

# Cruise Report of the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPAII) in 2010/2011

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## ABSTRACT

The 2010/11 Second Phase of the Japanese Whale Research Program under the Special Permit in the Antarctic (JARPA II) was conducted during austral summer season. A dedicated sighting vessel (SV), two sighting and sampling vessels (SSVs) and one research base ship engaged in the research. Although the original plan was designed to research Area VI West (145°W - 170°W) and Area V (130°E - 145°W), the research activity was interrupted several times by violent action of an anti-whaling group. The Government of Japan decided to withdraw the research fleet for the safety of crew in the middle of research period, which shortened research period and the research of western part of the Area V was cancelled. The SV and one of the SSVs had to dedicate to security task to deal with obstructive activity of the anti-whaling group for a long time therefore research was conducted only 31 days of 52 days from 29 December 2010 to 18 February 2011. The results of the sighting survey showed that the sighting number of Antarctic minke whales overwhelmed those of other species. Sighting number of humpback whales and fin whales followed those of Antarctic minke whales. Most of the sightings of Antarctic minke whales were located in the Ross Sea where ice-free extent was much larger than that of previous surveys. On the contrary, humpback whales distributed north of the Ross Sea, which concentrated even at the ice edge in mouth of the Ross Sea. Fin whales were found off the ice edge north of the Ross Sea. Distribution of these three rorquals around the Ross Sea was clearly separated. Biological sample from Antarctic minke whales showed that immature animals and matured male distributed north of the Ross Sea, whereas pregnant female concentrated in the Ross Sea. These results showed that segregative distribution of Antarctic minke whales by sex and sexual maturity in and out of the Ross Sea. It seems that early and wide melting of sea ice of the Ross Sea in this season produced large polynya (ice free area) in the Ross Sea area and most of matured female Antarctic minke whales entered in the closed Ross Sea earlier than usual years.

**KEYWORDS:** JARPAII, ANTARCTIC MINKE WHALES, HUMPBACK WHALES, ROSS SEA, SCIENTIFIC PERMITS.

## INTRODUCTION

The Japanese Whale Research Program under the 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. The IWC Scientific Committee (SC) conducted an interim review of JARPA results in 1997 and the final review in 2006. In 2005, another JARPA review meeting called by the Government of Japan was also held. 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 sexual maturity as well as narrowing down the parameters of relevance for stock management. IWC recognized these results from JARPA have the potential to improve management of minke whales in the Southern Hemisphere (IWC, 1998, 2007). JARPA data also demonstrated that there were at least two Antarctic minke whale stocks in the research area, and that their geographical boundaries were different from those used by the IWC, i.e. 150°E -165°E was suggested (IWC, 2007). The review meeting in 2005 agreed that results from JARPA were consistent with the behavior to be expected for baleen whale populations competing for a dominant single food resource, krill. The meeting also agreed that the JARPA results provided clear support for the need to take species-interaction effects into account in understanding the dynamics of the baleen whale species in the Antarctic ecosystem, and predicting future trends in their abundance and population structure (Government of Japan, 2005).

Based on these considerations, the Government of Japan launched a new comprehensive study, the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA II), which combined lethal and non-lethal methods, starting from the 2005/06 austral summer season.

The 2010/11 season was the sixth survey of JARPA II. 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.

This is a cruise report of the 2010/11 JARPA II. In this season, the survey area could not be covered completely and the number of whale sample was restricted because of violent obstruction from an anti-whaling group. The Government of Japan decided to withdraw the research fleet for the safety of crew on board at 18 February 2011, which shortened research period and the research of western part of the Area V was cancelled.

## RESEARCH METHODS

### Research vessels

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

Dedicated sighting vessels (SV)

*Yushin-Mar* No. 3 (YS3; 742 tons)

Sighting and sampling vessels (SSVs)

*Yushin-Mar* (YS1; 720 tons)

*Yushin-Mar* No. 2 (YS2; 747 tons)

Research base ship

*Nisshin-Mar* (NM; 8,044 tons)

Although the SV was planned to conduct independent sighting survey, oceanographic survey and some non-lethal experiments, it had to dedicate to security task to deal with obstructive activity of the anti-whaling group most of all research period. One of the SSVs was also dedicated to the security task for long time, which resulted limited research activity.

### **Research area**

The area to be covered by JARPA II is basically same as former JARPA; the eastern part of Area III, Areas IV and V and the western part of Area VI (Area VIW), 35°E - 145°W south of 60°S. The research area for 2010/11 JARPA II was eastern side of the whole research area, i.e. Area V (130°E - 170°W) and Area VIW (170°W - 145°W). Area V (130°E - 170°W) was divided into western part (Area VW: 130°E - 165°E) and eastern part (Area VE: 165°E - 170°W). Area VE was further divided into East-north stratum and Ross Sea (East-south stratum). The Ross Sea was defined as south of 69°S. In this season, the Ross Sea area included a part of Area VIW because it was widely opened in the mid summer. Fig.1 shows geographic location of the research area for the 2010/11 JARPAII survey.

### **Survey track line design**

In the Area VIW, East-north stratum of Area V and Area VW, the survey track line consisted of a zigzag course changing direction at 1°40' longitudinal degree intervals. Two parallel track lines were set at 7 n. miles apart. Two legs of track line for the northern stratum were set every six legs for southern stratum, in principle. The interval of legs and number of legs for the northern stratum could be changed by sub-area according to progress of the survey. In these areas, the southern stratum was defined from ice edge to 45 n. miles north in principle. The ice edge line was estimated by DMSP SSM/I daily polar gridded sea ice concentration data set available from the National Snow and Ice Data Center (NSIDC, Cavalieri *et al.*, 1999).

In the Ross Sea, the survey track line consisted of a mesh designed zigzag course changing direction at 1°30' latitudinal and 10° longitudinal degree intervals.

### **Sighting method**

Sighting procedures followed the previous JARPA surveys (e.g. Nishiwaki *et al.* 2007) in principle. The sighting survey using SSVs was conducted under limited closing mode (when a sighting of target species was made on the predetermined track line, the vessel approached the whales and species and school size were confirmed). Two SSVs advanced along parallel track lines at a standard speed of 11.5 knots.

The survey was operated under optimal research conditions (when the wind speed was below 25 knots in the south strata or 20 knots in the north strata and visibility was over 2 n. miles).

In addition to the sightings of Antarctic minke whales and fin whales or whales suspected to be these species, the SV and SSVs approached blue whales (*Balaenoptera musculus*) and southern right whales (*Eubalaena australis*) for conducting experiments. Humpback whales and other whales were also approached for conducting experiments.

### **Low and middle latitudinal sighting survey**

During transit cruises, sighting surveys were conducted in the area between 30°S and 60°S outside of national EEZs. The results of these surveys are not shown in this report.

### **Non-lethal research and experiments**

### *Sighting distance and angle experiment*

This experiment was conducted in order to evaluate the accuracy of sighting distance and sighting angle given by observers on the SV and SSV in this cruise. Observers on each vessel were required to assess eight sets of angles and distance from two platforms (barrel and upper bridge). All trials were conducted under good sighting condition.

### *Photo-identification*

The following species were targeted for photographic record of natural markings during the surveys conducted from the SV; blue whales, humpback whales and southern right whales. Photographic records of these species were also occasionally taken from the SSVs.

### *Biopsy sampling*

In addition to the species targeted for the photo-identification experiment, pygmy right whale (*Caperea marginata*), fin whale, sei whale (*B.borealis*), Antarctic minke whale, sperm whale (*Physeter macrocephalus*), killer whale (*Orcinus orca*), long-finned pilot whale (*Globicephala melas*) and southern bottlenose whale (*Hyperoodon planifrons*) were targeted for biopsy skin sampling by the SV and SSVs using a compound-crossbow. All samples collected were preserved at  $-80^{\circ}\text{C}$ .

### *Oceanographic survey*

SV conducted the following oceanographic survey; 1) consecutive measuring of vertical water temperature profile by Temperature and Depth Recorder (TDR), 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.

### **Sampling and biological survey for whales (lethal research)**

Two SSVs were engaged in the whale sampling survey. 850 Antarctic minke whales (with 10 % allowance) and 50 fin whales were planned to be taken in the research area south of  $62^{\circ}\text{S}$ . Although the original plan included 50 humpback whales (Government of Japan, 2005), Government of Japan decided to suspend the sampling of humpback whales.

One or two Antarctic minke whales were targeted randomly for sampling from each primary sighted school within 3 n. miles of each track line. The dwarf minke whale was not a target for sampling. The fin whale was also targeted randomly from each primary sighted school within 3 n. miles of each track line. However, target of fin whales was restricted to an estimated body length less than ca. 20 meter due to a limitation of the research base ship facility for dissection. Biological research on all sampled whales was conducted on the NM.

## **RESULTS**

### **Outline of the research activities**

Table 1 shows an outline of the research activities. Although the research in the 2010/11 JARPAII was planned to continue by middle of March with a SV and two SSVs, it was shortened and the research activity was restricted because of the obstruction of the violent anti-whaling group. Research vessels were frequently attacked by the anti-whaling group and the survey was interrupted. SV (YS3) and one of the SSVs (YS2) were dedicated to search and monitor the anti-whaling group vessels most of research period.

On 9 February, NM encountered the anti-whaling group vessels and the survey was interrupted again. The

Government of Japan decided to withdraw the research fleet for the safety of crew on board at 18 February 2011. Total research period was 52 days from 29 December 2010 to 18 February 2011, however, 21 of 52 days were unable to survey to avoid obstruction. Therefore the research of western part of the Area V had to be cancelled.

## **Results of non-lethal survey**

### *Sighting survey*

Although the sighting survey of SV was planned to operate independently, it was cancelled because of obstruction from the anti-whaling group. On the other hand, dedicated sighting survey was conducted in the Ross Sea by two SSVs (YS1 and YS2) for eight days during the interruption of the sighting and sampling survey (Table 1).

The searching distances of the research vessels are shown in Table 2. The total searching distance was 1,877.2 n. miles consisting of 687.5 n. miles for dedicated sighting survey and 1,189.7 n. miles for sighting and sampling survey. Compared to the 2008/09 survey in the same research area (Nishiwaki *et al.*, 2009), the searching distance of this season was noticeably low with 13.1 %. This is because the research vessels (SV and SSV) were reduced from five to three and research activity was interrupted for a prolonged period of time as described above.

### *Whale species sighted*

Eight species including four baleen whales and four toothed whales were identified during the research period. Table 3 shows the number of sightings for six large whale species and Figs 2, 3 and 4 show sighting position of Antarctic minke whales, humpback and fin whales and blue whales, respectively. Antarctic minke whale was the most abundant species in the research area, followed by humpback whale. The number of sightings of minke whales (530 schools and 1,576 individuals in total) was more than 10 times of that of humpback whales (44 schools and 83 individuals) and most of them were sighted in the Ross Sea (469 schools and 1,491 individuals in total, Fig 2). Humpback whales were distributed north of the Ross Sea. Most of them were found in northern stratum of the area VE (33 schools and 53 individuals). In this area, they distributed even at ice edge during the sea ice remained north of the Ross Sea (Fig 3). Fin whales were also found north of the Ross Sea, however, they distributed far of ice edge and most of them were separated from humpback whales (Fig 3). Although sightings of blue whales were small, they were found in all of the research area even in the Ross Sea, ice edge and offshore (Fig. 4).

In the toothed whales, all sightings of sperm whales were made north of the Ross Sea (no figure). An adult male killer whale in a school of 25 individuals was observed eating an Antarctic minke whale in the Ross Sea (73° 48' S, 148° 01' W).

Table 4 shows density indices (DI, the number of primary sighted schools per 100 n. miles) and mean school size (MSS) of Antarctic minke, humpback and fin whales. The DI of Antarctic minke whale was the highest among three species except for humpback whales in the northern stratum of the Area VE. The DI of Antarctic minke whales in the Ross Sea was extremely high, but mean school size was relatively small with 2.94 and 40.8 % of schools sighted was solitary.

### *Photo-ID and biopsy sampling*

As the SV was dedicated to security task to deal with the anti-whaling group most of all research period, these experimental activity were restricted. Natural markings of four individuals of humpback whales were recorded by photograph and one biopsy sample was collected from a killer whale in the Ross Sea. A skin sample for DNA

analysis was collected from a minke whale that was predated by killer whales in the Ross Sea.

#### *Oceanographic survey*

SV conducted the oceanographic survey to observe the vertical water temperature profile in 20 points using TDR. The marine debris survey was also carried out by SV in the research area. A total of three debris items was recorded and all of them were fishing buoys.

#### *Sighting distance and angle experiment*

A sighting distance and angle experiment was performed on 11 February by SSVs and on 17 February 2011 by SV, respectively. The results of this experiment will be used in calculation of abundance estimates.

### **Results of lethal survey**

#### *Sampling for Antarctic minke whales*

Out of 333 schools (935 individuals) in the primary sightings of Antarctic minke whales, 170 schools (402 individuals) were targeted for sampling. A total of 170 individuals were sampled (9 from Area VIW, 20 from northern stratum of Area VE and 141 from the Ross Sea. Sampling efficiency (the rate of successful sampling for targeted individuals) was 89.7 % for solitary schools, 96.4 % for the first targeted individual from multitude schools. 24 individuals were sampled as the second targeted individual from the multitude schools. An explosive harpoon was used as the primary killing method for all whales collected. When the animal was not killed instantaneously, a large caliber rifle and/or the second harpoon was used immediately as the secondary killing method. One struck and lost case occurred because the harpoon was pulled out just after hitting.

#### *Sampling for fin whales*

SSVs made seven primary sightings of fin whales. Two individuals were sampled from eight individuals of two schools. The explosive harpoon was used as both the primary and the secondary killing method for all whales collected.

#### *Biological research*

Biological research was conducted on the research base ship for all whales sampled. Of 170 Antarctic minke whales, 62 were male (36.5 %) and 108 were female (63.5 %). Both of two fin whales were male.

#### *Biological information of sampled whales*

Table 5 shows the sex and reproductive status of sampled Antarctic minke whales by stratum. Fig. 5 shows distribution of sighting position of sampled Antarctic minke whales by sex and sexually mature status. Sampling of Antarctic minke whales in the Ross Sea was biased eastern part of the Ross Sea because of interruption by the anti-whaling group. Most of mature females (86.1 %) were sampled in the Ross Sea. While maturity rate of both females and males was high (93.9 % in female and 71.4 % in male) in the Ross Sea, those in other areas were low even animals caught near the ice edge (Fig. 5). No lactating female was sampled. Neither suckling calf was sampled nor observed by the sighting survey in the research area.

Fig. 6 shows body length distribution of Antarctic minke whales sampled during the 2010/11 JARPA II survey. Maximum length of the sample was 9.67 m for females and 8.89 m for males. Minimum length was 4.82 m and 5.24 m for female and male, respectively. Maximum body length of immature animals was 8.47 m and 8.77 m for female and male, whereas minimum body length of mature animals was 7.70 m and 7.65 m for female and male,

respectively. Table 6 shows some biological data of the collected fin whales.

## DISCUSSIONS

Because of obstruction by the violent anti-whaling group, Sea Shepherd (SSCS), the research was canceled in a middle stage of Austral summer season by the decision of the Government of Japan. It was the first time to quit the research by so-called “eco-terrorism” during 24 years JARPA program.

JARPAII is a perfectly legal activity carried out under the International Convention for the Regulation of Whaling. The Institute of Cetacean Research strongly condemns the SSCS and its continued dangerous and violent actions against Japan’s whale research vessels in the Antarctic. The IWC has also condemned Sea Shepherd’s tactics against Japan’s whale research vessels. In 2008 the IWC member countries adopted by consensus a statement which calls on SSCS “to refrain from dangerous actions that jeopardize safety at sea” regardless of different positions of countries on whaling (IWC 2008). International Maritime Organization (IMO) also adopted the 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).

It never happen again therefore we request that all of member nations of IWC that related to SSCS and their vessels should behave earnestly and according to their obligations as members of the international society and fulfill their duties under international law to deal with SSCS criminal actions in a strict and objective manner.

Although the sampling of Antarctic minke whales was biased eastern area of the Ross Sea, it was the first time to collect biological samples in the Area VI part of the Ross Sea (Fig. 7). In spite of shorted research period and low sample number, results of 2010/11 research shows some unique aspects of the Antarctic Areas VE and VI.

In this austral summer season, it is characteristic that the sea ice covering the Ross Sea was melted earlier and wider than usual and eastern edge of the Ross Sea was disappeared by the end of January. According to the satellite photographs and information from the National Snow and Ice Data Center (NSIDC), US., a large ice-free area (polynya) in the Ross Sea was developed from the end of November 2010 to January 2011 until the sea ice covering the mouth of the Ross Sea was melted.

Distribution of Antarctic minke whales was relatively low in the northern stratum of Area VE and Area VIW in January even near the ice edge covering the north of the Ross Sea, however, it was very high in the Ross Sea in February. Results of past JARPA/JARPAII surveys strongly suggested that Antarctic minke whales, especially mature females tend to concentrate in the ice free area beyond the ice edge where research vessels could not enter (Ishikawa *et al.*, 1998, 2008, Ishikawa, 2003). It was also suggested that recent drastic expansion of humpback whale distribution in the Areas IIIE and IV may force Antarctic minke whales to move in the pack ice (Ishikawa *et al.*, 2004, Fujise *et al.*, 2006).

In fact, biological survey on the sampled Antarctic whales in this season revealed extensively high ratio of matured females in the Ross Sea, whereas low ratio of matured female north of the Ross Sea, even near the ice edge in mid summer season. On the other hand, distribution of humpback whales was observed near the ice edge north of the Ross Sea. These results suggested that early development of the ice free area in the Ross Sea caused low density and low maturity rate of females of the Antarctic minke whales near the ice edge north of the Ross Sea.

In addition, the segregative distribution of three major rorquals, Antarctic minke, humpback and fin whales was observed. As described above, many Antarctic minke whales were distributed in the Ross Sea, whereas humpback whales were not found in the Ross Sea even it was widely opened. Fin whales also not enter the Ross

Sea and observed north of ice edge. Distribution of blue whales were not separated from those three rorquals and found both in and out of the Ross Sea. These observations were almost same as past JARPA/JARPAII surveys (Nishiwaki *et al.* 2009) and seems to assure accuracy of the results of the 2010/11 JARPAII.

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Table1. Outline of the research activities. NM was operated with SSV in principle. Double circles and single circles represent sighting survey and sighting/sampling survey, respectively.

EVENT	DATE	SV (YS3)	SSV (YS1)	SSV (YS2)
Departure from Japan	2 Dec. 2010	—	—	—
Low and middle latitudinal sighting survey	22 Dec. ~ 28 Dec. 2010	◎	◎	◎
Survey in the Antarctic Area VIW	29 Dec. 2010 ~ 4 Jan. 2011	*1	○*2	○*3
Survey in the Antarctic Area VEN	5 Jan. ~ 22 Jan. 2011	*1	○*4	*1
Survey in the Antarctic Area VES (Ross Sea)	23 Jan. ~ 9 Feb. 2011	*1	○*5	○*6
Avoidance from the anti-whaling group *7	10 Feb. ~ 18 Feb. 2011	*1	—	—
Sighting distance and angle experiment	11 Feb. 2011	*1	○	○
Sighting survey in the Ross Sea	12 Feb. ~ 18 Feb. 2011	*1	◎	◎
Termination of the research *8	18 Feb. 2011	—	—	—
Low and middle latitudinal sighting survey	21 Feb. ~ 1 March 2011	◎	◎	◎
Arrival to Japan	21 March. 2011	—	—	—

- 1) All survey was cancelled because the vessel was dedicated to search and monitor the violent anti-whaling group
- 2) Survey of YS1 was cancelled 2days because of the obstruction of the violent anti-whaling group
- 3) Survey of YS2 was cancelled 4days because the vessel was dedicated to search and monitor the violent anti-whaling group
- 4) Survey of YS1 was cancelled 7days because of the obstruction of the violent anti-whaling group
- 5) Survey of YS1 was cancelled 3days because of the obstruction of the violent anti-whaling group
- 6) Survey of YS2 was cancelled 11days because the vessel was dedicated to search and monitor the violent anti-whaling group
- 7) Sampling survey was cancelled because NM was attacked by the violent anti-whaling group
- 8) Government of Japan decided to withdraw the research fleet because of safety of the crew

Table 2. Searching distances (n. miles) of the two sighting / sampling vessels (SSVs) in each research area. ASP mode represents dedicated sighting survey and NSC mode represents sighting and sampling survey.

Area / Mode	ASP	NSC	Total
VI West	0.0	413.8	413.8
V East-South (Ross Sea)	687.5	401.4	1088.9
V East-North	0.0	374.5	374.5
Total	687.5	1189.7	1877.2

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Table 3. Summary of whale sightings conducted by SV and SSVs in each research area.

Species	VI West				V East-North				V East-South				Transit		Total					
	Primary sch.		Secondary ind.		Primary sch.		Secondary ind.		Primary sch.		Secondary ind.		Secondary sch.		Primary ind.		Secondary sch.		Total ind.	
Blue whale	1	2	2	4	2	3	1	1	0	0	1	2	3	7	3	5	7	14	10	19
Fin whale	3	8	1	1	4	12	6	23	0	0	0	0	20	76	7	20	27	100	34	120
Antarctic minke whale	10	17	5	6	19	23	5	10	304	895	165	596	22	29	333	935	197	641	530	1,576
Like Antarctic minke whale	0	0	0	0	0	0	0	0	6	6	7	40	3	251	6	6	10	291	16	297
Humpback whale	3	3	0	0	33	53	0	0	0	0	0	0	8	27	36	56	8	27	44	83
Unidentified baleen whales	0	0	0	0	0	0	1	13	0	0	0	0	1	5	0	0	2	18	2	18
Sperm whale	6	6	0	0	2	2	0	0	0	0	0	0	2	2	8	8	2	2	10	10
Southern bottlenose whale	0	0	1	2	0	0	0	0	0	0	0	0	2	4	0	0	3	6	3	6

Table 4. Density indices (DI, the number of primary sighted schools per 100 n. miles) and mean school size (MSS) of Antarctic minke whale, humpback whale and fin whale.

Species / Area	VI West		V East-North		V East-South (Ross Sea)		Total	
	DI	MSS	DI	MSS	DI	MSS	DI	MSS
Fin whale	0.72	2.67	1.07	3.00	-	-	0.37	2.86
Antarctic minke whale	2.42	1.70	5.07	1.21	27.92	2.94	17.74	2.81
Humpback whale	0.72	1.00	8.81	1.61	-	-	1.92	1.56

Table 5. Reproductive status of Antarctic minke whales sampled in 2010/11 JARPAII. Numbers in percentage represent ratio of samples in whole research area. Maturity of males was tentatively defined by testis weight according to Kato (1986). "Ovulating" represents non-pregnant mature female with corpus luteum. "Resting" represents non-pregnant mature female without corpus luteum.

Area	Sector & Stratum	Male			Female						All combined
		Immature	Mature	Total	Immature	Mature				Total	
						Ovulating	Resting	Pregnant	Unknown		
V	East-North	7 4.1%	7 4.1%	14 8.2%	6 3.5%	0 -	0 -	0 -	0 -	6 3.5%	20 11.8%
	East-South (Ross Sea)	12 7.1%	30 17.6%	42 24.7%	6 3.5%	1 0.6%	5 2.9%	85 50.0%	2 1.2%	99 58.2%	141 82.9%
VI	West	2 1.2%	4 2.4%	6 3.5%	2 1.2%	0 -	0 -	1 0.6%	0 -	3 1.8%	9 5.3%
Total		21 12.4%	41 24.1%	62 36.5%	14 8.2%	1 0.6%	5 2.9%	86 50.6%	2 1.2%	108 63.5%	170 100.0%

Table 6. Some biological information on fin whales sampled in 2010/11 JARPAII.

No.	Body length	Body weight*	Sex	Weight of testis (L/R)	Stomach content
F-001	19.05m	39.63t	M	4.26 / 4.49 kg	Euphausiacea
F-002	18.99m	43.78t	M	4.00 / 3.76 kg	Euphausiacea

\* Body weight was represented by total weight of body parts.

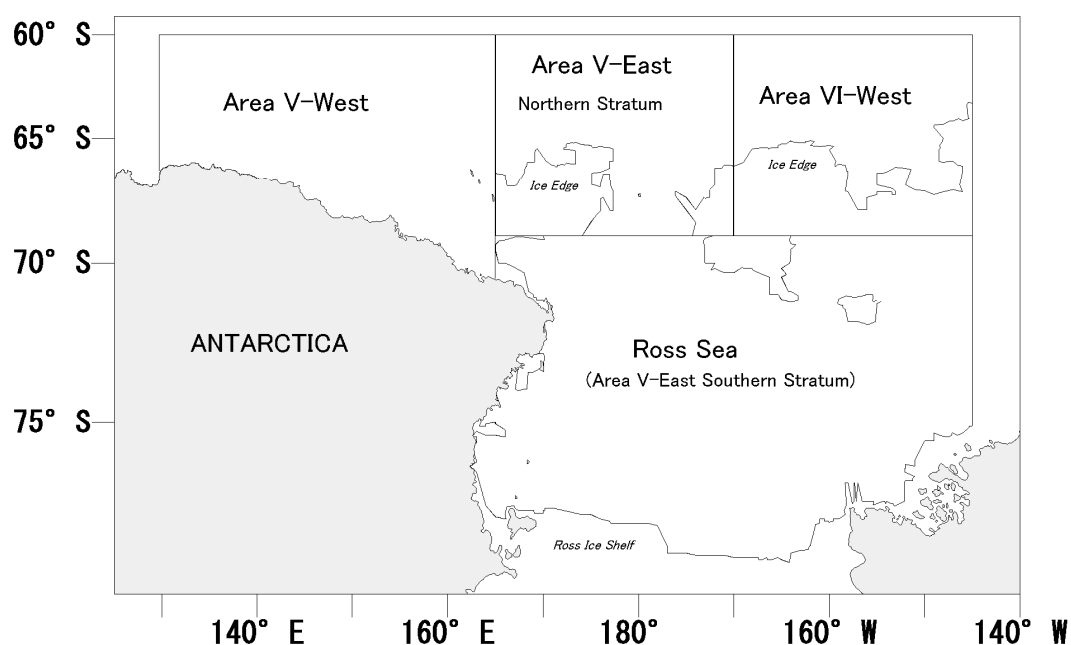


Fig. 1. Geographic location of the research area of 2010/11 JARPAII. A strait solid line represents a border of each stratum.

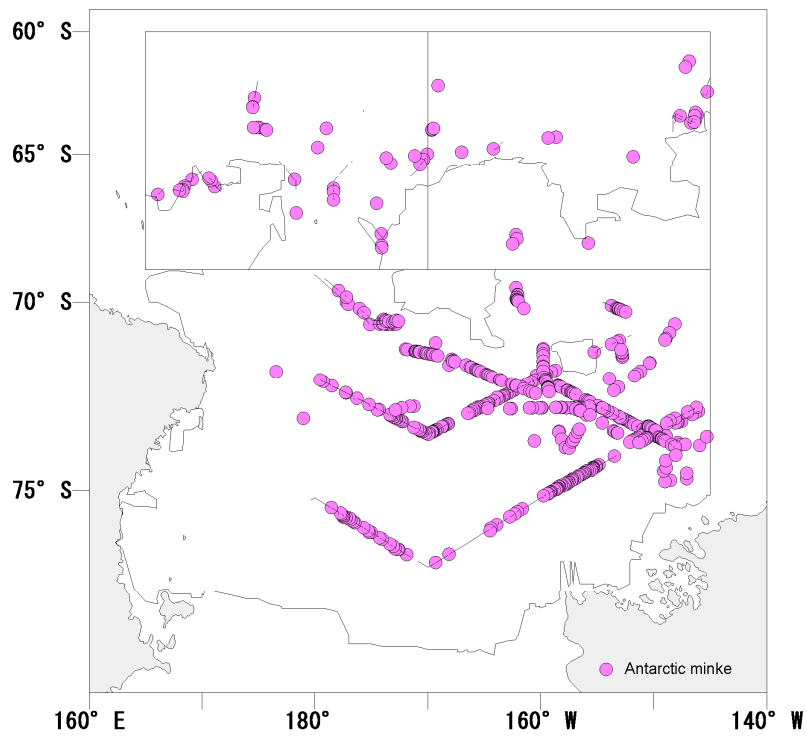


Fig. 2. Distribution of sightings of Antarctic minke whales in 2010/11 JARPAII.

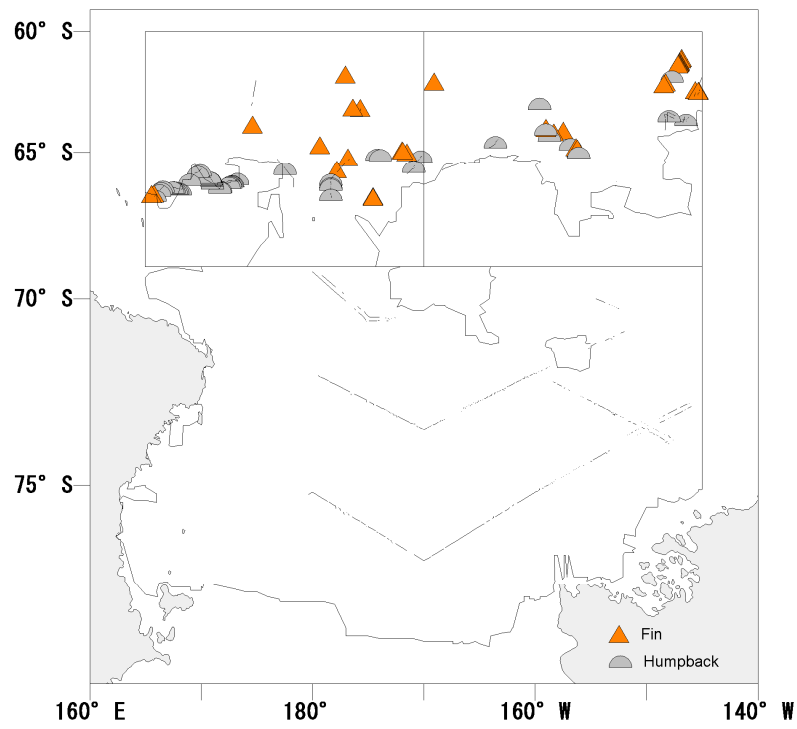


Fig. 3. Distribution of sightings of humpback and fin whales in 2010/11 JARPAII.

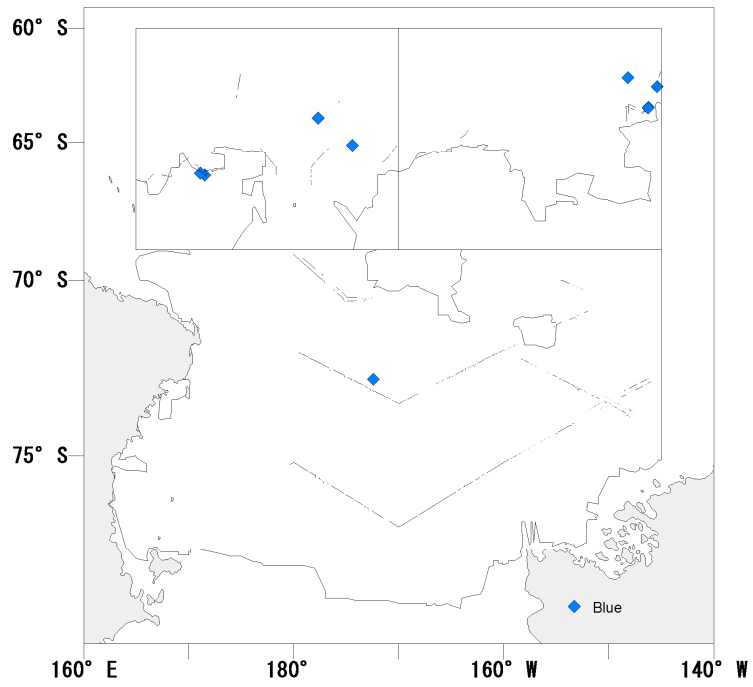


Fig. 4. Distribution of sightings of blue whales in 2010/11 JARPAII.

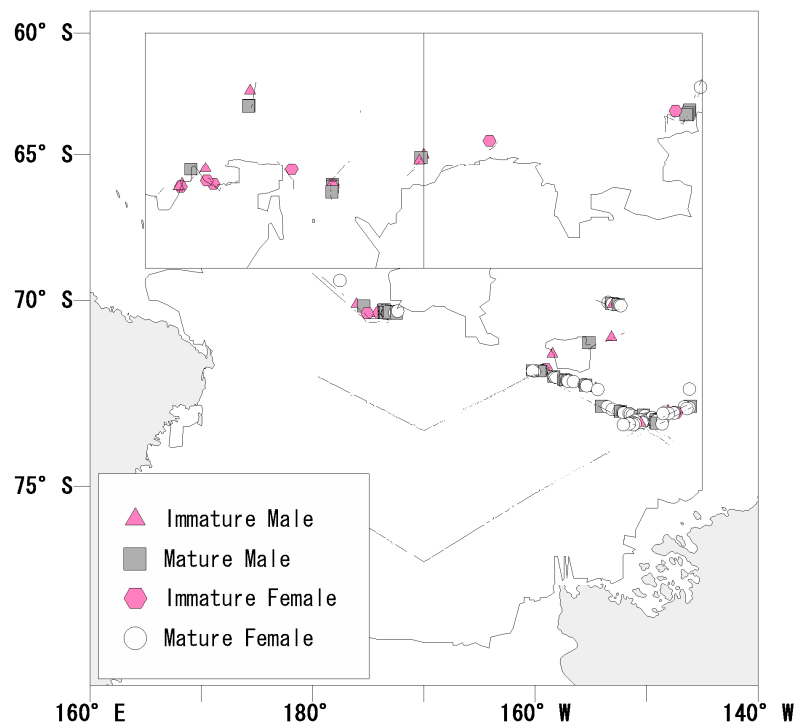


Fig. 5. Distribution of sampled Antarctic minke whales by sex and sexual maturity status in 2010/11 JARPAII.

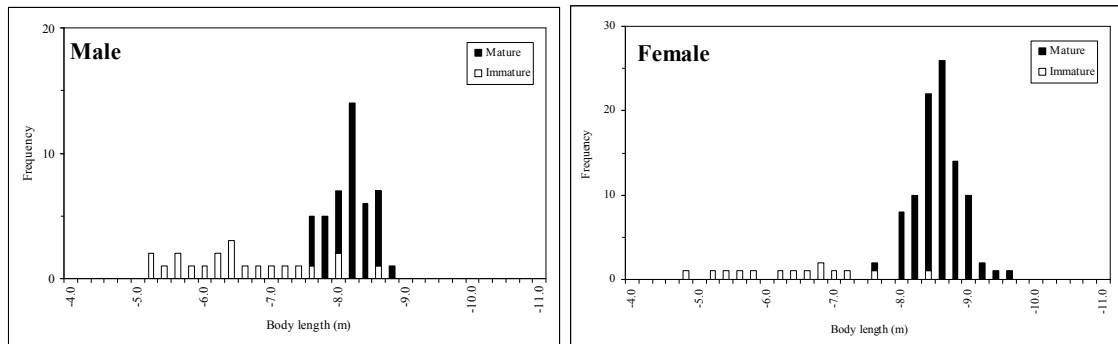


Fig. 6. Body length distribution of Antarctic minke whales sampled during 2010/11 JARPAII.

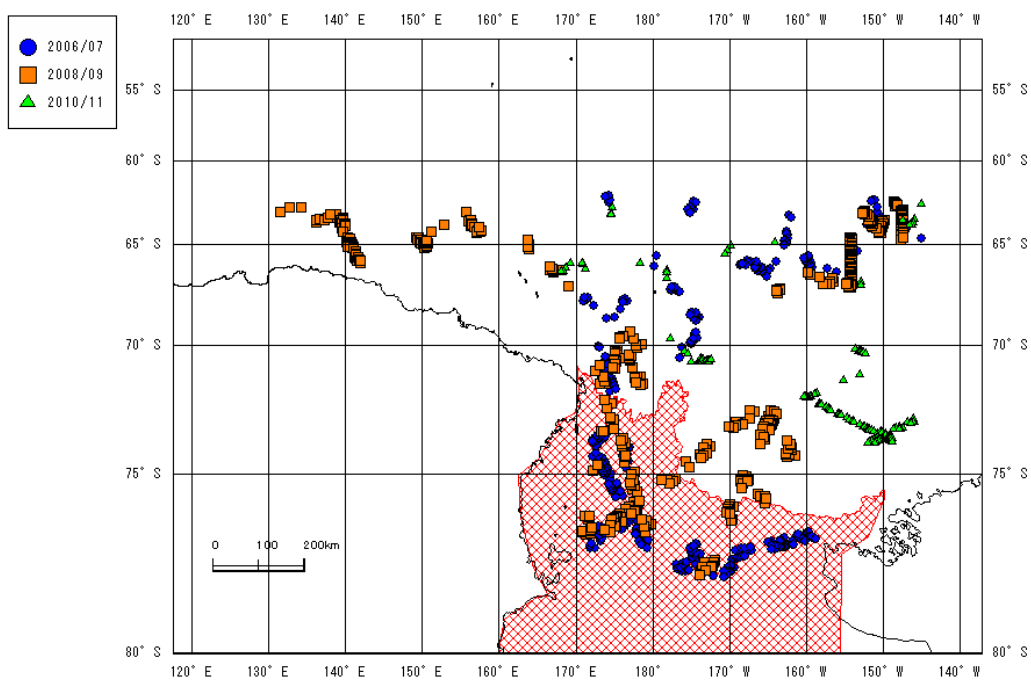


Fig. 7. Sampling position of Antarctic minke whales around the Ross Sea during JARPAII surveys. Mesh area represents a continental shelf of the Ross Sea which depth of water is less than 1000 m.