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Results of the dedicated sighting survey under the Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) in the western part of Area III in the 2020/21 austral summer season

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ABSTRACT

The results of the sighting survey of the Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) in the 2020/21 austral summer season are reported. A dedicated sighting vessel was engaged in the line transect method survey in the eastern part of Antarctic Area III West (015°E–035°E) for 28 days, from 10 January to 6 February 2021. The total searching distance in the research area was 1,744.3 n.miles (3,230.4 km). Four baleen whale species and at least three 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 Antarctic Area III West (000°–035°E) was covered during the 2019/20 and 2020/21 JASS-A surveys.

INTRODUCTION

Long-term systematic surveys on whales and the ecosystem in the Antarctic such as the JARPA/JARPAII[1], NEWREP-A[2], and IDCR/SOWER[3] obtained important data to study the abundance and abundance trends of large whales as well the biology and role of whales in the Antarctic ecosystem. All these research programs have been terminated. The last NEWREP-A survey was carried out in the 2018/19 austral summer season.

The Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) commenced in the 2019/20 austral summer season 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 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, 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). The JASS-A surveys are conducted alternatively in IWC Management Areas III, IV, V and VI by one or two specialized vessels, during a tentative period of eight austral summer seasons.

The first JASS-A survey was carried out in the 2019/20 austral summer season and covered the sector 000°–015°E of Area III. The second survey was carried out during the 2020/21 season and covered the sector 015°E–035°E of this Area. This paper presents a summary of the results of the 2020/21 JASS-A survey.

[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

SURVEY DESIGN

Research area

The research area of JASS-A is comprised by IWC Management Areas III, IV, V and VI, south of 60°S (Figure 1). The research area in the 2020/21 season covered by the survey was the eastern part of Antarctic Area III West (015°E–035°E), south of 60°S (Figure 1). The area was divided into northern and southern strata based on a line 45 n.miles from the ice-edge (Figure 2). In the northern and southern strata, the survey track lines consisted of a zigzag course changing direction at 5°00′ and 2°30′ longitudinal degree intervals in a 10 degrees longitudinal band, respectively (Figure 2). The starting point in this survey followed the last longitudinal point of the 2019/20 JASS-A survey (000°–015°E).

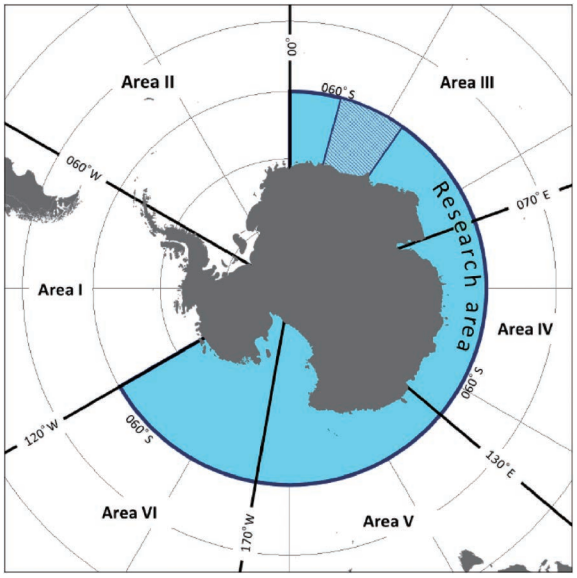

Figure 1. Research area of JASS-A. The shaded area (015°E–035°E) indicates the surveyed area in the 2020/21 austral summer season.

Research vessel

The dedicated sighting vessel *Yushin-Maru* No. 2 (*YS2*) was engaged in the survey. Its specifications are: gross tonnage 747GT, total length 69.6 m, top barrel platform (TOP) 19.5 m, Independent Observer Platform (IOP) 13.5 m, and upper bridge platform (UBP) 11.5 m (Figure 3). Three Japanese researchers participating in the survey had experience in conducting line transect surveys, biopsy sampling, photo-identification (photo-ID), satellite tagging, and oceanographic survey in the Antarctic through the previous JARPA/JARPAII and NEWREP-A programs.

Sighting procedures and mode

The sighting survey was conducted using (1) Passing with abeam Closing mode (NSP) and (2) Passing with Independent Observer (IO) mode. For NSP mode, there were two primary observers on the TOP. For IO mode, there were two primary observers on the TOP and one primary observer on

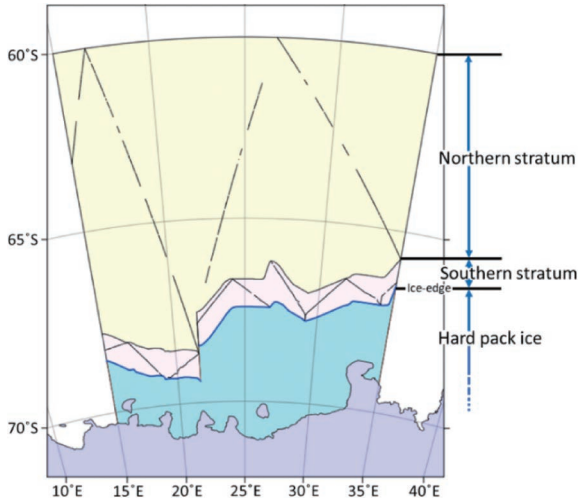

Figure 2. Research area (015°E–035°E) and searching efforts of the JASS-A survey in 2020/21. The research commenced at 60°00′S; 026°41′E and ended at 68°17′S; 015°00′E.

Figure 3. The dedicated sighting vessel *Yushin-Maru* No. 2 and its equipped three platforms.

the IOP. There was no open communication between the IOP and the TOP. Two primary observers were at the UBP, regardless of the research mode. The observers conducted searching for cetaceans by using angle board and binoculars with reticles (7x), which include the distance estimate scales. Sighting-information by these TOP and IOP observers was reported to researchers and observers on the UBP for data recording and tracking of cetaceans.

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 conditions 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', and all other sightings were classified as 'Secondary sightings'.

Guidelines for species identification and determining group size were the same as those used during the IWC-SOWER surveys (Anon, 2008).

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 see Isoda *et al.* (2021).

RESULTS OF THE SURVEY

Narrative of the survey

Table 1 shows the itinerary of the survey. The duration of this cruise was 109 days. The *YS2* departed Shiogama, Japan on 4 December 2020 arriving in Maputo, Republic of Mozambique on 2 January 2021. The *YS2* started the sighting survey in Antarctic Area III West at 60°00'S; 026°41'E on 10 January. The survey was completed at 68°17'S; 015°00'E on 6 February. The *YS2* arrived back in Maputo on 20 February and Japan on 22 March.

Research effort in the research area

Table 2 shows a summary of the effort spent during the survey. The *YS2* was engaged in the research for 28 days, from 10 January to 6 February 2021. The total searching effort was 1,744.3 n.miles (3,230.4 km); 887.3 n.miles in NSP mode for 84 hours 59 minutes and 857.0 n.miles in IO mode for 83 hours 27 minutes. In the northern stratum, the total searching effort was 1,097.7 n.miles (NSP: 528.3 n.miles; IO: 569.4 n.miles), and the searching effort coverage was 68%. In the southern stratum, the total searching effort was 646.6 n.miles (NSP: 359.0 n.miles; IO: 287.6 n.miles), and the searching effort coverage was 90%. Therefore, a good distribution of effort within both strata and survey mode was achieved. The total experimental time for photo-ID, biopsy sampling, tagging and distance and angle experiment was 31 hours 41 minutes.

Whale sightings in the research area

Four baleen whale species and at least three toothed whale species were sighted in the research area. The dominant whale species in the research area was the humpback whale (359 schools/697 individuals) followed by the fin whale (136/228). Sightings of other species were as follows; Antarctic minke whale (51/120), Antarctic blue whale (24/29), sperm whale (6/6), killer whale (4/13), southern bottlenose whale (6/16), and Ziphiidae (10/16) (Table 3).

Antarctic blue whales

Blue whales were found more frequently in the southern stratum (Figure 4) as found in previous surveys (Ensor *et al.*, 2005; Isoda *et al.*, 2020). Nine schools (13 individuals) were sighted in the vicinity of 67°10'S; 030°10'E.

Table 1
Narrative of the 2020/21 JASS-A dedicated sighting survey.

Date (y/m/d)	Event
2020/11/20	Planning meeting at Tokyo, Japan
2020/12/03	Pre-cruise meeting at Shiogama, Japan
2020/12/04	*YS2* departed Shiogama, Japan
2020/12/20	Transit survey started at 10°11'S; 089°26'E
2021/01/02	*YS2* arrive in Maputo, Mozambique
2021/01/10	Transit survey finished and survey started in the research area at 60°00'S; 026°41'E
2021/02/06	Survey completed in the research area (28 days) and transit survey start at 68°17'S; 015°00'E
2021/02/20	*YS2* arrive in Maputo, Mozambique
2021/03/04	Transit survey completed at 10°30'S; 085°20'E
2021/03/22	*YS2* arrived in Japan and post cruise meeting carried out in Shiogama, Japan

Table 2
Summary of searching effort (time and distance) and time (hours) spent during the 2020/21 JASS-A survey.

Survey Sections	Date and time		Searching effort (distance [n.miles] and time [hours:minutes])				Experiments time	
	Start	End	NSP		IO		Photo-ID, Biopsy, tagging experiment	Estimated angle and distance training/ experiment
Transit survey (10°S-Entering MZ EEZ)	2020/12/20 06:10	2020/12/31 17:20	519.7	45:03	—	—	00:29	—
Transit survey (Leaving SA EEZ-60°S)	2021/01/04 12:00	2021/01/10 08:30	283.0	24:17	—	—	00:33	—
Research area (Area IIIW 015°E-035°E)	2021/01/10 08:47	2021/02/06 14:30	887.3	84:59	857.0	83:27	25:08	06:33
Transit survey (015°E-Entering SA EEZ)	2021/02/06 14:30	2021/02/17 11:51	474.8	41:38	—	—	04:17	—
Transit survey (Leaving MZ EEZ-10°S)	2021/02/22 11:32	2021/03/04 16:35	593.4	50:02	—	—	—	—
Total	2020/12/20 06:10	2021/03/04 16:35	2,758.2	245:59	857.0	83:27	30:27	06:33

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

Species	Eastern part of Area IIIW (015°E–035°E)								Sub-total				Total	
	Southern stratum				Northern stratum									
	Primary		Secondary		Primary		Secondary		Primary		Secondary			
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Antarctic blue whale	21	25	1	1	2	3	0	0	23	28	1	1	24	29
Fin whale	14	17	0	0	117	201	5	10	131	218	5	10	136	228
Like fin	0	0	0	0	2	2	0	0	2	2	0	0	2	2
Antarctic minke whale	23	42	12	57	13	18	3	3	36	60	15	60	51	120
Like minke	0	0	0	0	1	1	0	0	1	1	0	0	1	1
Humpback whale	96	128	4	7	256	559	3	3	352	687	7	10	359	697
Like humpback	0	0	0	0	1	1	0	0	1	1	0	0	1	1
Baleen whales	4	4	0	0	4	4	0	0	8	8	0	0	8	8
Sperm whale	1	1	0	0	5	5	0	0	6	6	0	0	6	6
Killer whale (Undetermined ecotypes)	2	7	0	0	2	6	0	0	4	13	0	0	4	13
Southern bottlenose whale	0	0	0	0	6	16	0	0	6	16	0	0	6	16
Ziphiidae	2	2	0	0	8	14	0	0	10	16	0	0	10	16
Unidentified whales	2	2	1	1	4	4	0	0	6	6	1	1	7	7

Fin whales

Fin whales were mainly distributed in the northern stratum (Figure 4). In a previous survey, this species was hardly observed in this area (Ensor *et al.*, 2005). This difference could be due to an increase in the abundance of this species, as suggested previously (Matsuoka and Hakamada, 2014).

Antarctic minke whales

Antarctic minke whales were mainly sighted in the western part of the research area, in the southern stratum (near the ice-edge). They were infrequently sighted in the southern stratum in the eastern part of the research area and in the northern stratum (Figure 4). In previous surveys, this species was more frequently sighted in the

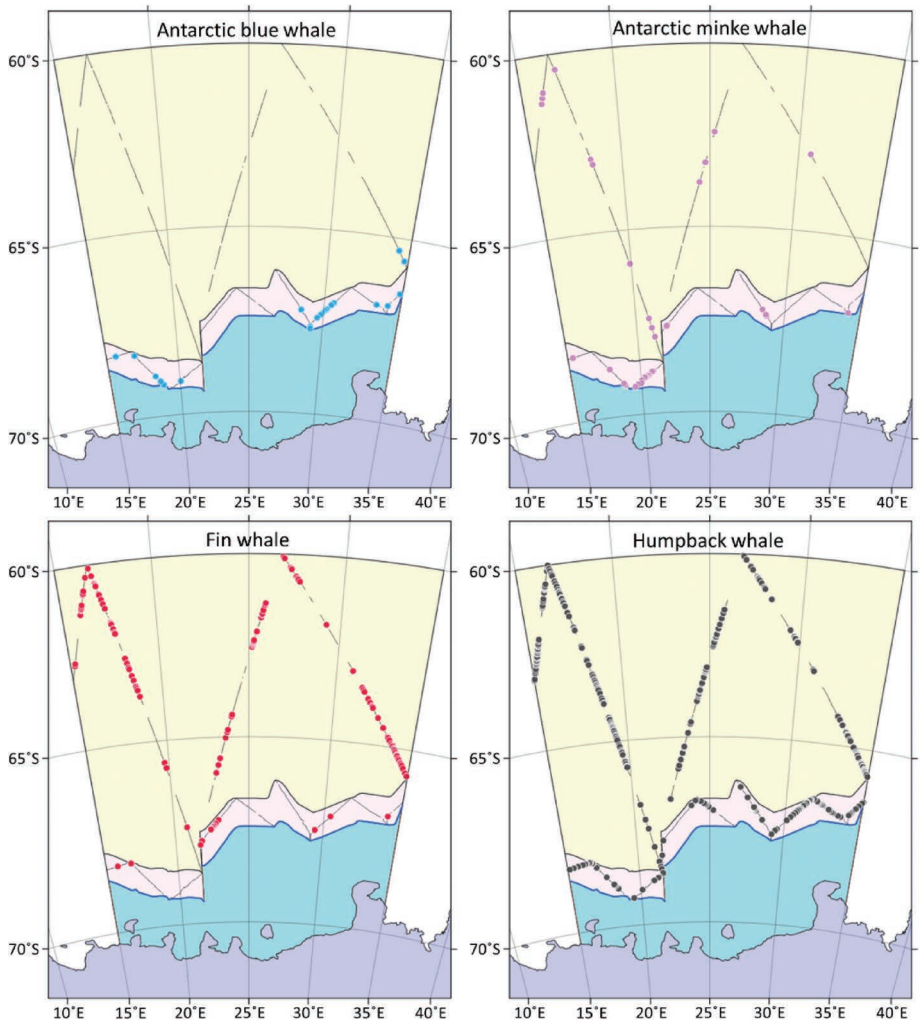

Figure 4. Position of primary sightings of Antarctic blue, fin, Antarctic minke, and humpback whales.

southern stratum in the western side of Area IIIW (Ensor *et al.*, 2005; Bando *et al.*, 2019).

Humpback whales

Humpback whales were sighted frequently across the entire research area (Figure 4) which is a different pattern from previous surveys (Ensor *et al.*, 2005). This observation could be due to an increase in abundance and distribution of this species in the research area as suggested previously (Hakamada and Matsuoka, 2014).

Duplicate sightings

Duplicates sightings were those sightings made 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 is used to adjust estimates of abundance. Duplicates were recorded for a total of 127 sightings (involving several whale species) in this survey.

Other research activities

Table 4 shows a summary of different research activities.

Sighting distance and angle experiment

The sighting distance and angle experiment was conducted in order to evaluate the accuracy of sighting distance and angle provided by primary observers. The results of this experiment will be used for the calculation of abundance estimates. A training for this experiment was conducted on 13 January. The actual experiments comprising 128 trials were successfully completed on 1 February.

Photo-ID

Photo-ID data is used for matching exercise to investigate distribution and movement of those large whales (Figure 5). A total of 20 Antarctic blue, 41 humpback and 1 killer whales were successfully photo-identified during the entire survey. These data will be registered with the Institute of Cetacean Research (ICR) catalogue and submission of photographs be made to relevant international

Table 4
Summary of experiments during the 2020/21 JASS-A survey.

Experiments	Results and descriptions
Sighting distance and angle experiment	128 trials completed by 1 February
Photo-ID	Obtained from 20 Antarctic blue, 41 humpback and 1 killer whales
Biopsy sampling	Collected from 8 Antarctic blue, 15 fin, 14 Antarctic minke, 16 humpback and 1 Bryde's whales
Satellite tagging	Deployed on 7 fin and 10 Antarctic minke whales
Data logger tagging	Deployed on 2 humpback whales
Oceanographic survey	99 XCTD casts
Marine debris observation	No debris was observed in the research area
UAV	Aerial images collected from 10 Antarctic blue, 7 fin and 2 humpback whales

Figure 5. Examples of photo-ID of humpback whales during the 2020/21 JASS-A survey, ventral side of the flukes (left) and left side of dorsal fin (right).

Figure 6. Biopsy sampling of blue whale using a Larsen system during the 2020/21 JASS-A survey (left and middle); skin/blubber samples of a blue whale obtained by biopsy sampling (right).

catalogues (e.g. Matsuoka and Pastene, 2014).

Biopsy sampling for large whales

Biopsy samples are used for studies on stock structure of large whale based on genetic analyses and for other feasibility studies included among the specific objectives of the JASS-A. A total of 54 biopsy samples were collected from eight Antarctic blue, 15 fin, 14 Antarctic minke, 16 humpback and 1 Bryde's whales, using the Larsen system (Larsen, 1998) for the entire survey (Figure 6). 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 (SPOT6, Wildlife Computers, Redmond, Washington, USA) were deployed with the Air Rocket Transmitter System (ARTS) (LK-ARTS, Skutvik, Norway). The detail of deployment system and protocols, and research results to date were described in Konishi *et al.* (2020). In the research area, seven and ten satellite tags were deployed on fin and Antarctic minke whales respectively.

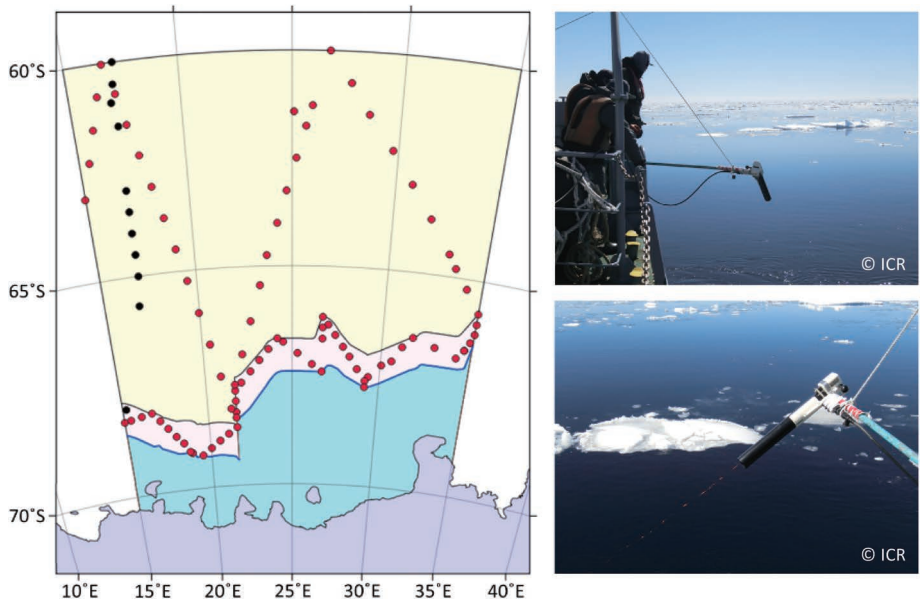

Figure 7. Oceanographic observation stations (XCTD casting points); Red circle: research area; black circle: transit (left). Oceanographic observation using XCTD (upper-right); XCTD launcher with the probe launched (lower-right).

Feasibility study on data logger (TDR) tagging

The feasibility study of data logger tagging was conducted in order to obtain information on dive-time of large whales using the satellite-linked Time-Depth Recorder (TDR) tags (SPLASH 10-F, Wildlife Computers, Redmond, Washington, USA). The tags were successfully deployed on two humpback whales and the data (position, time and depth) were collected in both cases. This experiment will be further refined in the next field surveys to obtain data of mean dive-time and diving behaviour of the animal, which are key parameters for abundance estimation considering availability bias.

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, Tsurumi-Seiki Co., Ltd., Yokohama, Japan) at 99 stations along the survey track lines (Figure 7). Oceanographic data will be analysed to study the oceanographic structure of the research area and the relationship with whale distribution.

Marine debris observation

Studies on marine debris in the Antarctic are very scarce. However, it is important to continue with this kind of survey to monitor future trends in the occurrence of marine debris. No marine debris objects were observed in the research area during the survey.

Feasibility study on the utility of UAV

This technique will be used to determine the number of individuals in the schools, information highly relevant for abundance estimation. It will be used also in photogrammetry studies. Aerial images were collected in a total of ten Antarctic blue, seven fin and two humpback whales using small UAV, DJI phantom 4 Pro, (Figures 8 and 9) (video clips can be accessed at https://www.youtube.com/channel/UCz3c9IIMiQPVeryAogmJIig). These data will be registered with the photo-ID catalogue of ICR.

Sighting survey in the transit areas

Sighting survey was conducted between south of 10°S and the research area, excluding areas of the foreign countries EEZs. The searching effort was 802.7 n.miles and total sightings included fin (8/13), Bryde's (1/1), Antarctic minke (1/1), and humpback (3/6) whales. Biopsy samples were collected from Bryde's (sighted position 27°17'S; 039°29'E) and Antarctic minke (sighted position 29°01S; 050°09'E) whales (Figure 10). During the transit survey from the Antarctic research area to 10°S, the searching effort was 1068.2 n.miles and the total sightings included fin (9/16), Antarctic minke (1/1), humpback (22/36), and sperm (3/3) whales. During the transit in the research area, biopsy samples were collected from three fin and five humpback whales and satellite tags were attached on two fin whales. Further biopsy samples were collected from two fin whales (a school comprising five whales) at 43°49'S; 19°12'E and one humpback whale at 38°58'S; 26°55'E.

Figure 8. UAV in flight obtaining overhead images of Antarctic blue (left) and humpback (right) whales during the 2020/21 JASS-A survey.

Figure 9. Examples of aerial image of Antarctic blue whales captured by UAV during the 2020/21 JASS-A survey.

Figure 10. Bryde's whale sighted at 27°17'S; 039°29'E on 31 December 2020 (left) and Antarctic minke whale sighted at 29°01'S; 050°09'E on 29 December 2020 (right) on sighting survey in the transit area.

HIGHLIGHTS OF THE SURVEY

The 2019/20 and 2020/21 JASS-A surveys covered the full Antarctic Area III West (000°–035°E) and succeeded in collecting sighting data necessary for estimation of cetacean abundance in this Area. In addition, 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/JARPA, 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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