

# Cruise Report of the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA II) in 2005/2006 -Feasibility study-

Shigetoshi Nishiwaki<sup>1)</sup>, Daisuke Tohyama<sup>2)</sup>, Hajime Ishikawa<sup>1)</sup>, Seiji Otani<sup>1)</sup>, Takeharu Bando<sup>1)</sup>, Hiroto Murase<sup>1)</sup>, Genta Yasunaga<sup>1)</sup>, Tatsuya Isoda<sup>1)</sup>, Katsuo Nemoto<sup>2)</sup>, Masakatsu Mori<sup>2)</sup>, Masaomi Tsunekawa<sup>2)</sup>, Kazuki Fukutome<sup>2)</sup>, Masataka Shiozaki<sup>2)</sup>, Masahiko Nagamine<sup>2)</sup>, Takahiro Konagai<sup>2)</sup>, Tohru Takamatsu<sup>2)</sup>, Saeko Kumagai<sup>1)</sup>, Takahiro Kage<sup>1)</sup>, Konomi Ito<sup>3)</sup>, Hiroki Nagai<sup>4)</sup> and Waka Komatsu<sup>5)</sup>

Contact e-mail: [nisiwaki@cetacean.jp](mailto:nisiwaki@cetacean.jp)

1) *The Institute of Cetacean Research, 4-5 Toyomi-cho, Chuo-ku, Tokyo 104-0055 Japan.*

2) *Kyodo Senpaku Kaisya, Ltd., 4-5 Toyomi-cho, Chuo-ku, Tokyo 104-0055 Japan.*

3) *Department of Veterinary Pathology, Faculty of Agriculture, Gifu University, 1-1 Yanagido, Gifu 501-1193 Japan*

4) *Department of Animal Science, Obihiro University of Agriculture and Veterinary Medicine, Inada-cho, Obihiro-city, Hokkaido, 080-0833 Japan.*

5) *Department of fisheries, Faculty of Oceanography, Tokai University, 3-20-1 Orido, Shimizu ward, Shimizu-city Shizuoka, 424-0902 Japan*

## ABSTRACT

The research plan for the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA II) was presented to the 2005 meeting of the International Whaling Commission's Scientific Committee (IWC/SC). The research program involves both non-lethal and lethal research techniques. The first two JARPA II surveys, to be conducted in the 2005/06 and 2006/07 austral summer seasons, were planned as feasibility studies with the following objectives: 1) to examine the practicability and appropriateness of sighting methods considering the enlarged research area, 2) to examine the practicability and appropriateness of sampling procedure considering the increased sample size for Antarctic minke whale and 3) to examine the practicability of methods of hunting, hauling, flensing and biological sampling of large-sized whales. For the feasibility surveys a total of 850+/-10% Antarctic minke whales and 10 fin whales were planned for sampling. The first feasibility survey of the JARPA II was carried out between 3 December 2005 and 20 March 2006 (108 days) in Areas III, IV and part of Area V. The total searching distance was 16,372.7n.miles (8,836.2n.miles covered by the two dedicated Sighting Vessels (SVs) and 7,536.5n.miles covered by the three Sighting and Sampling Vessels (SSVs). The following species managed by the IWC were sighted: Antarctic minke, blue, fin, sei, humpback, southern right, sperm and southern bottlenose whales. The Antarctic minke and humpback whales were the dominant species. Out of 821 schools (1,959 individuals) in the primary sightings of Antarctic minke whales by SSVs, 779 schools (1,879 individuals) were targeted for sampling. A total of 853 individuals were sampled. Out of 37 schools (245 individuals) in the primary sightings of fin whales by SSVs, 11 schools (112 individuals) were targeted for sampling. A total of 10 animals were sampled. The maximum body length for the sampled fin whales was 20.22m (female, 61.52tons). Photo-id experiments were conducted on blue, humpback and southern right whales and a total of 85 animals were photographed. A total of 46 skin biopsy samples were collected from seven species. CTD, XCTD and XBT castings were conducted at 86, 123 and 22 locations, respectively. EPCS (Electric Particle Counting and Sizing System) survey was conducted for 94 and 99 days by each SV, respectively. One of SV conducted the quantitative echo sounder survey for 94 days in the whole research area. The main results of this feasibility survey were as follows: 1) Antarctic minke and the humpback whales were the dominant species observed in similar numbers in the research area, 2) fin whales were widely distributed in the south strata from 80°E to 135°E, 3) large baleen whales intermingled in the south strata throughout the whole research area. Regarding the objectives of the feasibility survey, the following results were obtained: 1) the sighting methods used were practical and appropriate for the enlarged research area, 2) sampling procedures were appropriate for covering the increased sample size of the Antarctic minke whales of 850+/- 10%, 3) method of hunting, hauling, flensing and biological sampling of large-sized whales was checked and found to be adequately done. Therefore it can be concluded that the first feasibility survey of JARPA II was conducted satisfactorily and that the objectives of the survey had been covered adequately.

**KEYWORDS:** ANTARCTIC MINKE WHALES; FIN WHALES; HUMPBACK WHALES; BALEEN WHALES; ANTARCTIC; SOUTHERN HEMISPHERE; 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. The IWC Scientific Committee conducted an interim review of JARPA results in 1997. In January 2005, a JARPA review meeting called by the Government of Japan was held.

JARPA provided a wide variety of information on biological parameters of Antarctic minke whale 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. JARPA also elucidated that there were two stocks in the research area but their geographical boundaries were different from those used by the IWC (Pastene *et al.* 2005). Further, JARPA found that pollutant concentration in whale's tissues, such as heavy metals and PCBs, was extremely low (Yasunaga *et al.*, 2005). JARPA has thus successfully obtained data related to the initially proposed objectives. The review meeting conducted in January 2005 agreed that results from JARPA were consistent with the behavior to be expected of baleen whale populations competing for a dominant single food resource, krill. The meeting also agreed that the results obtained provide clear support for the need to take species-interaction (ecosystem) 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), combining lethal and non-lethal methods, starting from the 2005/06 austral summer season. The first two seasons (2005/06 and 2006/07) are dedicated to feasibility studies.

The full-scale JARPA II will start from the 2007/08 season. It will be a long-term research program with the following objectives 1) Monitoring of the Antarctic ecosystem, 2) Modeling competition 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 will focus on Antarctic minke, humpback and fin whales and possibly other species in the Antarctic ecosystem that are major predators of Antarctic krill. Annual sample sizes for the full-scale research (lethal sampling) are 850 (with 10% of allowance) Antarctic minke whales (Eastern Indian Ocean and Western South Pacific Stocks), 50 humpback whales (D and E-Stocks) and 50 fin whales (Indian Ocean and the Western South Pacific Stocks). During the feasibility study, a maximum annual sample size of 850+-10% Antarctic minke whales will be sampled. A maximum of ten fin whales will be sampled in each season. Humpback whales will not be taken during the feasibility study.

The research methods for the JARPA II are basically the same as the previous JARPA with some modifications. The program involves both non-lethal research techniques such as sighting surveys, biopsy sampling, acoustic surveys for prey species and the collection of oceanographic data and lethal sampling since collection of certain information, of vital importance to the overall study, requires examination of internal organs such as ovaries, earplugs and stomachs. A comprehensive review will be conducted following completion of the first 6 years of the research (Government of Japan, 2005).

This is the first cruise report in JARPA II. This season was dedicated to feasibility studies. The practicability and appropriateness of sighting methods in the enlarged area and sampling procedures for the increased sample size were examined. Methods for catching, flensing and taking biological measurements of large body-sized fin whales were also tested.

## RESEARCH METHODS

### Research vessels

The whale research unit was composed of two dedicated sighting vessels (*Kyoshin Maru No.2: KS2* and *Kaikoh Maru No.1:KK1*), three sighting and sampling vessels (*Yushin Maru No.2: YS2*, *Yushin Maru: YS1*, and *Kyo Maru No.1: KO1*) and one research base vessel (*Nisshin Maru: NM*).

Two sighting vessels (SVs) were dedicated to sighting survey and most of the experiments were conducted by these vessels. Three sighting and sampling vessels (SSVs) vessels were engaged in sighting and sampling surveys. NM served as a research base on which all biological examinations of collected samples were conducted.

### Research area

JARPA began with surveys in Areas IV (70°-130°E) and V (130°E-170°W). From the austral summer season 1995/96, the research area was extended to include the eastern part of Area III (35°-70°E) and the western part of Area VI (170°-145°W). The stock structure of Antarctic minke whales was therefore investigated in an area spanning 180 degrees in longitude.

With regard to the Antarctic minke whales, it was found that there were two independent stocks in the research area and a soft boundary at 165°E (middle of Area V) was proposed for management purposes (Pastene *et al.*, 2005a). To the west of this boundary line, but especially in Area IV, humpback whales have shown a rapid increase in recent years, and have surpassed the Antarctic minke whales in biomass. Fin whales have also shown a rapid increase with an abundance estimate of about 9,000 animals in Area IV+III. On the other hand, there has been significant decrease in blubber thickness of the

minke whales and a reversal in the trend of age at maturity toward younger ages (Bando *et al.*, 2005; Konishi and Tamura, 2005; Zenitani and Kato, 2005), which strongly indicates competition among the whale species in the area. Comparative studies of both areas will be useful to understand the pattern of competition among whale species.

The area to be covered by JARPA II is basically same as JARPA: the eastern part of Area III, Areas IV and V, and the western part of Area VI (35°E - 145°W). In the first year, JARPA II surveyed the East Indian Ocean Stock of Antarctic minke whales in a longitudinal span of 140° on the western side of the research area (35°E - 175°E). Fig.1 shows geographic location of the research area for the 2005/2006 JARPAII surveys

### **Survey track line design**

The minimum unit of the longitudinal width is 10 degrees in principle. The number of units was allocated to correspond with the longitudinal width of each stratum. However, the width of the units was changed based on the planned research days within the stratum. Track lines were constructed for SVs and SSVs, separately. Vessels made sightings alternately in the north and south strata. In the case of SV, two vessels crossed each other. Three SSVs conducted sighting and samplings simultaneously in the interval of 7 n.miles. The schematic figures are shown in Fig. 2 for SVs and Fig. 3 for SSVs, respectively.

The survey track line is systematically designed in the 10 degree longitudinal width interval in principle from the survey starting point. The survey starting point was randomly selected on the longitudinal border of the research area. Details are shown under the heading “The longitudinal interval and number of the survey track line in the sub-research area” on pages 4 and 5.

### **Sighting method**

Sighting procedures were the same as in the previous JARPA surveys (Nishiwaki *et al.* 1999, Ishikawa *et al.* 2000). The sighting survey using SSVs was conducted under limited closing mode (when a sighting of Antarctic minke whales was made on the predetermined track line, the vessel approached the whales and species and school size confirmed). Three SSVs advanced along parallel track lines 7 n.miles apart, at a standard speed of 11.5 knots. The sighting survey by SV was conducted under limited closing mode and passing mode (even if sighting was made on the predetermined track line, the vessel did not approach the whales directly and searching from the barrel was uninterrupted).

The survey was operated under optimal research conditions (when the wind speed was below 25 knots in the south strata and 20 knots in the north strata and visibility was more than two n.miles). In addition to the sighting of Antarctic minke and fin whales or whales suspected to be those species, the SV approached blue (*B. musculus*), humpback (*Megaptera novaeangliae*), southern right (*Eubalaena australis*), pigmy right (*Caperea marginata*), sei (*B.borealis*), sperm (*Physeter macrocephalus*) and southern bottlenose (*Hyperoodon planifrons*) whales for conducting some experiments. The SSVs also approached the same whale species as experiments in SV while they engaged in the sighting survey.

### **Sampling method**

Three sampling/sighting vessels were engaged in the sampling survey. 850 Antarctic minke whales (with 10 % Allowance) and ten fin whales were planned to be taken in the research area south of 62°S.

One or two Antarctic minke whale was sampled randomly from each primary sighted school within 3n.miles of the track line. The dwarf form minke whales were not a target for sampling. Sampling of fin whales was restricted to an estimated body length less than 20m, because of limitation of the research base ship (NM) facility for dissection.

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

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

### **Biological research**

Non-lethal means are not satisfactory to address all objectives of the planned in JARPA II. For example, age of whale, nutrition condition of the whale, food consumption, and heavy metal load can not be obtained by the current non-lethal methods. As well as the former JARPA, JARPA II will be conducted as a comprehensive research plan using lethal and non-lethal methods allocated properly for each research objective. Most of the research methods used in JARPA II were established through a research period of 18 years in JARPA.

Biological research on all sampled whales were 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 SV and SSVs.

#### **Photo-identification experiment**

The following species were targeted for photographic record of natural markings by SV and SSVs: blue, humpback and

southern right whales.

### **Biopsy sampling**

In addition to the species targeted for the photo-identification experiment, pygmy right, fin, sei, sperm, southern bottlenose whales were targeted for biopsy skin sampling by the SV and SSVs using compound-crossbow. All collected sample were preserved at  $-80^{\circ}\text{C}$ .

### **Oceanographic and acoustic survey**

SVs conducted the following oceanographic survey.

- 1) Consecutive measuring of water surface temperature, conductivity, surface chlorophyll, dissolved oxygen, surface particle and surface flow by Electric Particle Counting and Sizing System (EPCS)
- 2) XCTD and CTD survey
- 3) Marine debris recording in the research area by KK1 and KS2. All marine debris found in the stomach of Antarctic minke whales was recorded and collected on NM.
- 4) Hydro-acoustic survey using a scientific echo sounder (EK500 with operating frequencies at 38kHz, 120kHz, 200kHz, SIMRAD, Norway) to elucidate distribution and abundance of prey species of baleen whales. Hydro-acoustic survey was conducted by KS2. This survey was conducted with sighting survey throughout the whole research area.

In addition to these surveys mentioned above, SVs deployed Argo profiling floats (profiling devices), which collected high quality oceanographic data of upper and middle layers of the world ocean almost simultaneously with very high space-time resolution, during this cruise in cooperation with Japan Marine Science and Technology Center (JAMSTEC) (See [http://w3.jamstec.go.jp/ARGO/J\\_ARGOe.html](http://w3.jamstec.go.jp/ARGO/J_ARGOe.html)).

During the 57<sup>th</sup> SC, three concerns were raised (IWC/57/Rep1, P58-59),

- 1) The level of details in proposed survey and sampling designs is insufficient to adequately review the proposal.
- 2) As noted in the proposal, krill plays a central role in the Antarctic ecosystem. However, the proposal appears to recognize this but contains no commitment or specific survey plans for such work.
- 3) Substantial numbers of Antarctic minke whales appear to occur within the pack ice and the pack ice is a potentially important habitat for this species. JARPA II contains no plans to surveys within the pack ice.

For sighting and sampling design, we considered the discussions and established a new design of track line in Figs. 2 and 3. These designs could assure the randomness and representativeness of sighting and sampling of whales.

With respect to krill survey, acoustic krill abundance survey using a scientific echo sounder (EK500) was planned. KS2 conducted this survey in the whole research area.

The survey of whales within the pack ice is very important. However, it is difficult and dangerous for the research unit NM. We conducted a survey using the Shirase (Ice-breaker vessel) in 2004/05 season and will make efforts to continue such surveys within pack ice.

## **RESULTS**

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

Table 1 shows an outline of the research activities. The research period in the 2005/06 JARPA II was 108 days from 3 December 2005 to 20 March 2006. The whale research unit (WRU) encountered a Greenpeace (GP) vessel during the research activity on 21 December 2005 and, the Sea Shepherd (SS) vessel together with GP on 25 December 2005. The WRU interrupted research activities from 25 December 2005 to 2 January 2006 to ensure safe refueling. The attempted obstruction and violent activities of GP occurred from 21 December 2005 to 19 January 2006.

### **The longitudinal interval and number of the survey track lines in the sub-research area**

The track lines by the SVs and the SSVs are shown in figures 4 and 5. The longitudinal interval and number in the unit of survey track line in each sub research area were as follows:

- 1) The eastern part of Area V

The research area in the eastern part of Area V is a range from  $60^{\circ}\text{S}$  to  $69^{\circ}\text{S}$  and from  $175^{\circ}\text{E}$  to  $165^{\circ}\text{E}$ . The research starting point of SVs and SSVs were provided on the  $175^{\circ}\text{E}$  longitudinal line. The survey track line was set zigzag in north and south to westward. The longitudinal interval of each tooth of the survey track line was  $1^{\circ} 15'$  for SSVs in both north and south strata, and  $2^{\circ} 30'$  in north stratum and  $1^{\circ} 15'$  of south stratum for SVs. Allocated survey track line of the research area is one tooth in the north stratum and 3 teeth in the south stratum for SSVs. SVs surveyed two teeth in the north stratum and four teeth in the south stratum. The pack ice line was estimated based on the latest ice-edge information from near real time 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). However, the actual pack ice line projected remarkably to the north because of the developed low atmospheric pressure. Therefore, the northern boundary of south

stratum in the research area ranged from 175°E to 165°E was fixed at the 62°S and SSVs only surveyed the south stratum.

2) The western part of Area V

The research area in the western part of Area V was south of 60°S and from 165°E to 130°E. The research starting points of SVs and SSVs were the 165°E. The survey track line was set zigzag in north and south to westward. The survey track line was continued from that of the eastern part of Area V. SSVs surveyed 3 teeth in the north stratum and 9 teeth in the south stratum. SVs surveyed six teeth in the north stratum and twelve teeth in the south stratum. The research activity was planned from 9 to 28 December for the convenience of refueling. The entire research activities were interrupted on 23 December to evade interference by the GP and SS. The range surveyed in this period was from 165°E to 139°E.

Un-surveyed range in the research area from 130°E to 139°E was covered later (in March). The research starting point of SVs and SSVs were set on the 130°E. The survey track line was set zigzag in north and south to eastward. The same design of survey track line was continued from that of the eastern part of Area IV again. For the longitudinal interval of one tooth of the survey track line, the SSVs made 3° 20' in the north and south strata, the SVs adopted 5° in the north stratum and 2.5° in the south stratum. Because of limitation of research period due to the harassment by GP and SS, survey effort of SSVs was concentrated in the south stratum and the north stratum in this area was not surveyed.

3) The eastern part of Area IV

The range of the eastern part of Area IV is south of 60°S and from 100°E to 130°E. The same design of survey track line was continued from the western part of Area IV. The research starting point of SVs and SSVs was on the 100°E latitudinal line. The track line of the SSVs was set zigzag in north and south to eastward. In the case of SVs, the research area was divided into two areas at 117° 38'. The survey was implemented zigzag in north and south to westward in western half and to eastward on eastern half from this longitude. For the longitudinal interval of one tooth of the survey track line, the SSVs had 3° 20' in both north and south strata, the SVs adopted 5° in the north stratum and 2°30' in the south stratum. The teeth in the survey track line of this area were composed of four and a half teeth in the south stratum in SSVs and three teeth in the north stratum and six teeth in the south stratum in SVs. Because of limitation of research period due to the harassment by GP and SS, survey effort of SSVs was concentrated the south stratum and the north stratum in this area was not surveyed.

4) The western part of Area IV

The range of the western part of Area IV is south of 60°S and from 70°E to 100°E. The research starting point of SVs and SSVs was on the 70°E longitude line. The track line was surveyed zigzag in north and south to eastward except to westward from west of 75° east longitude. For the longitudinal interval of one tooth of survey track line, the SSVs had 1°40' in both north and south strata, the SVs adopted 5° of the north stratum and 2°30' in the south stratum. The survey track line in this area for the SSVs was composed of two and half teeth in the north stratum and eight and half units in the south stratum. SV track lines were composed of three teeth in the north stratum and five and half teeth in the south stratum. In east of 95E, because of limitation of research period due to the harassment by GP and SS, survey effort of SSVs was concentrated the south stratum and the north stratum in this area was not surveyed.

5) The Prydz Bay (the western part of Area IV)

The range of the Prydz Bay is from south of 66°S from 70°E to 80°E. A tongue-shape ice field projected to the west side from 66°S to 67°S and from 80°E to 73°E. The entrance to the bay was blockaded in the neighborhood of 73°E and 67°S. The research area was divided into north and south at the 67°S. The research starting point of SVs and SSVs was on the 80°E. For the longitudinal interval of one tooth of survey track line, the SSVs had 3°20' and the 2°30' for the SVs. The survey track line of the research area was composed one and half teeth for the SSVs and two teeth for the SVs.

6) The eastern part of Area III

The research area in the eastern part of Area III is a range from south of 60° and from 55°E to 70°E. The research starting point of SVs and SSVs provided on the 55°E. The survey track line was set zigzag in north and south to eastward. For the longitudinal interval of one tooth of the track line, the SSVs had 1°40' in both north and south strata. The SVs had 5° of the north stratum and 2°30' of the south stratum. The survey track line of the research area was composed of one and a half teeth in the north stratum and three and a half teeth in the south stratum for SSVs and one and a half teeth for the north stratum and three teeth in the south stratum for the SVs.

**Searching distance**

The searching distances of the SVs and the SSVs were shown in table 2. The research period was 108 days but 9 days were not surveyed because of harassment of GP and SS. The total searching distance was 16,372.7 n.miles consist of 8,836.2 n.miles in the two SVs and 7,536.5 n.miles in the three SSVs.

## **Whale species sighted**

Fourteen species were identified during the research period. Table 3 shows eight whale species number of sightings by SV and SSVs. The following six species of baleen whales were confirmed; Antarctic minke, blue, fin, sei, humpback and southern right whales, and two toothed whales were confirmed; sperm and southern bottlenose whales.

The number of the primary sightings was; humpback whales (1702 schools and 3200 individuals), Antarctic minke whales (1658 schools and 4383 individuals) and fin whales (188 schools and 748 individuals). These account for 76.2% in the sighting composition with 36.6% for the humpback, 35.6% for the Antarctic minke and 4.0% for the fin whales in schools. The Antarctic minke and the humpback whales were equally dominant species. When considering biomass, it is suggested that the humpback whales exceeds that of fin whales which were the same as Antarctic minke whales.

## **Distributions of confirmed whale species in the research areas**

### **1) Antarctic minke whales**

The distribution of sightings of the Antarctic minke whales by SVs is shown in figure 6 and SSVs in figure 7. The Antarctic minke whales were widely distributed throughout the research areas. The density and distribution of sightings seemed to be different between east and west of 115 degrees of east longitude. In the east of this line, high density area was found only near the ice-edge, and density was low in the north strata and offshore in the south strata. In the west side of the line, high density and concentrated areas were observed from east of 55°E to the Prydz Bay and around the Drygarsky Island in the south strata of the Area IVW. Antarctic minke whales were low density in the north stratum but were widely distributed.

### **2) Humpback whales**

The distribution of sightings of the humpback whales by SVs is shown in figure 8 and SSVs in figure 9. The humpback whales were widely distributed throughout the research areas. The density and distribution of sightings seemed to be different between east and west of 130 °E. In the east of this latitudinal line, humpback whales were concentrated near the ice-edge. In the west of 130°E latitudinal line, high concentrated areas were confirmed in the south strata of Area IV except the Prydz Bay and around the Drygarsky Island where Antarctic minke whales were dominant. They were medium density in the north strata and offshore in the south strata.

### **3) Fin whales**

The distribution of sightings of the fin whales by SVs is shown in figure 10 and SSVs in figure 11. Fin whales were widely distributed in the research areas throughout the research periods. High concentrated areas were confirmed in the south strata of Area IV, while they were rare in the Prydz Bay and around the Drygarsky Island. Sightings of fin whales in Areas IIIE and IV in the north strata were low.

### **3) Blue, sei and southern right whales**

The distribution of sightings of blue, sei and southern right whales by SVs is shown in figure 12 and SSVs in figure 13. Sightings of blue whales were widely spread in the entire research area. Southern right whales were concentrated in the limited area in the south strata of the Area IV. Sei whales were sighted in the north stratum in the eastern part of Area IV.

## **Density index and mean school size**

### **1) Antarctic minke whales**

Table 4 shows density indices (DI; number of schools sighted/100 n.miles searching distance) and mean school size (MSS) of primary sightings of Antarctic minke whales by vessels and stratum. For the whole research area the DI was 12.7 schools and the MSS was 2.8 individuals for the SVs. For the SSVs, DI was 10.9 schools and MSS was 2.4 individuals.

In the case of the SVs, there is no difference in the DI within south and the north strata of the Areas VW (18.1 on north and 18.4 on south strata) and IIIE (15.0 on north and 11.7 on south strata). MSS was also nearly same (2.8 in the north and 2.3 in the south strata in Area VW and 2.3 in the north and 2.1 in the south strata in the Area IIIE). There is no difference in the DI and MSS within the south stratum of Area IIIE (DI 11.7 and MSS 2.1 ) and the Prydz Bay (DI 12.3 and MSS 1.9). However, there was a large difference of DI between north and south strata in the Area IV. These were 1.4 in eastern to 7.1 in western in the north stratum and 10.7 in eastern to 29.0 in western in the south stratum. The MSS also showed a similar tendency. These were 1.5 in eastern to 3.8 in western in the north stratum and 2.4 in eastern to 4.4 in western in the south stratum. The MSS for the south and north strata in the Area IVW was a maximum through the whole research area.

### **2) Humpback whales**

Table 5 shows DI and MSS of primary sightings of humpback whales by vessels and stratum. In the whole research area, DI was 17.8 schools and the MSS was 1.9 individuals for the SVs. For the SSVs DI was 8.2 schools and MSS was 1.9 individuals. The MSS was the same level through the whole research areas.

In the case of the SVs, the DI was remarkably high in the south stratum of eastern and western part of Area IV. The south

stratum of Area IVE (50.0) was a maximum through the whole research area and was remarkable high density compared with other strata. There is not a difference in the DI within south and the north strata in the western part of Area VW (22.2 on north and 22.6 on south strata).

### 3) Fin whales

Table 6 shows DI and MSS of primary sightings of fin whales by vessels and stratum. In the whole research area DI was 2.7 schools and MSS was 3.1 individuals for the SVs. For the SSVs DI was 0.5 schools and MSS was 6.6 individuals. In the case of the SVs, the DI in the north was remarkably lower than in the south stratum in the Area VE (0.5 in the north and 8.4 in the south strata) and in the Area IV (1.2 in the north and 8.9 in the south strata of eastern part, 1.8 in the north and 4.2 in the south strata of western part) except for the Prydz Bay. The range of the MSS was from 2.3 to 4.8 and there was no remarkable fluctuation by the research strata.

## Sampling of Antarctic minke whales and fin whales

### 1) Antarctic minke whales

Out of 821 schools (1959 individuals) in the primary sightings of Antarctic minke whales by SSVs, 779 schools (1,879 individuals) were targeted for sampling. A total of 853 individuals were sampled (2 from Area VE, 148 from Area VW, 74 from Area IVE, 499 from Area IVW and 130 from Area IIIE). Sampling efficiency (the rate of successful sampling for targeted individuals) was 95.6%. This value was the highest level during the previous JARPA surveys. Struck and lost occurred in only three cases.

### 2) Fin whales

Out of 37 schools (245 individuals) in the primary sightings of fin whales by SSVs, 11 schools and 112 individuals (6 schools and 90 individuals in the south stratum of Area IVW, 5 schools and 22 individuals in the south stratum of Area IVE) were targeted for sampling. A total of 10 individuals were sampled (6 from Area IVW-S and 4 from Area IVE-S). Sampling efficiency was 90.16%. No struck and lost occurred.

## Biological research

Biological research was conducted on the research base ship for all whales sampled. Table 6 summarizes biological data and samples collected from the Antarctic minke whales. Table 7 summarizes biological data and samples collected from the fin whales.

## Preliminary analyses of biological information

### 1) Antarctic minke whales

Table 8 shows the reproductive status of samples by stratum in Antarctic minke whales. Mature females were dominant in Prydz Bay, whereas mature males were dominant in most of other strata. In the south stratum of Area IVE, both immature males and females were dominant. Pregnancy rate in mature females was 93.8% (227 individuals) in the whole research areas and two twins were observed.

Table 10 shows mean body length of Antarctic minke whales collected in each stratum. Maximum length of the sample was 9.58m for males and 10.47m for females. Minimum length was 4.85m and 4.73m, respectively.

### 2) Fin whales

The biological data of the collected fin whales is shown in Table 9. The maximum body length was 20.22 m with body weight of a 61.52t for a female. The minimum body length of the mature female was 19.47 m with weight of 51.80 t.

## Experiments

### 1) Sighting distance and angle experiment

A sighting distance and angle experiment was performed on 30 December 2005 by SSVs, 3 and 4 January 2006 by the KS2 and 6 January 2006 by KK1. The results of this experiment will be used in calculation of abundance estimates.

### 2) The results of photo-ID

Table 10 summarizes the results of photo-ID. The photo-ID experiment was conducted within the entire research area. A total of 85 targeted individuals were photographed (13 blue, 34 humpback and 38 southern right whales).

### 3) The results of biopsy sampling

Table 11 summarizes the results of biopsy sampling. A total of 46 skin biopsy samples were collected from blue whales (n=5), fin whales (n=9), sei whales (n=1), humpback whales (n=13), southern right whales (n=15), carcass of sperm whale (n=1), carcass of southern bottlenose whale (n=1) and long-finned pilot whale (n=1).

### 4) The attachment of the satellite tags

YS1 tried to attach satellite tags to two individuals of one school of Antarctic minke whales on 14 February 2006. The body lengths were estimated at 8.2 m and 8.5 m. Both tags hit but one was omitted from the body because of trouble with the discharge. The other was attached to the body in the position behind the dorsal fin. However, the transmission antenna was ineffective and did not operate.

5) The Oceanographic and acoustic surveys

Table 12 shows the summary of oceanographic and acoustic surveys. CTD, XCTD and XBT castings which were conducted at 86, 123 and 22 locations, respectively. EPCS survey was conducted for 94 days by KS2 and 99 days by YS2 in total. KS2 conducted the quantitative echo sounder survey which ranged over 94 days in the whole research area.

6) The marine debris

The marine debris survey was carried out concomitant with the sighting survey of the SVs in all research areas. A total of fifteen debris (thirteen buoys, one wad of fishing net and one lump of styrol) were confirmed. Eight sheets feathers as alien substances from the stomach content were confirmed in eight of the collected Antarctic minke whales.

**Products**

All the whales collected were processed on NM after biological sampling was completed, according to the provisions of Article VIII of the Convention. A total of 3441.4 tons (268.9 tons of fin and 3171.5 tons of Antarctic minke whales) of meat, blubber, viscera, etc. was produced.

**DISCUSSION**

This paper describes research methods and reports results from the first feasibility survey of the JARPA II. The objectives of this feasibility survey were the following: 1) to examine the practicability and appropriateness of sighting methods considering the enlarged research area, 2) to examine the practicability and appropriateness of sampling procedure considering the increased sample size for Antarctic minke whale and 3) to examine the practicability of methods of hunting, hauling, flensing and biological sampling of large-sized whales. For the feasibility surveys a total of 850+/-10% Antarctic minke whales and 10 fin whales were planned for sampling, and this target was met in this first feasibility survey.

The main results of the first feasibility survey can be summarized as follows:

- 1) Antarctic minke and humpback whales were the dominant species observed in similar numbers in the research area. Both species were highly concentrated in the south strata. However, some segregation was observed as high density for one species did not coincide with the high density of the other species in a same stratum. Antarctic minke whale was dominant in the western part of Area IVW while the humpback whale was dominant in the eastern part of Area IVE. In terms of biomass it can be suggested that the humpback whale is the dominant species in the research area.
- 2) Fin whales were widely distributed in the south strata from 80°E to 135°E. In the past it was suggested that fin whales do not distribute in large number in the south strata compared with Antarctic minke and humpback whales. However, it was observed during this survey that fin whales distributed in the south strata presenting large mean school sizes (MSS) compared with that of other baleen whale species. It is clear that the biomass of fin whales is similar to that of Antarctic minke whales.
- 3) Large baleen whales intermingled in the south strata through whole research area. Blue whales were widely observed in the entire research area. Southern right whales were concentrated in the south strata of Area IV. Sightings of both species were few compared with those of Antarctic minke, humpback and fin whales. However increasing in sighting composition of large baleen whales is important for studies of inter-species relationships of whales.

Regarding the objectives of the first feasibility survey, the following results were obtained:

- 1) The practicability and appropriateness of sighting methods in the enlarged area  
This cruise was planned to cover a longitudinal span of 140° from 35°E to 175°E through early December to late March. It was planned that the search effort would be distributed mainly in Area IV, in the peak feeding season of baleen whales. The only un-surveyed areas were those from 35°E to 55°E and 135°E to 139°E, due to external disturbances. Despite these disturbances, sighting was conducted in the peak season from early January to early March in the main research area from 55°E to 130°E which included Area IV. The practicability and appropriateness of the planned sighting methods were confirmed.



2) Sampling procedures given the increased sample size and additional species.

A total of 779 schools (1,879) individuals of Antarctic minke whales were targeted for sampling. A total of 853 individuals were sampled from 4 December to 20 March. Sampling efficiency was 95.6%. A total of 11 schools (112 individuals) of the fin whales were targeted for sampling. A total of 10 individuals were sampled from 3 February to 13 March. Sampling efficiency was 90.16%. These results showed that sampling procedure were appropriate for the increased sample size of Antarctic minke whale and for additional species.

3) Methods for catching, flensing and taking biological measurements of large body-sized fin whales

Although it took more time to catch, transport, measure and dissect the fin whales than is the case for the Antarctic minke whales, the process from catching to biological sampling of fin whales was successfully conducted. Therefore the method of hunting, hauling, flensing and biological sampling of large-sized whales was checked and confirmed as adequate for whales of body length of at least 20.22m.

Therefore it can be concluded that the first feasibility survey of JARPA II was conducted satisfactorily and that the objectives of the feasibility survey were covered adequately.

#### ACKNOWLEDGMENTS

We are indebted to Dr. Hiroshi Hatanaka, director-general of the ICR and Mr. Hideki Moronuki, the Government of Japan for implementation of the research. We thank research technicians, Messrs. Yasuhiro Murai, Chinori Asahina, Akio Kuji and Fukuo Oyama, Kyodo Senpaku Kaisya Ltd., for their contribution. Mr. Takashi Takaoka from the Government of Japan, served as onboard inspector. We are also indebted to all the crew, colleagues of the ICR and other related institutions who participated in the research for their contributions. We would like to express our appreciation to the Government of Japan for providing financial support for this research.

#### REFERENCES

- Bando, T., Zenitani, R., Fujise, Y. and Kato, H. 2005. Biological parameters of Antarctic minke whale based on materials collected by the JARPA survey in 1987/88 to 2003/04. Paper JA/J05/JR5 presented to the JARPA Review meeting, January 2005. 37pp.
- Cavalieri, D., P. Gloerson and J. Zwally. 1999, updated regularly. Near real-time DMSP SSM/I daily polar gridded sea ice concentrations. Edited by J. Maslanik and J. Stroeve. Boulder, CO: National Snow and Ice Data Center. Digital media.
- Government of Japan. 2005. Plan for the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA II) -Monitoring of the Antarctic Ecosystem and Development of New Management Objectives for Whale Resources. Paper SC/57/O1 presented to the IWC Scientific Committee, Jun 2005 (unpublished). 99pp.
- Ishikawa, H. Murase, H., Tohyama, D., Yuzu, S., Otani, S., Mogoe, T., Masaki, T., Kimura, N., Ohshima, T., Konagai, T., Asada, M., Takeuchi, J., and Kinoshita, T. 2000. Cruise Report of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA) Area IV and Eastern Part of Area III in 1999/2000. Paper SC/52/O20 presented to the IWC Scientific Committee, July 2000 (unpublished). 25pp.
- Konishi, K. and Tamura, T. 2005. Yearly trend of blubber thickness in the Antarctic minke whale *Balaenoptera bonaerensis* in Areas IV and V. Paper JA/J05/JR9 presented to the JARPA Review meeting, January 2005. 9pp.
- Nishiwaki, S., Tohyama, D., Yuzu, S., Bando, T., Watanabe, M., Kitajima, A., Takeda, S., Murase, H., Otose, S., OKubo, J., Tsutsui, S., Takatsuki, M. and Kinoshita, T. 1999. Cruise Report of the Japanese Whale Research Program under special Permit in the Antarctic (JARPA) Area V and Western Part of Area VI in 1998/1999. Paper SC/51/O20 presented to the IWC Scientific Committee, May 1999 (unpublished). 20pp.
- Pastene, L.A., Goto M., Kanda, N., Bando, T., Zenitani, R., Hakamada, T., Otani, S. and Fujise, Y. 2005a. A new interpretation of the stock identity in the Antarctic minke whale (*Balaenoptera bonaerensis*) based on analyses of genetics and non-genetics markers. Paper JA/J05/JR3 presented to the JARPA Review meeting, January 2005. 31pp.
- Yasunaga, G., Fujise, Y., Zenitani, R., Honda, K. and Kato, H. 2005. Yearly trend of trace element accumulation in liver of Antarctic minke whales, *Balaenoptera bonaerensis*. Paper JA/J05/JR13 presented to the JARPA Review meeting, January 2005. 27pp.
- Zenitani, R. and Kato, H., 2005. Long- term trend of age at sexual maturity of Antarctic minke whales by counting transition phase in earplugs. Paper JA/J05/JR7 presented to the JARPA Review meeting, January 2005. 12pp.

**Table1. Outline of the research activities**

| Event  | Date                            | RBV | SSVs | SV  |     |
|--|---------------------------------|-----|------|-----|-----|
|  |                                 |     |      | KK1 | KS2 |
| Departure from Shimonoseki-city in Yamaguchi prefecture Japan                    | 8/ Nov./ 2005                   |     |      |     |     |
| Low and middle latitudinal sighting survey in transit area                       | 24/ Nov./ 2005 ~ 2/ Dec./ 2005  |     |      |     |     |
| Starting of the sighting and sampling survey in the Antarctic Ocean              | 3/ Dec./ 2005                   |     |      |     |     |
|  | 4/ Dec./ 2005                   |     |      |     |     |
| Sighting and sampling survey in the eastern part of Area V from 175E to 165E     | 3/ Dec./ 2005 ~ 8/ Dec./ 2005   |     |      |     |     |
| Sighting and sampling survey in the Western part of Area V from 165E to 155E     | 9/ Dec./ 2005 ~ 11/ Dec./ 2005  |     |      |     |     |
| Sighting and sampling survey in the Western part of Area V from 155E to 145E     | 12/ Dec./ 2005 ~ 22/ Dec./ 2005 |     |      |     |     |
| Sighting and sampling survey in the Western part of Area V on west of 139E       | 24/ Dec./ 2005                  |     |      |     |     |
| Sighting and sampling survey in the Western part of Area IV from 75E to 70E      | 3/ Jan./ 2006 ~ 6/ Jan./ 2006   |     |      |     |     |
| Sighting and sampling survey in the Western part of Area IV from 75E to 70E      | 3/ Jan./ 2006 ~ 7/ Jan./ 2006   |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area III from 70E to 55E     | 7/ Jan./ 2006                   |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area III from 70E to 55E     | 10/ Jan./ 2006 ~ 20/ Jan./ 2006 |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area III from 70E to 55E     | 10/ Jan./ 2006 ~ 13/ Jan./ 2006 |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area III from 70E to 55E     | 14/ Jan./ 2006 ~ 19/ Jan./ 2006 |     |      |     |     |
| Sighting and sampling survey in the Western part of Area IV from 75E to 80E      | 14/ Jan./ 2006 ~ 20/ Jan./ 2006 |     |      |     |     |
| Sighting and sampling survey on the Prydz Bay in the Western part of Area IV     | 20/ Jan./ 2006 ~ 31/ Jan./ 2006 |     |      |     |     |
| Sighting and sampling survey on the Prydz Bay in the Western part of Area IV     | 21/ Jan./ 2006 ~ 3/ Feb./ 2006  |     |      |     |     |
| Sighting and sampling survey on the Prydz Bay in the Western part of Area IV     | 21/ Jan./ 2006 ~ 30/ Jan./ 2006 |     |      |     |     |
| Sighting and sampling survey in the Western part of Area IV from 75E to 100E     | 1/ Feb./ 2006 ~ 14/ Feb./ 2006  |     |      |     |     |
| Sighting and sampling survey in the Western part of Area IV from 80E to 100E     | 1/ Feb./ 2006 ~ 15/ Feb./ 2006  |     |      |     |     |
| Sighting and sampling survey in the Western part of Area IV from 75E to 80E      | 3/ Feb./ 2006 ~ 4/ Feb./ 2006   |     |      |     |     |
| Sighting and sampling survey on the Prydz Bay in the Western part of Area IV     | 5/ Feb./ 2006 ~ 6/ Feb./ 2006   |     |      |     |     |
| Sighting and sampling survey in the Western part of Area IV from 80E to 100E     | 7/ Feb./ 2006 ~ 4/ Mar./ 2006   |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area IV from 117-38E to 100E | 17/ Feb./ 2006 ~ 24/ Feb./ 2006 |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area IV from 117-38E to 100E | 18/ Feb./ 2006 ~ 24/ Feb./ 2006 |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area IV from 100E to 130E    | 4/ Mar./ 2006 ~ 16/ Mar./ 2006  |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area IV from 117-38E to 130E | 5/ Mar./ 2006 ~ 11/ Mar./ 2006  |     |      |     |     |
| Sighting and sampling survey in the Eastern part of Area IV from 117-38E to 130E | 5/ Mar./ 2006 ~ 12/ Mar./ 2006  |     |      |     |     |
| Sighting and sampling survey in the Western part of Area V from 130E to 135E     | 17/ Mar./ 2006 ~ 20/ Mar./ 2006 |     |      |     |     |
| Sighting and sampling survey in the Western part of Area V from 130E to 132-38E  | 11/ Mar./ 2006 ~ 13/ Mar./ 2006 |     |      |     |     |
| Sighting and sampling survey in the Western part of Area V on east of 130E       | 12/ Mar./ 2006                  |     |      |     |     |
| Sighting and sampling survey in the Western part of Area V from 131E to 135E     | 17/ Mar./ 2006 ~ 20/ Mar./ 2006 |     |      |     |     |
| Ending of the sighting and sampling survey in the Antarctic Ocean                | 20/ Mar./ 2006                  |     |      |     |     |
| Low and middle latitudinal sighting survey in transit area                       | 23/ Mar./ 2006 ~ 29/ Mar./ 2006 |     |      |     |     |
| Arrive on Shimonoseki-city in Yamaguchi prefecture Japan                         | 13/ Apr./ 2006                  |     |      |     |     |
| Arrive on Kanazawa-city in Ishikawa prefecture Japan                             | 14/ Apr./ 2006                  |     |      |     |     |
| Arrive on Ohi in Tokyo Japan   | 15/ Apr./ 2006                  |     |      |     |     |
| Arrive on Shioyama-city in Miyagi prefecture Japan                               | 16/ Apr./ 2006                  |     |      |     |     |

RBV:Resarch Base Vessel(Nisshin Maru) . SSVs:Sighting and Sampling Vessels.Sighting Vessel(KK1;Kaikoh Maru. KS2;Kyoushin Maru No.2)

**Table2. Searching distances (n.miles) of two sighting vessel (SVs) and three sighting / sampling vessels (SSVs) in each stratum.**

| Area               | Stratum          | Block                | SVs           |               |               | SSVs          |               |               | Grand total    |               |
|--------------------|------------------|----------------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|---------------|
|                    |                  |                      | Closing       | Passing       | Sub total     | Closing       | Passing       | Sub total     |                |               |
| V                  | East             | North-North          | 21.8          | 75.1          | <b>96.9</b>   | 0.0           | 0.0           | <b>0.0</b>    | <b>96.9</b>    |               |
|                    |                  | North-South          | 50.3          | 103.5         | <b>153.8</b>  | 803.8         | 0.0           | <b>803.8</b>  | <b>957.7</b>   |               |
|                    | West             | North                | 202.5         | 411.3         | <b>613.8</b>  | 808.9         | 0.0           | <b>808.9</b>  | <b>1422.7</b>  |               |
|                    |                  | South                | 156.5         | 496.2         | <b>652.7</b>  | 1195.6        | 0.0           | <b>1195.6</b> | <b>1848.3</b>  |               |
|                    | <b>Sub-total</b> |                      | <b>431.1</b>  | <b>1086.2</b> | <b>1517.2</b> | <b>2808.4</b> | <b>0.0</b>    | <b>2808.4</b> | <b>4325.6</b>  |               |
| IV                 | East             | North                | 462.7         | 987.6         | <b>1450.3</b> | 0.0           | 0.0           | <b>0.0</b>    | <b>1450.3</b>  |               |
|                    |                  | North (Transit-KS2)  | 0.0           | 134.6         | <b>134.6</b>  | 0.0           | 0.0           | <b>0.0</b>    | <b>134.6</b>   |               |
|                    |                  | South                | 189.6         | 675.9         | <b>865.5</b>  | 1707.2        | 0.0           | <b>1707.2</b> | <b>2572.7</b>  |               |
|                    |                  | South (Special-KS2)  | 0.0           | 80.3          | <b>80.3</b>   | 0.0           | 0.0           | <b>0.0</b>    | <b>80.3</b>    |               |
|                    |                  | South (Ice edge-KK1) | 0.0           | 407.1         | <b>407.1</b>  | 0.0           | 0.0           | <b>0.0</b>    | <b>407.1</b>   |               |
|                    | West             | North                | 297.5         | 827.8         | <b>1125.3</b> | 706.9         | 0.0           | <b>706.9</b>  | <b>1832.2</b>  |               |
|                    |                  | North (Transit-KS2)  | 0.0           | 143.3         | <b>143.3</b>  | 0.0           | 0.0           | <b>0.0</b>    | <b>143.3</b>   |               |
|                    |                  | South                | 227.8         | 637.8         | <b>865.6</b>  | 608.4         | 0.0           | <b>608.4</b>  | <b>1474.0</b>  |               |
|                    | Prydz Bay        |                      |               | 95.1          | 285.9         | <b>381.1</b>  | 672.2         | 0.0           | <b>672.2</b>   | <b>1053.3</b> |
|                    |                  | Transit-KS2          | 0.0           | 53.5          | <b>53.5</b>   | 0.0           | 0.0           | <b>0.0</b>    | <b>53.5</b>    |               |
|                    |                  | Special-KS2          | 0.0           | 31.9          | <b>31.9</b>   | 0.0           | 0.0           | <b>0.0</b>    | <b>31.9</b>    |               |
| Ice-edge-KK1       |                  | 0.0                  | 431.5         | <b>431.5</b>  | 0.0           | 0.0           | <b>0.0</b>    | <b>431.5</b>  |                |               |
| <b>Sub-total</b>   |                  | <b>1272.7</b>        | <b>4697.2</b> | <b>5969.8</b> | <b>3694.8</b> | <b>0.0</b>    | <b>3694.8</b> | <b>9664.6</b> |                |               |
| III                | East             | North                | 149.8         | 524.5         | <b>674.2</b>  | 322.6         | 0.0           | <b>322.6</b>  | <b>996.8</b>   |               |
|                    |                  | South                | 238.7         | 436.3         | <b>675.0</b>  | 664.0         | 46.8          | <b>710.8</b>  | <b>1385.8</b>  |               |
|                    | <b>Sub-total</b> |                      | <b>388.4</b>  | <b>960.8</b>  | <b>1349.2</b> | <b>986.5</b>  | <b>46.8</b>   | <b>1033.4</b> | <b>2382.6</b>  |               |
| <b>Grand total</b> |                  |                      | <b>2092.2</b> | <b>6744.1</b> | <b>8836.2</b> | <b>7489.7</b> | <b>46.8</b>   | <b>7536.5</b> | <b>16372.7</b> |               |

**Table 3. Summary of whale sightings conducted by SV and SSVs in whole research areas.**

| Vessls                     | Sighting vessls |       |          |      | Sighting and sampling vessels |       |          |      | Total   |       |          |      |
|----------------------------|-----------------|-------|----------|------|-------------------------------|-------|----------|------|---------|-------|----------|------|
|                            | Primary         |       | Secondly |      | Primary                       |       | Secondly |      | Primary |       | Secondly |      |
|                            | Sch.            | Ind.  | Sch.     | Ind. | Sch.                          | Ind.  | Sch.     | Ind. | Sch.    | Ind.  | Sch.     | Ind. |
| Antarctic minke whales     | 837             | 2,424 | 170      | 470  | 821                           | 1,959 | 20       | 64   | 1,658   | 4,383 | 190      | 534  |
| Liked minkewhales          | 85              | 138   | 8        | 14   | 12                            | 13    | 0        | 0    | 97      | 151   | 8        | 14   |
| Blue whales                | 18              | 29    | 2        | 3    | 6                             | 9     | 5        | 7    | 24      | 38    | 7        | 10   |
| Fin whales                 | 151             | 503   | 12       | 40   | 37                            | 245   | 24       | 148  | 188     | 748   | 36       | 188  |
| Sei whales                 | 2               | 3     | 0        | 0    | 0                             | 0     | 0        | 0    | 2       | 3     | 0        | 0    |
| Humpback whales            | 1,085           | 2,024 | 99       | 161  | 617                           | 1,176 | 47       | 93   | 1,702   | 3,200 | 146      | 254  |
| Southern right whales      | 33              | 44    | 4        | 4    | 20                            | 29    | 4        | 5    | 53      | 73    | 8        | 9    |
| Baleen whales              | 226             | 456   | 25       | 71   | 8                             | 8     | 11       | 72   | 234     | 464   | 36       | 143  |
| Sperm whales               | 138             | 139   | 12       | 12   | 43                            | 43    | 6        | 6    | 181     | 182   | 18       | 18   |
| Southern bottlenose whales | 71              | 150   | 3        | 6    | 17                            | 29    | 0        | 0    | 88      | 179   | 3        | 6    |

**Table 4. Density indices (DI, number of schools per 100 n.miles) and mean school size (MSS) of Antarctic minke whale primary sightings by SV and SSVs.**

| Area               | Part             | Stratum              | SVs                         |  |             |             | SSVs                        |  |            |             |             |            |
|--------------------|------------------|----------------------|-----------------------------|--|-------------|-------------|-----------------------------|--|------------|-------------|-------------|------------|
|                    |                  |                      | Searching distance (n.mile) | Antarctic minke whale (primary sighting) |             |             | Searching distance (n.mile) | Antarctic minke whale (primary sighting) |            |             |             |            |
|                    |                  |                      |                             | Sch.                                     | Ind.        | DI          |                             | MSS                                      | Sch.       | Ind.        | DI          | MSS        |
| V                  | East             | North-North          | 96.9                        | 0  | 0           | 0.0         | 0.0                         | -  | -          | -           | -           |            |
|                    |                  | North-South          | 153.8                       | 0  | 0           | 0.0         | 0.0                         | 803.8                                    | 2          | 2           | 0.2         | 1.0        |
|                    | West             | North                | 613.8                       | 111                                      | 311         | 18.1        | 2.8                         | 808.9                                    | 41         | 78          | 5.1         | 1.9        |
|                    |                  | South                | 652.7                       | 120                                      | 280         | 18.4        | 2.3                         | 1195.6                                   | 85         | 165         | 7.1         | 1.9        |
|                    | <b>Sub-total</b> |                      | <b>1517.2</b>               | <b>231</b>                               | <b>591</b>  | <b>15.2</b> | <b>2.6</b>                  | <b>2808.4</b>                            | <b>128</b> | <b>245</b>  | <b>4.6</b>  | <b>1.9</b> |
| IV                 | East             | North                | 1450.3                      | 20                                       | 30          | 1.4         | 1.5                         | -  | -          | -           | -           |            |
|                    |                  | North (Transit-KS2)  | 134.6                       | 11                                       | 12          | 8.2         | 1.1                         | -  | -          | -           | -           |            |
|                    |                  | South                | 865.5                       | 93                                       | 224         | 10.7        | 2.4                         | 1707.2                                   | 70         | 126         | 4.1         | 1.8        |
|                    |                  | South (Special-KS2)  | 80.3                        | 1  | 1           | 1.2         | 1.0                         | -  | -          | -           | -           |            |
|                    |                  | South (Ice edge-KK1) | 407.1                       | 28                                       | 52          | 6.9         | 1.9                         | -  | -          | -           | -           |            |
|                    | West             | North                | 1125.3                      | 80                                       | 307         | 7.1         | 3.8                         | 706.9                                    | 112        | 238         | 15.8        | 2.1        |
|                    |                  | North (Transit-KS2)  | 143.3                       | 3  | 3           | 2.1         | 1.0                         | -  | -          | -           | -           |            |
|                    |                  | South                | 865.6                       | 251                                      | 1096        | 29.0        | 4.4                         | 608.4                                    | 214        | 752         | 35.2        | 3.5        |
|                    | Prydz Bay        | Transit-KS2          | 381.1                       | 47                                       | 89          | 12.3        | 1.9                         | 672.2                                    | 155        | 344         | 23.1        | 2.2        |
|                    |                  | Special-KS2          | 53.5                        | 20                                       | 33          | 37.4        | 1.7                         | -  | -          | -           | -           |            |
|                    |                  | Ice-edge-KK1         | 31.9                        | 2  | 3           | 6.3         | 1.5                         | -  | -          | -           | -           |            |
|                    |                  | Ice-edge-KK1         | 431.5                       | 156                                      | 280         | 36.2        | 1.8                         | -  | -          | -           | -           |            |
|                    | <b>Sub-total</b> |                      | <b>5969.8</b>               | <b>712</b>                               | <b>2130</b> | <b>11.9</b> | <b>3.0</b>                  | <b>3694.8</b>                            | <b>551</b> | <b>1460</b> | <b>14.9</b> | <b>2.6</b> |
| III                | East             | North                | 674.2                       | 101                                      | 236         | 15.0        | 2.3                         | 322.6                                    | 20         | 34          | 6.2         | 1.7        |
|                    |                  | South                | 675.0                       | 79                                       | 169         | 11.7        | 2.1                         | 710.8                                    | 122        | 220         | 17.2        | 1.8        |
|                    | <b>Sub-total</b> |                      | <b>1349.2</b>               | <b>180</b>                               | <b>405</b>  | <b>13.3</b> | <b>2.3</b>                  | <b>1033.4</b>                            | <b>142</b> | <b>254</b>  | <b>13.7</b> | <b>1.8</b> |
| <b>Grand Total</b> |                  |                      | <b>8836.2</b>               | <b>1123</b>                              | <b>3126</b> | <b>12.7</b> | <b>2.8</b>                  | <b>7536.5</b>                            | <b>821</b> | <b>1959</b> | <b>10.9</b> | <b>2.4</b> |

**Table5 . Density indices (DI, number of schools per 100 n.miles) and mean school size (MSS) of humpback whale primary sightings by SV and SSVs.**

| Area               | Part             | Stratum              | SVs                         |                                   |             |             | SSVs                        |                                   |            |             |             |            |
|--------------------|------------------|----------------------|-----------------------------|-----------------------------------|-------------|-------------|-----------------------------|-----------------------------------|------------|-------------|-------------|------------|
|                    |                  |                      | Searching distance (n.mile) | Humpback whale (primary sighting) |             |             | Searching distance (n.mile) | Humpback whale (primary sighting) |            |             |             |            |
|                    |                  |                      |                             | Sch.                              | Ind.        | DI          |                             | MSS                               | Sch.       | Ind.        | DI          | MSS        |
| V                  | East             | North-North          | 96.9                        | 2                                 | 3           | 2.1         | 1.5                         | -                                 | -          | -           | -           |            |
|                    |                  | North-South          | 153.8                       | 3                                 | 3           | 2.0         | 1.0                         | 803.8                             | 18         | 28          | 2.2         | 1.6        |
|                    | West             | North                | 613.8                       | 31                                | 58          | 5.1         | 1.9                         | 808.9                             | 42         | 68          | 5.2         | 1.6        |
|                    |                  | South                | 652.7                       | 87                                | 154         | 13.3        | 1.8                         | 1195.6                            | 45         | 67          | 3.8         | 1.5        |
|                    | <b>Sub-total</b> |                      | <b>1517.2</b>               | <b>123</b>                        | <b>218</b>  | <b>8.1</b>  | <b>1.8</b>                  | <b>2808.4</b>                     | <b>105</b> | <b>163</b>  | <b>3.7</b>  | <b>1.6</b> |
| IV                 | East             | North                | 1450.3                      | 118                               | 234         | 8.1         | 2.0                         | -                                 | -          | -           | -           |            |
|                    |                  | North (Transit-KS2)  | 134.6                       | 96                                | 189         | 71.3        | 0.0                         | -                                 | -          | -           | -           |            |
|                    |                  | South                | 865.5                       | 433                               | 791         | 50.0        | 1.8                         | 1707.2                            | 293        | 569         | 17.2        | 1.9        |
|                    |                  | South (Special-KS2)  | 80.3                        | 0                                 | 0           | 0.0         | 0.0                         | -                                 | -          | -           | -           |            |
|                    |                  | South (Ice edge-KK1) | 407.1                       | 182                               | 298         | 44.7        | 1.6                         | -                                 | -          | -           | -           |            |
|                    | West             | North                | 1125.3                      | 250                               | 460         | 22.2        | 1.8                         | 706.9                             | 72         | 155         | 10.2        | 2.2        |
|                    |                  | North (Transit-KS2)  | 143.3                       | 88                                | 171         | 61.4        | 1.9                         | -                                 | -          | -           | -           |            |
|                    |                  | South                | 865.6                       | 196                               | 381         | 22.6        | 1.9                         | 608.4                             | 129        | 255         | 21.2        | 2.0        |
|                    | Prydz Bay        | Transit-KS2          | 381.1                       | 0                                 | 0           | 0.0         | 0.0                         | 672.2                             | 5          | 8           | 0.7         | 1.6        |
|                    |                  | Special-KS2          | 53.5                        | 0                                 | 0           | 0.0         | 0.0                         | -                                 | -          | -           | -           |            |
|                    |                  | Special-KS2          | 31.9                        | 0                                 | 0           | 0.0         | 0.0                         | -                                 | -          | -           | -           |            |
|                    |                  | Ice-edge-KK1         | 431.5                       | 2                                 | 4           | 0.5         | 2.0                         | -                                 | -          | -           | -           |            |
|                    | <b>Sub-total</b> |                      | <b>5969.8</b>               | <b>1365</b>                       | <b>2528</b> | <b>22.9</b> | <b>1.9</b>                  | <b>3694.8</b>                     | <b>499</b> | <b>987</b>  | <b>13.5</b> | <b>2.0</b> |
| III                | East             | North                | 674.2                       | 77                                | 159         | 11.4        | 2.1                         | 322.6                             | 6          | 9           | 1.9         | 1.5        |
|                    |                  | South                | 675.0                       | 6                                 | 12          | 0.9         | 2.0                         | 710.8                             | 7          | 17          | 1.0         | 2.4        |
|                    | <b>Sub-total</b> |                      | <b>1349.2</b>               | <b>83</b>                         | <b>171</b>  | <b>6.2</b>  | <b>2.1</b>                  | <b>1033.4</b>                     | <b>13</b>  | <b>26</b>   | <b>1.3</b>  | <b>2.0</b> |
| <b>Grand Total</b> |                  |                      | <b>8836.2</b>               | <b>1571</b>                       | <b>2917</b> | <b>17.8</b> | <b>1.9</b>                  | <b>7536.5</b>                     | <b>617</b> | <b>1176</b> | <b>8.2</b>  | <b>1.9</b> |

**Table6 . Density indices (DI, number of schools per 100 n.miles) and mean school size (MSS) of fin whale primary sightings by SV and SSVs.**

| Area               | Part             | Stratum              | SVs                         |                              |            |            | SSVs                        |                              |            |            |            |            |     |
|--------------------|------------------|----------------------|-----------------------------|------------------------------|------------|------------|-----------------------------|------------------------------|------------|------------|------------|------------|-----|
|                    |                  |                      | Searching distance (n.mile) | Fin whale (primary sighting) |            |            | Searching distance (n.mile) | Fin whale (primary sighting) |            |            |            |            |     |
|                    |                  |                      |                             | Sch.                         | Ind.       | DI         |                             | MSS                          | Sch.       | Ind.       | DI         | MSS        |     |
| V                  | East             | North-North          | 96.9                        | 0                            | 0          | 0.0        | 0.0                         | -                            | -          | -          | -          | -          |     |
|                    |                  | North-South          | 153.8                       | 0                            | 0          | 0.0        | 0.0                         | 803.8                        | 0          | 0          | 0.0        | 0.0        |     |
|                    | West             | North                | 613.8                       | 3                            | 14         | 0.5        | 4.7                         | 808.9                        | 3          | 7          | 0.4        | 2.3        |     |
|                    |                  | South                | 652.7                       | 55                           | 154        | 8.4        | 2.8                         | 1195.6                       | 1          | 3          | 0.1        | 3.0        |     |
|                    | <b>Sub-total</b> |                      | <b>1517.2</b>               | <b>58</b>                    | <b>168</b> | <b>3.8</b> | <b>2.9</b>                  | <b>2808.4</b>                | <b>4</b>   | <b>10</b>  | <b>0.1</b> | <b>2.5</b> |     |
| IV                 | East             | North                | 1450.3                      | 18                           | 35         | 1.2        | 1.9                         | -                            | -          | -          | -          | -          |     |
|                    |                  | North (Transit-KS2)  | 134.6                       | 0                            | 0          | 0.0        | 0.0                         | -                            | -          | -          | -          | -          |     |
|                    |                  | South                | 865.5                       | 77                           | 177        | 8.9        | 2.3                         | 1707.2                       | 17         | 108        | 1.0        | 6.4        |     |
|                    |                  | South (Special-KS2)  | 80.3                        | 1                            | 25         | 1.2        | 25.0                        | -                            | -          | -          | -          | -          |     |
|                    |                  | South (Ice edge-KK1) | 407.1                       | 10                           | 30         | 2.5        | 3.0                         | -                            | -          | -          | -          | -          |     |
|                    | West             | North                | 1125.3                      | 20                           | 56         | 1.8        | 2.8                         | 706.9                        | 0          | 0          | 0.0        | 0.0        |     |
|                    |                  | North (Transit-KS2)  | 143.3                       | 1                            | 1          | 0.7        | 1.0                         | -                            | -          | -          | -          | -          |     |
|                    |                  | South                | 865.6                       | 36                           | 172        | 4.2        | 4.8                         | 608.4                        | 10         | 116        | 1.6        | 11.6       |     |
|                    | Prydz Bay        |                      |                             | 381.1                        | 0          | 0          | 0.0                         | 0.0                          | 672.2      | 1          | 2          | 0.1        | 2.0 |
|                    |                  | Transit-KS2          |                             | 53.5                         | 0          | 0          | 0.0                         | 0.0                          | -          | -          | -          | -          | -   |
|                    |                  | Special-KS2          |                             | 31.9                         | 0          | 0          | 0.0                         | 0.0                          | -          | -          | -          | -          | -   |
|                    |                  | Ice-edge-KK1         |                             | 431.5                        | 0          | 0          | 0.0                         | 0.0                          | -          | -          | -          | -          | -   |
| <b>Sub-total</b>   |                  | <b>5969.8</b>        | <b>163</b>                  | <b>496</b>                   | <b>2.7</b> | <b>3.0</b> | <b>3694.8</b>               | <b>28</b>                    | <b>226</b> | <b>0.8</b> | <b>8.1</b> |            |     |
| III                | East             | North                | 674.2                       | 16                           | 75         | 2.4        | 4.7                         | 322.6                        | 2          | 4          | 0.6        | 2.0        |     |
|                    |                  | South                | 675.0                       | 0                            | 0          | 0.0        | 0.0                         | 710.8                        | 3          | 5          | 0.4        | 1.7        |     |
|                    | <b>Sub-total</b> |                      | <b>1349.2</b>               | <b>16</b>                    | <b>75</b>  | <b>1.2</b> | <b>4.7</b>                  | <b>1033.4</b>                | <b>5</b>   | <b>9</b>   | <b>0.5</b> | <b>1.8</b> |     |
| <b>Grand Total</b> |                  |                      | <b>8836.2</b>               | <b>237</b>                   | <b>739</b> | <b>2.7</b> | <b>3.1</b>                  | <b>7536.5</b>                | <b>37</b>  | <b>245</b> | <b>0.5</b> | <b>6.6</b> |     |

**Table 7. Summary of biological data and samples collected from Antarctic minke whales.**

| Samples and data   | Number of whales |        |       |
|--|------------------|--------|-------|
|  | Male             | Female | Total |
| Photographic record of external character                                | 461              | 389    | 850   |
| Body length and sex identification                                       | 462              | 391    | 853   |
| Measurement of external body proportion                                  | 462              | 391    | 853   |
| Body weight  | 12               | 11     | 23    |
| Body weight by total weight of parts                                     | 5                | 6      | 11    |
| Skull measurement (length and breadth)                                   | 437              | 360    | 797   |
| Standard measurement of blubber thickness (two points)                   | 462              | 391    | 853   |
| Lactation status   | -                | 391    | 391   |
| Measurement of mammary gland   | -                | 391    | 391   |
| Testis weight  | 462              | -      | 462   |
| Weight of stomach content  | 440              | 378    | 818   |
| Diatom film observation  | 462              | 391    | 853   |
| Blood plasma for physiological study                                     | 459              | 389    | 848   |
| Earplug for age determination  | 462              | 391    | 853   |
| Ocular lens for age determination  | 107              | 107    | 214   |
| Tympanic bone for chemical analysis                                      | 48               | 27     | 75    |
| Largest baleen plate for chemical analysis                               | 462              | 390    | 852   |
| Vertebral epiphyses sample   | 401              | 308    | 709   |
| Ovary  | -                | 391    | 391   |
| Histological sample of endometrium                                       | -                | 15     | 15    |
| Histological sample of mammary gland                                     | -                | 391    | 391   |
| Milk sample for chemical analysis  | -                | 2      | 2     |
| Histological sample of testis  | 462              | -      | 462   |
| Skin and liver tissues for genetic study                                 | 462              | 391    | 853   |
| Blubber, muscle and liver tissues for environmental monitoring           | 462              | 391    | 853   |
| Lung tissue for air monitoring   | 21               | 16     | 37    |
| Macro pathological observation (thyroid, lung, stomach, liver and gonad) | 462              | 391    | 853   |
| Tissues for histopathological study                                      | 110              | 98     | 208   |
| Stomach contents for food and feeding study                              | 38               | 24     | 62    |
| Stomach contents for environmental monitoring                            | 15               | 10     | 25    |
| External parasites   | 9                | 9      | 18    |
| Internal parasites   | 1                | 5      | 6     |
| Photographic record of fetus   | 126              | 93     | 227*  |
| Fetal length and weight  | 126              | 93     | 227*  |
| Collection of small fetus  | 0                | 0      | 8*    |
| Fetal ocular lens for age determination                                  | 16               | 11     | 27    |
| Fetal skin for genetic study   | 126              | 93     | 227*  |
| Oocyte for <i>in-vitro</i> fertilization (IVF)                           | -                | 132    | 132   |
| Oviductal fluids for <i>in-vitro</i> culture (IVC)                       | -                | 5      | 5     |
| Spermatogenic cell for round spermatid injection (ROSI)                  | 1                | -      | 1     |
| Fetal ovary for <i>in-vitro</i> fertilization (IVF)                      | -                | 16     | 16    |
| Uterus and placenta tissues for histomorphological study                 | -                | 40     | 40    |
| Blubber for sphingolipid analysis  | 10               | 10     | 20    |
| Tissues for organogenic study of bone                                    | 5                | 0      | 5     |
| Fetal tissues for organogenic study of bone                              | 4                | 1      | 5     |
| Fetal tissues for organogenic study of olfactory system                  | 9                | 3      | 12    |
| Fetal head for organogenic study   | 1                | 2      | 3     |
| Various organ tissues for histological study                             | 17               | 20     | 37    |
| Baleen plates for educational exhibition                                 | 0                | 1      | 1     |

\* : including a fetus of sex unidentified.

**Table 8. Summary of biological data and samples collected from fin whales.**

| Samples and data   | Number of whales |        |       |
|--|------------------|--------|-------|
|  | Male             | Female | Total |
| Photographic record of external character                                | 4                | 6      | 10    |
| Body length and sex identification                                       | 4                | 6      | 10    |
| Measurement of external body proportion                                  | 4                | 6      | 10    |
| Body weight by total weight of parts                                     | 3                | 6      | 9     |
| Skull measurement (length and breadth)                                   | 4                | 4      | 8     |
| Detailed measurement of blubber thickness (fourteen points)              | 4                | 6      | 10    |
| Lactation status   | -                | 6      | 6     |
| Measurement of mammary gland   | -                | 6      | 6     |
| Breadth measurement of uterine horn                                      | -                | 6      | 6     |
| Testis weight  | 4                | -      | 4     |
| Epididymis weight  | 4                | -      | 4     |
| Weight of stomach content  | 4                | 6      | 10    |
| Number of ribs   | 4                | 6      | 10    |
| Diatom film observation  | 4                | 6      | 10    |
| Diatom film sample   | 4                | 6      | 10    |
| Blood plasma for physiological study                                     | 4                | 6      | 10    |
| Earplug for age determination  | 4                | 6      | 10    |
| Ocular lens for age determination  | 4                | 6      | 10    |
| Tympanic bone for chemical analysis                                      | 4                | 6      | 10    |
| Largest baleen plate for chemical analysis                               | 3                | 6      | 9     |
| Vertebral epiphyses sample   | 4                | 6      | 10    |
| Ovary  | -                | 6      | 6     |
| Histological sample of endometrium                                       | -                | 6      | 6     |
| Histological sample of mammary gland                                     | -                | 6      | 6     |
| Milk sample for chemical analysis  | -                | 0      | 0     |
| Histological sample of testis  | 4                | -      | 4     |
| Histological sample of epididymis  | 3                | -      | 3     |
| Skin and liver tissues for genetic study                                 | 4                | 6      | 10    |
| Blubber, muscle and liver tissues for environmental monitoring           | 4                | 6      | 10    |
| Lung tissue for air monitoring   | 4                | 6      | 10    |
| Macro pathological observation (thyroid, lung, stomach, liver and gonad) | 4                | 6      | 10    |
| Tissues for histopathological study                                      | 4                | 3      | 7     |
| Muscle, liver, kidney, lumbar and blubber tissues for lipid analysis     | 4                | 6      | 10    |
| Muscle, liver and blubber tissues for chemical analysis                  | 4                | 6      | 10    |
| Muscle and blubber tissues for nutritional analysis                      | 4                | 6      | 10    |
| Stomach contents for food and feeding study                              | 4                | 5      | 9     |
| Stomach contents for environmental monitoring                            | 2                | 3      | 5     |
| Stomach contents for lipid analysis                                      | 2                | 4      | 6     |
| External parasites   | 3                | 2      | 5     |
| Internal parasites   | 1                | 0      | 1     |
| Photographic record of fetus   | 1                | 1      | 2     |
| Fetal length and weight  | 1                | 1      | 2     |
| External measurements of fetus   | 1                | 1      | 2     |
| Collection of whole fetus  | 0                | 0      | 0     |
| Fetal ocular lens for age determination                                  | 1                | 1      | 2     |
| Fetal skin for genetic study   | 1                | 1      | 2     |
| Baleen plates for educational exhibition                                 | 1                | 0      | 1     |

**Table 9. Reproductive status of Antarctic minke whales sampled in 2005/2006 JARPAII. Numbers in parenthesis represent ratio of samples in each stratum (%). Maturity of males was tentatively defined by testis weight according to Kato (1986). "Resting" represents non-pregnant mature female without corpus luteum and "Ovulating" represents female that had corpus luteum but fetus was not observed.**

| Stratum                             | Male        |              |              | Female       |                          |            |              |           | Total        | Combined |
|-------------------------------------|-------------|--------------|--------------|--------------|--------------------------|------------|--------------|-----------|--------------|----------|
|                                     | Immature    | Mature       | Total        | Immature     | Mature                   |            | Total        | Total     |              |          |
|                                     |             |              |              |              | No-pregnant<br>Ovulating | Resting    |              |           |              |          |
| AreaV East-North<br>(Northern part) | 0<br>0.0%   | 0<br>0.0%    | 0<br>0.0%    | 1<br>50.0%   | 0<br>0.0%                | 0<br>0.0%  | 1<br>50.0%   | 0<br>0.0% | 2<br>100.0%  | 2        |
| AreaV West-North                    | 2<br>3.9%   | 36<br>70.6%  | 38<br>74.5%  | 7<br>13.7%   | 0<br>0.0%                | 0<br>0.0%  | 6<br>11.8%   | 0<br>0.0% | 13<br>25.5%  | 51       |
| AreaIV East-North                   | 0<br>-      | 0<br>-       | 0<br>-       | 0<br>-       | 0<br>-                   | 0<br>-     | 0<br>-       | 0<br>-    | 0<br>-       | 0        |
| AreaIV West-North                   | 18<br>14.5% | 53<br>42.7%  | 71<br>57.3%  | 29<br>23.4%  | 1<br>0.8%                | 1<br>0.8%  | 22<br>17.7%  | 0<br>0.0% | 53<br>42.7%  | 124      |
| AreaIII East-North                  | 1<br>4.5%   | 11<br>50.0%  | 12<br>54.5%  | 6<br>27.3%   | 0<br>0.0%                | 0<br>0.0%  | 3<br>13.6%   | 1<br>4.5% | 10<br>45.5%  | 22       |
| Northern Strata<br>(Total)          | 21<br>10.6% | 100<br>50.3% | 121<br>60.8% | 43<br>21.6%  | 1<br>0.5%                | 1<br>0.5%  | 32<br>16.1%  | 1<br>0.5% | 78<br>39.2%  | 199      |
| AreaV East-North<br>(Southern part) | 0<br>-      | 0<br>-       | 0<br>-       | 0<br>-       | 0<br>-                   | 0<br>-     | 0<br>-       | 0<br>-    | 0<br>-       | 0        |
| AreaV West-South<br>(First period)  | 7<br>8.9%   | 30<br>38.0%  | 37<br>46.8%  | 13<br>16.5%  | 0<br>0.0%                | 1<br>1.3%  | 28<br>35.4%  | 0<br>0.0% | 42<br>53.2%  | 79       |
| AreaV West-South<br>(Second period) | 7<br>38.9%  | 7<br>38.9%   | 14<br>77.8%  | 1<br>5.6%    | 0<br>0.0%                | 0<br>0.0%  | 3<br>16.7%   | 0<br>0.0% | 4<br>22.2%   | 18       |
| AreaV West-South<br>(Total)         | 14<br>14.4% | 37<br>38.1%  | 51<br>52.6%  | 14<br>14.4%  | 0<br>0.0%                | 1<br>1.0%  | 31<br>32.0%  | 0<br>0.0% | 46<br>47.4%  | 97       |
| AreaIV East-South                   | 12<br>16.2% | 27<br>36.5%  | 39<br>52.7%  | 22<br>29.7%  | 0<br>0.0%                | 3<br>4.1%  | 10<br>13.5%  | 0<br>0.0% | 35<br>47.3%  | 74       |
| AreaIV West-South                   | 28<br>12.3% | 108<br>47.4% | 136<br>59.6% | 33<br>14.5%  | 1<br>0.4%                | 4<br>1.8%  | 54<br>23.7%  | 0<br>0.0% | 92<br>40.4%  | 228      |
| AreaIV Prydz Bay                    | 8<br>5.4%   | 55<br>37.4%  | 63<br>42.9%  | 14<br>9.5%   | 2<br>1.4%                | 1<br>0.7%  | 66<br>44.9%  | 1<br>0.7% | 84<br>57.1%  | 147      |
| AreaIV West-South<br>+ Prydz Bay    | 36<br>9.6%  | 163<br>43.5% | 199<br>53.1% | 47<br>12.5%  | 3<br>0.8%                | 5<br>1.3%  | 120<br>32.0% | 1<br>0.3% | 176<br>46.9% | 375      |
| AreaIII East-South                  | 15<br>13.9% | 37<br>34.3%  | 52<br>48.1%  | 23<br>21.3%  | 0<br>0.0%                | 1<br>0.9%  | 31<br>28.7%  | 1<br>0.9% | 56<br>51.9%  | 108      |
| Southern Strata<br>(Total)          | 77<br>11.8% | 264<br>40.4% | 341<br>52.1% | 106<br>16.2% | 3<br>0.5%                | 10<br>1.5% | 192<br>29.4% | 2<br>0.3% | 313<br>47.9% | 654      |
| Combined                            | 98<br>11.5% | 364<br>42.7% | 462<br>54.2% | 149<br>17.5% | 4<br>0.5%                | 11<br>1.3% | 224<br>26.3% | 3<br>0.4% | 391<br>45.8% | 853      |

**Table 10. Some biological information on fin whales sampled in 2005/2006 JARPAII.**

| No.   | Date of capture | Body length | Body weight* | Sex | Weight of testis (L/R) | Reproductive information | Remarks                  |
|-------|-----------------|-------------|--------------|-----|------------------------|--------------------------|--------------------------|
| F-001 | 060203          | 19.17m      | -            | M   | 1.84/2.19kg            |                          |                          |
| F-002 | 060208          | 20.05m      | 53.48t       | F   | -                      | Pregnant                 | Fetal length<br>127.5cm  |
| F-003 | 060209          | 19.47m      | 52.05t       | F   | -                      | Pregnant                 | Fetal length<br>280.7cm  |
| F-004 | 060210          | 18.73m      | 41.87t       | M   | 5.36/5.54kg            |                          |                          |
| F-005 | 060213          | 19.14m      | 47.28t       | M   | 10.10/10.60kg          |                          | Spondylitis<br>deformans |
| F-006 | 060214          | 19.15m      | 47.04t       | F   | -                      | Immature                 |                          |
| F-007 | 060307          | 20.22m      | 61.52t       | F   | -                      | Mature/Resting           |                          |
| F-008 | 060309          | 18.22m      | 41.06t       | F   | -                      | Immature                 |                          |
| F-009 | 060310          | 18.30m      | 42.27t       | M   | 1.65/1.91kg            |                          |                          |
| F-010 | 060313          | 19.35m      | 47.24t       | F   | -                      | Immature                 |                          |

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



**Table 11. Average body length (m) with standard deviation (S.D.) and body length range of Antarctic minke whales sampled in each stratum. Maturity of males was defined as Table 8.**

| Stratum                          | Average S.D. | Max Min      | N   | Average S.D. | Max Min      | N  | Average S.D. | Max Min       | N  | Average S.D. | Max Min      | N  |
|----------------------------------|--------------|--------------|-----|--------------|--------------|----|--------------|---------------|----|--------------|--------------|----|
| AreaV East-North (Northern part) | -            | -            | -   | -            | -            | -  | 8.98         | 8.98          | 1  | 6.77         | 6.77         | 1  |
| AreaV West-North                 | 8.32<br>0.42 | 9.37<br>7.58 | 36  | 7.52<br>0.46 | 7.84<br>7.19 | 2  | 8.75<br>0.48 | 9.41<br>8.18  | 6  | 6.22<br>1.11 | 8.12<br>4.95 | 7  |
| AreaIV East-North                | -            | -            | -   | -            | -            | -  | -            | -             | -  | -            | -            | -  |
| AreaIV West-North                | 8.40<br>0.36 | 9.12<br>7.76 | 53  | 6.40<br>0.85 | 7.88<br>5.13 | 18 | 9.01<br>0.35 | 9.75<br>8.38  | 24 | 6.60<br>0.86 | 8.00<br>4.99 | 29 |
| AreaIII East-North               | 8.36<br>0.39 | 9.13<br>7.72 | 11  | 6.68         | 6.68         | 1  | 8.98<br>0.43 | 9.53<br>8.49  | 4  | 7.23<br>0.94 | 8.77<br>6.31 | 6  |
| AreaV East-North (Southern part) | -            | -            | -   | -            | -            | -  | -            | -             | -  | -            | -            | -  |
| AreaV West-South (First period)  | 8.29<br>0.32 | 9.00<br>7.75 | 30  | 6.92<br>0.52 | 7.61<br>6.17 | 7  | 8.79<br>0.38 | 9.41<br>8.19  | 29 | 6.91<br>1.01 | 8.30<br>5.16 | 13 |
| AreaV West-South (Second period) | 8.40<br>0.38 | 9.06<br>8.00 | 7   | 6.86<br>1.04 | 7.72<br>4.85 | 7  | 8.92<br>0.33 | 9.14<br>8.54  | 3  | 5.55         | 5.55         | 1  |
| AreaIV East-South                | 8.55<br>0.32 | 9.03<br>7.92 | 27  | 6.04<br>0.75 | 7.47<br>5.02 | 12 | 8.92<br>0.39 | 9.70<br>8.28  | 13 | 6.39<br>0.91 | 8.22<br>4.73 | 22 |
| AreaIV West-South                | 8.44<br>0.38 | 9.58<br>7.54 | 108 | 6.67<br>0.97 | 8.43<br>5.02 | 28 | 8.90<br>0.34 | 9.54<br>8.08  | 59 | 7.14<br>0.82 | 8.58<br>5.31 | 33 |
| AreaIV Prydz Bay                 | 8.37<br>0.39 | 9.35<br>7.36 | 55  | 7.04<br>0.71 | 7.79<br>5.60 | 8  | 8.94<br>0.42 | 10.47<br>8.15 | 70 | 7.67<br>0.77 | 8.80<br>5.82 | 14 |
| AreaIII East-South               | 8.39<br>0.30 | 8.98<br>7.70 | 37  | 6.49<br>0.88 | 7.81<br>5.16 | 15 | 8.92<br>0.40 | 9.71<br>7.96  | 33 | 7.43<br>0.83 | 8.32<br>5.40 | 23 |

**Table12.Summary of photo-ID**

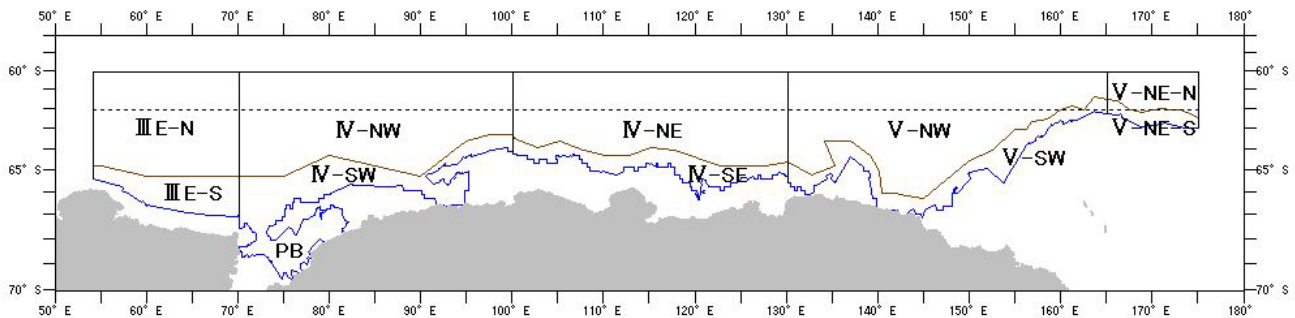
| Species              | Stratum  |       |         |       |       |       |        |       |           |           | Total |
|----------------------|----------|-------|---------|-------|-------|-------|--------|-------|-----------|-----------|-------|
|                      | Area III |       | Area IV |       |       |       | Area V |       | Prydz Bay | Total     |       |
|                      | East     |       | East    |       | West  |       | West   |       |           |           |       |
|                      | North    | South | North   | South | North | South | North  | South |           |           |       |
| Blue whale           |          | 3     | 1       | 6     | 1     | 2     |        |       |           | 13        |       |
| Humpback whale       |          |       | 3       |       | 11    | 20    |        |       |           | 34        |       |
| Southern right whale |          |       | 9       | 22    |       | 7     |        |       |           | 38        |       |
| <b>Total</b>         | 0        | 3     | 13      | 28    | 12    | 29    | 0      | 0     | 0         | <b>85</b> |       |

**Table13.Summary of biopsy sampling**

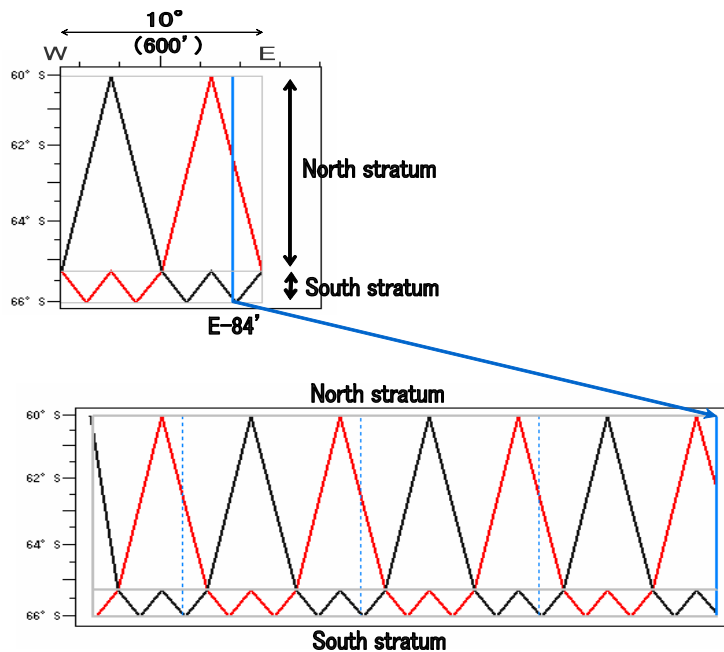
| Species                             | Stratum  |       |         |       |       |       |        |       |           |           | Total |
|-------------------------------------|----------|-------|---------|-------|-------|-------|--------|-------|-----------|-----------|-------|
|                                     | Area III |       | Area IV |       |       |       | Area V |       | Prydz Bay | Total     |       |
|                                     | East     |       | East    |       | West  |       | West   |       |           |           |       |
|                                     | North    | South | North   | South | North | South | North  | South |           |           |       |
| Blue whale                          |          |       | 1       | 1     | 1     | 2     |        |       |           | 5         |       |
| Fin whale                           |          |       |         | 1     |       | 7     | 1      |       |           | 9         |       |
| Sei whale                           |          |       | 1       |       |       |       |        |       |           | 1         |       |
| Humpback whale                      |          | 1     | 2       |       | 4     | 6     |        |       |           | 13        |       |
| Southern right whale                |          |       | 2       | 10    |       | 3     |        |       |           | 15        |       |
| Sperm whale (Carcass)               |          |       | 1       |       |       |       |        |       |           | 1         |       |
| Southern bottlenose whale (Carcass) |          |       |         |       |       |       | 1      |       |           | 1         |       |
| Long-finned pilot whale             |          |       |         |       | 1     |       |        |       |           | 1         |       |
| <b>Total</b>                        | 0        | 1     | 7       | 12    | 5     | 18    | 2      | 0     | 0         | <b>46</b> |       |

**Table14 . Summary of oceanographic and acoustic survey.**

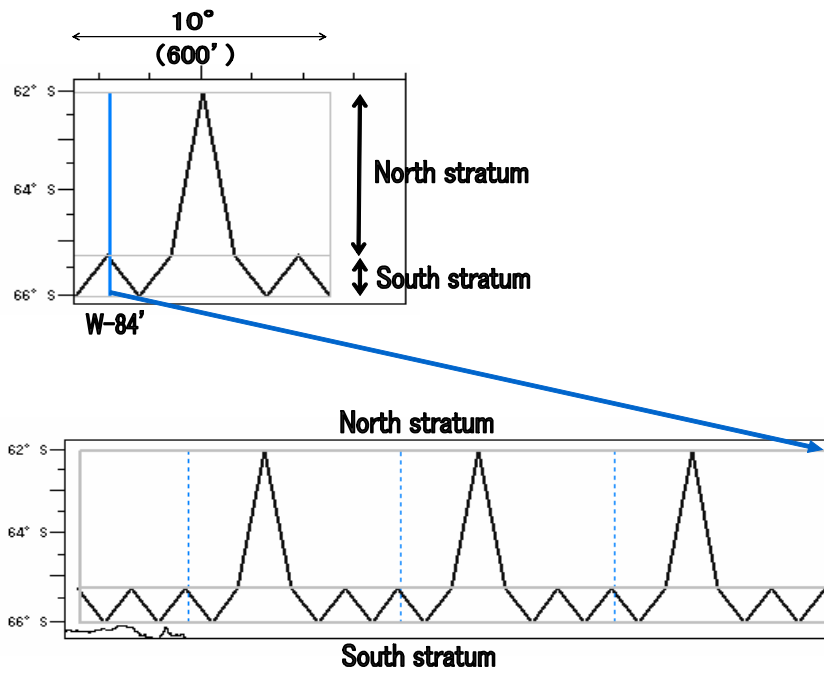
| Vessel | Area         | Stratum |           | CTD<br>(stations) |     | XCTD<br>(stations) |     | XBT<br>(stations) |     | EPCS<br>(days) |     | Quantitative<br>echo sounder<br>(days) |
|--------|--------------|---------|-----------|-------------------|-----|--------------------|-----|-------------------|-----|----------------|-----|--|
|        |              |         |           | KS2               | KK1 | KS2                | KK1 | KS2               | KK1 | KS2            | YS2 | KS2                                    |
|        | Area III     | East    | North     | 7                 | 1   | 5                  |     | 2                 |     | 7              | 3   | 7                                      |
|        |              |         | South     | 5                 | 2   | 2                  | 1   |                   |     | 7              | 8   | 7                                      |
|        | Area IV      | East    | North     | 10                | 2   | 13                 | 10  | 4                 | 4   | 14             |     | 14                                     |
|        |              |         | South     | 3                 | 4   | 6                  | 7   | 2                 | 1   | 8              | 13  | 8                                      |
|        |              | West    | North     | 5                 | 5   | 9                  | 14  | 3                 | 1   | 7              | 11  | 7                                      |
|        |              |         | South     | 8                 | 4   | 5                  | 1   |                   |     | 11             | 24  | 11                                     |
|        |              |         | Prydz Bay | 3                 | 4   | 18                 |     |                   |     | 9              | 14  | 9                                      |
|        | Area V       | East    | North     | 1                 | 1   | 1                  | 2   |                   |     | 3              |     | 3                                      |
|        |              |         | South     |                   | 2   |                    | 2   |                   |     | 4              | 6   | 4                                      |
|        |              | West    | North     | 5                 | 5   | 11                 | 7   | 2                 | 1   | 12             | 6   | 12                                     |
|        |              |         | South     | 7                 | 2   | 5                  | 4   | 1                 | 1   | 12             | 14  | 12                                     |
|        | <b>Total</b> |         |           |                   | 54  | 32                 | 75  | 48                | 14  | 8              | 94  | 99                                     |



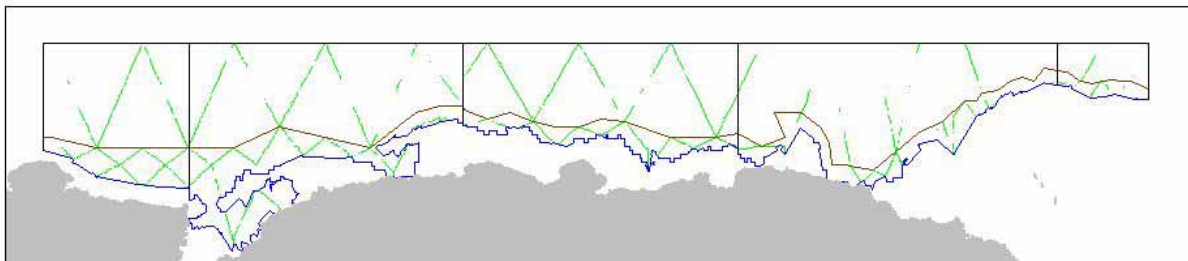
**Fig. 1. Geographic location of research area of the 2005/2006 JARPA II surveys.**



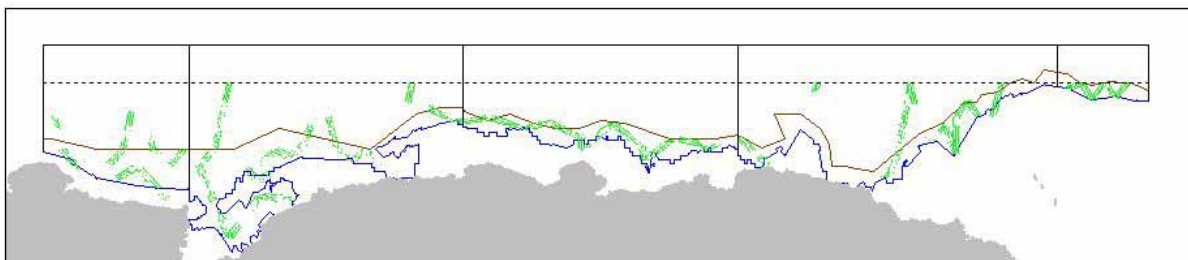
**Fig2. The design of survey track line of SVs based on the minimum unit.**



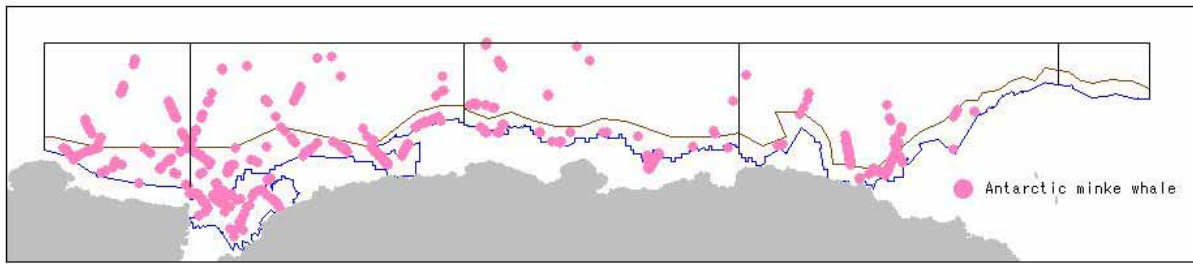
**Fig3. The design of survey track line of SSVs from the minimum unit.**



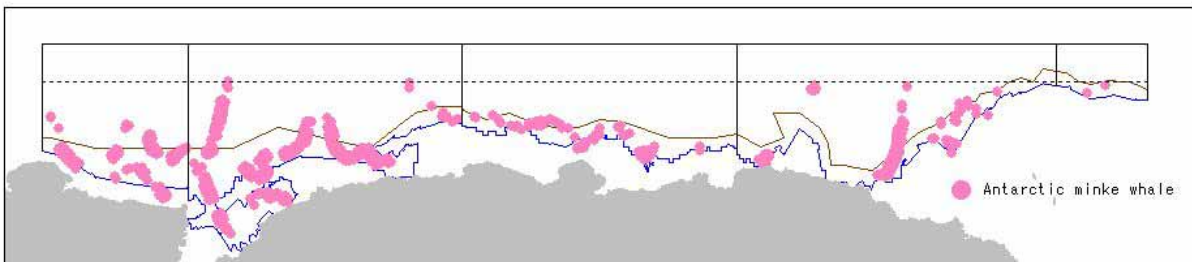
**Fig. 4. Survey track line of SVs in 2005/2006 JARPAII. Pack ice lines are estimated by observation of research vessels and the information from Near real time DMSP SSM / I daily polar gridded sea ice concentration data set available from the National Snow and Center (NSIDC, Cavalieri et al. 1999), US.**



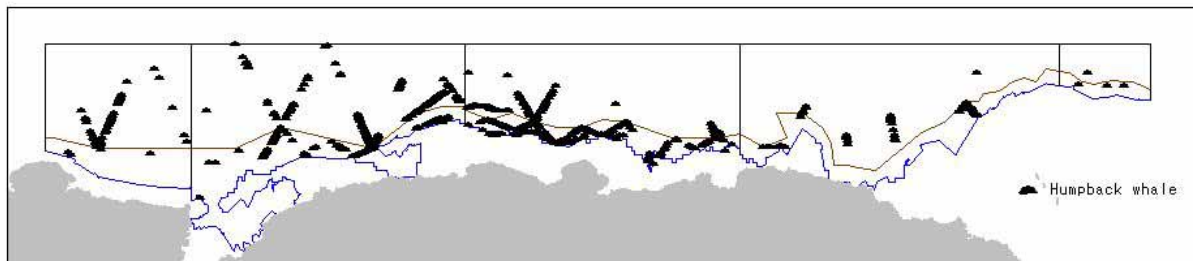
**Fig. 5. Survey track line of SSVs in 2005/2006 JARPAII. Pack ice lines are estimated by observation of research vessels and the information from Near real time DMSP SSM / I daily polar gridded sea ice concentration data set available from the National Snow and Center (NSIDC, Cavalieri et al. 1999), US. Because of limitation of research period due to the harassment by GP and SS, survey effort of SSVs was concentrated the south stratum and un-surveyed the north stratum from 95°E to 135°E.**



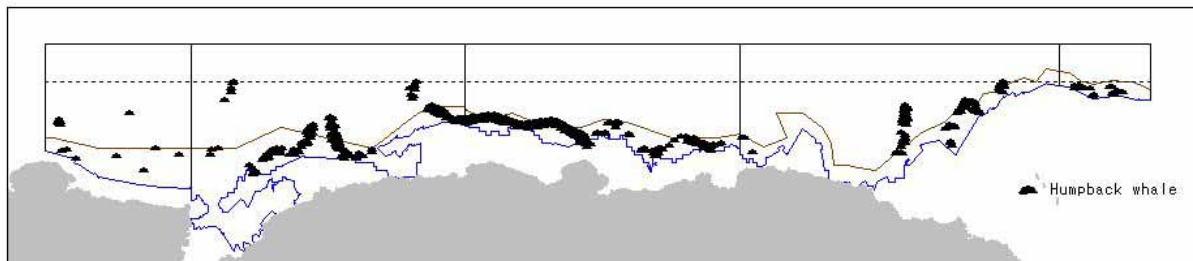
**Fig. 6. Distribution of all sightings of Antarctic minke whales sighted by SVs in 2005/2006 JARPAII**



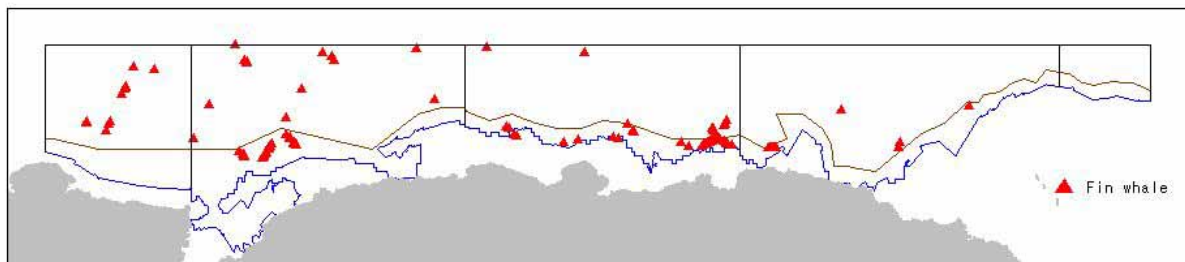
**Fig. 7. Distribution of all sightings of Antarctic minke whales sighted by SSVs in 2005/2006 JARPAII**



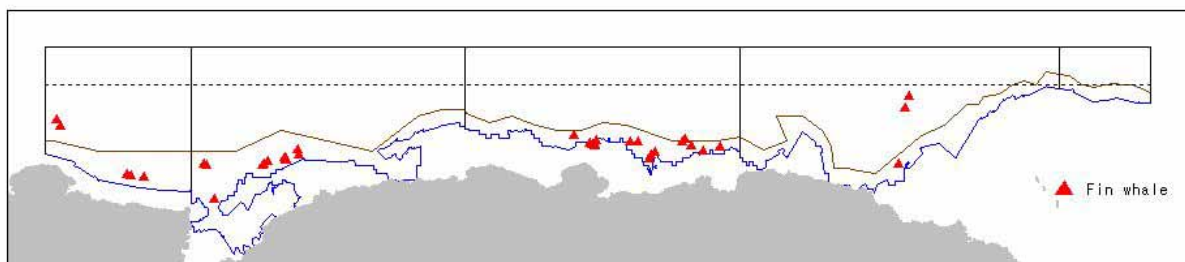
**Fig.8. Distribution of all sightings of humpback whales sighted by SVs in 2005/2006 JARPAII.**



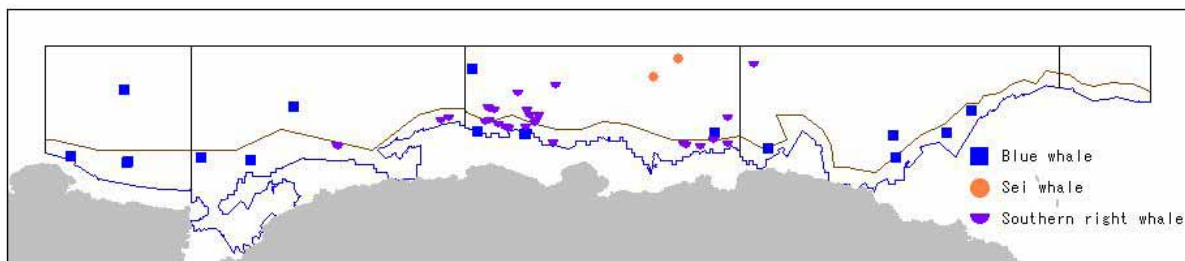
**Fig. 9. Distribution of all sightings of humpback whales sighted by SSVs in 2005/2006 JARPAII**



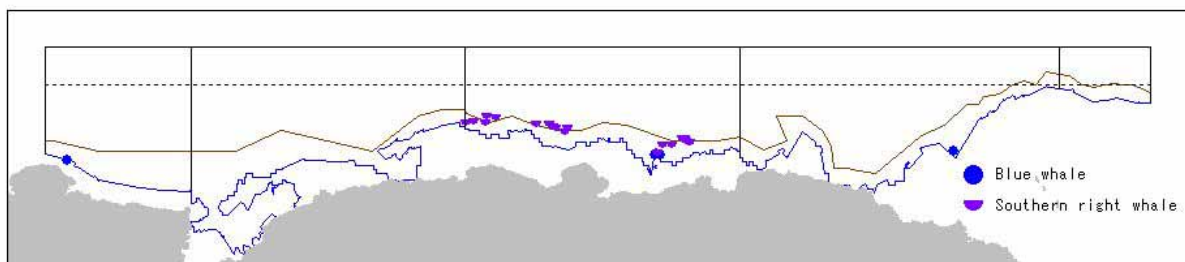
**Fig.10. Distribution of all sightings of fin whales sighted by SVs in 2005/2006 JARPAII**



**Fig.11. Distribution of all sightings of fin whales sighted by SSVs in 2005/2006 JARPAII**



**Fig.12. Distribution of all sightings of blue, sei and southern right whales sighted by SVs in 2005/2006 JARPAII**



**Fig.13. Distribution of all sightings of blue and southern right whales sighted by SSVs in 2005/2006 JARPAII**