | 0 | 2 | 11 |
| Killer whale (Undtermined) | 0 | 0 | 0 | 0 | 3 | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 44 | 0 | 0 | 3 | 44 |
| Killer whale (Type B) | 0 | 0 | 0 | 0 | 1 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 21 | 0 | 0 | 1 | 21 |
| Killer whale (Type C) | 0 | 0 | 0 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 0 | 0 | 1 | 6 |
| Ziphiidae | 3 | 3 | 0 | 0 | 3 | 4 | 1 | 2 | 0 | 0 | 0 | 0 | 5 | 8 | 0 | 0 | 11 | 15 | 1 | 2 | 12 | 17 |
| Unidentified whale | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 6 | 0 | 0 | 7 | 9 | 0 | 0 | 7 | 9 |

Table 2c. Identification of duplicate sightings during surveys in Independent Observer (IO) mode. Duplicate status was based on the number of sightings made by the Independent Observer Platform (IOP) that were observed also by the Topmen in the Standard TOP Barrel. Status codes: D - Definite duplicate, P -Possible duplicate, R - Remote duplicate, N - Not duplicate.

| Species | Number of all schools sighted by TOP & IOP | Number of schools sighted by IOP | Duplicate Status | | | |
|---|---|---|---|---|---|---|
| | | | D | P | R | N |
| Antarctic blue whale | 5 | 2 | 2 | 0 | 0 | 0 |
| Fin whale | 26 | 12 | 10 | 0 | 0 | 2 |
| Like fin | 2 | 1 | 1 | 0 | 0 | 0 |
| Antarctic minke whale | 50 | 21 | 11 | 2 | 0 | 8 |
| Like minke | 2 | 0 | 0 | 0 | 0 | 0 |
| Humpback whale | 15 | 7 | 4 | 0 | 0 | 3 |
| Like humpback | 1 | 0 | 0 | 0 | 0 | 0 |
| Baleen whale | 1 | 0 | 0 | 0 | 0 | 0 |
| Sperm whale | 4 | 1 | 1 | 0 | 0 | 0 |
| Arnoux's beaked whale | 1 | 0 | 0 | 0 | 0 | 0 |
| Ziphiidae | 1 | 1 | 0 | 0 | 0 | 1 |
| Unidentified whale | 2 | 1 | 0 | 0 | 0 | 1 |

Table 3. Summary of biopsy samples collected by 2021/2022 JASS-A.

| Photo-ID | Transit From 0°00 to R.A. | Eastern part of Area VIE (130°W-120°W) | | | Transit to the coastal ice-free waters, south of 72°S | Transit From R.A. to 0°00 | Total |
|---|---|---|---|---|---|---|---|
| | | Southern stratum | Northern stratum | Coastal ice-free waters, south of 72°S | | | |
| Antarctic blue whale | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| Fin whale | 2 | 0 | 7 | 0 | 0 | 3 | 12 |
| Bryde's whale | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Antarctic minke whale | 1 | 1 | 3 | 3 | 6 | 1 | 15 |
| Humpback whale | 1 | 0 | 4 | 0 | 0 | 6 | 11 |
| Killer whale | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| Total | 5 | 1 | 16 | 3 | 6 | 9 | 43 |

Table 4. Summary of the photo-ID data by 2021/2022 JASS-A.

| Photo-ID | Transit From 0°00 to R.A. | Eastern part of Area VIE (130°W-120°W) | | | Transit to the coastal ice-free waters, south of 72°S | Transit From R.A. to 0°00 | Total |
|---|---|---|---|---|---|---|---|
| | | Southern stratum | Northern stratum | Coastal ice-free waters, south of 72°S | | | |
| Antarctic blue whale | 0 | 0 | 6 | 0 | 1 | 0 | 7 |
| Humpback whale | 2 | 0 | 2 | 0 | 0 | 5 | 9 |
| Killer whale | 0 | 3 | 0 | 7 | 0 | 0 | 10 |
| Total | 2 | 3 | 8 | 7 | 1 | 5 | 26 |

Table 5. Summary of Oceanographic observations by 2021/2022 JASS-A.

| | Transit From 0°00 to R.A. | Eastern part of Area VIE (130°W-120°W) | | | Transit to the coastal ice-free waters, south of 72°S | Transit From R.A. to 0°00 | Total |
|---|---|---|---|---|---|---|---|
| | | Southern stratum | Northern stratum | Coastal ice-free waters, south of 72°S | | | |
| Number of XCTD cast | 13 | 17 | 48 | 26 | 6 | 6 | 116 |

Table 6. Summary of observed marine debris in research area by 2021/2022 JASS-A.

| No. | Date (y/m/d) | Latitude | Longitude | Description | Note |
|---|---|---|---|---|---|
| 1 | 2022/02/01 | 70°18'S | 128°52'W | Fishing buoy | Length 0.7m, photographed. |

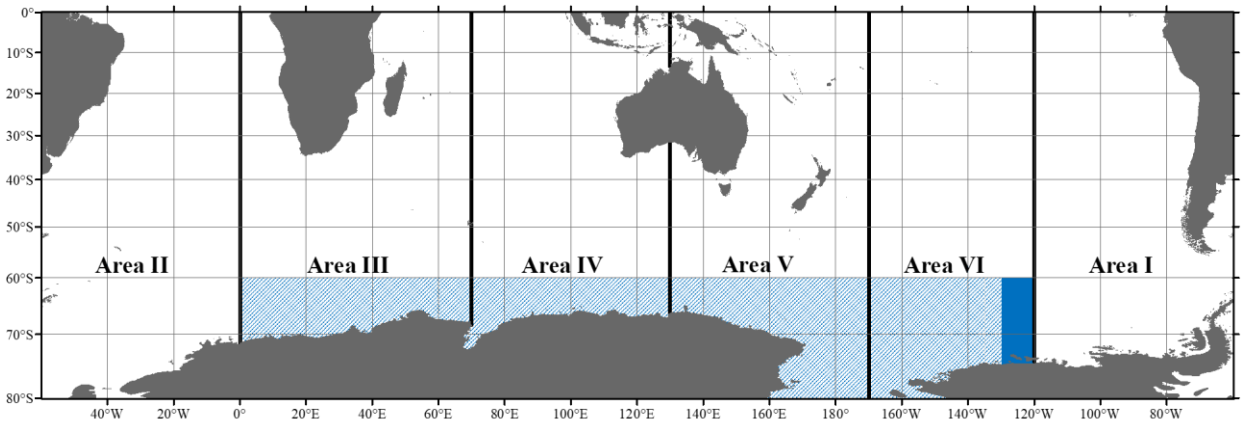


Figure 1a. Research area of the JASS-A dedicated sighting survey. Blue area indicates the researched area of the dedicated sighting survey in 2021/2022 JASS-A.

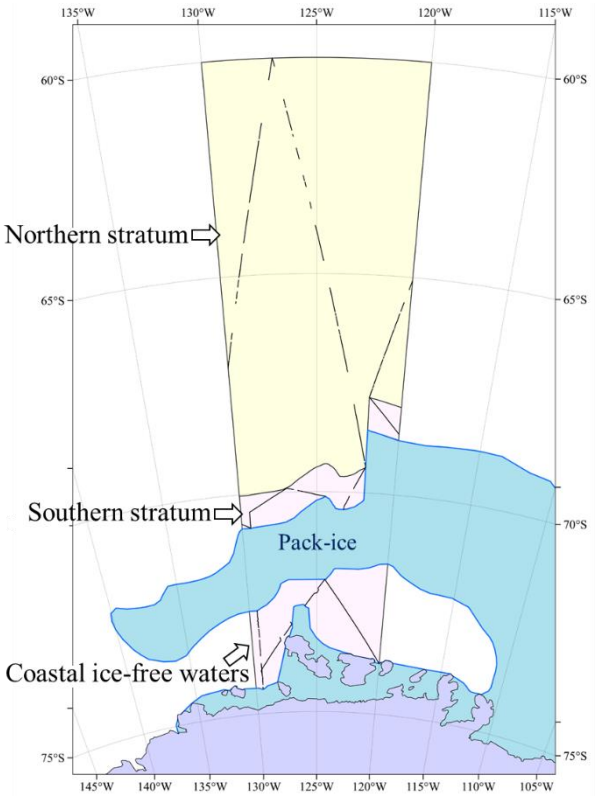


Figure 1b. Research area (130°W–120°W) and the track line of the 2021/2022 JASS-A dedicated sighting survey covered on search effort. Southward navigation to the coastal ice-free waters, south of 72°S was followed narrow ice-free area and lower concentration ice area within pack ice between 133°W and 129°W.

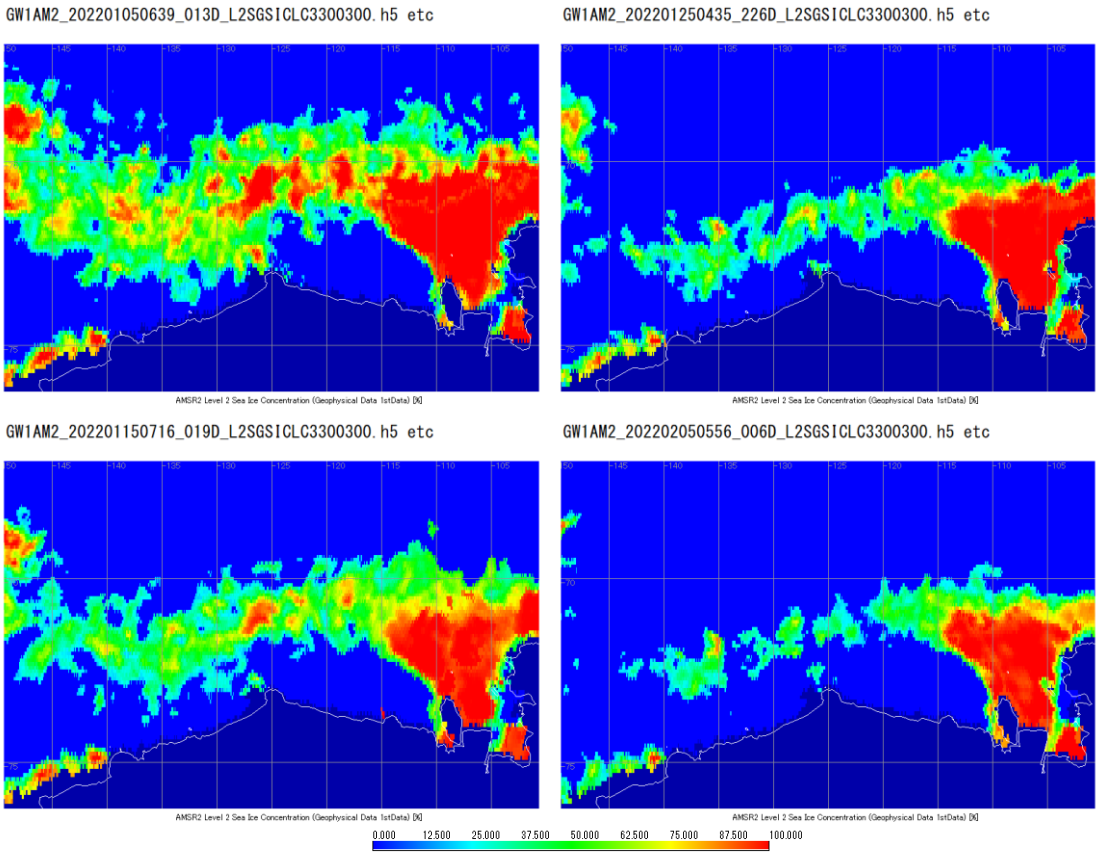


Figure 2. The pack-ice distributions in the research area, dated 5 January (upper left), 15 January (lower left), 25 January (upper right) and 5 February (lower left) 2022 using observational data acquired by the Advanced Microwave Scanning Radiometer 2 (AMSR2). Original data for this value added data product was provided by Japan Aerospace Exploration Agency (JAXA).

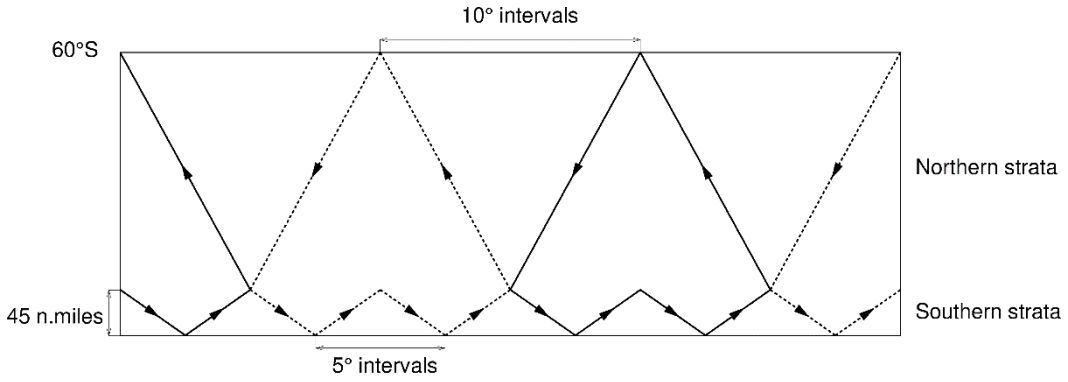


Figure 3a. Basic design for pre-determined cruise track lines in the Antarctic using one vessel. Track lines are decided based on the original longitudinal line, which is selected at random. The interval of legs and number of legs in each stratum could be changed in consideration of delay caused by bad weather conditions and other factors. Considerable flexibility may be needed by the Cruise Leader in determining the final cruise tracks.

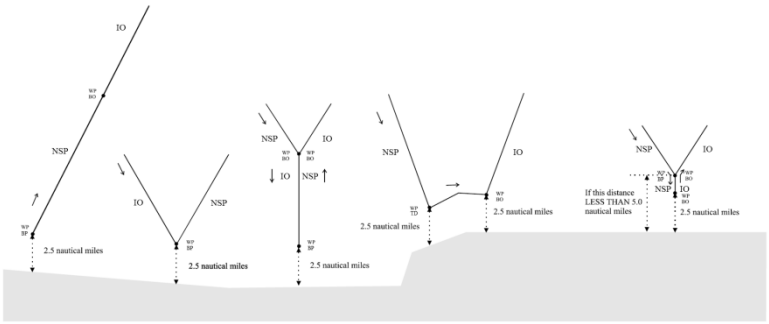


Figure 3b. Standard procedures for modifications to the cruise track line in the southern strata (IWC, 2008). If the ice edge is encountered prior to reaching a planned waypoint, 2.5n.miles from the estimated ice edge, the vessel shall follow the ice edge, off-effort, until survey can be resumed on the planned track line. If the ice edge is not encountered on reaching a planned ice edge waypoint, research shall be conducted on a bisector. Survey mode is to be changed at the planned waypoint (unless the ice edge is within 5n.miles of the waypoint), and again on reversing direction when the true ice edge is encountered.

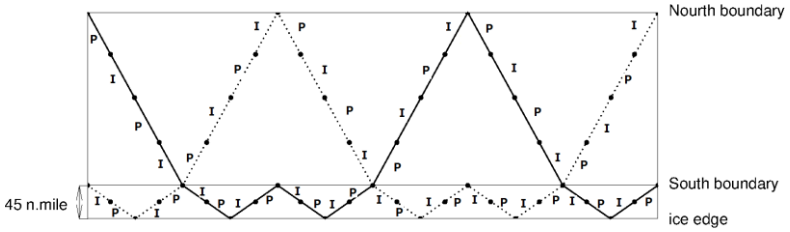


Figure 3c. The survey modes (NSP (P) and IO (I) modes) were set alternately in each track line.

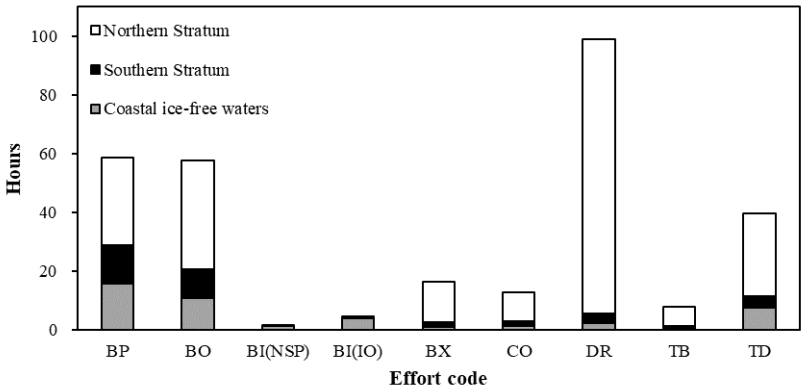


Figure 4a. Breakdown of research time in hours, by effort code in the research area. BP: Normal Passing mode searching (NSP); BO: Passing with Independent Observer searching (IO); BI: NSP and BO with in the ice area; BX: Estimated angle and distance experiment, Photo-ID, Biopsy experiments, Satellite tagging experiments; CO: Confirmation of school; DR: Drifting; TB: Time back to track line; TD: Top down steaming.

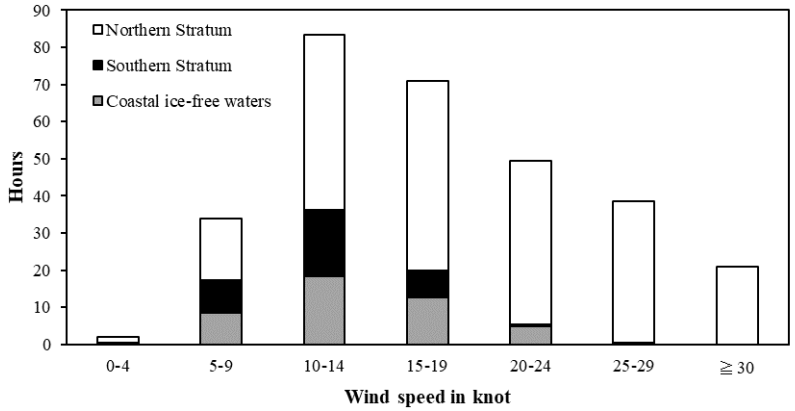


Figure 4b. Breakdown of research time in hours in the research area, by wind speed in knots.

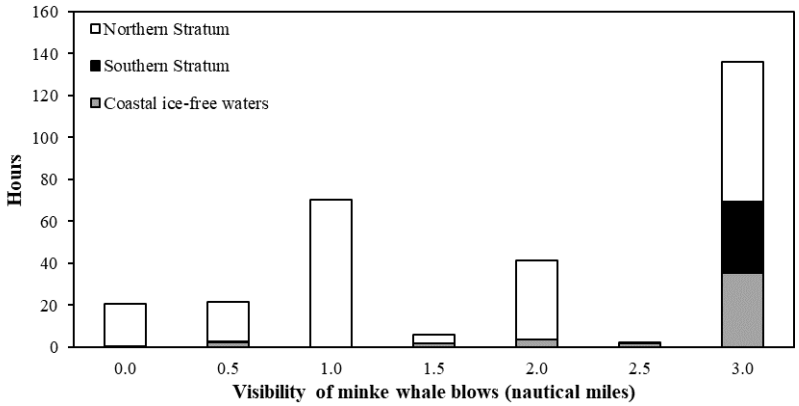


Figure 4c. Breakdown of research time in hours in the research area, by visibility (minke whale visibility) in nautical mile.

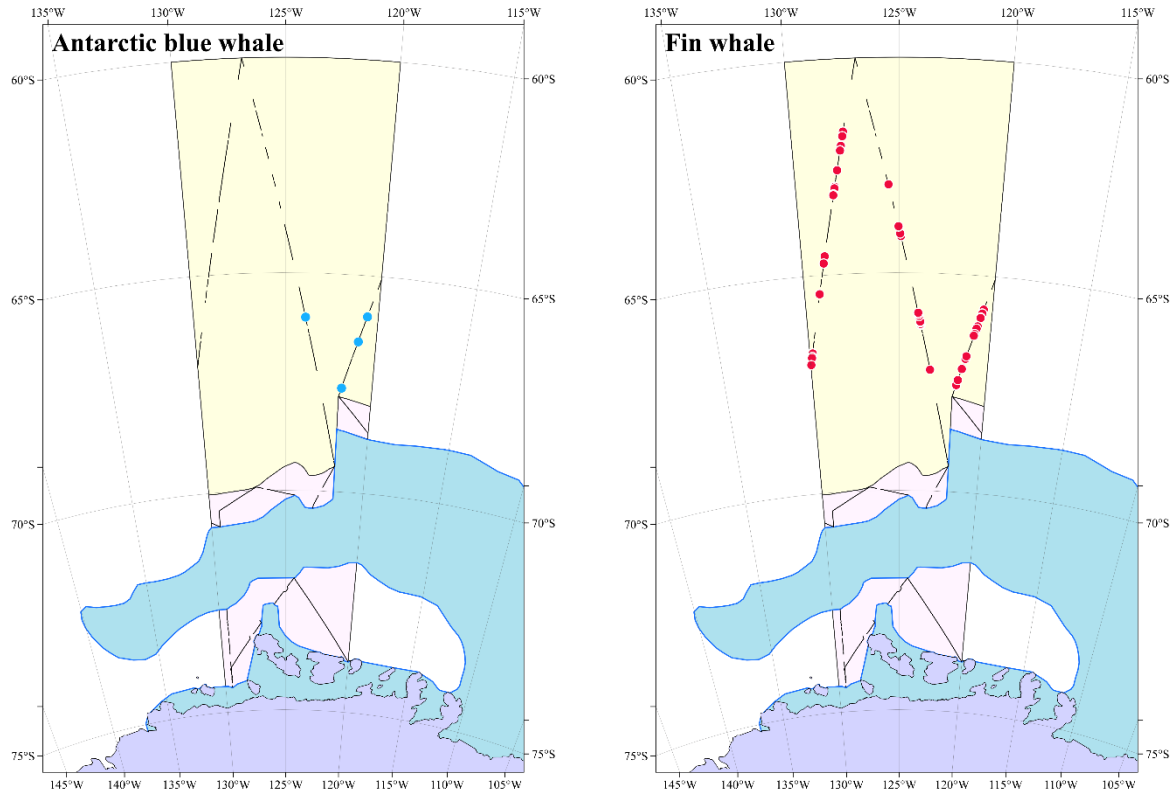


Figure 5a. Primary sighting positions of Antarctic blue (left) and fin (right) whales with searching effort in the research area.

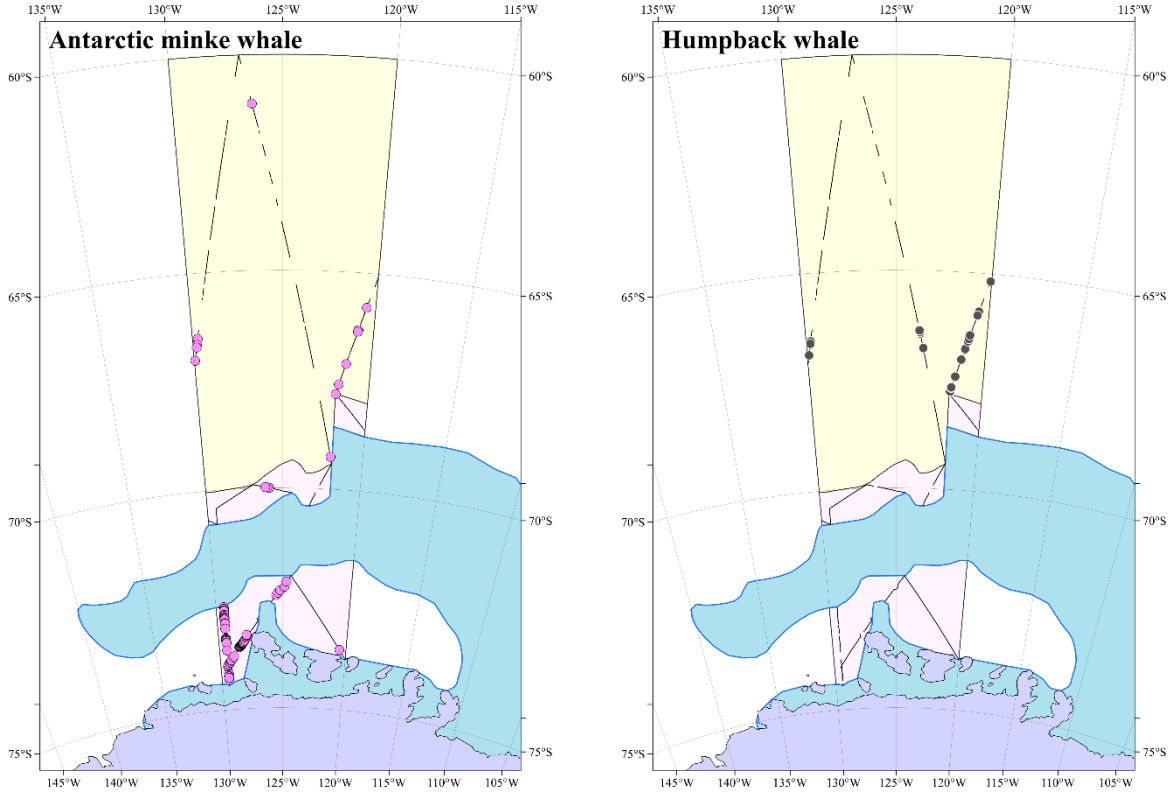


Figure 5b. Primary sighting positions of Antarctic minke (left) and humpback (right) whales with searching effort in the research area.

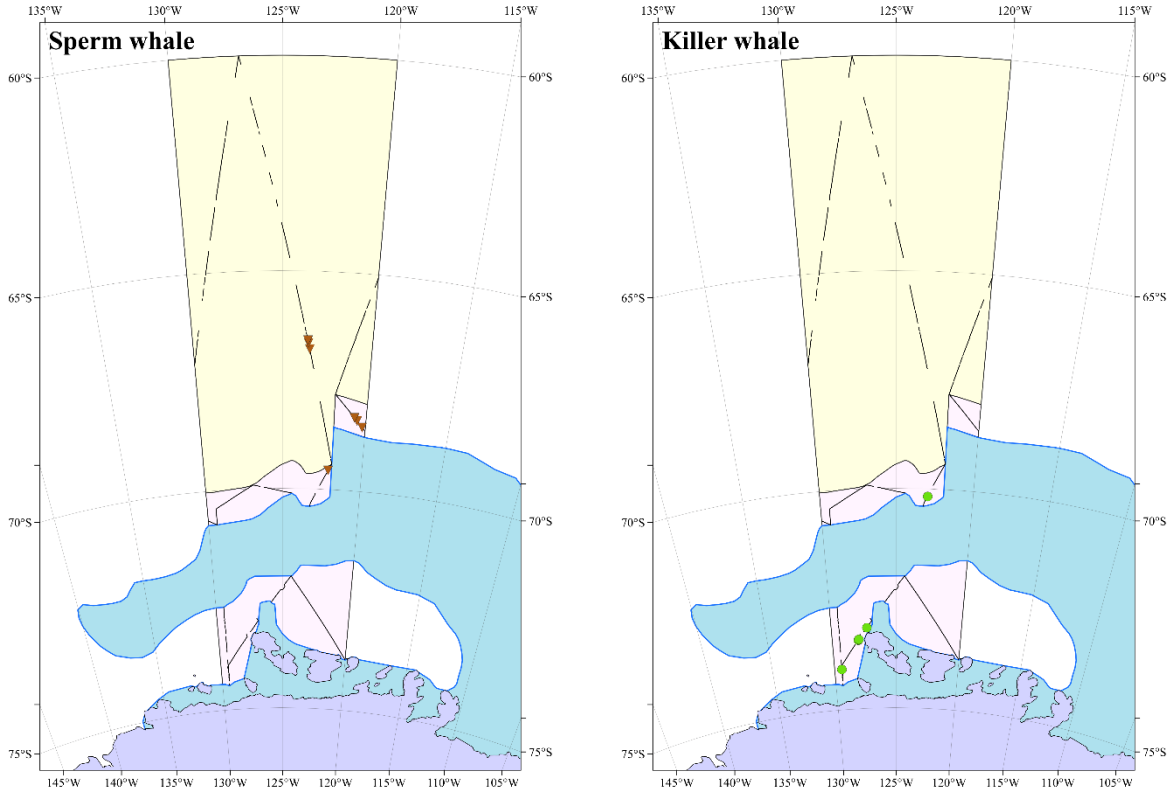


Figure 5c. Primary searching positions of sperm (left) and killer (right) whales with searching effort in the research area.

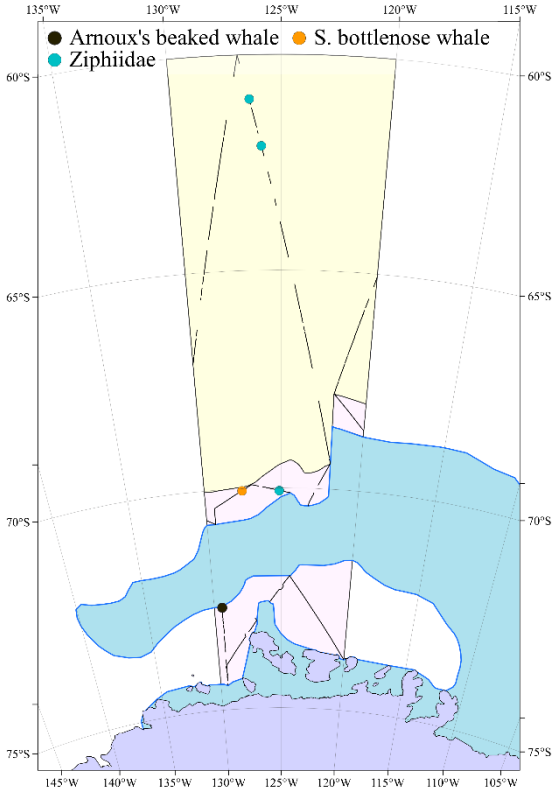


Figure 5d. Primary sighting positions of southern bottlenose, Arnoux's beaked whales and Ziphiidae with searching effort in the research area.

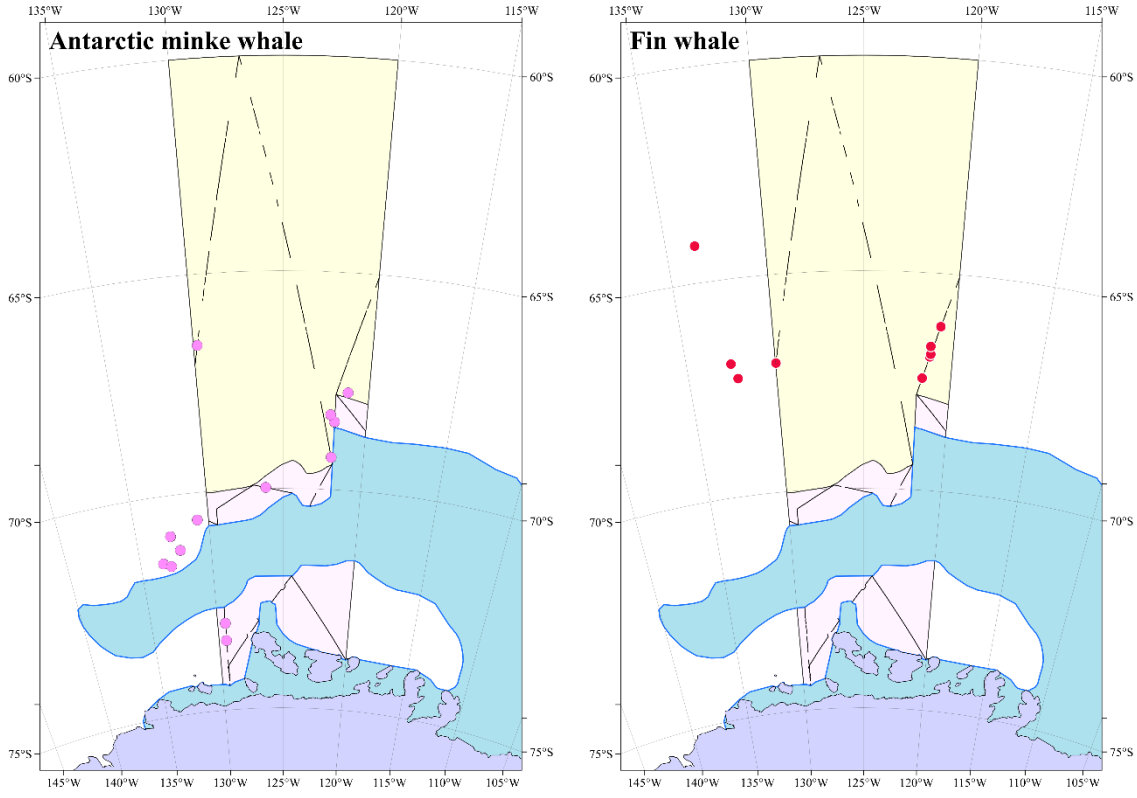


Figure 6. Satellite deployed positions of Antarctic minke (left) and fin (right) whales in the 2021/2022 JASS-A.

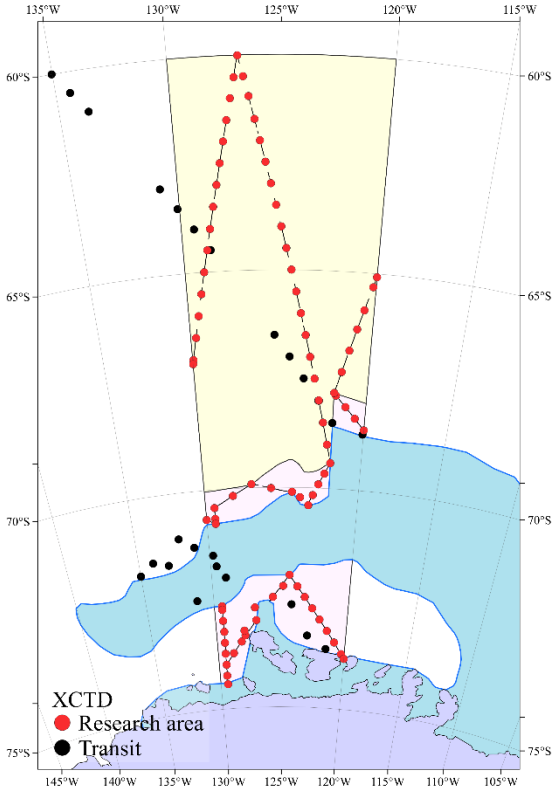


Figure 7. Oceanographic observation stations (XCTD casting points) in the 2021/2022 JASS-A. Dots that appear in the pack ice were observed at those locations when transit within pack ice from/to the coastal ice-free waters, south of 72°S.

Figure 8. Marine debris, one fishing buoy, found on the sea surface at 70°18'S; 128°52'W in the 2021/2022 JASS-A.

**Appendix 1**

**Ship specifications of *Yushin-Maru* No.2**

**Vessel photos:**

*Yushin-Maru* No.2

**Vessel specifications:**

| | *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 heigh [m] | 13.5 |
| Upper bridge height [m] | 11.5 |
| Bow height [m] | 6.5 |
| Engine power [PS / kW] | 5,280 / 3,900 |

## Appendix 2

## RESULTS OF THE SATELLITE-MONITORED TRACKINGS OF ANTARCTIC BALEEN WHALES UNDER THE JASS-A CRUISE IN 2021/2022

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Satellite-monitored tagging is a part of main objective 2 in JASS-A program regarding distribution, movement and stock structure of baleen whales (Government of Japan, 2019). Implantable satellite-monitored tags in a stainless-steel housing and limpet tags (SPOT and SPLASH-types; Wildlife Computers, Redmond, Washington, USA) were used for tracking whales. The tags were deployed with the Air Rocket Transmitter System (ARTS) (LK-ARTS, Skutvik, Norway), a pneumatic air launcher. The tags were deployed from the bow deck (6.5 m height from sea surface) of the R/V *Yushin-Maru* No.2 (747GT, 70m-length). Skin biopsies were also collected for genetic analyses using a biopsy Larsen gun (Larsen, 1998). Biopsies were simultaneously sampled after the deployment of the satellite tags if possible and stored at -20°C for later molecular analyses. The detail of the deployment system is described in Konishi *et al*. (2020).

The tag deployments were conducted during end of January to mid-February 2022 in the eastern part of Area VI (135°W - 120°W). The tags were deployed on 15 Antarctic minke whales *Balaenoptera bonaerensis* and nine fin whales *B. physalus* (Table 1; Figures 1 and 2). Most of the Antarctic minke whales moved westward and some individuals arrived at the Ross Sea (Figure 1). Fin whales also moved westward at offshore area and an individual arrived at 175°E close to Balleny Islands (Figure 2). Two limpet SPLASH-type tags were deployed successfully and diving and surfacing data were obtained (Figures 3-5). These tracking data will be analyzed with those of previous years to investigate distribution, movement, stock structures and diving behavior of these whales. The practicality in use of surfacing timing data to estimate $g(0)$ for abundance estimate will be reviewed as a part of main objective 1 of JASS-A program.

Tracked records of the whales will be analyzed in line with the objectives and schedule of JASS-A program. Further improvements of the technique will be considered and applied in future surveys.

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Government of Japan. 2019. 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). 16pp. [Paper available at the IWC Office].

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 Biology*. 43(4), pp. 343–357. doi: 10.1007/s00300-020-02638-x.

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. 8pp. [Paper available at the IWC Office].

Table 1
Summary of the satellite-monitored tags satellite for Antarctic minke and fin whales in 2021/22 JASS-A cruise.

| No. | Vessel | Date | Species | School size | Latitude (degree West) | Longitude (degree South) | Estimated body length (m)* | PTT ID | Biopsy samples | Tag type |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | YS2 | 20220107 | AM | 2 | 121.9 | 68.5 | 7.1 | 203444 | n | SPOT |
| 2 | YS2 | 20220107 | AM | 1 | 122.2 | 68.3 | 8.0 | 203445 | y | SPOT |
| 3 | YS2 | 20220107 | AM | 1 | 121.2 | 67.8 | 5.7 | 203464 | n | SPOT |
| 4 | YS2 | 20220128 | AM | 2 | 121.6 | 67.4 | 19.1 | 203449 | y | SPOT |
| 5 | YS2 | 20220130 | AM | 1 | 121.3 | 66.9 | 20.4 | 203476 | y | SPOT |
| 6 | YS2 | 20220201 | AM | 3 | 121.2 | 66.9 | 20.5 | 203439 | y | SPOT |
| 7 | YS2 | 20220206 | AM | 1 | 120.8 | 66.2 | 22.3 | 203459 | y | SPOT |
| 8 | YS2 | 20220206 | AM | 2 | 121.3 | 66.7 | 20.2 | 203486 | y | SPOT |
| 9 | YS2 | 20220206 | AM | 1 | 129.8 | 66.6 | 7.3 | 207827 | y | SPLASH |
| 10 | YS2 | 20220207 | AM | 1 | 130.0 | 67.0 | 20.6 | 203484 | y | SPOT |
| 11 | YS2 | 20220208 | AM | 17 | 122.0 | 69.3 | 6.7 | 203463 | y | SPOT |
| 12 | YS2 | 20220208 | AM | 17 | 126.1 | 70.0 | 7.1 | 203455 | y | SPOT |
| 13 | YS2 | 20220209 | AM | 4 | 133.4 | 71.5 | 6.5 | 212349 | y | SPLASH |
| 14 | YS2 | 20220213 | AM | 1 | 132.9 | 71.6 | 7.4 | 203471 | y | SPOT |
| 15 | YS2 | 20220112 | FI | 1 | 132.1 | 71.3 | 8.1 | 203468 | y | SPOT |
| 16 | YS2 | 20220112 | FI | 2 | 132.7 | 70.9 | 6.7 | 181867 | y | SPOT |
| 17 | YS2 | 20220112 | FI | 3 | 129.4 | 73.0 | 8.4 | 203474 | y | SPOT |
| 18 | YS2 | 20220114 | FI | 1 | 129.4 | 73.0 | 8.6 | 203466 | y | SPOT |
| 19 | YS2 | 20220114 | FI | 1 | 129.4 | 73.4 | 7.9 | 203460 | y | SPOT |
| 20 | YS2 | 20220128 | FI | 1 | 130.8 | 70.6 | 6.4 | 203443 | y | SPOT |
| 21 | YS2 | 20220214 | FI | 2 | 130.8 | 70.6 | 6.4 | 203454 | y | SPOT |
| 22 | YS2 | 20220214 | FI | 3 | 132.2 | 67.3 | 20.2 | 203465 | y | SPOT |
| 23 | YS2 | 20220215 | FI | 2 | 132.5 | 67.0 | 22.3 | 203452 | y | SPOT |

* Body lengths of whales were estimated by the researcher on board.

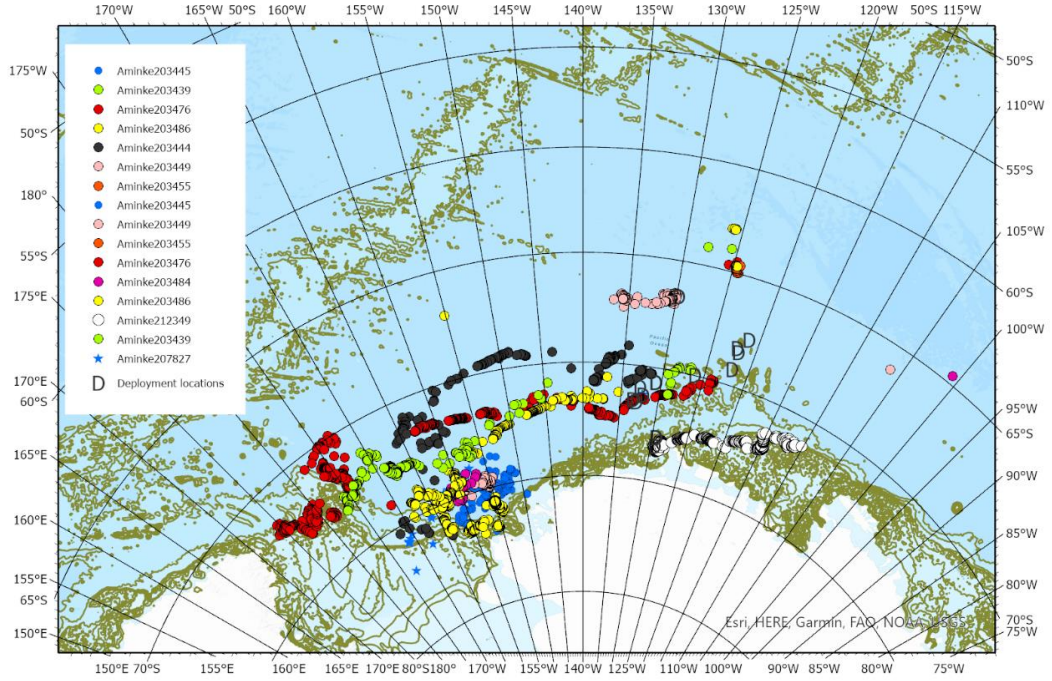


Figure 1. Satellite tracking for the Antarctic minke whales during 2021/22 JASS-A cruise (Updated on 10th March). Green lines show the contour lines of topography (200m-3000m).

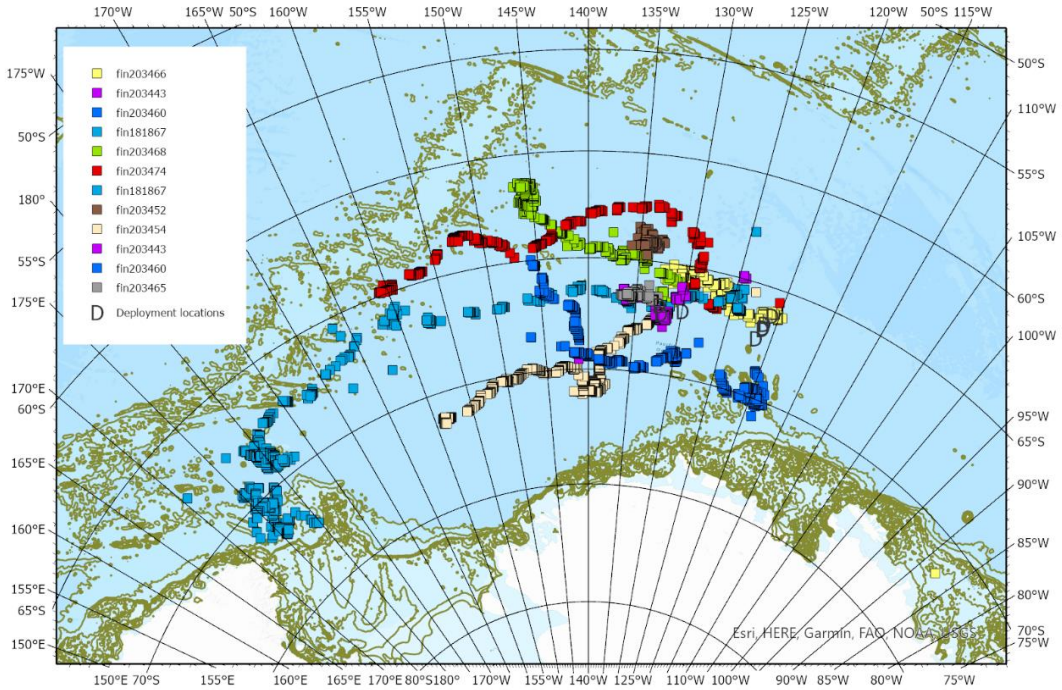


Figure 2. Satellite tracking for Antarctic fin whales during 2021/22 JASS-A cruise (Updated on 10th March). Green lines show contour lines of topography (200m-3000m).

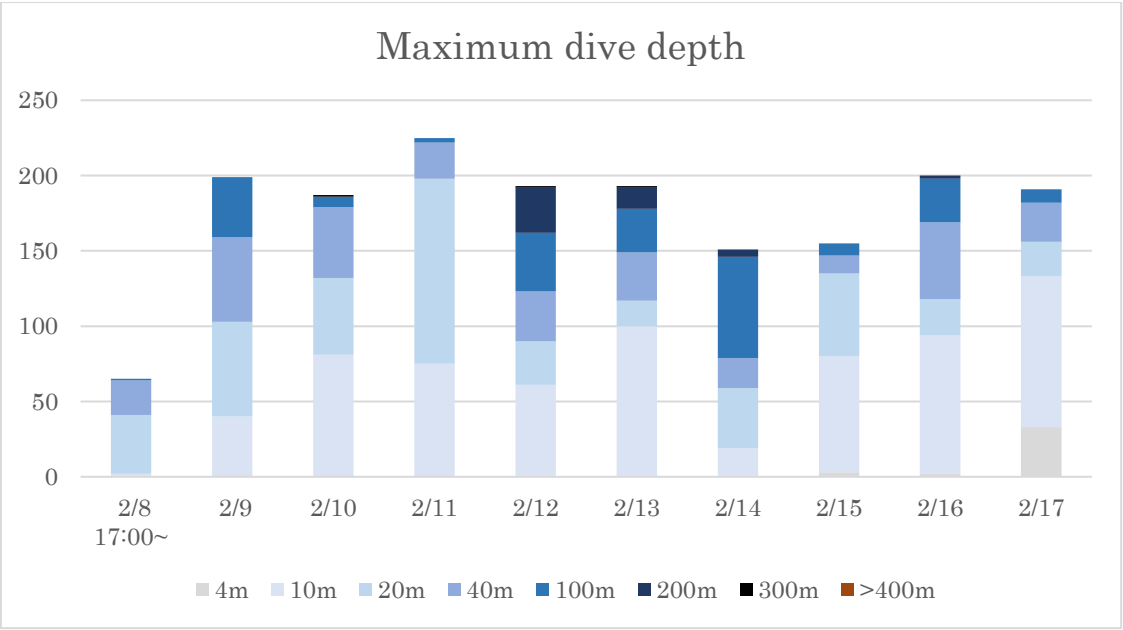


Figure 3. Summary of maximum diving depth of the Antarctic minke whales (PTT ID 212349) during ten days. Data were generated as daily summary (start at GMT 00:00) based on 1 second sampling interval. Shallower than 4m is ignored.

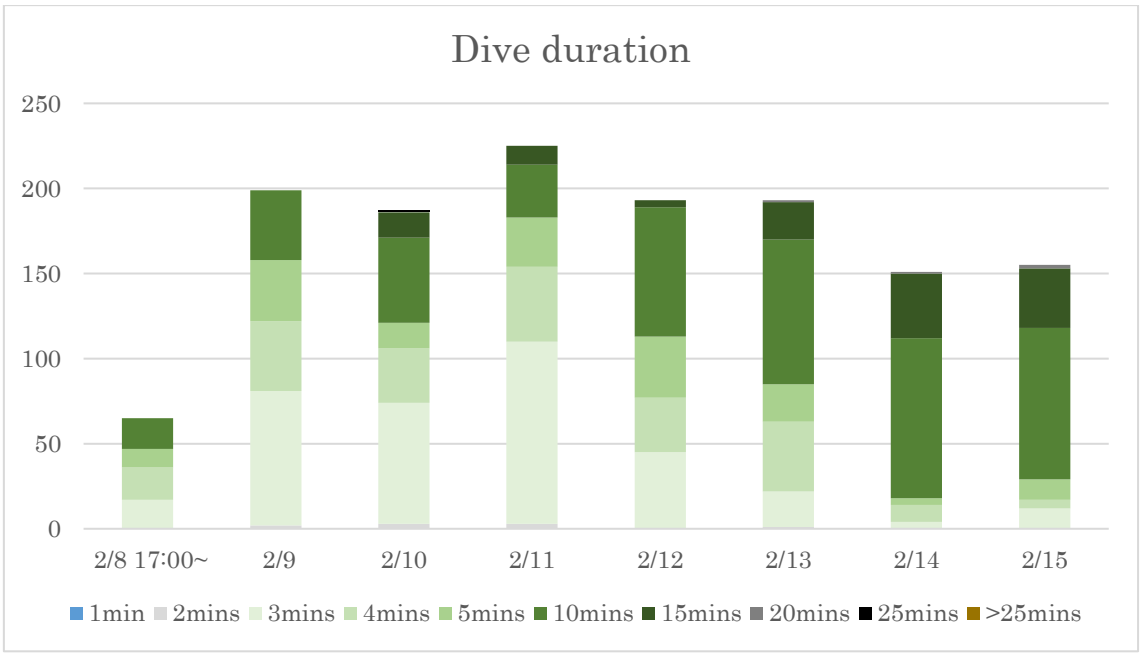


Figure 4. Summary of diving duration of the Antarctic minke whales (PTT ID 212349) during eight days. Data were generated as daily summary (start at GMT 00:00) based on 1 second sampling interval. Vertical axis represents the number of diving.

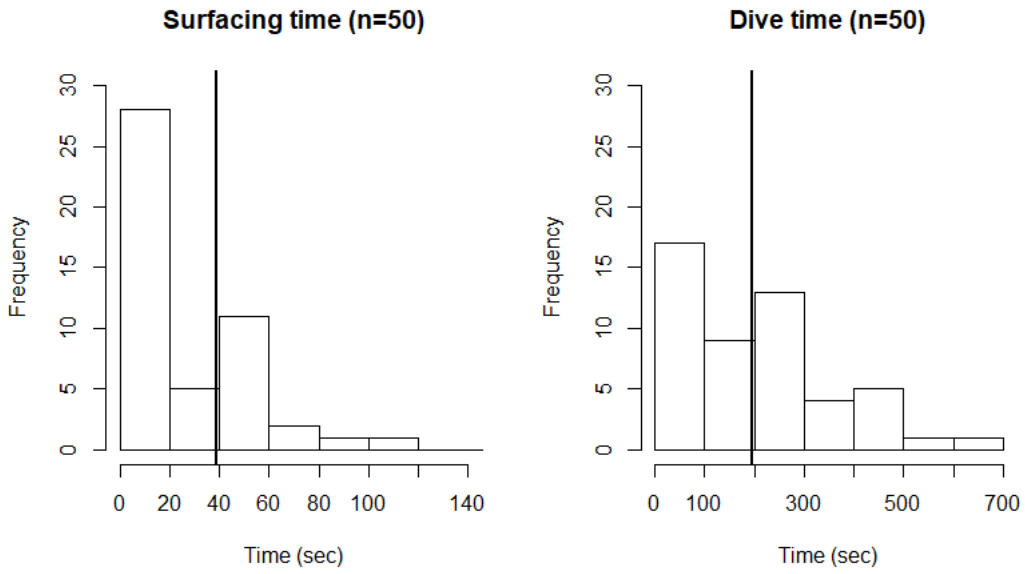


Figure 5. Histograms of surfacing (left) and dive times (right) of the behavior data recorded during the deployment period in an Antarctic minke whale (PTT207827). The solid line represents the mean in both figures.

## Appendix 3

## Oversight for the 2021/2022 JASS-A dedicated sighting survey

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The plan of this survey was presented to the 2021 IWC/SC meeting (Matsuoka *et al*, 2021) and endorsed by the Scientific Committee (IWC, 2021). On behalf of the IWC Scientific Committee I carried out the oversight work during the 2021/2022 JASS-A dedicated sighting survey. This is a brief report of the oversight activities conducted on that survey.

**Preparatory work**

I participate in the planning meeting held in Tokyo, Japan on 16 November 2021. During the meeting, survey plan and contents, logistical aspects for the cruise and operations of the ship were finalized. I also participated in the pre-cruise meeting carried out in Shiogama, Japan on 2 December. The survey organizers, cruise leader, researchers, captain and crew members joined the pre-cruise meeting. During the meeting, the organizers explained the objective of the survey and the procedure to be used for sighting surveys, experiments and oceanographic survey using the latest sea ice information of the research area. The planned sighting procedure was in order with that agreed by the IWC Scientific Committee. The research vessel R/V *Yushin-Maru* No.2 (*YS2*) (747GT) was available for the survey. This vessel was assigned to cover the research area, south of 60°S in IWC Antarctic Area VI East and in the longitudinal range of 130°W–120°W, and also to cover predetermined transects, Normal Passing mode and passing with Independent Observer mode. Cruise leader and two experienced researchers were assigned to the vessel.

**Oversight period and method**

I carried out the oversight work through the planning and the execution of this sighting survey conducted by the Institute of Cetacean Research (ICR). The research activities in the research vessel were oversight by examining the daily report prepared by the cruise leader and researchers on board with weather forecast and sea ice information. In some instances, telephone calls were made for further clarification of the activities, procedure and sightings made. Geographical positions and weather information of the vessel was tracked every day from ICR. Thus, the total survey was oversighted.

**Brief narrative of the oversight vessel**

The duration of this cruise was 109 days. The *YS2* departed from Shiogama, in Japan on 3 December 2021 and started the transit survey on 13 December, and arrived in Suva, Republic of Fiji on 23 December. The transit survey to the Antarctic was completed and the survey started in the research area on 11 January 2022. The survey was completed in the eastern part of the Area VI East, and then the vessel and started transit survey on 12 February. It remained in Suva, Republic of Fiji on 1–4 March. The transit survey was completed on 9 March and the vessel arrived at Shiogama, Japan on 21 March.

**Post-cruise meeting**

I participated in a post-cruise meeting held on 21 March 2022 in Shiogama, Japan. Survey organizers, cruise leader, researchers and captain also participated in that meeting. Apart to discuss and assess the results of the surveys, the researchers engaged in the verification and checking of data.

**Conclusion**

All equipment and the survey method of vessel were the same as in the past sighting surveys. The design of the survey strata and track lines were improved to cover each area completely. The planned sighting procedure was in accordance with the guideline agreed by the SC (IWC, 2012). Objectives and procedure of the survey were explained to the captains, officers, crew and researcher in advance. I then endorse the information and data obtained during the 2021/2022 JASS-A dedicated sighting survey.

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