Cruise Report of the Japanese Whale Research Program under Special Permit in the Antarctic-Second Phase (JARPA II) in 2012/2013

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ABSTRACT

The eighth research cruise of the Japanese Whale Research Program under the Special Permit in the Antarctic-Second Phase (JARPA II) was conducted during the 2012/13 austral summer season, under Article VIII of the International Convention for the Regulation of Whaling (ICRW). Three sighting and sampling vessels (SSVs) and one research base ship were engaged in the research for 48 days, from 26 January to 14 March 2013 in Areas III East (35°E - 70°E), IV (70°E - 130°E), V West (130°E - 165°E) and part of Area V East (165°E - 175°E). Unfortunately the research activities were interrupted several times by an anti-whaling group (Sea Shepherd, SS) which directed violent sabotage activities against Japanese research vessels. The research activity of the SSVs was also interrupted several times by the SS group. There was direct sabotage on the research activities from the SS over 21 days. However, the research activities were influenced negatively by the SS during the entire research period. The total searching distance was 2,103.3n.miles. Eleven species including five baleen whales (Antarctic minke, blue, fin, humpback and southern right whales) and two toothed whales (sperm, southern bottlenose whales) were sighted during the research period. A total of 227 schools (412 animals) of humpback whales was sighted. It was the dominant whale species in the research area followed by the Antarctic minke whales (149 schools, 280 animals), fin whales (61 schools, 241 animals). The number of sightings of the humpback whales was about 1.5 times higher than that of Antarctic minke whales. A total of 103 Antarctic minke whales were sampled. All whales sampled were examined on board the research base vessel. Photo-id experiments were conducted on three blue whales, seven humpback whales and one southern right whale. A total of three skin biopsy samples were collected from humpback whales. Oceanographic surveys were conducted at 55 points using XCTD to investigate vertical sea temperature and salinity profiles. The main results of this survey can be summarized as follows: 1) humpback whales were widely distributed in the research area and its density index was higher than that of the Antarctic minke whales in all areas except in the Prydz Bay; 2) the ice-free extent of the research area was substantially larger than in past seasons; 3) mature female Antarctic minke whale were observed only in the Prydz Bay; 4) all Antarctic minke whales sampled in Area IV east were immature animals.

KEYWORDS: ANTARCTIC MINKE WHALE; HUMPBACK WHALE; SCIENTIFIC PERMITS

INTRODUCTION

The Japanese Whale Research Program under Special Permit in the Antarctic (JARPA) was conducted between 1987/88 and 2004/05 austral summer seasons, under Article VIII of the International Convention for the Regulation of Whaling. JARPA provided a wide variety of information on biological parameters of Antarctic minke whale (*Balaenoptera bonaerensis*) such as the natural mortality coefficient and changes over time in the age at maturity as well as narrowing down the parameters of relevance for stock management (IWC, 1998, Anonymous, 2005). JARPA also elucidated that there were at least two stocks of Antarctic minke whales in the research area but their geographical boundaries were different from those used for the IWC Areas (Pastene, 2006). Also JARPA found that pollutant concentration in whale's tissues, such as heavy metals and PCBs, was extremely low (Yasunaga *et al*, 2006). Further, JARPA showed an annual decreasing trend in energy storage in the 18 year period of JARPA (Konishi *et al*., 2008). JARPA has thus successfully obtained data related to the initially proposed objectives (IWC, 2007; 2008a).

Based on these considerations, the Government of Japan launched a new comprehensive study under the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA II), combining lethal and non-lethal methods, starting from the 2005/2006 austral summer season (Government of Japan, 2005). The full-scale JARPAII started from the 2007/08 season. JARPA II is a long-term research program with the following objectives: 1) Monitoring of the Antarctic ecosystem, 2) Modeling interaction among whale species and developing future management objectives, 3) Elucidation of temporal and spatial changes in stock structure and 4) Improving the management procedure for the Antarctic minke whale stocks. JARPA II focuses on Antarctic minke whale, humpback whale (*Megaptera novaeangliae*), fin whale (*B. physalus*) and possibly other species in the Antarctic ecosystem that are major predators of Antarctic krill.

JARPAII is a perfectly legal activity carried out under the ICRW. Despite this in recent years a violent anti-whaling group (Sea Shepherd, SS) has engaged in violent sabotage activities against the research vessels of JARPA II. The IWC has condemned SS's tactics against Japan's whale research vessels. In 2008 the IWC member countries adopted by consensus a statement which calls this group "to refrain from dangerous actions that jeopardize safety at sea", regardless of different positions of countries on whaling (IWC 2008b). The International Maritime Organization (IMO) also adopted a resolution that seriously concerned safety and security of vessels, human life and marine environment caused by unlawful protests or confrontations on the high seas (IMO, 2010).

Despite those international efforts to avoid confrontations at sea, the research activities of the JARPA II survey in 2012/13 were again interrupted by the SS group during the research area. In order to secure safety for the research vessels and their crew members, the planned sighting vessels had to dedicate many of its planned research time to security tasks. It was very regrettable and disappointing to report that this large investment - dedicated sighting survey in the Antarctic - had to be cancelled in the 2012/13 season as same as the 2011/12. These dedicated sighting surveys were planned according to the IWC survey guideline (IWC, 2005) and were endorsed by the IWC SC in 2011 and 2012 (IWC, 2011, 2012).

The present paper reports the eighth survey of the JARPA II conducted during the austral summer season 2012/13.

MATERIALS AND METHODS

Research vessels

The research fleet was composed of one dedicated sighting vessel, two sighting and sampling vessels and one research base vessel. The following vessels were used.

Research base vessel

Nisshin-Maru (NM; 8,141 tons)

Sighting and sampling vessels (SSVs)

Yushin-Maru (YS; 720 tons)

Yushin-Maru No.2 (YS2; 747 tons)

Yushin-Maru No.3 (YS3; 742 tons)

Two SSVs (YS and YS2) were engaged in sighting and oceanographic surveys and most of the experiments. NM served as a research base on which all biological examinations of sampled whales were conducted.

Research area and ice edge
The area covered by JARPA II is basically the same as in JARPA; the eastern part of Area III, Areas IV and V, and the western part of Area VI. The total area extents from 35°E to 145°W, south of 60°S. In this season, JARPA II surveyed the eastern part of Area III, Area IV and western part of Area V (35°E - 165°E). Figure 1 shows the geographic location of the research area for the 2012/2013 JARPA II survey. For this survey, our best estimate of the position of the ice edge was based on our visual and radar observations of the ice edge as well as satellite predictions. In this season, the ice-free extent of the research area including the Prydz Bay was substantially larger than previous surveys.

Survey track design
The survey track line for the SSVs consisted of a zigzag course changing direction at 1°40' longitudinal degree intervals. For SSVs, two parallel track lines were set at 7n.miles apart.

Sighting methods
Sighting procedures were the same as in the previous JARPA surveys (e.g. Nishiwaki *et al*. 2007). The sighting surveys by SSVs were conducted under limited closing mode (when a sighting of Antarctic minke whales were made on the predetermined track line, the vessel approached the whales and confirmed species and school size). Three SSVs advanced along parallel track lines 7n.miles apart, at a standard speed of 11.5 knots. The survey was operated under optimal research conditions (i.e., the wind speed below 25 knot in the south strata and 20 knot in the north strata, and visibility of more than 1.5n.miles). In addition to the sighting of Antarctic minke whales, the SSVs approached blue (*B. musculus*), fin, humpback, southern right (*Eubalaena australis*), pigmy right (*Caperea marginata*), sei (*B.borealis*), sperm (*Physeter macrocehpalus*) and southern bottlenose (*Hyperoodon planifrons*) for conducting some experiments. The SSVs also approached the same whale species for experiments while they engaged in sighting survey.

Sampling methods
Three SSVs were engaged in sampling survey. Sampling of 850 Antarctic minke whales (with 10 % of allowance) and 50 fin whales was planned in the research area south of 62°S during 2012/13 JARPA2. Although the original plan included 50 humpback whales (Government of Japan, 2005), Government of Japan decided to suspend the sampling of humpback whales.

One to two Antarctic minke whales were sampled randomly from each primary sighted school within 3n.miles of the track line. Dwarf minke whales were not a target for sampling. Sampling of fin whales was restricted to those animals with an estimated body length less than 20m due to logistic limitations at the NM. Only one fin whale was planed to be sampled from each primary sighted school within 3n.miles of the track line. If two or more animals smaller than 18m were found in a school, then only one of them was randomly selected and sampled.

Biological research
Most of the biological research methods used in this JARPA II survey were developed and improved during the JARPA 18 year research period. Biological research including scaling body weight on all sampled whales was conducted on the NM.

Experiments
Sighting distance and angle experiment

This experiment was conducted in order to evaluate the accuracy of the information on sighting distance and sighting angle given by observers of the SSVs.

Photo-identification experiment

The following species were targeted for photographic record of natural markings by SSVs: blue, humpback and southern right whales.

Biopsy sampling

In addition to the species targeted for photo-identification experiment, pygmy right, fin, sei, Antarctic minke, sperm and southern bottlenose, were targeted for biopsy skin sampling by the SSVs using compound-crossbow. All collected sample were preserved at –20°C.

Satellite tag

Blue, southern right and humpback whales were the target species for this experiment by the SSVs, which used the ICR air gun (Kasamatsu *et al*., 1991).

Vomiting and feacal observation

The SSVs were engaged in observations of vomits and feaces of sighted whales.

Marine debris observation

Observation of marine debris was conducted from the wheelhouse of the SSV (YS2) in the research area. Marine debris was also investigated in the stomach contents of Antarctic minke and fin whales sampled.

Oceanographic survey

Two SSVs (YS and YS2) planned the following oceanographic survey; 1) consecutive measuring of vertical water temperature profile by Expendable XCTD system and 2) marine debris recording in the research area. All marine debris found in the stomach of whales taken was also recorded on the NM.

RESULTS AND DISCUSSIONS

Outline of the cruise

SSV (YS3) departed Shiogama (Japan) on 26 December 2012. Two SSVs (YS1 and YS2) and NM departed from Shimonoseki and Innoshima, respectively on 28 December 2012 and started Antarctic sighting and sampling surveys in the research area on 26 January 2013. The Antarctic research period of this cruise was 48 days from 26 January 2013 to 14 March 2013. The research activities were interrupted directly by the SS over 21 days. However, the research activities in the whole period were influences negatively by this group. Sighting and sampling effort was substantially diminished. Research vessels were frequently attacked by the anti-whaling group and the survey was interrupted in several opportunities. One SSV (YS3) had to be engaged in monitoring the anti-whaling group vessels most of the research period. Due to this interference SSVs (YS1 and YS2) cancelled the research in the large part of the research area, Area III east, a part of Area IV, Area V. SSV (YS3) arrived at Tokyo on 4 April 2013 and Two SSVs (YS1 and YS2) and NM arrived at Shimonoseki on 7 April 2013.

Sighting survey and whale species sighted

The total searching distances was 2,103.3n.miles consisting of 1,304.8 nameless for the sampling mode and 798.5 n.miles for the sighting mode. Seven species including five baleen whales and two toothed whales were identified during the research period. The following five species of baleen whales were confirmed: Antarctic minke, blue, fin, humpback and southern right whales, and two toothed whale species were confirmed; sperm and southern bottlenose whales.

Table 1 shows the number of sightings during the survey and Figure 2 shows the sighting position of Antarctic minke and humpback whales. The number of sightings of humpback whales (227 groups and 412 animals in total) was about 1.5 times higher than that of Antarctic minke whales (149 groups, 280 animals) and was considerably higher than those of other species. Both Antarctic minke whale and humpback whales were widely distributed in the entire research area, but density was different among strata.

The 1994-95 the IWC/SOWER cruise (Ensor *et al*. 1995) was conducted in similar areas and period as in the present survey. This fact provides a good opportunity to compare the whale composition in the area in two different seasons. In 1994/95 season Antarctic minke whales were the most frequent species encountered in the research area. Humpback whales were also common in the research area. The number of sightings of Antarctic minke whales (291 schools and 508 individuals) was about 5.0 times higher than that of humpback whales (46 schools and 100 individuals). This comparison suggests that humpback whales were increasing and expanding in the research area.

Table 2 shows the density indices (D.I., the number of primary sighted schools per 100 n. miles) and mean school size (M.S.S.) of Antarctic minke, humpback and fin whales. The D.I. of Antarctic minke whale was highest in the Prydz Bay. On the other hand, the density of humpback whale was higher than that of Antarctic minke whale in the Areas IIIE and IV excluding the Prydz Bay. The D.I. of humpback whales was about 1.6 times higher than that of Antarctic minke whales in the entire research area. It was also suggested that recent drastic expansion of humpback whale distribution in the Areas IV and V may force Antarctic minke whales to move in the pack ice (Ishikawa *et al*., 2004, Fujise *et al*., 2006; Matsuoka *et al*, 2011).

Figure 2 and 3 shows the sighting position of other large baleen whales. The sightings of fin whales were concentrated in the southern strata of Area IV West. Humpback, fin and other large whales distributed in deeper waters (e.g. deeper than 500 m). See also Murase *et al*. (2013).

Sampling for Antarctic minke and fin whales

Out of 149 schools (280 individuals) in the primary sightings of Antarctic minke whales by three SSVs, 117 schools (216 individuals) were targeted for sampling. A total of 103 individuals were sampled (three from Area III East, 99 from Area IV and one from Area V West). Sampling efficiency (the rate of successful sampling for targeted individuals) was 92.2 % for the first targeted individual from schools with single individual and 97.6 % for the first targeted individual from schools with more than one individual. No struck and lost case occurred.

SSVs found out of 48 schools (185 individuals) as primary sightings of fin whales.

Sampling for these fin whales was not conducted due to sabotage by the anti-whaling group and inappropriate sea condition for safe transferring and flensing and/or practical reasons. As a result, no individual of fin whales was sampled.

Biological research

Biological research was conducted on the research base vessel for all whales sampled. Table 3 summarizes biological data and samples collected from the Antarctic minke whales.

Biological information of sampled whales

Table 4 shows the reproductive status of sampled Antarctic minke whales by stratum. Figures 4-1, 4-2 and 4-3 show distribution of sighting position of sampled Antarctic minke whales by sex and sexually mature status. Mature females were only observed in the Prydz Bay strata. In the other hand, all individuals sampled were only immature males and females in the Areas IV East and V West. Appearance pregnancy rate in mature females was 96.2 % in the Prydz Bay strata. No lactating females were sampled, and no suckling calf was sampled nor observed.

Figure 5 shows body length distribution of Antarctic minke whales sampled during this survey. Maximum body length of the sample was 9.88 m for females and 9.15 m for males. Minimum body length was 5.01 m and 4.43 m for female and male, respectively. Maximum body length of immature animals was 8.25 m and 8.24 m for female and male, respectively, whereas minimum body length of mature animals was 8.20 m and 7.87 m for female and male, respectively.

Experiments

Photo-ID and biopsy sampling

Table 5 summarizes the results of the photo-identification experiment. A total of three blue, seven humpback whales and one southern right whale was photographed. Table 6 summarizes results of biopsy sampling. A total of three biopsy samples were collected from three humpback whales.

Vomiting and feacal observation

No case of vomiting and faecal was observed.

Marine debris observation

No case of marine debris was observed in the research area or in the stomach contents of Antarctic minke whale.

Oceanographic survey

SSVs (YS and YS2) conducted the oceanographic survey to get the vertical water temperature profile in 55 points using XCTD.

Sighting distance and angle experiment

A sighting distance and angle experiment was performed by two SSVs (YS and YS2). The results of this experiment will be used in calculation of abundance estimates.

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Table 1. List of cetacean species and number of sightings (no. schools/no. individuals) .

Type of the sightings	Primary		Secondary		Total	
Species	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Blue whale	4	6	0	0	4	6
Fin whale	48	185	13	56	61	241
Antarctic minke whale	135	259	14	21	149	280
Like Antarctic minke whale	3	3	0	0	3	3
Humpback whale	214	382	13	30	227	412
Southern right whale	3	4	1	1	4	5
Unidentified baleen whales	1	3	0	0	1	3
Sperm whale	9	9	1	1	10	10
Southern bottlenose whale	8	13	0	0	8	13

Table 2. The density indices (DI, number of schools per 100 n.miles) and mean school size (MSS) of Antarctic minke, fin and humpback whales by SSV during 2012/13 JARPA II.

Area	Sector	Stratum	Effort	Antarctic minke		Humpback		Fin	
			[n.miles]	D.I.	M.S.S	D.I.	M.S.S	D.I.	M.S.S
III	East	North	228.09	1.3	1.0	2.6	1.3	0.0	0.0
		South	162.60	1.2	1.0	3.1	1.0	0.6	3.0
IV	East	North	124.84	3.2	1.0	8.8	1.5	0.0	0.0
		South	722.16	1.5	1.1	7.2	2.1	0.0	0.0
	West	North	137.53	2.9	1.0	10.2	1.8	1.5	3.0
		South	368.64	8.4	1.5	27.4	1.7	6.5	4.1
	Prydz Bay		291.29	27.1	2.4	8.2	1.8	6.9	3.8
V	West	North	68.11	1.5	2.0	0.0	0.0	1.5	1.0
Total			2,103.27	6.4	1.9	10.1	1.8	2.3	3.9

Table 3. Summary of biological research items conducted for sampled Antarctic minke whales.

Research and sampling item	Male	Female	Total
Obserbation of external character	50	53	103
Observation of diatom	50	53	103
Obserbation of external parasites	50	53	103
Sampling of external parasites	1	0	1
Photographic record of external character	50	53	103
Measurement of body length and sex identification	50	53	103
Measurement of external body proportion	50	53	103
Measurement of body weight	50	53	103
Measurement of body weight by total weight of parts	1	0	1
Measurement of blubber thickness (two points)	50	53	103
Record of lactation status	−	53	53
Measurement of mammary gland	−	53	53
Observation of ovary	−	53	53
Sampling of ovary for histological study	−	53	53
Obserbation of fetus	11	11	23*
Photographic record of fetus	11	11	23*
Measurement of fetal length and weight	11	11	23*
Sampling of fetal skin tissues for genetic study	11	11	23*
Sampling of small fetus (B.L.<10 cm)	−	−	1*
Measurement of testis weight	50	−	50
Sampling of testis for histological study	50	−	50
Obserbation of stomach contents	50	53	103
Measurement of stomach content weight	50	53	103
Sampling of stomach contents for feeding study	16	12	28
Sampling of stomach contents for environmental monitoring	11	9	20
Obserbatiuon of marine debris	50	53	103
Obserbation of internal parasites	50	53	103
Observation of macro pathological (thyroid, lung and liver)	50	53	103
Sampling of blood plasma for physiological study	14	16	30
Sampling of skin tissues for genetic study	50	53	103
Sampling of blubber, muscle and liver tissues for environmental monitoring	50	53	103
Sampling of lung and liver tissue for air monitoring	10	0	10
Muscle and blubber tissues for various analysis	3	3	6
Sampling of earplug for age determination	50	53	103
Sampling of ocular lens for age determination	50	53	103
Sampling of largest baleen plate for various analysis (B.L.>7.0 m)	14	22	36
Sampling of vertebral epiphyses (B.L.>7.0 m)	35	31	66
Measurement of skull (length and breadth)	50	51	101
Sampling of muscle and blubber tissues for functional food study	3	2	5
Sampling of placenta for histological study	0	17	17
Sampling of umbilical cord for histological study	0	17	17

* : including foetus of sex unidentified.

Table 4. Reproductive status of Antarctic minke whales sampled in 2012/13 JARPAII. Maturity of males was tentatively defined by testis weight according to Kato (1986). "Resting" represents non-pregnant mature female without corpus luteum.

Area	Sector	Male			Female							Combined
						Mature						
		Immature	Mature	Total	Immature	No-pregnant			Pregnant		Total	
						Maturing	Lactating	Resting	No-Lactating	Lactating		
III	East	0	0	0	1	0	0	0	0	0	1	1
	North	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
	East	1	1	2	0	0	0	0	0	0	0	2
	South	50.0%	50.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
IV	West	0	1	1	3	0	0	0	0	0	3	4
	North	0.0%	25.0%	25.0%	75.0%	0.0%	0.0%	0.0%	0.0%	0.0%	75.0%	
	West	7	14	21	6	0	0	0	0	0	6	27
	South	25.9%	51.9%	77.8%	22.2%	0.0%	0.0%	0.0%	0.0%	0.0%	22.2%	
	Prydz	5	15	20	7	1	0	0	25	0	33	53
		9.4%	28.3%	37.7%	13.2%	1.9%	0.0%	0.0%	47.2%	0.0%	62.3%	
	East	2	0	2	2	0	0	0	0	0	2	4
	North	50.0%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	
	East	3	0	3	8	0	0	0	0	0	8	11
	South	27.3%	0.0%	27.3%	72.7%	0.0%	0.0%	0.0%	0.0%	0.0%	72.7%	
V	West	1	0	1	0	0	0	0	0	0	0	1
	North	100.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Combined		19	31	50	27	1	0	0	25	0	53	103
		18.4%	30.1%	48.5%	26.2%	1.0%	0.0%	0.0%	24.3%	0.0%	51.5%	

Table 5. Summary of photo-ID data collected during 2012/13 JARPA II.

Species	Number of experiments (A)	Targeted individuals (B)	Number of photos (C)
Humpback whale	3	7	26
Blue whale	2	3	3
Right whale	1	1	2

Table 6. Summary of biopsy samples collected during 2012/13 JARPA II.

Species	Ship Type	Number of experiments (A)	Targeted individuals (B)	Number of shoots (C)	Number of hits (D)	Number of samples (E)	Effort (hr:min) (F)	sample per trial (E)/(C)	sample per hit (E)/(D)
Humpback whale	SSVs	3	5	4	3	3	0:38	0.75	1.00

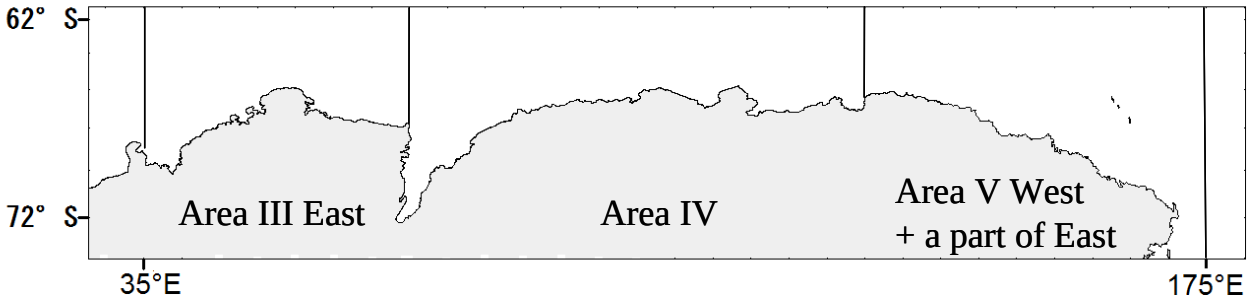

Fig 1. Map showing the research area and strata in the 2012/13 JARPA II survey.

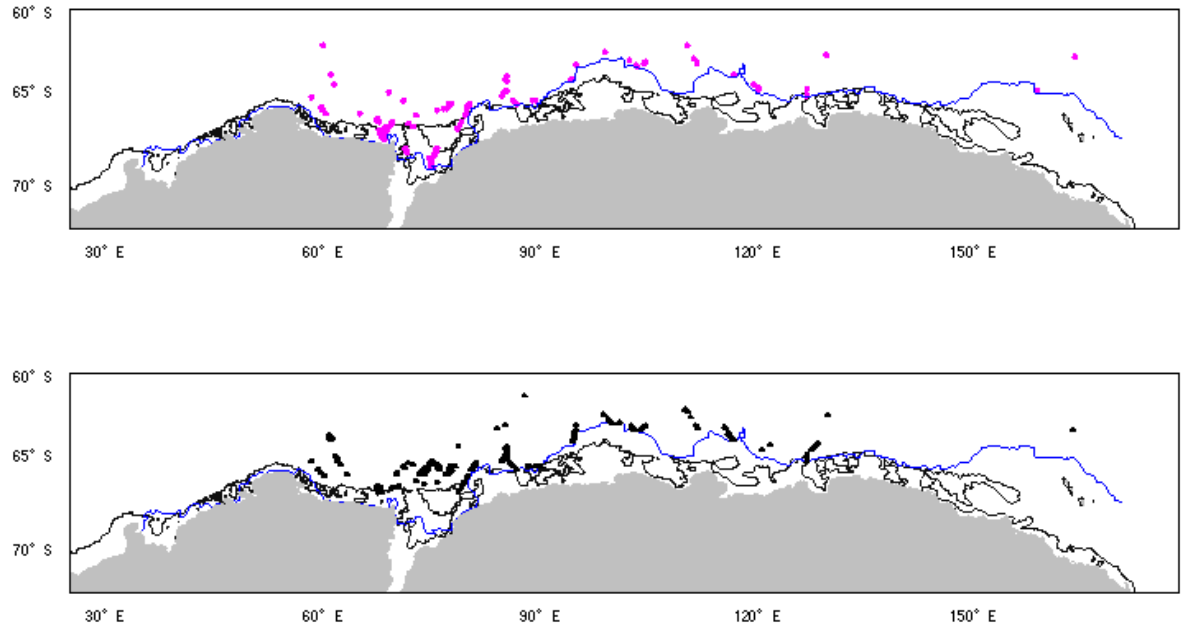

Fig. 2. Distribution of sightings of Antarctic minke (upper) and humpback whales (lower) sighted by SSVs.

Blue line: ice-edge line; Black line: 500m Sea depth line.

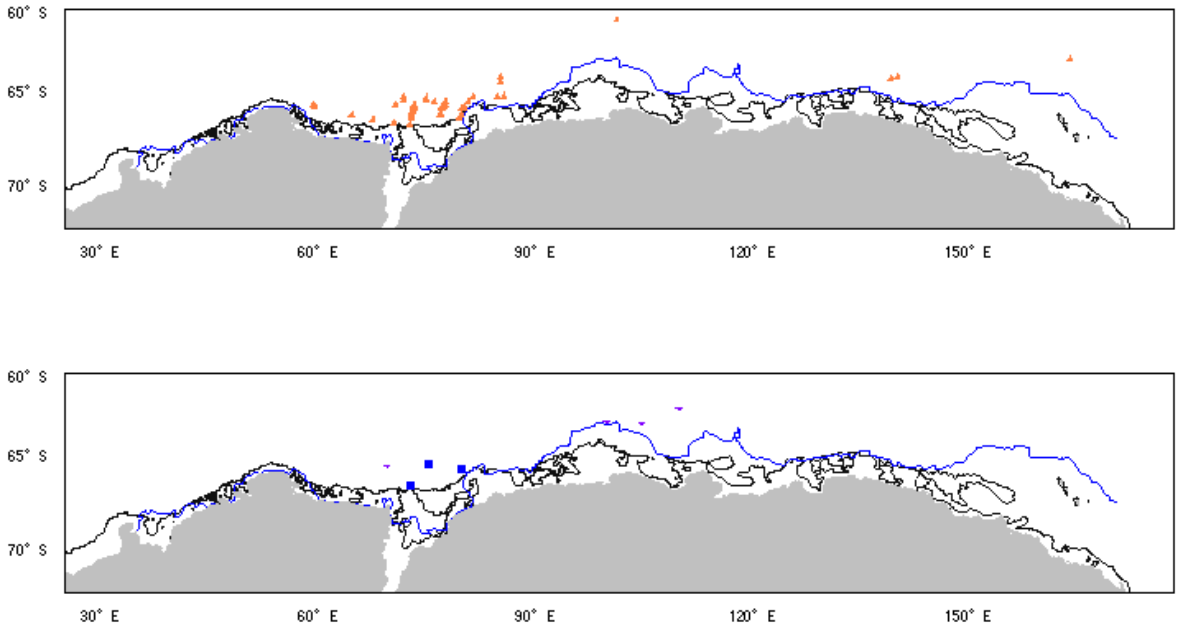

Fig. 3. Distribution of primary sightings of fin whale (upper) and other baleen whales (Lower ■Blue whale, ■ Southern right whale) sighted by SSVs. Blue line: ice-edge line; Black line: 500m Sea depth line.

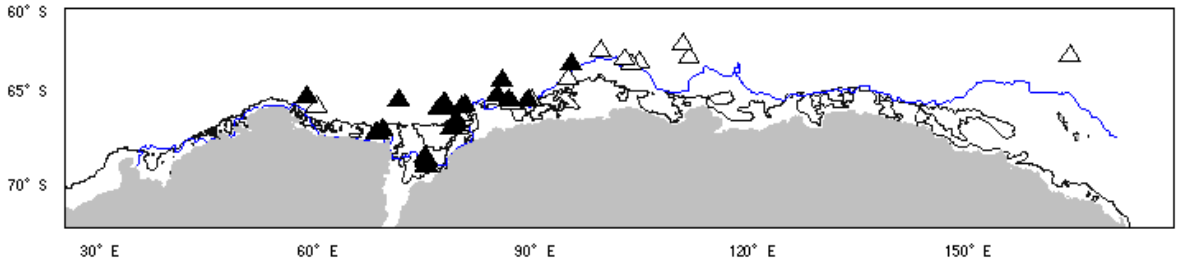

Fig. 4-1. Distribution of sampled immature and mature male of Antarctic minke whales

Blue line: ice-edge line; Black line: 500m Sea depth line.

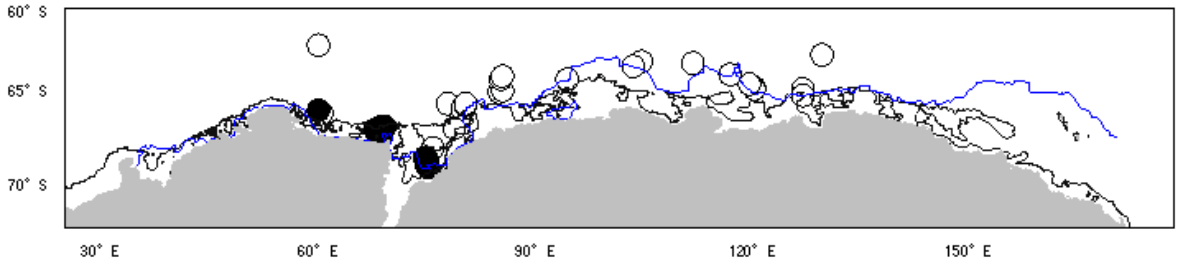

Fig. 4-2. Distribution of sampled immature and mature female of Antarctic minke whales

Blue line: ice-edge line; Black line: 500m Sea depth line.

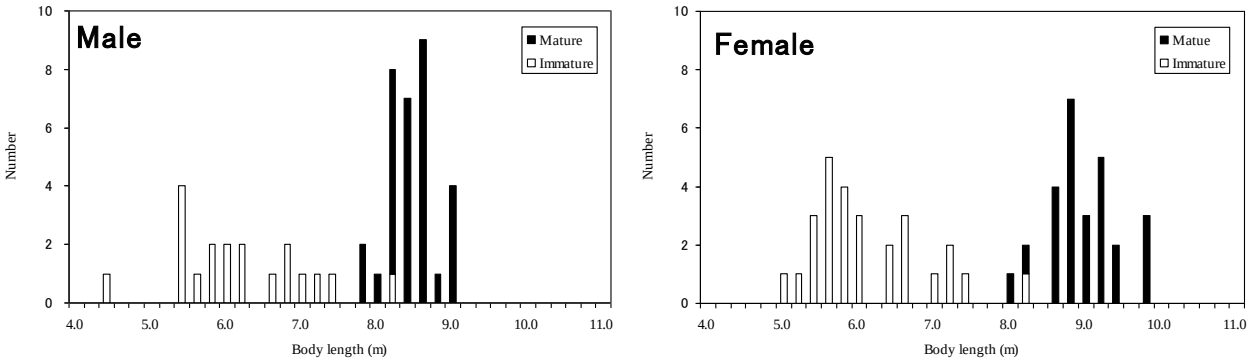

Fig. 5. Body length distribution of sampled Antarctic minke whales by sexual maturity.